THE PREVALENCE OF FRAILTY AMONG GERIATRIC HOSPITAL INPATIENTS, AND THE FEASIBILITY OF ADAPTED EXERCISE INTERVENTIONS FOR GERIATRIC HOSPITAL INPATIENTS, AND ASSISTED LIVING FACILITY RESIDENTS WITH FRAILTY

By

PAUL DOODY

A thesis submitted to the University of Birmingham

for the degree of DOCTOR OF PHILOSOPHY

School of Sport, Exercise, and Rehabiliation Sciences

College of Life and Environmental Sciences

University of Birmingham

July 2021

ABSTRACT

The world's population is ageing, and most older adults experience a latter phase of life burdened with disease and illness. Frailty is a common, and clinically significant condition among geriatric populations, associated with hospitalisation, disability, and mortality. The absolute prevalence, and overall burden of frailty, is projected to increase substantially in the coming decades as the population ages. Exercise interventions have been proposed as potentially offering the best treatment for frail older adults. However, relatively little is known regarding the prevalence of frailty among geriatric hospital inpatients; the association between the prevalence of frailty and national economic indicators; or the feasibility of exercise interventions for frail populations within different settings.

In this PhD, a systematic review and meta-analysis were conducted to elucidate the prevalence of frailty and pre-frailty among geriatric hospital inpatients, and the association between the prevalence of frailty and national economic indicators. Further, utilising a mixed methods approach, the feasibility of a potential future clinical trial, aimed at assessing the impact of exercise interventions among frail geriatric populations within a delayed discharge hospital ward, and assisted living facility setting, was examined. A systematic review and subsequent meta-analysis of ninety-six eligible studies, comprising a pooled sample of n=467,779 geriatric hospital inpatients, revealed an overall pooled prevalence of frailty, and pre-frailty, among geriatric hospital inpatients of 47.4% and 25.8%, respectively. Stratified analyses illustrated frailty was more prevalent among those aged ≥ 85 years; residing on rehabilitation wards; assessed using the Groningen frailty indicator, and patients classified as rehabilitation or delayed discharge. No significant differences were observed in pooled prevalence estimates of frailty stratified by sex or geographic location. Further, no significant associations were observed between the prevalence of frailty and national economic indicators. Mixed methods analysis regarding the feasibility of exercise

interventions among geriatric delayed discharge hospital inpatients found impracticalities regarding the dynamics of the setting, and the profile of patients within the setting, which resulted in the interpretation of a future clinical trial being largely unfeasible within a delayed discharge hospital ward setting. Feasibility analysis further revealed a study of this nature is likely best suited primarily in more stable environments, such as transitional care facilities, assisted living facilities, or nursing home settings, or in the increasing 'hospital at home' settings. Overall, the findings of this thesis provide several novel and practically useful findings, and resources which will aid future research and policy planning in this increasingly important field of research, which, if present demographic trends persist, will continue to grow in contemporary and future importance as the world's population ages.

ACKNOWLEDGEMENTS

Firstly, I would like to thank and acknowledge my supervisors, Professor Anna Whittaker, Professor Carolyn Greig, and Professor Janet Lord, for their guidance and support throughout this PhD. I would also like to extend my gratitude to Dr. Evans Asamane, Dr. Justin Aunger, Ms. Bridgitte Swales, Dr. Zoe Wyrko, and Dr. Thomas Jackson, for their assistance and support throughout the course of this PhD.

Further, I would like to acknowledge the larger Physical Activity and Nutritional INfleunces In ageing (PANINI) project network, and extend my gratitude to all of the early stage researchers and their respective supervisors who supported me throughout this PhD. Particularly in this regard, I would like to thank Professor Sarianna Sipilä, and Dr. Dimitry Bondarev for hosting me during my secondment to the University of Jyväskyl in Finland. Having visited Finland several times over the course of my PhD, and Jyväskylä twice, it has made a strong positive impression on me and I am sure I will be back on several more occassions.

Further, I would also like to thank and acknowledge my colleagues on the Irish longitudinal study on ageing (TILDA) at Trinity College Dublin, the University of Dublin, particularly Ms. Lucy Doogan, Professor Cathal McCrory, Dr. Ann Hever, Dr. Paul O'Mahony, and Professor Rose Anne Kenny, for their support during the write up phase of this PhD.

I would also like to thank and acknowledge all the patients who agreed to take part, or expressed interest in taking part, in the Seated Physical Activity in Ageing (SPAA) study, during what was, for many, an unsettling and uncertain time in their lives, and further to all ward staff who took part in post-study interviews.

Moreover, I would also like to extend my gratitude to all 256 authors who responded to inquiries with regard to the Frailty Levels In Geriatric Hospital inpaTients (FLIGHT)

systematic review and meta-analysis; particuarly those generous enough to provide additional data for various aspects of the analyses.

Finally, and foremost, I am grateful to God for giving me the strength to complete this PhD, and to my Mother, Father, Brother, Aisling, and Ellen, for all of their love and support, especially during the challenging times of this PhD.

LIST OF PEER REVIEW PAPERS

Publications in thesis (Chapters 1-6):

1. **Doody, P.**, Aunger, J., Asamane, E., Greig, C.A., Lord, J., & Whittaker, A., 2019 *(Published).* "Frailty Levels in Geriatric Hospital paTients (FLIGHT) — The prevalence of frailty amongst geriatric populations within hospital ward settings: a systematic review protocol", *BMJ Open*, vol. 9, no. 8, pp. e030147.
2. **Doody, P.**, Lord, J.M., Greig, C.A. & Whittaker, A.C., 2019 *(Published).* "Assessing the feasibility and impact of specially adapted exercise interventions, aimed at improving the multi-dimensional health and functional capacity of frail geriatric hospital inpatients: protocol for a feasibility study", *BMJ Open*, vol. 9, no. 11, pp. e031159.
3. **Doody, P.**, Lord, J.M., & Whittaker, A.C., 2019 *(Published).* "Assessing the feasibility and impact of an adapted resistance training intervention, aimed at improving the multi-dimensional health and functional capacity of frail older adults in residential care settings: protocol for a feasibility study", *BMC Pilot and Feasibility Studies*, vol. 5, no. 1, pp. 86.
4. **Doody, P.**, Asamane, E.A., Aunger, J.A., Swales, B., Lord, J.M., Greig, C.A., & Whittaker, A.C., 2021 (*Under review*). "The prevalence of frailty and pre-frailty among geriatric hospital inpatients and its association with economic prosperity and healthcare expenditure: A systematic review and meta-analysis of 467,779 geriatric hospital inpatients". *Ageing Research Reviews.*
5. **Doody, P.**, Lord, J.M., Greig. C.A., & Whittaker, A.C. (*In preparation*). "Frailty: pathophysiology, theoretical and operational definition(s), impact, prevalence, management and prevention, in an increasingly economically developed and ageing world" (Target journal – Age and Ageing).

6. **Doody, P.**, Asamane, E.A., Lord, J.M., Greig, C.A., & Whittaker, A.C. (*In preparation*). *"*Assessing the feasibility and impact of specially adapted exercise interventions, aimed at improving the multi-dimensional health and functional capacity of frail geriatric hospital inpatients in a delayed discharge setting". (Target journal – Journal of frailty, sarcopenia, and falls).

Collaborative publications during the PhD period:

1. Aunger, J.A., **Doody, P.** & Greig, C.A., 2018 (*Published*). "Interventions targeting sedentary behaviour in non-working older adults: a systematic review", *Maturitas*, vol. 116, pp. 89-99.
2. Whittaker, A.C., Asamane, E.A., Aunger, J.A., Bondarev, D., Cabbia, A., **Doody, P.**, Gensous, N., Iadarola, B., Ramsey, K.A. & Rodrigues, B., 2019 (*Published*). "Physical Activity and Nutrition INfluences in Ageing: Current Findings from the PANINI Project", *Advances in Geriatric Medicine and Research*, 1(1).
3. Richard, G., O'Halloran, A., **Doody, P.**, Harbison, J., Kenny, R.A., & Romero, R, O. (*In press*). "Atrial fibrillation and acceleration of frailty: Findings from the Irish Longitudinal Study on Ageing", *Age and Ageing*.
4. **Doody, P.**, Laird, E., & Kenny, R.A. (*In preparation*). "Vitamin D status and supplementation use among adults in residential care settings: A systematic review and meta-analysis". (Target journal – Nutrition Research Reviews)
5. **Doody, P.**, O'Halloran, A., & McCrory, C. (*In preparation*). "Measures of epigenetic age-acceleration and frailty in older adults: A narrative review". (Invited review – Mutation Research – Reviews in Mutation Research).
6. Bourke. R., **Doody, P.**, Perez, S., & Kenny, R.A.. (*In preparation*). "The association between cardiovascular abnormalities and falls: An updated systematic review and meta-analysis" (Target journal – the Journal of the American Medical Directors Association).
7. **Doody, P.**, Bondarev, D., Greig, C.A., Whittaker, A.C., & Sipilä, S. (*In progress*). "Effects of a 12-month home-based physical rehabilitation programme on the mitigation of sarcopenia in older hip fracture patients: a randomised controlled trial". (Target journal – BMC geriatrics).

8. **Doody, P.**, Donoghue, O., Cronin, M., O'Flahery, E., Rigby, J., Kenny, R.A., & O'Connell, B. (*In progress*). "Association between lifetime fluoridated water exposure, and multi-dimensional health outcomes in a nationally representative cohort of community-dwelling adults (aged ≥ 50 years) in Ireland". (No target journal presently).

LIST OF CONFERENCE / NETWORK MEETING PRESENTATIONS

1. **Doody, P.**, Asamane, E.A., Aunger, J.A., Swales, B., Lord, J.M., Greig, C.A., & Whittaker, A.C. "Frailty prevalence among geriatric hospital inpatients and its association with economic indicators: A systematic review and meta-analysis of 467,779 geriatric hospital inpatients" *Irish Gerontological Society Annual Scientific Meeting. Ireland. November 2021.* Oral Presentation.
2. **Doody, P.**, Greig, C.A., Lord, J.M., & Whittaker, A.C. "Healthy Ageing: New challenges, Physical activity research in PANINI" *PANINI co-creation conference, University of Birmingham, United Kingdom. June 2019*. Oral Presentation.
3. **Doody, P.**, Greig, C.A., Lord, J.M., & Whittaker, A.C. "Seated Physical Activity in Ageing (SPAA): Determining the feasibility of chair-based exercise interventions, aimed at improving the multi-dimensional health and functional capacity of frail geriatric hospital inpatients". *3rd PANINI advanced training network meeting. Leiden, Netherlands. October 2018*. Poster presentation.
4. **Doody, P.**, Lord, J.M., & Whittaker, A.C. "Assessing the impact of exercise in healthy ageing, with specialised chair-based exercise interventions, in populations with differing levels of pre-existing frailty and independence". *2nd PANINI advanced training network meeting. University of Birmingham, United Kingdom. February 2017*. Oral presentation.
5. **Doody, P.**, Lord, J.M., & Whittaker, A.C. "Assessing the impact of physical activity in healthy ageing, with specialised chair-based physical activity interventions, in populations with differing levels of pre-existing frailty and independence". *1st PANINI advanced training network meeting. University of Jyväskylä, Finland. April 2017*. Oral presentation.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1

CHAPTER 2

CHAPTER 3

CHAPTER 4

CHAPTER 5

LIST OF FIGURES

CHAPTER 1

CHAPTER 2

CHAPTER 3

CHAPTER 4

CHAPTER 5

LIST OF ABBREVIATIONS

1RM	One repetition maximum
5RM	Five repetition maximum
ACS	Acute coronary syndrome
ADL	Activities of daily living
AE	Adverse event
ANOVA	Analysis of variance
AW	Anna C. Whittaker
BMC	BioMed Central
BMI	Body mass index
BMJ	British Medical Journal
BS	Bridgitte Swales
BUPA	The British United Provident Association Limited
CAB	Centre for Agriculture and Biosciences International
CAF	Comprehensive assessment of frailty
CDSR	Cochrane Database of Systematic Reviews
CENTRAL	Cochrane Central Register of Controlled Trials
CFS	Clinical frailty scale
CG	Carolyn A. Greig
CGA	Comprehensive geriatric assessment
CI	Confidence interval
CINAHL Plus	Cumulative Index of Nursing and Allied Health Literature Plus
CMR	Cochrane Methodology Register

CONCORDANCE	Cooperative National Registry of Acute Coronary care, Guideline Adherence and Clinical Events
COREC	Consolidated criteria for reporting qualitative research
CpG	Cytosine-phospho-guanine
CRF	Case report form
CRI-S	Conference Proceedings Citation Index – Science
CRP	C-reactive protein
CSHA	Canadian Study on Health and Ageing
CSHA CFS	Canadian Study on Health and Ageing clinical frailty scale
DARE	Database of Abstracts of Reviews of Effect
DHEAS	Dehydroepiandrosterone-sulphate
DNA	Deoxyribonucleic acid
e.g.	Exempli gratia (Latin for "for example")
EA	Evans A. Asamane
EAB	Enhanced assessment bed
EFS	Edmonton frailty scale
ELISA	Enzyme-linked immunosorbent assay
EMBASE	Excerpta Medica dataBASE
ESCI	Emerging Sources Citation Index
FI	Frailty index
FIFE	Frailty index for elders
FLIGHT	Frailty Levels In Geriatric Hospital inpaTients
FORECAST	Frailty predicts death one year after cardiac surgery test

FRAIL scale	Fatigue, resistance, ambulation, illness, and loss of weight scale
FRAIL-NH scale	Fatigue, resistance, ambulation, illness, loss of weight scale, nutritional approach, and help with dressing scale
G-8	Geriatric 8 questionnaire
GDP	Gross domestic product
GDS	Geriatric depression scale
GFI	Groningen frailty indicator
HADS	Hospital anxiety depression scale
HTA	Health Technology Assessment database
i.e.	id est (Latin for "that is")
IBM	International Business Machines
ICU	Intensive care unit
ID	Identification
IFNγ	Interferon gamma
IL-6	Interleukin 6
IPA	Interpretative phenomenological analysis
ISAR	Identification of seniors at risk
ISEL-12	Interpersonal support evaluation list-12
JA	Justin A. Aunger
JBI	Joanna Briggs Institute
JL	Janet M. Lord
KARE	Keeping Active in Residential Elderly

MEDLINE	Medical Literature Analysis and Retrieval System Online, or MEDLARS (Medical Literature Analysis and Retrieval System) Online
mFI	Modified frailty index
MIOLI	Move It Or Lose It
NHS	National Health Service
NHS EED	National Health Service Economic Evaluation Database
NSQIP-FI	National Surgical Quality Improvement Program frailty index
NSTEMI	Non ST-segment elevation myocardial infarction
PANINI	Physical Activity and Nutritional INfleunces In ageing
PD	Paul Doody
pFI	Preoperative frailty index
PhD	Doctor of Philosophy
PI	Principal Investigator
PIS	Participant information sheet
PPI	Patient and public involvement
PPP	Purchasing power parity
PRISMA	Preferred reporting items for systematic reviews and meta-analyses
PRISMA 7	Program of Research to Integrate the Services for the Maintenance of Autonomy-7
PROSPERO	The International Prospective Register of Systematic Reviews
PSS	Perceived stress scale
PsychINFO	Psychological INFOrmation database

REC	Research Ethics Committee
REFS	Reported Edmonton frailty scale
ris	Research information systems
SAE	Serious adverse event
SAVR	Surgical aortic valve replacement
SCI-Expanded	Science Citation Index Expanded
SD	Standard deviation
SHARE	Survey of Health, Ageing and Retirement in Europe
SHARE-FI	Survey of Health, Ageing and Retirement in Europe-frailty Instrument
SMMSE	Standardized mini-mental state examination
SOF	Study of Osteoporotic Fractures
SOP	Standard operating procedure
SPAA	Seated Physical Activity in Ageing
SPIRIT	Standard protocol items: recommendations for Interventional trials
SPPB	Short physical performance battery
SPSS	Statistical package for social sciences
STEMI	ST-segment elevation myocardial infarction
TAVI	Transcatheter aortic valve implantation
TAVR	Transcatheter aortic valve replacement
TNFα	Tumor necrosis factor alpha
TUG	Timed-up and go
UEF	Upper-extremity function
UHB	University Hospitals Birmingham

UK or United Kingdom	United Kingdom of Great Britain and Northern Ireland
UoB	University of Birmingham
USA	United States of America
VES-13	Vulnerable elderly survery-13
VIG	Spanish/Catalan abbreviation for comprehensive geriatric assessment

Chapter 1. Introduction

1.1 Chapter summary

This chapter provides a comprehensive introduction to the literature and concepts relevant to areas of inquiry explored within this PhD thesis. Specifically, a broad overview of frailty is discussed, exploring its pathophysiology, theoretical and operational definition(s), impact, prevalence, management, and prevention, as well as its increasing emergence as a major public health challenge, in an increasingly economically developed and ageing world. The utilisation of exercise interventions, aimed at improving the health of older adults, are also explored. Further, the feasibility and efficacy of extending these interventions to more frail geriatric populations within a variety of settings are examined. Within the context of this existing knowledge, this chapter concludes by outlining the overall aim, and unexamined research questions that are addressed within this PhD thesis.

1.2 Context

The twentieth, and presently twenty-first centuries anno Domini, have been characterised by perpetual, and accelerating, medical, pharmacological, and technological advances (1-3). In the context of population demographics, one of the most significant outcomes of these advances, is the exponential increase in overall population, and the relatively rapid increase in life expectancy (4, 5). These increases can be partially attributed to improvements in public health that have resulted in a profound reduction in global child mortality rates; with an increasing proportion of the population now living to sexual maturity (3, 6, 7). However, increases in life expectancy has also occurred in the later part of life, albeit to a relatively lesser extent, in the increased population of older adults (4, 5) (Figure 1.1).

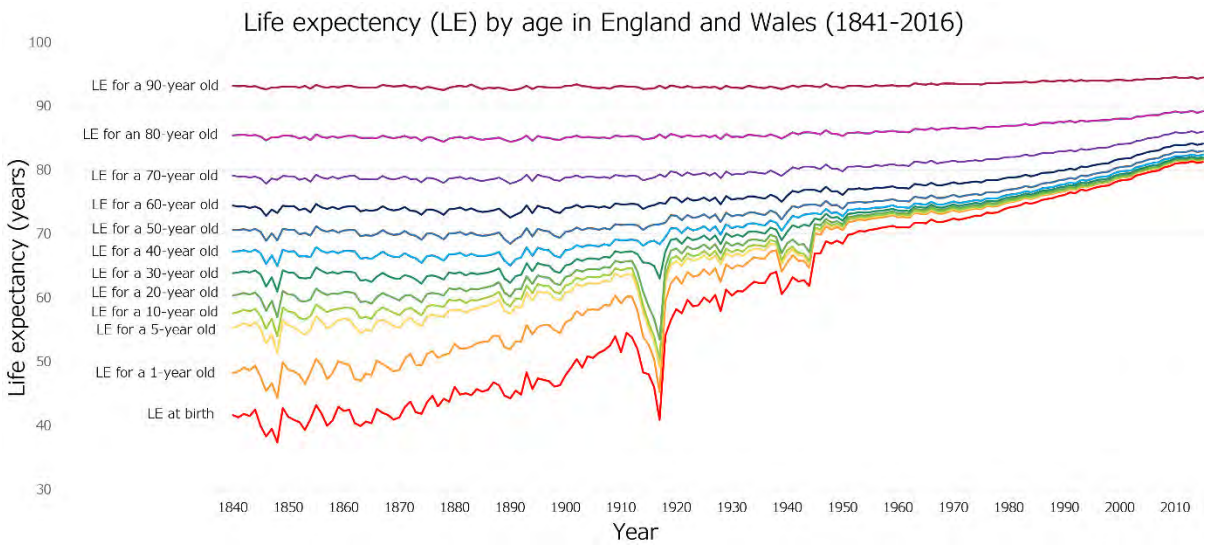


Figure 1.1. Estimated life expectancy by age in England and Wales (1841-2016). Human Mortality Database. University of California, Berkeley (USA), and Max Planck Institute for Demographic Research (Germany). Data available at www.mortality.org, raw data downloaded on 22/02/2020. Adapted from (8).

Closely succeeding these increases in life expectancy, another demographic phenomenon has been observed: a substantial reduction in global fertility rates, particularly in developed countries. With most of the developed world now below the population replacement rate of 2.1 births per female for several consecutive decades (9, 10). The combination of these two demographic phenomena has resulted in a growing, yet increasingly ageing population throughout the developed world; and even in the developing world, the onset of these changes are beginning to be observed (9, 10).

In Europe, current demographic trends indicate that by the year 2030 almost one in six of the European population will be aged 60 years or older, and the number of older people will grow to 247 million by 2050; representing a 35% increase from 2017, with one in four older adults being over 85 by 2040 (11). The social and economic impacts of this epidemiological transition have yet to be fully experienced, as dependency ratios remain relatively stable, as the increase in the older population is, to an extent, offset by the reduction in youth dependency (5, 12). However, if present trends persist, over time, dependency ratios in

developed countries may shift, as the absolute and relative number of those entering older age increases, while the absolute and relative number of those entering from youth dependency, to workforce participation, decreases (12). When taken in conjunction with progressive declines in physical activity throughout all stages of the lifespan, this leaves this increasing population of older adults particularly susceptible to the development of disease and co-morbidities associated with a lack of physical activity and an increase in sedentary behaviour (13-15). This alone, irrespective of future dependency ratios, will have substantial personal and economic impacts as life expectancy increases, while the proportion of the lifespan spent without disease and disability fails to keep pace, or potentially deceases; as has been observed with a number of lifestyle mediated non-communicable diseases in recent decades (16). It is in this context that frailty, particularly in older age, has been described as *"without question, one of the most serious public health challenges we will face in this coming century"* (17).

1.3 Frailty

Frailty is a multi-dimensional and dynamic condition, theoretically defined as a state of increased vulnerability, resulting from age-associated declines in reserve and function across multiple physiologic systems, such that the ability to cope with every day or acute stressors is compromised (18) (Figure 1.2).

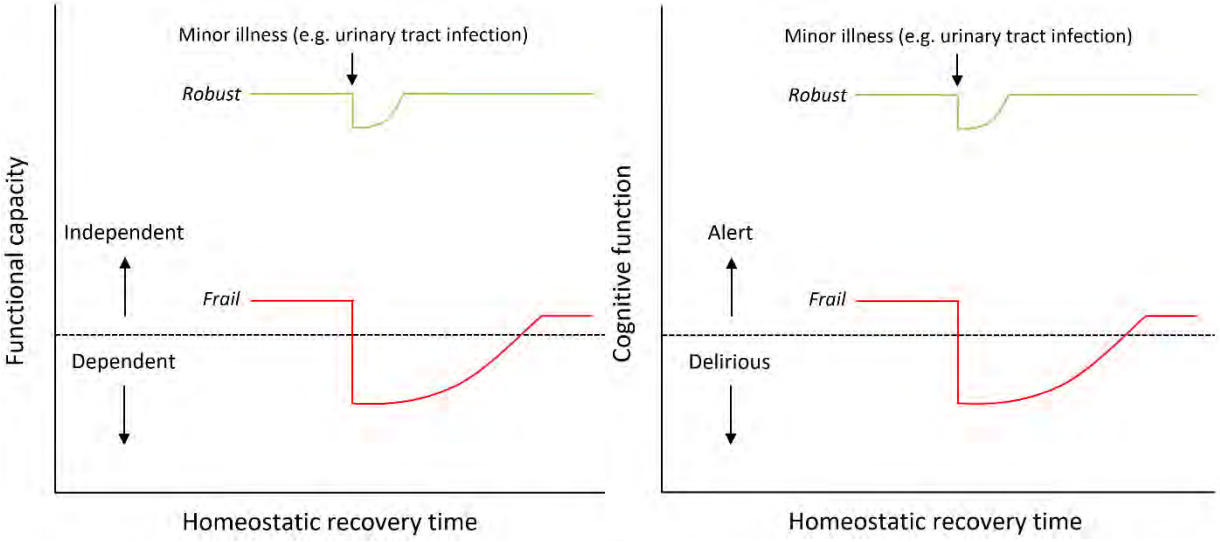


Figure 1.2. An illustration of the multidimensional nature of frailty as a loss of physiological reserve across multiple systems, such that resilience, and homeostatic response to stressors becomes compromised (Adapted from (19)).

Although declines in physiological reserve are associated with senescence in the normal ageing process, frailty is an extreme consequence of this process, where this decline is accelerated and homeostatic responses begin to fail (20, 21). Frailty is a common and clinically significant condition among older adults (22). This is predominantly due to its association with adverse health outcomes, such as hospitalisation, falls, disability, and mortality (19, 22-27). All older adults are susceptible to the risk of developing frailty, and even their younger counterparts (28, 29). However, this risk is significantly increased with increases in chronological age, in the presence of comorbidities, low physical activity, poor dietary intake, and low socio-economic status, among a number of other factors (Figure 1.3) (27, 30-34).

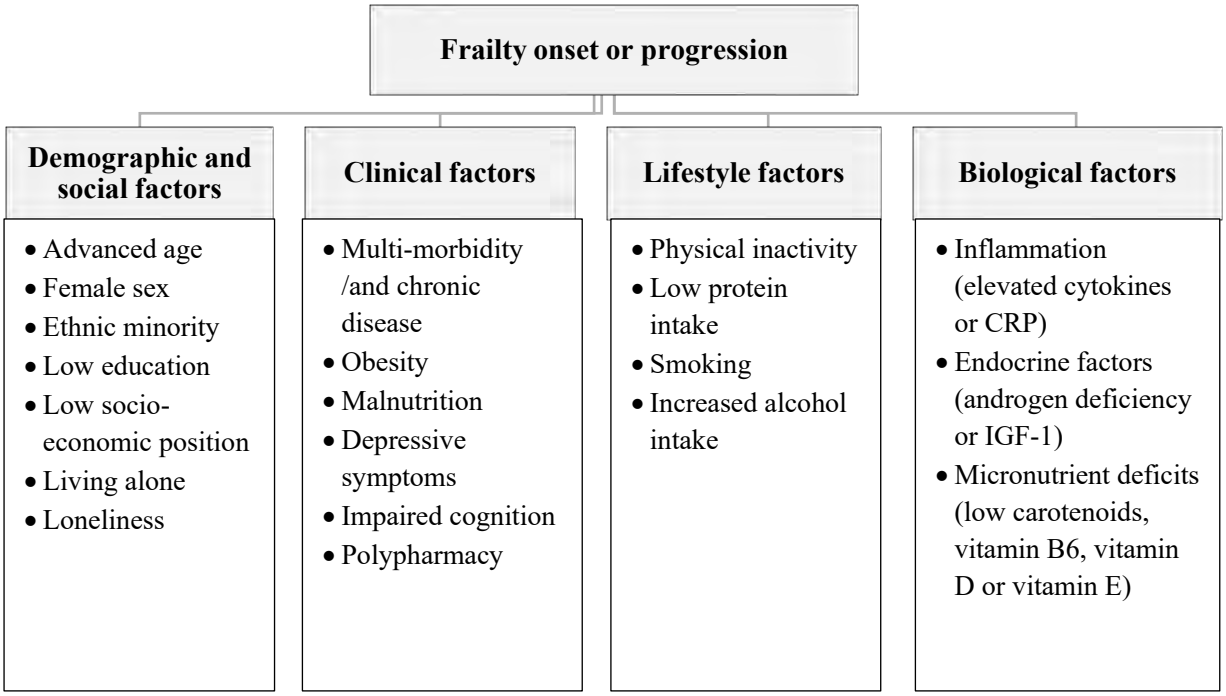


Figure 1.3. Risk factors associated with the development and progression of frailty. Reprinted from The Lancet, 394, Hoogendijk, E.O., Afilalo, J., Ensrud, K.E., Kowal, P., Onder, G. & Fried, L.P., Frailty: implications for clinical practice and public health, 1365-75, Copyright (2019), with permission from Elsevier. [redacted]

While frailty is a dynamic condition, with the possibility of bi-directional transition between frailty states (26, 36, 37), this transition is more commonly progressive (38). This is largely due to the association of frailty with a plethora of adverse health outcomes, which can often lead to a spiral of decline. As frailty progresses, interventions to mitigate, manage or reverse this decline, become increasingly difficult to implement, both from practical and physiological perspectives (38, 39). The relative prevalence of frailty in older adults may be reduced with future improvements in treatment, particularly those identified as effective at mitigating the onset of frailty (17). However, irrespective of this, the absolute prevalence, and overall burden of frailty, is projected to increase dramatically in the coming decades as the population ages (35). Perhaps of most concern in this regard, is that several longitudinal birth cohort studies have reported increases in the relative prevalence of frailty among more

contemporary generations of older adults, when compared to their generational predecessors (40-42).

1.3.1 Operational definitions of frailty

Although there is a general consensus regarding the theoretical definition of frailty, as a multi-dimensional and dynamic condition characterised by a loss of reserve across multiple physiological systems, which collectively result in a compromised resilience to cope with stressors. Presently, there is no one universally utilised or accepted operational definition for the classification of frailty. However, there are a number of valid operational definitions which exist i.e., definitions which take into consideration the multi-dimensional nature of the condition and have been specifically validated for the assessment of frailty; either through their predictive validity regarding negative health outcomes associated with frailty, or their concurrent validity regarding comparison with validated frailty tools (Table 1.2). The most commonly utilised and well-regarded of these operational definitions are the Fried frailty phenotype (27), and the Frailty Index (FI) (43). The Fried frailty phenotype proposes that frailty be defined as a clinical syndrome is which three or more of the five following criteria are present: unintentional weight loss (≥ 10lbs in the past year), self-reported exhaustion, weakness (grip strength), slow walking speed, and low physical activity (active kcals expended per week) (27) (Table 1.1).

Table 1.1. Components of the Fried frailty phenotype operational definition for the classification of frailty (27).

Components	Method of assessment
1. Unintentional weight loss	Self-reported unintentional weight loss of ≥10lbs in the last year
2. Self-reported exhaustion	Centre of Epidemiological Studies – Depression scale: two subjective questions regarding endurance and energy, scored from 0-3 (a score > 1 on either of these questions signifies confirmation of the exhaustion criteria)
3. Weakness	Grip strength measurement. Classification criteria relative to sex and body mass index (BMI)
4. Slow walking speed	15-foot gait speed assessment. Classification criteria relative to sex and height
5. Low physical activity	Short version of the Minnesota leisure time activity questionnaire utilised to estimated active calories expended per week. Classification criteria relative to sex.

The FI proposes that frailty should be operationally defined on a spectrum utilising a mathematical model which considers frailty in regard to the accumulation of 'deficits'. In this model, deficits represent any symptom, sign, disability, or laboratory measurement regarded as 'abnormal'. The FI score is assessed as the accumulative proportion of these potential deficits that are present. Typically, the list of deficits ranges from approximately 30-70 items related to various aspects of health and well-being (44). Although these are among the most commonly utilised definitions of frailty, there are also a number of other valid operational definitions which are frequently employed (Table 1.2).

Table 1.2. Valid operational definitions for the classification of frailty.

Operational definition	Number of items	Components	Classification criteria
Fried frailty phenotype criteria (27)	5	o Unintentional weight loss (≥10lbs in the last year) o Self-reported exhaustion o Weakness (grip strength) o Slow gait speed o Low levels of physical activity	0 = Robust (non-frail) 1-2 = Pre-frail ≥ 3 = Frail
Frailty Index (of cumulative deficits) (45)	~ 30-70	Accumulative health deficits (typically 30 or more), with scoring ranging from 0 (absence of all deficits), to 1 (presence of all deficits).	Typically reported as a continuous variable; cut-off of > 0.25 suggested for frailty
Frailty Index (from comprehensive geriatric assessment (CGA)) (46)	14-52	Accumulative health deficits, with scoring ranging from 0-1, derived from the CGA. 10 domains: o Cognition o Emotion o Communication o Mobility o Balance o Bladder o Bowel o Nutrition o Activities of daily living o Social	Typically reported as a continuous variable; cut-off of > 0.25 suggested for frailty
Edmonton Frailty Scale (47)	11	o Cognition o Hospital admission o General health o Functional capacity (x2) o Social support o Medication usage (x2)* o Nutrition* o Mood* o Continence*	0-5 = Non-frail 6-7 = Vulnerable 8-9 = Mild frailty 10-11 = Moderate frailty 12-17 = Severe frailty
Reported Edmonton Frailty Scale (48)	11	o Cognition o Hospital admission o General health o Functional capacity o Social support o Medication usage (x2)* o Nutrition* o Mood* o Continence* o Self-reported performance	0-5 = Non-frail 6-7 = Vulnerable 8-9 = Mild frailty 10-11 = Moderate frailty 12-18 = Severe frailty

Clinical Frailty Scale (43)	1	Visual and written chart scoring frailty on a continuous scale between 1 (very fit) - 9 (terminally ill)	1-3 = Non-frail 4 = Vulnerable 5-9 = Frail
Canadian Study on Health and Ageing (CSHA) Clinical Frailty Scale (43)	1	Visual and written chart scoring frailty on a continuous scale between 1 (very fit) - 7 (severely frail)	1-3 = Non-frail 4 = Vulnerable 5-7 = Frail
FRAIL Scale (49)	5	o Fatigue o Resistance (ability to climb stairs) o Ambulation (ability to walk one block) o Illnesses o Loss of weight	0 = Robust (non-frail) 1-2 = Pre-frail ≥ 3 = Frail
Survey of Health, Ageing and Retirement in Europe-Frailty Instrument (SHARE-FI) (50)	5	o Walking difficulties o Weakness (grip strength) o Exhaustion o Loss of appetite o Low physical activity	Typically reported as a continuous variable; the following cut-offs are suggested: < 0.08 = Non-frail ≤ 0.08-< 0.25 = Pre-frail ≥ 0.25 = Frail
Groningen Frailty Indicator (51)	15	4 domains: o Physical (x9) o Cognitive o Social (x3) o Psychological (x2)	≥ 4 = Frail
modified Frailty Index (mFI) (52)	11	o Functional status o Diabetes mellitus o Lung problems o Congestive heart failure o Myocardial infarction o Cardiac problems o Hypertension o Impaired sensorium o Prior transient ischemic attack o History of stroke o Peripheral vascular disease	0 = Robust (non-frail) > 0-< 0.21 = Pre-frail ≥ 0.21 = Frail
Tilburg Frailty Indicator (53)	15	3 domains: o Physical (x8) o Psychological (x5) o Social (x3)	≥ 5 = Frail
Study of Osteoporotic Fractures (SOF) Index (54)	3	o Weight loss o Exhaustion o Chair rise	0 = Robust 1-2 = Pre-frail ≥ 2 = Frail

Multi-dimensional Prognostic Index (55)	8	o Comorbidity o Nutrition o Polypharmacy o Pressure sore risk o Living status o Activities of daily living o Instrumental activities of daily living	< 0.34 = Robust (non-frail) 0.34-0.66 = Pre-frail > 0.66 = Frail
Trauma Specific Frailty Index (56)	15	5 categories: o Co-morbidities (x3) o Daily activities (x5) o Health attitude (x5) o Function (x1) o Nutrition (x1)	≤ 0.12 = Robust 0.13-0.25 = Pre-frail > 0.25 = Frail
Emergency General Surgery Specific Frailty Index (57)	15	5 categories: o Co-morbidities (x4) o Daily activities (x5) o Health attitude (x5) o Nutrition (x1)	≥ 0.25 = Frail
Rockwood frailty assessment (58)	4	o Activities of daily living o Bladder function o Bowel function o Cognition	≥ 2 = Frail
Kihon checklist (59, 60)	25	7 categories: o Physical strength o Nutrition o Oral function o Socialisation o Memory o Mood o Lifestyle	Dichotomous scoring of all items as per the frailty index. Cut-off of > 0.25 suggested for classification of frailty
preoperative Frailty Index (pFI) (61)	30	Accumulative health deficits with scoring ranging from 0 (absence of all deficits), to 1 (presence of all deficits).	> 0.21 = Frail
Comprehensive Assessment of Frailty (CAF) (62)	14	4 domains: Laboratory assessment o Serum albumin o Forced expiratory volume o Serum creatine Phenotype assessment o Exhaustion o Physical activity levels o Gait speed o Weakness (grip strength) Modified physical performance assessment** o Balance o Chair rise	1-10 = Non-frail 11-25 = Moderately frail 26-35 = Severely frail

		o Timed ability to put on and remove jacket o Timed ability to pick a pen from the floor o 360-degree turn CSHA clinical frailty scale (CFS) assessment**	
Frailty predicts death One yeaR after CArdiac Surgery Test (FORECAST) (63)	5	o Chair rise*** o Weakness o Stair climb o CSHA CFS assessment*** o Serum creatine	0-4 = Non-frail 5-7 = Moderately frail 8-14 = Severely frail
Robinson criteria (64)	7	o Timed up and go o Katz index of activities of daily living o Cognition o Charleston index o Anemia o Nutrition o Falls	0-1 = Non-frail 2-3 = Pre-frail 4-7 = Frail
National Surgical Quality Improvement Program Frailty Index (NSQIP-FI) (65)	11	o History of: - Diabetes - Obstructive pulmonary disease, or pneumonia - Cognitive heart failure - Myocardial infarction within 6 months of surgery - Percutaneous coronary intervention cardiac surgery or angina o Impaired functional status o Hypertensive medications o Peripheral vascular disease or rest pain o Impaired sensorium o Transient ischaemic attach or cardiovascular accident o History of cardiovascular attack with persistent residual dysfunction	> 0.25 = Frail

*= *All criteria on the EFS are scored from 0-2, with the exception of these items which are scored 0-1;* **= *All criteria on the CAF are score 0-1, with the exception of the modified physical performance assessment, and the CSHA CFS, for which each component is scored 0-4, and 0-7 respectively;* ***= *All criteria on the FORECAST are scores 0-1, with the exception of the chair rise, and CSHA CFS assessments, which are scored 0-4, and 0-7 respectively.*

Further to these validated operational definitions, proxy indicators of frailty are also commonly utilised, such as unidimensional measures of physical function, e.g., the Short Physical Performance Battery (SPPB) (66), Timed-Up and Go (TUG) (67), Upper-Extremity Function (UEF) frailty index (68), gait speed (69), and hand grip strength (70). These measures are associated with frailty and may even possess concurrent validity with existing frailty tools, or predictive validity regarding negative health outcomes associated with frailty. However, they lack the content validity regarding assessment of the multi-dimensional nature of the condition to be regarded themselves as valid operational definitions.

Similarly, there are a number of other tools, such as the geriatric 8 questionnaire (G-8) (71), identification of seniors at risk (ISAR) (72), vulnerable elderly survey (VES-13) (73), frailty index for elders (FIFE) (74), frailty risk score (75), hospital frailty risk score (76), and PRISMA 7 (77), which serve as proxy indicators of frailty through identifying "frailty risk", often with the suggestion of further more comprehensive evaluation. However, they are not valid operational definitions which definitively distinguish between frail, pre-frail, or robust classification states.

Recently an alternative approach, separating itself from the phenotypic and accumulation of deficits models, has proposed a focus on intrinsic capacity, i.e., a composite measure of all physical and mental resources which an individual can draw from to overcome environmental, physical, and psychological challenges (78). The development of this construct was initially supported by the World Health Organisation, however, remains to be empirically validated (78, 79). While the construct of intrinsic capacity is in its theoretical and operational infancy, it may provide a new paradigm for future exploration, closely aligned with that of frailty research (80).

Presently, one of the major weaknesses in the frailty field, is not only a lack of a single standardised operational definition, but also the common utilisation of non-validated iterations of the above definitions. This produces a detrimental effect on both the internal and external validity of such studies, resulting in a reduced capacity for accurate evaluation and comparison; even between studies which report to be utilising the same operational definition (81). In this regard, the academic field of frailty is somewhat lacking in desired order and uniformity. This is likely the manifestation of the multi-dimensional and heterogenous nature of frailty as a combination of a multitude, and often different array, of phenomena which can result from many differential causes and pathways (19). The breadth of proposed frailty definitions is a manifestation of this complexity. Ultimately what may be required regarding progress towards the establishment of a universally accepted operational definition, in addition to exploration of emerging constructs, is mathematical modelling of large longitudinal datasets which can identify frailty through an abundance of potential multi-dimensional pathways over time, as it relates to the dynamic ability to cope with acute stressors over these periods. However, to date, a universally accepted operational definition for the classification of frailty remains elusive, despite the utility this may provide in the future.

1.3.2 The prevalence of frailty

Although the exact prevalence of frailty within geriatric populations is poorly defined due to the lack of a single standardised operational definition, there are a number of systematic reviews and meta-analyses which have attempted to provide well-evidenced pooled estimates of the overall prevalence of frailty among older adults within a variety of settings (82-89). An enhanced understanding regarding the prevalence of a condition within a specific setting, has a number of important consequences; including the enhanced ability to contribute

towards improvements in the planning and orientation of organisational structures and resources, to meet population needs. This is particularly true regarding the ability to tailor services within particular settings to the needs of service users. For example, specifically with regard to frailty, the potential implementation of exercise rehabilitation treatments within settings for this population; with physical activity and exercise being proposed as potentially offering the best form of treatment for frail older adults (90).

1.3.2.1 Community-dwelling older adults

Presently, there are several systematic reviews and meta-analyses which have examined the prevalence of frailty in various cohorts of community-dwelling older adults (82-85, 89) (Table 1.3). In the single review which examined the overall prevalence of frailty within this population, the pooled prevalence of frailty was 10.7%. However, the reported prevalence of frailty within the studies comprising this review ranged from 4.0-59.1%; largely due to this lack of a single standardised operation definition (89). In the remaining four systematic reviews / meta-analyses of the prevalence frailty in various specific cohorts of community-dwelling older adults, the overall pooled prevalence of frailty ranged from 7.4%, among community-dwelling older adults in Japan, to 68%, among the overall population of undernourished community-dwelling older adults (84, 85). Along a similar line of inquiry, a recent systematic review and meta-analysis found the global incidence of frailty, and pre-frailty, among community-dwelling older adults (≥ 60 years) to be 43.4, and 150.6 per 1,000 person-years respectively (91).

Table 1.3. Systematic reviews and meta-analyses examining the prevalence of frailty among community-dwelling older adults.

Author(s)	Study design	Population	Minimum age (years)	Included studies	Pooled sample	Pooled prevalence of frailty (95% CI) (%)	Pooled prevalence of pre-frailty (95% CI) (%)	Range of reported frailty prevalence (%)	Range of reported pre-frailty prevalence (%)
He et al., 2019 (82)	Systematic review and meta-analysis	Community-dwelling older adults in China	≥ 65	14	81,258	10 (8.0 - 12.0)	43 (37 - 50)	5.9 - 17.4	26.8 - 52.4
Siriwardhana et al., 2018 (83)	Systematic review and meta-analysis	Community-dwelling older adults in low-, and middle-income countries	≥ 60	47	75,133	17.4 (14.4 - 20.7)	49.3* (46.4 - 52.2)	3.9 - 51.4	13.4 - 71.6*
Kojima et al., 2017 (84)	Systematic review and meta-analysis	Community-dwelling older adults in Japan	≥ 65	5	11,414	7.4 (6.1 - 9.0)	48.1 (41.6 - 54.8)	4.6 - 9.5	38.0 - 65.2
Verlaan et al., 2017 (85)	Systematic review and meta-analysis	Malnourished community-dwelling older adults	≥ 50	10	128	68 (59.9 - 76.1)**	25.8 (18.2 - 33.4)**	n/a	n/a
Collard et al., 2012 (89)	Systematic review	Community-dwelling older adults	≥ 65	21	61,500	10.7 (10.5 - 10.9)	41.6*	4 - 59.1	18.7 - 53.1***

** = data only available for 42/47 studies (47,302/75,133 participants); ** = Not reported in original paper, derived from available data; *** = data only available for 15/21 studies (53,727/61,500 participants).*

1.3.2.2 Older adults in residential care (assisted living and nursing home facility residents)

Presently, there are no well-evidenced pooled estimates of the overall prevalence of frailty among older adults in assisted living facility settings. Although, it could be postulated that this prevalence would likely be higher than that of community-dwelling older adults, given that older adults residing in assisted living facilities typically tend to be chronologically older, and often exhibit a greater number of comorbidities and a reduced functional capacity than their community-dwelling counterparts. However, these differences routinely become non-significant once standardised for age (92). Additionally, the estimated prevalence of frailty, and pre-frailty in nursing homes (where qualified nursing care is required, in addition to care assistance) is approximately 52.3%, and 40.2% respectively (88). As such, the prevalence of frailty in assisted living facilities likely lies somewhere in between that of community-dwelling older adults and nursing home residents; given the inherent nature of these respective settings, and the demographics of the individuals who occupy them. However, presently there appears a lack of individuals studies which have examined the prevalence of frailty specifically within assisted living facility settings.

1.3.2.3 Hospitalised older adults

Although there are systematic reviews and meta-analyses assessing the prevalence of frailty among community-dwelling older adults (82-85, 89, 93), nursing home residents (88), older individuals with cardiovascular disease (94), cancer (86), diabetes (95), and general surgery patients (96), presently there are no well-evidenced pooled estimates of the overall prevalence of frailty among geriatric hospital inpatients. There are, however, several studies which have primarily aimed to produce estimates of the overall prevalence of frailty within this population (87, 97-103). Through preliminary analysis of these existing studies,

depending on the criteria utilised, the prevalence of frailty among geriatric hospital inpatients appears to range widely, from 27% to 94%. In the five of the eight studies which utilised the Fried Frailty phenotype (27) as the operational definition of frailty, there is a narrower range (27-48.5%); with a mean prevalence of frailty across the five studies of 37.5±6.8% (Table 1.4) (97-100, 103).

Recently, a scoping review reported a median frailty prevalence of 49% (range 34-69%) in acute care hospital settings (104). However, this review had a number of methodological limitations, including the inclusion of the entire sample in any study with a single participant ≥ 65 years, where up to 50% of the sample were not hospital inpatients, and studies that did not report on the method of frailty assessment. Similarly a recently published systematic review and meta-analysis which examined the prevalence of pre-frailty and frailty together among hospitalised older adults, in studies which also assessed undernutrition risk, found a mean prevalence of 84%, but with limited data from only 11 studies (n = 2,725 patients) eligible for meta-analysis (105).

Consequently, there is an evident need for more robust and comprehensive research to thoroughly assess the overall prevalence of frailty within the overall population of geriatric hospital inpatients. This constitutes an important gap in the literature which needs to be addressed, as it has a number of potentially important consequential utilities, such as those regarding the tailoring of services within this setting to the needs of the growing population of older and often frail service users. This will form a primary area of inquiry within this PhD thesis.

Table 1.4. Studies which have primarily aimed to produce estimates of the prevalence of frailty within geriatric hospital inpatient populations.

Author(s)	Study design	Ward / Department / Unit / Hospital / Clinical population	Minimum age (years)	Mean age	Criteria utilised for the operational definition of frailty	Sample size	Prevalence of frailty (95% CI) (%)	Prevalence of pre-frailty (95% CI) (%)
Joosten et al., 2014 (97)	Prospective study	Acute geriatric ward	≥ 70	Frail: 83.3 ± 5.4 Pre-frail/Robust: 83.7 ± 4.8	Fried frailty phenotype criteria	220	40.0 (33.5 - 46.5)*	58.6 (52.1 - 65.1)*
As above	*As above*	*As above*	*As above*	*As above*	Study of Osteoporotic Fracture (SOF) Frailty Index	204	32.4 (25.9 - 38.8)*	51 (44.1 - 57.8)*
Oliveira et al., 2013 (99)	Cross-sectional study	Tertiary-level hospital	≥ 65	74.5 ± 6.8	Fried frailty phenotype criteria	99	46.5 (36.6 - 56.3)*	49.5 (39.6 - 59.3)*
Ekerstad et al., 2011 (101)	Prospective observational study	Patients with non-ST-segment elevation myocardial infarction (NSTEMI)	≥ 75	Frail: 85 Non-frail: 83	Canadian Study on Health and Ageing (CSHA) Clinical Frailty Scale	307	48.5 (42.9 - 54.1)*	25.4 (20.5 - 30.3)*

Purser et al., 2006 (103)	Prospective observational study	Patients with coronary artery disease	≥ 70	77 ± 5	Fried frailty phenotype criteria	309	27.2 (22.2 - 32.1)*	Not available
As above	*As above*	*As above*	*As above*	*As above*	Rockwood frailty assessment	*As above*	62.8 (57.4 - 68.2)*	n/a
Khandelwal et al., 2012 (100)	Prospective study	Tertiary-level hospital	≥ 60	66.4 ± 6.3	Fried frailty phenotype criteria	250	33.2 (27.4 - 39.0)*	Not available
Le Maguet et al. 2014 (98)	Prospective observational study	Intensive care unit	≥ 65	75 ± 6	Clinical Frailty Scale (CFS)	196	23.5 (17.5 - 29.4)*	31.6 (25.1 - 38.1)*
Hewitt et al., 2015 (87)	Multi-centre observational study	Acute general surgery units	≥ 65	77.3 ± 8.2	Canadian Study on Health and Ageing (CSHA) Clinical Frailty Scale	317	27.8 (22.8 - 32.7)*	18.6 (14.3 - 22.9)*
Andela et al., 2010 (102)	Observational study	Five clinical wards of different specialisms within a tertiary-level hospital	≥ 75	Not available	Groningen frailty indicator	276	73.2 (68.0 - 78.4)*	n/a
As above	*As above*	Geriatric	*As above*	83.8 ± 4.7	*As above*	32	90.6 (80.5 - 100.0)*	n/a
As above	*As above*	Traumatology	*As above*	83.3 +/- 5.3	*As above*	69	69.9 (58.7 - 80.4)*	n/a

As above	*As above*	Pulmonary / rheumatology	*As above*	79.8 +/- 3.2	*As above*	71	70.4 (59.8 - 80.1)*	n/a
As above	*As above*	Internal medicine	*As above*	81.2 +/- 5.1	*As above*	76	80.3 (71.3 - 89.2)*	n/a
As above	*As above*	Surgical	*As above*	81.1 +/- 4.9	*As above*	28	50.0 (31.5 - 68.5)*	n/a

*= *Confidence Intervals (CI) not reported in original paper; derived from available data.*

1.3.3 The impact of frailty

Frailty is associated with a myriad of adverse health outcomes, which have both personal and economic consequences. Among these adverse outcomes include the increased occurrence of falls, fractures, worsening mobility, disability, cognitive decline, dementia, depression, hospitalisation, institutionalisation, and mortality (54, 106-111). Moreover, frailty has been consistently shown to be associated with increased healthcare cost and usage (112-115). For example, a cross sectional analysis of approximately 2,600 older adults aged ≥ 60 years in Germany found that the mean three-month healthcare expenditure was almost six-fold higher among the frailest participants (five-positive Fried frailty phenotype criteria), at €3,659, compared to the least frail participants (no positive Fried frailty phenotype criteria), at €642 (115). A subsequent three-year longitudinal analysis of over 1,600 older adults within the same cohort found that progression from a non-frail to a frail state was associated with an average of 54% to 101% increase in healthcare cost in those with 3, and 4 or 5 positive frailty criteria respectively; including a 200% increase in inpatient costs from those who transitioned from non-frail (no positive Fried frailty phenotype criteria) to low-levels of frailty (three positive Fried frailty phenotype criteria) (116). Similarly, a recent analysis of 5,300 community-dwelling older adults aged ≥ 60 years in China, found frailty to be an independent predictor of increased health expenditure (112). However, the impact of frailty on an individual's life extends further than the clinical manifestation or economic impact of these adverse health outcomes, with frailty additionally being associated with a reduced quality of life, and loneliness (117, 118).

1.3.4 The associations between frailty and socio-economic variables

While at the individual level there is evidence of the association between socio-economic status and frailty onset and progression (33), at the societal level the association between

economic variables and frailty is less well evidenced. Preliminary research into this area has shown the prevalence of frailty in the community to be correlated with national economic indicators such as gross domestic product (GDP) per capita purchasing power parity (PPP), and health care expenditure per capita PPP; with the postulation that increases in economic prosperity may limit the prevalence and burden of frailty within national health systems. However, it is noted that more research is needed in this regard to better understand this relationship between macro-economic indicators and the prevalence of frailty (119). This will be another primary area of inquiry within this PhD thesis.

1.3.5 The prevention, treatment, and management of frailty

Presently, care plans specifically for frail individuals have yet to be extensively developed or assessed. However, there are several proposed treatments and care pathways involved in the prevention, treatment, and management of frailty. Initial establishment of agreed goals of care may be assisted in clinical settings in particular by a comprehensive geriatric assessment, which can provide a framework from which to develop a management and intervention plan for frail individuals. Further, as frailty progresses patients will develop different care needs, and require different forms of care, often in different settings (Table 1.5).

Table 1.5. Trajectory of care for frail individuals. Reprinted from The Lancet, 394, Hoogendijk, E.O., Afilalo, J., Ensrud, K.E., Kowal, P., Onder, G. & Fried, L.P., Frailty: implications for clinical practice and public health, 1365-75, Copyright (2019), with permission from Elsevier. [redacted]

Primary care	Advanced age older adult	**Primary prevention**
	Adoption / continuation of unhealthy lifestyle behaviours	
	Accumulation of frailty deficits and risk factors for disease	
	Diagnosis of chronic disease	**Secondary prevention**
Acute care	Acute decompensation of disease	
	Cycle of stabilisation and destabilisation	
Specialist care	Progression of disease to advanced stage	
	Intensive medical or surgical therapy	
	Iatrogenic complication from therapy	**Tertiary prevention**
	Prolonged hospitalisation	
Post-acute care	Functional decline	
	Admission to long-term care facility	
Palliative care	Readmission	
	Death	

Regular physical activity and exercise has been shown to provide a degree of protection against multiple components of frailty in both sexes, at all stages of the condition, and all stages of the life cycle (120, 121). Further, exercise interventions have been proposed as potentially offering the best form of treatment for frail older adults (90), with promising results in a variety of settings and geriatric populations (122, 123), and even shown to mediate the reversal of frailty in some cases (124, 125). However, more research is needed to determine the feasibility and efficacy of exercise interventions in different settings and clinical populations (22, 125).

1.4 Exercise interventions for frail geriatric populations

Regular physical activity and exercise have been shown to consistently improve cognition, physical function, sarcopenia (low muscle quantity, strength, and performance) and mood in

both non-frail and frail older adults (120). While inactivity is a modifiable risk factor for frailty onset and progression, physical activity and exercise are known to improve function across multiple physiologic systems, including the muscle, heart, brain, endocrine system, and inflammation response (126). In this regard, exercise can improve function in all physiological systems known to be dysregulated with the onset and progression of frailty (127). However, while there is evidence of the benefits of exercise regarding the prevention, treatment, and potential reversal of frailty, it is universally noted that there needs to be more studies within this area to truly assess the feasibility and efficacy of exercise in frail geriatric populations within different settings, and particularly in clinical settings (22, 128). Further, to increase external validity of such studies, particularly those among clinical cohorts, it is imperative that prospective studies attempt to recruit as representative a sample as possible, so that feasibility and efficacy assessments are extrapolatable to real world settings. In this regard for example, a recent systematic review examining exclusion rates in 305 randomised controlled trials involved in the treatment of 31 physical conditions, reported that a quarter of all trials excluded 89% of patients with the specific condition to be treated within that trial, while half excluded 77.1% of patients with the condition. Those excluded were primarily attributed to advanced age, and those with significant co-morbidity and co-prescription; characteristics which are ubiquitous among those treated in clinical practice (129). Though it is often required to exclude certain cohorts to define the clinical population and control for confounding factors, particularly with regard to exercise interventions which pose a low likelihood of contra-indication, it is essential that representative samples are examined, which among frail older adults, and particularly in certain settings, invariably includes those with significant co-morbidities and polypharmacy.

1.4.1 Interventions among community-dwelling older adults

Exercise, or exercise and nutrition interventions combined, have been shown to be capable of reversing frailty (124, 125, 130), or limiting its progression (131, 132), among cohorts of community-dwelling older adults.

1.4.2 Interventions among older adults in residential care (assisted living and nursing home facility residents)

The implementation of exercise interventions in nursing home settings have been shown to be effective in improving strength, gait speed, and balance in older adults residing in these settings (133, 134). Further, individualised and progressive multicomponent exercise interventions at a moderate intensity have been shown to be effective in the prevention of falls, and the reduction of frailty and mortality among older nursing home residents (123).

1.4.3 Interventions among hospitalised older adults

Acute hospital admission for older adults is associated with further loss of physical activity and represents a period of increased susceptibility to sarcopenia and frailty (135). Frailty is associated with longer stay and increased rates of mortality in hospitalised older adults, as well as serving as a predictor of readmission (100, 136). Therefore, there is an urgent need to examine the feasibility of such interventions within this setting, and whether these interventions can be employed to improve various aspects of health in frail older populations in inpatient hospital ward settings. Preliminary research has shown some success in the implementation of exercise interventions to reverse functional decline among general geriatric inpatient populations (137, 138), and walking during hospitalisation has been shown to be associated with a shorter length of stay (139). However, to date, presently there are no studies which have attempted to assess the feasibility or efficacy of such an intervention in

operationally defined frail participants with more significant initial impairments. This thesis will further attempt to address this gap.

1.5 Aim

The overall aim of this thesis is to assess the prevalence of frailty among geriatric hospital inpatients, and the feasibility of exercise interventions among frail geriatric populations within hospital inpatient delayed discharge, and assisted living facility, settings. This aim is achieved through the sequential addressing of the primary research questions of this PhD thesis, outlined in section 1.6.

1.6 Research questions

Within the context of the literature described above, five research questions are addressed within this PhD thesis:

1. What is the overall pooled prevalence of frailty and pre-frailty among geriatric populations within inpatient hospital settings?
2. What is the prevalence of frailty within inpatient hospital settings stratified by age, sex, operational frailty definition, prevalent morbidities, ward type, clinical population, and geographic location?
3. What is the association between the prevalence of frailty among geriatric hospital inpatients, and economic prosperity and healthcare expenditure?
4. Are adapted exercise interventions, aimed at improving the multi-dimensional health and functional capacity of frail older adults, feasible in a delayed discharge hospital ward setting?

5. Is an adapted resistance training intervention, aimed at improving the multi-dimensional health and functional capacity of frail geriatric assisted living facility residents, feasible within this setting?

Research question 1-3 are addressed chapter 2, which comprises of the results manuscript of a systematic review and meta-analysis which aimed to systematically search and analyse the prevalence of frailty among geriatric populations (≥ 65 years) within inpatient hospital settings within the literature. Further, this review aimed to synthesise well-evidenced pooled estimates of the prevalence of frailty and pre-frailty, as well as the prevalence of frailty stratified by age, sex, operational frailty definition, prevalent morbidities, ward type, clinical population, and geographic location, among geriatric hospital inpatients. Moreover, this review aimed to examine the relationship between the prevalence of frailty among geriatric hospital inpatients, and GDP per capita PPP, and health care expenditure per capita PPP.

Research question 4 is addressed in Chapters 3-4, which are comprised of the published methodology, and results and discussion of a mixed methods study which examined the feasibility of adapted exercise interventions aimed at improving the multi-dimensional health of frail delayed discharge hospital inpatients. In this regard, this study was designed to examine the feasibility of tertiary level treatment of frailty in older adults in a delayed discharge setting.

Research question 5 is addressed in Chapter 5, which comprises the published protocol for a study to assess the feasibility of an adapted resistance training intervention aimed at improving the multi-dimensional health and functional capacity of frail older adults in a residential care setting. Similar to research question 4, this study was designed to examine the feasibility of late secondary/early tertiary level treatment of frailty among older adults within

residential care settings. These five research questions are further consolidated and discussed in Chapter 6 of this thesis, the general discussion.

Chapter 2. Systematic review and meta-analysis results

A published protocol manuscript: Doody, P., Aunger, J., Asamane, E., Greig, C.A., Lord, J., Whittaker, A., 2019, “Frailty Levels in Geriatric Hospital paTients (FLIGHT) — The prevalence of frailty amongst geriatric populations within hospital ward settings: a systematic review protocol”, BMJ Open, vol. 9, no. 8, pp. e030147, doi: 10.1136/bmjopen-2019-030147, relating to this chapter is available within the appendices of this thesis, as Appendix 2.1.

2.1 Abstract

Background: Frailty is a common and clinically significant condition among geriatric populations, associated with adverse health outcomes such as hospitalisation, disability, and mortality. Although there are well-evidenced pooled estimates of the prevalence of frailty among community-dwelling older adults, nursing home residents, older individuals with cardiovascular disease, cancer, diabetes, and general surgery patients, presently there are none assessing the overall prevalence of frailty among geriatric hospital inpatients.

Purpose: To systematically search and analyse the prevalence of frailty among geriatric populations within inpatient hospital settings within the literature, and to synthesise pooled estimates of the prevalence of frailty and pre-frailty; as well as the prevalence of frailty stratified by age, sex, operational frailty definition, prevalent morbidities, ward type, clinical population, and geographical location. Additionally, to examine the association between the prevalence of frailty among geriatric hospital inpatients and gross domestic product per capita purchasing power parity (PPP) and health care expenditure per capita PPP.

Data Sources: Systematic searches were performed on Ovid, Web of Science, Scopus, CINAHL Plus, and the Cochrane Library, encompassing all available literature published prior to 21 November 2018, and supplemented with manual reference searches of all included articles.

Study Selection: Any observational or experimental study design which utilised a validated operational definition of frailty, reported the prevalence of frailty, had a minimum age ≥ 65 years, attempted to assess the whole ward/clinical population, and occurred in hospital inpatients. Title and abstract and full text screening of systematic search results were performed by three reviewers independently.

Data Extraction: Two reviewers independently extracted all relevant data and assessed the quality of eligible studies using the Joanna Briggs Institute critical appraisal tool for studies reporting prevalence data.

Data Synthesis: Ninety-six eligible studies were identified, comprising a pooled sample of n=467,779 geriatric hospital inpatients. The median critical appraisal score for included studies was 8 out of 9 (range 7-9). The overall pooled prevalence of frailty, and pre-frailty, among geriatric hospital inpatients was 47.4% (95% CI 43.7-51.1%), and 25.8% (95% CI 22.0-29.6%), respectively. Stratified analysis illustrated frailty was more prevalent among female patients; those aged ≥ 85 years; those residing on rehabilitation wards; those assessed using the Groningen frailty indicator, and patients classified as rehabilitation or delayed discharge. The prevalence of frailty was relatively consistent when stratified by geographic location. No significant associations were identified between the prevalence of frailty among geriatric hospital inpatients and economic indicators.

Limitations: As eligibility was limited to studies available in the English language, included studies may be relatively over-representative of Western nations (Europe, Australasia, and the Americas).

Conclusions: Frailty is a prevalent condition among geriatric hospital inpatients. There is a relatively high heterogeneity across this setting based on age, sex, prevalent morbidity, ward type / clinical population, and the operational definition utilised for the classification of frailty. Pooled estimates reported in this review, place the prevalence of frailty among geriatric hospital inpatients between that reported for community-dwelling older adults and older adults in nursing homes, outlining an increase in the relative prevalence of frailty with progression through the healthcare system.

Registration: PROSPERO registration number 79202.

Funding Source: European Commission Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement (675003).

2.2 Introduction

As outlined in Chapter 1, although there are systematic reviews and meta-analyses assessing the prevalence of frailty amongst community-dwelling older adults (1-6), nursing home residents (7), older individuals with cardiovascular disease (8), cancer (9), diabetes (10), and general surgery patients (11), presently there are no well-evidenced pooled estimates of the overall prevalence of frailty among geriatric hospital inpatients. There are, however, several studies which have primarily aimed to produce estimates of the overall prevalence of frailty within this population (12-19). Further, recently, a scoping review reported a median frailty prevalence of 49% (range 34-69%) in acute care hospital settings (20). However, as noted in Chapter 1, this review had a number of methodological limitations, including the inclusion of the entire sample of any study with a single participant ≥ 65 years, where up to 50% of the sample were not hospital inpatients, and studies that did not report on the method of frailty assessment. Similarly, a recently published systematic review and meta-analysis which examined the prevalence of pre-frailty and frailty together among hospitalised older adults, in studies which also assessed undernutrition risk, found a mean prevalence of 84%, but with limited data from only 11 studies (n=2,725 patients) eligible for meta-analysis (21).

Consequently, there is an evident need for more robust and comprehensive research to thoroughly assess the prevalence of frailty within the overall population of geriatric hospital inpatients. As such, the purpose of this review was to systematically search and analyse the prevalence of frailty among geriatric populations (aged ≥ 65 years) within inpatient hospital settings within the literature. If a meta-analysis proved possible, the aim of this review was also to synthesise pooled estimates of the prevalence of frailty and pre-frailty, as well as the prevalence of frailty stratified by age, sex, operational frailty definition, prevalent morbidities, ward type, clinical population, and geographic location, among geriatric hospital inpatients. Additionally, this review examined the association between the prevalence of

frailty among geriatric hospital inpatients, and gross domestic product (GDP) per capita purchasing power parity (PPP) and health care expenditure per capita PPP. As noted in Chapter 1, preliminary research into these areas have shown frailty in the community to be correlated with national economic indicators (22), but note that more research is needed in this regard to better understand this relationship.

2.3 Methods

This systematic review and meta-analysis was designed and conducted in accordance with PRISMA standards (23, 24). A comprehensive review protocol was developed and adhered to for all steps of this systematic review and meta-analysis. This protocol is published elsewhere (25).

2.3.1 Data sources and searches

Searches were conducted on the platforms of Ovid (incorporating the databases of Journals @Ovid full text, EMBASE, CAB abstracts, Ovid MEDLINE ® In process and other non-indexed citations, Ovid MEDLINE, and PsycINFO) and Web of Science (incorporating the databases of Science Citation Index Expanded (SCI-Expanded), Conference Proceedings Citation Index – Science (CRI-S), and Emerging Sources Citation Index (ESCI)), and the databases of CINAHL Plus, Scopus, and the Cochrane Library databases (the Cochrane Database of Systematic Reviews (CDSR), the Cochrane Central Register of Controlled Trials (CENTRAL), the Cochrane Methodology Register (CMR), the Database of Abstracts of Reviews of Effect (DARE), Health Technology Assessment database (HTA) and the NHS Economic Evaluation Database (EED)), encompassing all available literature published prior to 21/11/2018 (Appendix 2.2), and supplemented with manual reference searches of all included articles.

2.3.2 Study Selection

Inclusion criteria required studies to have: a minimum age of ≥ 65 years; used a clearly defined and validated operational definition for the classification of frailty (i.e., one which takes into consideration the multi-dimensional nature of the condition, and has been specifically validated for the assessment of frailty; either through comparison with existing validated frailty tools, or its predictive value regarding negative health outcomes associated with frailty); either assessed (or attempted to assess) the whole ward, department, unit, hospital, or specific clinical population, or employed some form of randomised selection of participants; occurred within a hospital setting, in, or including, hospital inpatients (operationally defined as any patient admitted to hospital who remains overnight, or were initially expected to remain overnight), and; reported the prevalence of frailty or provided sufficient data to allow its calculation. If a study examined a mixed cohort, only data relating to hospital inpatients were included in this review. Exclusion criteria were all studies whose full text was not available in the English language, and studies where the sample were not hospital inpatients (i.e., outpatients, day patients, or community-dwelling individuals).

Prior to the commencement of title and abstract screening by three independent reviewers (PD, EA, and JA), duplicates were removed using EndNote (VX 8.2). The succeeding reduced list of studies was further manually screened for the removal of any remaining duplicates. All reviewers were provided with an instructional screening form, and a .ris file containing all studies captured within the platform and database searches. This screening form outlined the eligibility criteria and instructions on setting up the file for screening within a reference manager (Appendix 2.3).

The title and abstract of all studies were independently screened by the three reviewers, with each reviewer placing potentially eligible studies into a separate folder. On completion, potentially eligible studies from all three reviewers were placed into a ‘master folder’ and the

results collated. Duplicates were removed, leaving the final combined list of studies for the full text screening phase. All reviewers independently screened the full text of remaining studies utilising the screening form and maintained separate files for included and excluded studies (including reasons), as well as for studies for which they believed there was need to contact the authors for clarification or additional information.

On completion, a full text screening master file was formulated by the lead reviewer displaying each reviewer's full text screening decision for each study (Appendix 2.4). All three reviewers subsequently met to discuss the decisions of each study and endeavoured to come to an agreement on studies for which there was not initial unanimous consensus. During this process, a full list of included (Appendix 2.4) and excluded studies (with reasons) (Appendix 2.5), and studies for which reviewers agreed to contact authors for additional information or clarification (Appendix 2.6) was formed by the lead reviewer. Subsequently, the lead reviewer contacted the relevant study authors and, on receipt of clarification or additional information, forwarded this information to the two other reviewers for independent assessment. All reviewers subsequently met to further discuss and come to resolution on the eligibility of all such studies (Appendix 2.6).

Manual screening was also employed by reviewers and included the reference lists of all included studies, as well as excluded but potentially relevant studies or systematic reviews captured within the screening. As part of the grey literature search of this review, in process publications were also searched and conference abstracts followed up with authors to ascertain if full texts relating to these data were available. Studies of the same cohort were included only once, specifically, the study which provided the most information about the cohort relevant to this review. In the event two or more studies reported an identical quantity of data relevant to the review, the study which was published first was given precedence for inclusion.

2.3.3 Data extraction and quality assessment

Data extraction of eligible studies was performed by two reviewers (PD and BS) independently. In the event of any discrepancies between the two reviewers, an attempt was made to reach a consensus by discussion. A contingency plan was in place, regarding obtainment of the opinion of a third reviewer, in the event that a full consensus could not be reached between the two reviewers after an exhaustive discussion, with the majority consensus taken. However, ultimately this contingency plan was not utilised, as both reviewers came to agreement after discussion in all cases.

The following data, where available, were extracted from all eligible studies. If any data were not immediately available, the authors of these studies were contacted in an attempt to retrieve all applicable data:

Study details: authors, year of publication, study title, journal of publication, and aim. Study methods: setting, ward/department/unit/hospital type, clinical population, study design, recruitment duration, subject characteristics (age of participants (mean and standard deviation, range)), sex (proportion of male/female participants), country/continent, sample size, diagnosis/prevalent morbidity (if applicable), any other relevant characteristics), criteria utilised for the operational definition of frailty. Results: Number of frail participants, number of pre-frail participants, number of robust/non-frail participants, prevalence of frailty, prevalence of pre-frailty, prevalence of robustness/non-frailty, number of male participants, number of frail male participants, number of pre-frail male participants, number of non-frail/robust male participants, prevalence of frailty in male participants, prevalence of pre-frailty in male participants, prevalence of non-frailty/robustness in male participants, number of female participants, number of frail female participants, number of pre-frail female participants, number of non-frail/robust female participants, prevalence of frailty in female participants, prevalence of pre-frailty in female participants, prevalence of non-

frailty/robustness in female participants, and finally authors' and reviewers' comments (Appendix 2.7).

External to the studies, data were additionally extracted with regard to the 5-year average gross domestic product (GDP) per capita purchasing power parity (PPP) (current international $) of the country in which each study was conducted, incorporating the 5 years directly preceding the commencement of recruitment to the study (26). External data were also extracted with regard to the 5-year average healthcare expenditure per capita PPP (current international $) of the country in which each study takes place, incorporating the 5-years directly preceding the commencement of recruitment to the study (27). Each calendar year of the study was also included provided recruitment continued through to > 6 months in the preceding year (Appendix 2.7).

The quality of eligible studies was independently assessed by two reviewers (PD and EA) using the Joanna Briggs Institute critical appraisal tool for studies reporting prevalence data (28). In the event of any discrepancies between the two reviewers, an attempt was made to reach a consensus by discussion. Similar to the process for data extraction, a contingency plan was in place to obtain the opinion of a third reviewer, in the event a consensus could not be reached, with the proceeding majority consensus taken as final. However, ultimately, this contingency plan was not utilised, as the two reviewers came to successful resolution in all cases.

2.3.4 Data synthesis and analysis

2.3.4.1 Quantitative synthesis (meta-analysis)

Where a sufficient quantity of identified studies were comparable, meta-analysis, pooling the aggregated data from each study, was performed. Clinical heterogeneity was assessed by two reviewers based on their judgement of the available data, and any disagreements discussed thoroughly with the aim of reaching unanimous consensus, which occurred in all cases. Statistical heterogeneity was assessed through the utilisation of a Cochran Q test and considered present at $p<0.05$ (29). An I^2 test was performed to assess the magnitude of this heterogeneity, with I^2 values of 25%, 50%, and 75% being considered low, moderate, and high, respectively (30). Where the Cochran Q statistic test detected statistically significant heterogeneity, combined with the researcher's assessments concluding that variation in effect size between studies could not be fully explained by the sampling error within each study, i.e., that the true effect-size was not identical for all studies, a randomised-effects model was utilised (31).

Stratified analysis was also conducted according to age (65-74 years, 75-84 years, and 85+ years), sex, operational frailty definition, ward type, prevalent morbidity, clinical population, and geographic location (country and continent) where possible. These variables were specifically chosen for stratified analysis due to an enhanced knowledge of these areas being of practical utility to researchers and clinicians; stemming from empirical evidence persistently showing variation in these factors to impact on the prevalence of frailty (32-34). As such, stratified analysis facilitated provision of a more in-depth and thorough insight into the prevalence of frailty among geriatric patients within this setting.

Clinical heterogeneity for stratified analysis was assessed by two reviewers based on their judgement of the available data. Any initial disagreements were discussed thoroughly, with a unanimous consensus reached in all cases. Statistical heterogeneity for stratified analysis was

assessed as above through the utilisation of Cochran Q tests, with I^2 tests performed to assess the magnitude of this heterogeneity (29, 30).

Correlation analysis was also employed to examine the relationship between the prevalence of frailty among geriatric hospital inpatients and economic prosperity (GDP per capita PPP) (current international $), and healthcare expenditure (per capita PPP) (current international $). In addition, multi-linear regression analysis was employed to examine the predictive value between economic prosperity and healthcare expenditure and the prevalence of frailty among geriatric inpatients.

2.3.4.2 Qualitative synthesis

A brief systematic narrative analysis of all outcomes was also performed, with findings presented in both textual and tabular formats.

2.3.5 Role of the funding source

This review was supported by the European Commission Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement (675003). The funding source had no role in the design, conduct, or reporting of the review, or the decision to publish the manuscript.

2.4 Results

Systematic searches yielded a combined total of 4,757 results, of which 1,549 were removed as duplicates. Four additional articles were identified within the reference list of included studies during manual screening. The remaining 3,208 articles were screened by title and abstract by the three independent reviewers and the results collated, leaving 655 studies for full text screening. 344 of these articles were initially excluded due to ineligibility: minimum

age <65 years (n=122); utilisation of a non-validated operational definition for the classification of frailty (n=91); sample were not hospital inpatients at the time of frailty assessment (n=89); did not assess (or attempt to assess) the entire ward/clinical population or employ some form of randomised selection of participants (n=5); other reasons (predominantly duplicate cohorts) (n=37); multiple (combination of the above reasons) (n=117).

A further 235 studies screened by full text were deemed to not be initially possible to definitively include or exclude based on available data. As such it was agreed by the three reviewers to contact the study authors for additional information or clarification regarding eligibility. The corresponding author of all 235 studies was contacted via email by the lead reviewer to obtain the relevant additional data, or clarification, to facilitate inclusion / exclusion. A response was received from 99 of the 235 corresponding authors. Of the 136 studies without an initial response from the corresponding author, a second author (typically first or senior author) of all 136 studies were contacted by the lead reviewer, a minimum of 14-days after the initial inquiry to corresponding authors. A response was received for 37 of these 136 studies, giving a combined response rate of 57.9% (n=136) for the 235 studies. Ultimately this process resulted in an additional 20 studies being deemed eligible for inclusion in the review, resulting in 96 eligible studies in total (Figure 2.1). However, this process did add considerably to the timeline for this review beyond the initial search period, which may be updated prior to manuscript submission (All inquiries to study authors, and responses received are detailed in Appendix 2.6).

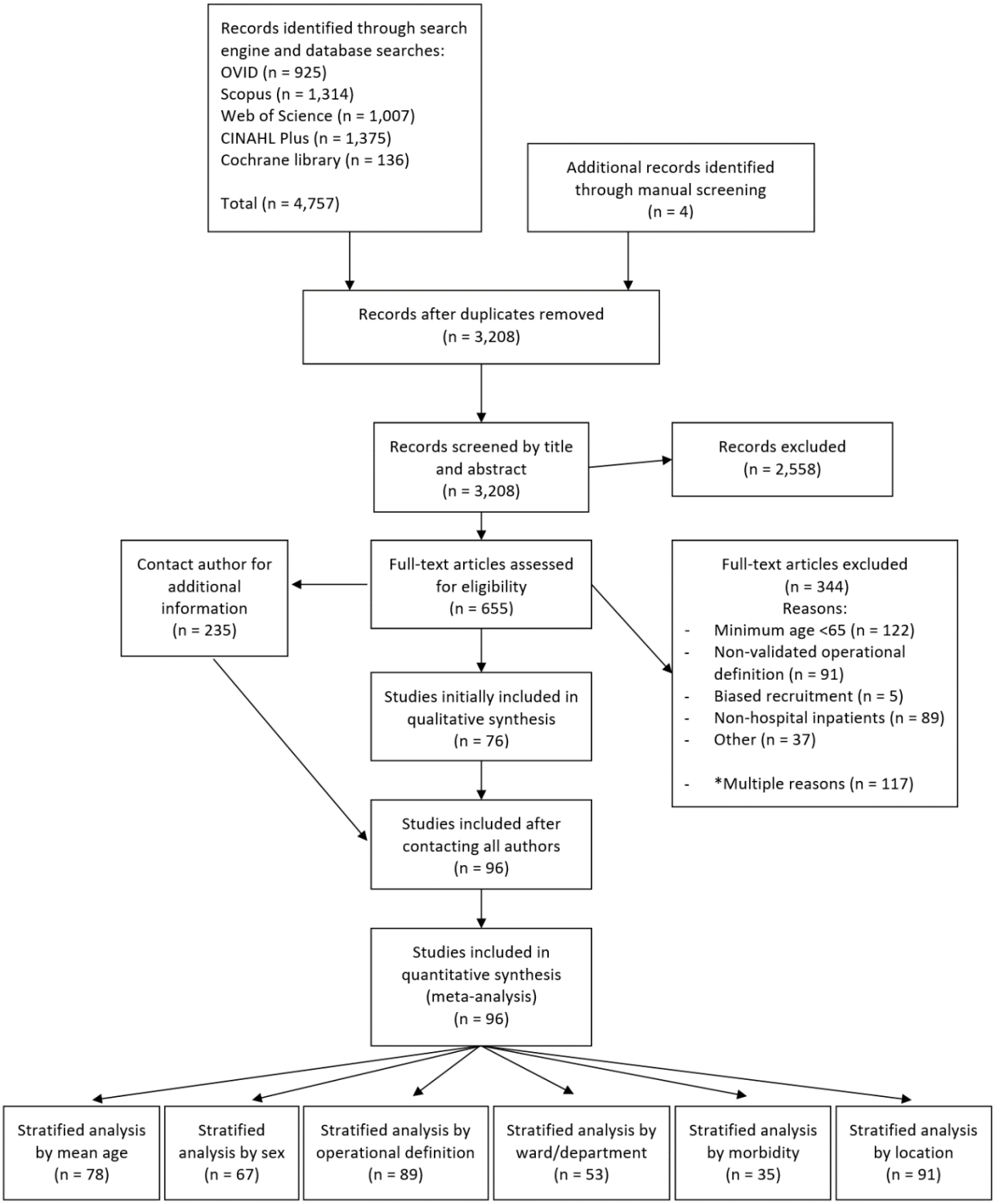


Figure 2.1. PRISMA flow diagram of systematic review and meta-analysis process.

Of these 96 eligible studies, only four initially reported the full range of data sought for stratified analysis. The corresponding author of the remaining 92 studies were contacted in an attempt to obtain these data. If a response was not received within 14-days, a second author was contacted. This process resulted in successful obtainment of additional data for 58 of the

92 studies with initially incomplete data for all elements of stratified analysis (All inquiries to study authors, and responses received are detailed in Appendix 2.6).

A detailed list of all 96 included studies, reporting selected relevant study characteristics is displayed in Table 2.1:

Table 2.1. Selected characteristics of the 96 included studies.

Author/Year	Study design	Setting	Ward / Clinical population type	Diagnosis / Prevalent morbidity	Age of participants (mean (SD))	Age of participants (range)	Country	Sample size	Criteria utilised for operational definition of frailty	Prevalence of frailty (%)	Prevalence of pre-frailty (%)	Prevalence of robust/non-frail (%)	Prevalence of frailty (males) (%)	Prevalence of pre-frailty (males) (%)	Prevalence of robust/non-frail (males) (%)	Prevalence of frailty (females) (%)	Prevalence of pre-frailty (females) (%)	Prevalence of robust/non-frail (females) (%)
Alonso Salinas et al., 2018 (35)	Prospective, observational study	Three tertiary-level hospitals	Patients with acute coronary syndrome (type 1 myocardial infarction)	Acute coronary syndrome (type 1 myocardial infarction)	82.5 ± 5.0*	78-88	Spain	285	SHARE-FI	38.2%	29.8%	31.9%	29.8%	26.9%*	43.3%*	50.9%	34.2%*	14.9%*
Amblas-Novellas et al., 2018 (36)	Prospective, observational, longitudinal study	University hospital of Vic (Barcelona, Spain)	Acute geriatric unit	N/A	86.4 ± 5.6	85+	Spain	590	Frail-VIG index	83.9%	14.6%*	1.5%	82.1%*	16.7%*	2.0%*	85.3%*	13.6%*	1.2%*
Andela et al., 2010 (37)	Observational study	Multiple: A large teaching hospital, and a university hospital	Multiple – Five wards of different specialisms	N/A	-	75+	Netherlands	276	Groningen Frailty Indicator (GFI)	73.2%	N/A	26.8%	-	N/A	-	-	N/A	-
As above	*As above*	*A large teaching hospital*	*Geriatric centre*	*N/A*	*83.8 ± 4.7*	*75+*	*As above*	*32*	*As above*	*90.6%*	*N/A*	*9.4%*	-	N/A	-	-	N/A	-
As above	*As above*	*A large teaching hospital*	*Traumatology*	*N/A*	*83.3 ± 5.3*	*75+*	*As above*	*69*	*As above*	*69.6%*	*N/A*	*30.4%*	-	N/A	-	-	N/A	-
As above	*As above*	*A large teaching hospital*	*Pulmonary / Rheumatology*	*N/A*	*79.8 ± 3.2*	*75+*	*As above*	*71*	*As above*	*70.4%*	*N/A*	*29.6%*	-	N/A	-	-	N/A	-
As above	*As above*	*A University hospital*	*Internal medicine*	*N/A*	*81.2 ± 5.1*	*75+*	*As above*	*76*	*As above*	*80.3%*	*N/A*	*19.7%*	-	N/A	-	-	N/A	-
As above	*As above*	*A University hospital*	*Surgical medicine*	*N/A*	*81.1 ± 4.9*	*75+*	*As above*	*28*	*As above*	*50.0%*	*N/A*	*50.0%*	-	N/A	-	-	N/A	-
Andrew et al., 2017 (38)	Prospective, multi-centre, test negative case control	38 academic and community sentinel hospitals	Medical and coronary intensive care units (ICUs) and medical wards. Patients with influenza related hospitalisation	Influenza related hospitalisation	-	65+	Canada	505	Frailty Index (39 item)	36.4%	45.3%	18.2%	32.7%	47.6%	19.7%	39.1%	43.8%	17.2%

Attinsano et al., 2017 (39)	Retrospective observational study	Several transcatheter aortic valve implantation (TAVI) centres	Cardiac surgery patients (trans-catheter aortic valve implantation (TAVI))	Cardiac surgery patients (trans-catheter aortic valve implantation (TAVI))	83 ± 7	80+*	Italy	331	Frailty Index*	54.4%	-	-	N/A	N/A	N/A	54.4%	-	-
Baldwin et al., 2014 (40)	Single-centre prospective cohort study	Columbia University medical centre	Medical Intensive Care Unit	Survivors of respiratory failure	77.0 ± 8.9	65-95	United States of America	22	Fried frailty phenotype criteria	81.8%	18.2%	0.0%	86.7%	13.3%	0.0%	71.4%	28.6%	0.0%
Blanco et al., 2017 (41)	Prospective observational study	Tertiary care centre at a University Hospital	Patients with Acute Coronary Syndrome (ACS) - Type 1 myocardial infarction	Acute Coronary Syndrome (ACS) - Type 1 myocardial infarction	85.9 ± 3.9	85+	France	236	Adjusted Edmonton Frailty Scale (EFS)	20.8%	28.8%	50.4%	18.9%	27.9%	53.3%	22.8%	29.8%	47.4%
Bo et al., 2015 (42)	Prospective observational study	Two large metropolitan university teaching hospitals	Atrial fibrillation patients	Atrial fibrillation	81.7 ± 6.8	65+	Italy	513	Groningen Frailty Indicator (GFI)	83.0%	N/A	17.0%	-	N/A	-	-	N/A	-
Bo et al., 2016 (43)	Prospective observational study	Two large metropolitan university teaching hospitals	Eight acute geriatric and medical wards	N/A	81.0 ± 7.3	65+	Italy	1,568	Fried Frailty phenotype criteria	41.4%	-	-	-	-	-	-	-	-
Cheung et al., 2016 (44)	Prospective cohort study	Tertiary referral centre	Orthopaedic, cardiothoracic, vascular, or colorectal surgical services	Surgical inpatients	78.0 ± 7.0	65+	Australia	100	Reported Edmonton Frailty Scale (REFS)	33.0%	27.0%*	40.0%*	23.8%	23.8%*	52.4%*	39.7%	29.3%*	31.0%*
Chew et al., 2017 (45)	Prospective observational cohort study	Tan Tock Seng Hospital, Singapore	Department of Geriatric Medicine, Geriatric Monitoring Unit	Delirium	84.1 ± 7.4	65+	Singapore	234	Frailty Index (FI)	67.9%	-	-	66.7%	-	-	68.9%	-	-
Chia et al., 2016 (46)	Prospective study	Khoo Teck Puat Hospital acute hospital, Singapore	Department of general surgery (colorectal surgery patients)	Colorectal surgery	80.4 ± 5.5*	65-97	Singapore	117	Fried Frailty Phenotype	25.6%	-	-	-	-	-	-	-	-
Chong et al., 2017 (47)	Prospective cohort study	Tan Tock Seng Hospital, Singapore	Department of geriatric medicine	N/A	89.0 ± 4.6	65+	Singapore	210	Multiple	74.5%	25.2%*	As below	72.7%	25.0%*	As below	75.3%	25.3%*	As below
As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*210*	*Frailty Index*	*87.1%*	-	*12.9%*	*82.8%*	-	*17.2%*	*89.0%*	-	*11.0%*

As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*210*	*FRAIL scale*	*50.0%*	*41.4%**	*8.6%**	*56.3%*	*34.4%**	*43.8%**	*47.3%*	*44.5%**	*6.8%**
As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*210*	*Tilburg Frailty Index*	*80.0%*	*N/A*	*20.0%*	*79.7%*	*N/A*	*20.3%*	*80.1%*	*N/A*	*19.9%*
As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*210*	*Clinical Frailty Scale*	*81.0%*	*9.0%**	*10.0%**	*71.9%*	*15.6%**	*28.1%**	*84.9%*	*6.2%**	*2.1%**
Coleman et al., 2012 (48)	Prospective observational study	A large urban hospital	Three rehabilitation wards	N/A	82.9 ± 6.4	65+	Ireland	32	Clinical Frailty Scale (CFS)	100.0%*	0%*	0%*	100.0%*	0%*	0%*	100.0%*	0%*	0%*
Courtney-Brooks et al., 2012 (49)	Prospective cohort study	Tertiary level hospital	Gynaecologic oncology patients	Gynaecologic cancer	73	65-95	United States of America	37	Fried frailty phenotype	16.2%	27.0%	56.8%	N/A	N/A	N/A	16.2%	27.0%	56.8%
Crozier-Shaw et al., 2018 (50)	Prospective cohort study (Retrospective review)	Tertiary referral private institution	Colorectal surgery patients	Benign and malignant colorectal diseases	-	65+	Ireland	206	National Surgical Quality Improvement Program frailty index	20.9%	N/A	79.1%	-	N/A	-	-	-	-
Dal Moro et al., 2017 (51)	Prospective observational study	Tertiary level hospital	Urological surgery patients (both endoscopy and open surgery)	Urological surgery (both endoscopy and open surgery)	78.5 ± 3.9	70-94	Italy	78	Edmonton Frailty Scale (EFS)	21.8%	16.7%*	61.5%*	36.4%*	27.3%*	36.4%*	19.4%*	14.9%*	65.7%*
Dent et al., 2015 (52)	Prospective, observational study	Queen Elizabeth Hospital, South Australia	Geriatric Evaluation Medical Unit	N/A	-	70+	Australia	172	Study of Osteoporotic Fractures (SOF) index	69.8%	26.2%	4.1%	-	-	-	-	-	-
Dorner et al., 2014 (53)	Cross-sectional study	Two hospitals in Vienna; one a University hospital, and one an acute care hospital	Endocrinology and metabolism, and gastroenterology wards	N/A	76.4 ± 8.2*	65-97	Germany	133	SHARE-FI	54.1%	21.8%	24.1%	50.0%	38.3%	11.7%	57.5%	8.2%	34.2%
Drudi et al., 2018 (54)	Prospective cohort study	14 medical centres in three countries (United States of America, Canada, and France)	Transcatheter Aortic Valve Replacement (TAVR) and Surgical Aortic Valve	Transcatheter Aortic Valve Replacement (TAVR) and Surgical	81.4 ± 6.1	70+	Multiple (United States of America, Canada, France)	1,035	Fried Frailty Phenotype criteria	39.8%	-	-	-	-	-	-	-	-

			Replacement (SAVR) inpatients*	Aortic Valve Replacement (SAVR) patients														
Dutzi et al., 2017 (55)	Observational cohort study	Centre for geriatric medicine, University Hospital	Post-acute geriatric rehabilitation centre (two geriatric rehabilitation wards) / patients with mild-moderate dementia	Mild-moderate dementia	83.7 ± 5.9	65+	Germany	154	Clinical Frailty Scale (CFS)	82.5%*	13.0%*	4.5%*	93.1%*	3.4%*	3.4%*	80.0%*	15.2%*	4.8%*
Eamer et al., 2018 (56)	Prospective, observational study	Two tertiary referral teaching hospitals	Emergency abdominal surgery patients	Emergency abdominal surgery	75.5 ± 7.6	65-96.5	Canada	150	Clinical Frailty Scale	15.3%	17.3%	60.7%	14.8%*	13.6%*	71.6%*	15.9%*	21.7%*	47.8%*
Eeles et al., 2012 (57)	Prospective cohort study	District general hospital	Patients admitted acutely to a general medical service	N/A	82.3 ± 7.5	75+	Australia	273	Frailty Index	40.7%	N/A	59.3%	-	-	-	-	-	-
Ekerstad et al., 2011 (58)	Clinical, prospective, observational study	A University Hospital, and two County Hospitals	Patients with non-ST segment elevation myocardial infarction (NSTEMI)	Non-ST-segment elevation myocardial infarction (NSTEMI)	-	75+	Sweden	307	Canadian Study of Health and Ageing (CSHA) Clinical Frailty Scale (7-point)	48.5%	25.4%	26.1%	43.3%	-	-	54.0%	-	-
Engelhardt et al., 2018 (59)	Prospective time series study	An urban academic hospital (Level 1 trauma centre)	Trauma and emergency general surgery patients	N/A	76.1 ± 8.0*	65+	United States of America	239	Trauma Specific and Emergency General Surgery Specific Frailty Indices	29.3%	N/A	70.7%	25.0%*	N/A	75.0%*	32.4%*	N/A	67.6%*
Ferrero et al., 2017 (60)	Retrospective multi-centre study	Mauriziano Hospital of Turin the University of Pisa.	Patients with ovarian cancer	Ovarian cancer	-	70-89	Italy	78	modified Frailty Index	29.5%	N/A	70.5%	N/A	N/A	N/A	29.5%	N/A	70.5%
Ga et al., 2018 (61)	Retrospective review	Chronic care hospital	Long-term care	Functional impairment and multi-morbidity	81.5 ± 7.2	65+	South Korea	100	Multiple	94.5%*	2.5%*	3.0%*	91.5%*	4.7%*	3.8%*	97.9%*	0.0%*	2.1%*
As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*100*	*FRAIL-NH scale*	*89.0%*	*5.0%*	*6.0%*	*83.0%**	*9.4%**	*7.5%**	*95.7%**	*0.0%**	*4.3%**

As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*100*	*Frailty index*	*100.0%**	*0.0%**	*0.0%**	*100.0%**	*0.0%**	*0.0%**	*100.0%**	*0.0%**	*0.0%**
Gleason et al., 2017 (62)	Retrospective cohort study	Level 1 trauma centre	Geriatric fracture co-management service (orthopaedic, trauma, geriatric services)	Fracture related surgical patients	82.3 ± 7.4	70+	United States of America	175	FRAIL Scale	41.7%	41.7%	16.6%	43.2%	43.2%	13.6%	41.2%	41.2%	17.6%
Goldforb et al., 2018 (63)	A prospective, single-arm, multinational, multicentre observational study	14 medical centres in three countries (Canada, United States of America, and France)	Cardiac surgery (transcatheter aortic valve implementation)	Cardiac surgery (transcatheter aortic valve implementation)	81.8 ± 6.2	80+	Multiple (Canada, United States of America, France)	1,158	Fried frailty phenotype criteria	37.4%	-	-	-	-	-	-	-	-
Guidet et al., 2018 (64)	Prospective observational study	39 intensive Care Units in 21 European countries	Intensive Care Unit	N/A	84.3 ± 3.6*	80-102	Multiple (Ireland, Great Britain, Portugal, Spain, France, Belgium, Denmark, Norway, Switzerland, Netherlands, Sweden, Russia, Germany, Austria, Poland, Czech Republic, Italy, Ukraine, Romania, Greece, Cyprus)	5,021	Clinical Frailty Scale	42.9%*	19.4%*	37.7%*	38.5%*	19.5%*	42.0%*	47.8%*	19.2%*	33.0%*
Gullon et al., 2017 (65)	An observational, prospective, multicentre study	64 hospitals from all the Spanish regions	Internal Medicine departments	Non-valvular atrial fibrillation	85 ± 5.1	75-101	Spain	755	FRAIL Scale	50.3%	-	-	-	-	-	-	-	-
Hartley et al., 2017 (66)	Retrospective observational study	A large tertiary University National Health Service (NHS) acute hospital	Department of Medicine for the Elderly wards	N/A	86 ± 5.8*	70+	United Kingdom	549	Clinical Frailty Scale	77.6%	10.0%*	12.4%*	74.2%	10.5%*	15.3%*	79.4%	9.7%*	10.9%*

Heppenstall et al., 2011 (67)	Prospective cohort study	Sub-acute geriatric unit	General wards	Delayed discharge	80.9 ± 7.2	66+	New Zealand	158	Edmonton Frailty Scale (EFS)	67.1%*	21.5%*	11.4%*	67.2%*	22.4%*	10.3%*	67.0%*	21.0%*	12.0%*
Hewitt et al., 2015 (68)	Multi-centre observational study	Acute general surgical admission units (1 site in each of Wales, England, and Scotland)	Acute general surgical units	Acute general surgery	77.3 ± 8.2	65+	United Kingdom	317	Canadian Study of Health and Ageing (CSHA) scale	27.8%	18.6%	53.6%	-	-	-	-	-	-
Hewitt et al., 2016 (69)	Cross-sectional observational study	A UK-based multicentre hospital study	Emergency general surgery units (Emergency general surgery patients)	Emergency general surgery	-	65-98	United Kingdom	408	Canadian Study of Health and Ageing (CSHA scale)	27.7%	19.9%	52.5%	-	-	-	-	-	-
Hii et al., 2015 (70)	Prospective study	Christchurch hospital, New Zealand	Cardiology patients	Percutaneous coronary intervention / cardiac surgery	78 ± 6.1*	72-90	New Zealand	47	Reported Edmonton Frailty Scale (REFS)	19.1%	23.4%*	57.4%*	19.2%	26.9%*	53.8%*	19.0%	19.0%*	61.9%*
Hilmer et al., 2011 (71)	Prospective observational study	Three teaching hospitals	Urology inpatients (administered single dose of prophylactic intravenous gentamicin)	Urology inpatients (administered single dose of prophylactic intravenous gentamicin)	77.1 ± 7.1	65+	Australia	31	Reported Edmonton Frailty Scale (REFS)	45.2%	-	-	46.2%	-	-	40.0%	-	-
Ibrahim et al., 2019 (72)	Cross-sectional prospective study	A tertiary level hospital	Acute wards	N/A	-	70+	United Kingdom	224	Multiple	40.6%	46.2%	13.2%	-	-	-	-	-	-
As above	*As above*	*As above*	*As above*	*N/A*	-	*As above*	*As above*	*230*	*FRAIL Scale*	*33.5%*	*46.1%*	*20.4%*	-	-	-	-	-	-
As above	*As above*	*As above*	*As above*	*As above*	-	*As above*	*As above*	*218*	*Fried frailty phenotype criteria*	*48.2%*	*46.3%*	*5.5%*	-	-	-	-	-	-
Induruwa et al., 2017 (73)	Retrospective observational study	A tertiary teaching hospital	General medicine patients	Atrial fibrillation	85.2 ± 5.6*	75+	United Kingdom	419	Clinical Frailty Scale (CFS)	67.3%	14.3%	18.4%	53.4%*	16.9%*	22.8%*	78.7%*	12.2%*	14.8%*

Jacobs et al., 2017 (74)	Explorative cross-sectional study	Inpatient hospital	Psychiatric ward	N/A	72.6 ± 7.6	65+	Netherlands	55	Frailty Index (44 items)	61.8%	-	-	-	-	-	-	-	-
Jokar et al., 2016 (75)	Prospective cohort study	Acute care surgery - Level 1 trauma centre	Surgical inpatients	Emergency general surgery patients	74.8 ± 7.8	65+	United States of America	130	Multiple	44.6%	N/A	55.4%	45.3%	N/A	54.7%	43.9%	N/A	56.1%
As above	*As above*	*As above*	*As above*	*As above*	*74.8 ± 7.8*	*As above*	*As above*	*200*	*Frailty Index*	*49.0%*	*N/A*	*51.0%*	*50.0%*	*N/A*	*50.0%*	*47.9%*	*N/A*	*52.1%*
As above	*As above*	*As above*	*As above*	*As above*	*75.4 ± 7.8*	*As above*	*As above*	*60*	*Emergency General Surgery-Specific Frailty Index*	*30.0%*	*N/A*	*70.0%*	*30.3%*	*N/A*	*69.7%*	*29.6%*	*N/A*	*70.4%*
Joosten et al., 2014 (76)	Prospective study	Tertiary care hospital	Acute geriatric ward	N/A	-	70+	Belgium	212	Multiple	36.3%	55.4%	8.3%	39.0%	-	-	34.7%	-	-
As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*220*	*Fried Frailty Phenotype*	*40.0%*	*58.6%*	*1.4%*	*45.7%*	*-*	*-*	*35.7%*	*-*	*-*
As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*204*	*Study of Osteoporotic Fracture (SOF) Frailty Index*	*32.4%*	*52.0%*	*15.7%*	*32.2%*	*48.3%*	*19.5%*	*32.5%*	*54.7%*	*12.8%*
Joseph et al., 2014 (77)	Prospective cohort study	Level 1 trauma centre	Trauma centre	Trauma patients	79 ± 8.1	65+	United States of America	250	Frailty Index	44.0%	N/A	56.0%	43.4%	N/A	56.6%	45.5%	N/A	54.5%
Joseph et al., 2016 (78)	Prospective cohort study	Level 1 trauma centre	Trauma centre	Trauma patients	74.8 ± 10.8	65+	United States of America	368	Trauma Specific and Emergency General Surgery Specific Frailty Indices	37.0%	37.8%	25.3%	34.2%	40.0%	25.8%	41.3%	34.3%	24.5%
Juma et al., 2016 (79)	Prospective observational study	Acute care university hospital	General internal medicine clinical teaching units	N/A	81.4 ± 8.8	65+	Canada	75	Clinical Frailty Scale	72.0%	6.7%	21.3%	48.1%	7.4%*	37.0%*	85.4%	6.3%*	12.5%*

Kang et al., 2015 (80)	Prospective cohort study	Peking Union Medical College Hospital	Cardiology and geriatric departments (inpatients with acute coronary syndrome) *	Acute Coronary Syndrome	74 ± 5.7*	65+	China	352	Canadian Study on Health and Ageing (CSHA) scale	43.2%	18.8%*	38.1%*	60.6%	-	-	19.5%	-	-
Karlekar et al., 2017 (81)	Quality improvement project	Vanderbilt University Medical Centre	Trauma intensive care unit	N/A	75.8 ± 8.3*	65+	United States of America	64	FRAIL Scale	37.5%	32.8%	29.7%	31.6%*	31.6%*	36.8%*	46.2%*	34.6%*	19.2%*
Keevil et al., 2018 (82)	Retrospective observational study	A National Health Service (NHS) University hospital	University hospital	Emergency admissions	-	75+	United Kingdom	10,662	Clinical Frailty Scale (CFS)	54.0%	17.3%*	28.7%*	48.2%*	18.7%*	33.2%*	58.2%*	16.3%*	25.5%*
Kenig et al., 2015 (83)	Prospective study	Tertiary referral hospital	Surgical unit (Emergency abdominal surgery patients)	Emergency abdominal surgery	76.9 ± 5.8	65-100	Poland	184	Multiple	52.2%	-	-	-	-	-		-	-
As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*184*	*Groningen Frailty Indicator (GFI)*	*54.3%*	-	-	-	-	-	-	-	-
As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*184*	*Rockwood frailty assessment*	*50.0%*	-	-	-	-	-	-	-	-
Khan et al., 2019 (84)	Prospective study	Banner University Medical, Centre, Tucson	Trauma centre (Emergency surgery patients)	Emergency general surgery patients	73.9 ± 8	65+	United States of America	326	Emergency General Surgery-Specific Frailty Index	39.0%	-	-	37.4%	-	-	41.0%	-	-
Kobe et al., 2016 (85)	Prospective cohort study	Two heart centres in Switzerland and Germany	Heart centres (Transcatheter Aortic Valve Replacement (TAVR) patients)	Transcatheter Aortic Valve Replacement (TAVR) patients	83.3 ± 4.3	75+	Multiple (Switzerland, Germany)	130	Frailty predicts death one yeaR after Cardiac Surgery Test (FORECAST)	54.6%	N/A	45.4%	52.3%	N/A	47.7%	56.9%	N/A	43.1%
As above	*As above*	*As above*	*As above*	*As above*	-	*75+*	*Switzerland*	-	*As above*	-	-	-	-	-	-	-	-	-
As above	*As above*	*As above*	*As above*	*As above*	-	*75+*	*Germany*	-	*As above*	-	-	-	-	-	-	-	-	-

Koyama et al., 2018 (86)	Prospective study	St. Marianna University School of Medicine Hospital, Kawasaki	Internal medicine patients	Internal medicine problems	77.2 ± 6.9	65+	Japan	151	Kihon checklist	22.5%	37.7%	39.7%	-	-	-	-	-	-
Kusunose et al., 2018 (87)	Prospective study	Tokushima University Hospital	Echocardiography inpatients*	Echocardiography inpatients*	75 ± 7	65+	Japan	191	Fried frailty phenotype criteria	19.9%	61.3%	18.8%	22.7%	60.0%	17.3%	16.0%	63.0%	21.0%
Lee et al., 2018 (88)	Cross sectional study	University hospital	Trauma, critical care, and emergency surgery service (Falls patients)	Patients admitted due to ground level falls	78.9 ± 9.1	66+	United States of America	100	Trauma specific frailty index	49%	N/A	51%	-	-	-	-	-	-
Le Maguet et al., 2014 (89)	Prospective observational study	Four university-affiliated hospitals	Intensive Care Unit (ICU)	N/A	75 ± 6	65+	France	196	Clinical Frailty Scale (CFS)	23.5%	31.6%	44.9%	21.9%	32.8%*	45.3%*	26.5%	29.4%*	44.1%*
Lin et al., 2017 (90)	Prospective cohort study	A tertiary hospital	Surgical patients	Surgical inpatients	79.0 ± 6.5	70+	Australia	246	Frailty Index - Comprehensive Geriatric Assessment (FI-CGA) (57 item)	19.1%	36.6%	44.3%	16.9%	29.7%	53.4%	21.1%	43.0%	35.9%
Llao et al., 2018 (91)	Prospective observational study	44 Spanish hospitals	Non-ST-segment elevation acute coronary syndromes	Cardiac (non-ST-segment elevation acute coronary syndromes patients	84.3 ± 4.0	80+	Spain	531	FRAIL scale	27.3%	-	-	-	-	-	-	-	-
Ma et al., 2013 (92)	Prospective observational study	Prince of Wales teaching Hospital, Hong Kong	Pneumonia patients	Pneumonia patients	-	65+	China	428	Canadian Study of Health and Ageing (CSHA) Clinical Frailty Scale	38.8%	13.8%	47.4%	-	-	-	-	-	-
Madni et al., 2017 (93)	Retrospective review study	Level 1 burn centre	Level 1 burn centre	Burn patients	75.5 ± 7.7	65+	United States of America	126	Canadian Study of Health and Ageing (CSHA) Clinical Frailty Scale	27.0%	34.1%	39.7%	-	-	-	-	-	-

Martin et al., 2018 (94)	Prospective observational study	Hospital de Mataró, Barcelona	Patients with Propharyngeal dysphagia in the Acute Geriatric Unit	Patients with oropharyngeal dysphagia	84.9 ± 6.0	70+	Spain	62	Fried frailty phenotype	80.6%	19.4%	0.0%	72.7%*	27.3%*	0.0%	89.7%*	10.3%*	0.0%
Mason et al., 2018 (95)	Prospective observational study	Musgrove Park Hospital	Emergency surgery patients	Emergency surgery patients	81*	70+	United Kingdom	435	Canadian Study on Health and Ageing (CSHA) Clinical Frailty Scale	41.1%	17.5%*	41.4%*	40.5%*	16.9%*	42.6%*	41.7%*	17.9%*	40.4%*
Maxwell et al., 2018 (96)	Prospective observational study	Inpatient hospital	Trauma patients (trauma, geriatrics, orthopaedic services)	Trauma patients	77.5 ± 8.9*	69-88	United States of America	188	FRAIL Scale	33.5%	37.8%	28.7%	25.6%*	42.7%*	31.7%*	39.6%*	34.0%*	26.4%*
McGuckin et al., 2018 (97)	Prospective observational study	University College Hospital London	Unscheduled non-cardiac surgery	Unscheduled non-cardiac surgery	77.1 ± 8.3	65+	United Kingdom	164	Canadian Study on Health and Ageing (CSHA) Clinical Frailty Scale	36.6%	14.0%	49.4%	38.3%*	13.3%*	48.3%*	35.6%*	14.4%*	50.0%*
McIsaac et al., 2018 (98)	Retrospective cohort study	Linked health administrative data in Ontario, Canada	Elective non-cardiac surgery	Elective non-cardiac surgery patients	-	66+	Canada	415,704	preoperative Frailty index (pFI)	28.8%	-	71.2%	31.9%	-	68.1%	26.2%	-	73.8%
Morton et al., 2018 (99)	Prospective cohort study	Inpatient hospital	Patient with acute kidney injury	Patients with acute kidney injury	81.4 ± 8.1	65+	United Kingdom	164	Clinical Frailty Scale	73.2%	-	-	70.1%	-	-	75.9%	-	-
Muessig et al., 2018 (100)	Prospectively realised observational multicentre European VIP-1 study	20 intensive care units	Intensive Care Units (ICU)	Intensive Care Unit (ICU) patients	84.6 ± 3.8*	80+	Germany	308	Clinical Frailty Scale	53.6%	22.7%	23.7%	48.7%	20.1%*	31.2%*	58.4%	25.3%*	16.2%*
Muller et al., 2017 (101)	Cross-sectional study	University Hospital Zurich, Switzerland	Geriatric Centre	Trauma patients	-	70+	Switzerland	156	Fried Frailty Phenotype	21.8%	59.6%	18.6%	-	-	-	-	-	-

Myint et al., 2018 (102)	Prospective cohort study	Five hospitals in the United Kingdom	Acute geriatric surgical unit	Acute surgical patients	-	65+	United Kingdom	644	Canadian Study of Health and Ageing (CSHA) Clinical Frailty Scale	17.5%	12.6%	69.9%	-	-	-	-	-	-
Nolan et al., 2016 (103)	Prospective cohort study	Post-acute rehabilitation unit	Post-acute rehabilitation unit	N/A	80.3 ± 7.1	65+	Ireland	41	Clinical Frailty Scale	97.6%	2.4%	0.0%	94.4%*	5.6%*	0.0%	100.0%*	0.0%*	0.0%
Nygen et al., 2016 (104)	Prospective cohort study	A tertiary referral teaching hospital	Atrial fibrillation	Atrial fibrillation	84.7 ± 7.1	65-100	Australia	302	Reported Edmonton Frailty Scale (REFS)	53.3%	-	-	49.7%	-	-	57.0%	-	-
Oliveria et al., 2013 (105)	Cross sectional study	São Vicente de Paulo Hospital	Tertiary level hospital	N/A	74.5 ± 6.8	65+	Brazil	99	Fried frailty phenotype	46.5%	49.5%	4.0%	46.9%	49.0%	4.1%	46.0%	50.0%	4.0%
Ozturk et al., 2017 (106)	Cross-sectional study	Faculty of Medicine of Gaziantep University	Internal medicine clinics	N/A	71.9 ± 6.3	65-98	Turkey	420	Fried frailty phenotype	65.5%	26.2%	8.3%	54.7%	33.0%	12.3%	76.4%	19.2%	4.3%
Papageorgiou et al., 2018 (107)	Prospective, observational study	General Hospital	Intensive Care Unit (ICU)	N/A	75.6	65+	Greece	36	Clinical Frailty Scale	27.8%	22.2%	50.0%	-	-	-	-	-	-
Papakonstantinou et al., 2018 (108)	Single-centre, observational perspective study	University Hospital	Department of Internal Medicine	Atrial fibrillation	84.9 ± 5.0*	75-97*	Greece	104	Clinical Frailty Scale	58.7%*	30.8%*	10.6%*	43.1%*	43.1%*	13.7%*	73.6%*	18.9%*	7.5%*
Parmar et al., 2019 (109)	Multi-centred prospective cohort study	Multiple (49 hospital sites across the United Kingdom)	Emergency laparotomy patients	Emergency laparotomy patients	76.0 ± 6.8	65-99	United Kingdom	937	Canadian Study of Health and Ageing (CSHA) Clinical Frailty Scale	20.3%	21.2%	58.8%	18.9%	21.9%	59.2%	21.3%	20.7%	58.5%

Pasqualetti et al., 2018 (110)	Prospective observational study	University hospital	Geriatric wards (Emergency department admissions with acute disease)	Emergency department admissions with acute disease	83.8 +/- 7.4	66+	Italy	643	Multi Prognostic Index	43.2%	25.3%	31.4%	39.3%*	26%*	35.7%*	46.9%*	24.5%*	27.7%*
Patel et al., 2018 (111)	Multi-centred (registry based), prospective, observational study	41 hospitals (CONCORDANCE registry, a prospective Australian registry of myocardial infarction patients)	Myocardial infarction (ST-segment-elevation Myocardial Infarction (STEMI) and non-STEMI (NSTEMI)) patients	Myocardial infarction (ST-segment-elevation Myocardial Infarction (STEMI) and non-STEMI (NSTEMI))	-	65+	Australia	3,944	Frailty index	27.7%	-	-	29.1%	-	-	25.1%	-	-
As above	*As above*	*As above*	*ST-segment elevation myocardial infarction (STEMI)*	*ST-segment elevation myocardial infarction (STEMI)*	-	*As above*	*As above*	*1,275*	*As above*	*15.1%*	-	-	*15.4%*	-	-	*14.4%*	-	-
As above	*As above*	*As above*	*Non-ST-segment elevation myocardial infarction (NSTEMI)*	*Non-ST-segment elevation myocardial infarction (NSTEMI)*	-	*As above*	*As above*	*2,669*	*As above*	*33.8%*	-	-	*35.9%*	-	-	*29.9%*	-	-
Peel et al., 2017 (112)	Retrospective observational study	Tertiary level hospital	Geriatric and general medicine patients with three or more transfers	N/A	85.0 ± 6.2*	65+	Australia	89	Clinical Frailty Scale (CFS)	91.0%	5.6%	3.4%	84.8%*	9.1%*	6.1%*	94.6%*	3.6%*	1.8%*
As above	*As above*	*As above*	*Geriatric medicine*	*N/A*	*84.7 ± 6.4**	*As above*	*As above*	*67*	*As above*	*98.5%*	*1.5%*	*0.0%*	*95.8%**	*4.2%**	*0.0%*	*100.0%**	*0.0%**	*0.0%*
As above	*As above*	*As above*	*General medicine*	*N/A*	*86.0 ± 5.9**	*As above*	*As above*	*22*	*As above*	*68.2%*	*18.2%*	*13.6%*	*55.6%**	*22.2%**	*22.2%*	*76.9%**	*15.4%**	*7.7%*
Pelavski et al., 2017 (113)	Prospective observational study	Tertiary care hospital	Elective surgery patients	N/A	87.5 ± 2.3*	85-96	Spain	127	Fried frailty phenotype	22.8%	51.2%	17.3%	21.1%*	47.4%*	31.6%*	24.3%*	54.3%*	5.7%*
Perera et al., 2009 (114)	Prospective observational study	Teaching hospital	Atrial fibrillation patients	Atrial fibrillation	82.7 ± 6.3	65+	Australia	220	Reported Edmonton Frailty Scale (REFS)	63.6%	-	-	-	-	-	-	-	-
Pollack et al., 2017 (115)	Prospective cohort study	An urban tertiary-care hospital and community hospital	Intensive Care Unit	Survivors of critical illness	74.0 ± 8.1*	65+	United States of America	125	Fried frailty phenotype criteria	85.6%	12.8%*	1.6%*	80.3%*	16.4%*	3.3%*	90.6%*	9.4%*	0.0%*

Poudel et al., 2016 (116)	Prospective study	11 acute care hospitals in Queensland and Victoria, Australia	Tertiary level hospitals	N/A	81.0 ± 6.8	70+	Australia	1,418	Frailty Index (52 items)	64.5%*	-	-	58.5%*	-	-	69.5%*	-	-
Purser et al., 2006 (117)	Prospective observational study	Duke University Medical Centre	Cardiology ward (severe (minimum two-vessel) coronary artery disease)	Severe (minimum two-vessel) coronary artery disease	77 ± 5	70+	United States of America	309	Multiple	45.0%	-	-	40.3%	-	-	55.9%	-	-
As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*309*	*Fried frailty phenotype*	*27.2%*	-	-	*22.7%*	-	-	*37.6%*	-	-
As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*309*	*Rockwood frailty assessment*	*62.8%*	-	-	*57.9%*	-	-	*74.2%*	-	-
Ritt et al., 2015 (118)	Prospective cohort study	Hospital of the Congregation of St. Francis, Sisters of Vierzehnheiligen, Erlangen	Geriatric wards	N/A	-	65+	Germany	307	Clinical Frailty Scale	72.0%	21.8%	6.2%	79.8%	17.2%	3.0%	68.3%	24.0%	7.7%
Rose et al., 2014 (119)	Prospective cohort study	Private hospital	General medical unit	N/A	86.5 ± 6.1	70+	Australia	133	Reported Edmonton Frailty Scale (REFS)	50.4%	17.3%	32.3%	-	-	-	-	-	-
Sanchez et al., 2011 (120)	Observational prospective study	University hospital	Clinical cardiology unit	Acute cardiac diseases (direct urgent admissions)	81.6 ± 5.0	75-95	Spain	211	Fried frailty phenotype criteria	40.8%	-	-	-	-	-	-	-	-
Sanchis et al., 2015 (121)	Prospective, single centre cohort study	University Clinic Hospital	Cardiology Department (patients with acute coronary syndromes)	Patients with acute coronary syndrome	77.5 ± 7.1*	75+	Spain	342	Fried frailty phenotype criteria	33.9%	58.8%*	7.3%*	24.0%	65.8%*	10.2%*	47.3%	49.3%*	3.4%*
Sikder et al., 2018 (122)	Prospective study	Two University hospitals	Elective abdominal surgery patients	Elective abdominal surgery	77.8 ± 5.0	70+	Canada	144	Fried frailty phenotype criteria	17.4%	60.4%	22.2%	19.0%	59.5%	21.5%	15.4%	61.5%	23.1%
Sundermann et al., 2014 (123)	Prospective cohort study	Heart centre	Heart centre (Elective cardiac surgery inpatients) *	Elective cardiac surgery	79 +/- 4	74+	Germany	450	Multiple	55.7%*	N/A	44.3%*	50.7%*	N/A	49.3%*	60.8%*	N/A	39.2%*

As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*450*	*Comprehensive Assessment of Frailty (CAF)*	*48.9%*	*N/A*	*51.1%*	*44.1%**	*N/A*	*55.9%**	*53.8%**	*N/A*	*46.2%**
As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*450*	*Frailty predicts death one yeaR after Cardiac Surgery Test (FORECAST)*	*62.4%**	*N/A*	*37.6%**	*57.3%**	*N/A*	*42.7%**	*67.7%**	*N/A*	*32.3%**
Thai et al., 2015 (124)	Cross-sectional study	A large teaching hospital	Patients prescribed a statin	Patients prescribed statins	-	65+	Australia	180	Reported Edmonton Frailty Scale (REFS)	35.0%	-	-	28.4%	-	-	42.4%	-	-
Ticinesi et al., 2016 (125)	Prospective cohort study	Teaching hospital	Acute care geriatric ward	Multimorbid patients with acute respiratory complaints urgently admitted from the emergency department	83 ± 10*	65+	Italy	270	Clinical Frailty Scale	59.6%*	24.1%*	16.3%*	61.3%*	23.4%*	15.3%*	58.2%*	24.7%*	17.1%*
Timmons et al., 2015 (126)	Prospective study	Six hospitals (five public (two rural, three urban) and one private) in County Cork, South-West Ireland	All hospital inpatients	N/A	80.0 ± 6.5*	70+	Ireland	248	SHARE-FI	45.2%	20.6%	30.2%	30.4%*	27.7%*	42.0%*	57.4%*	22.1%*	20.6%*
Valentini et al., 2018 (127)	Observational study	The “Tor Vergata” Polyclinic in Rome	Orthopaedic Department (hip fracture)	Hip fracture patients	79.9 ± 7.7	65+	Italy	62	SHARE -FI	59.7%	21.0%	19.4%	-	-	-	-	-	-
Vidan et al., 2014 (128)	Prospective cohort observational study	Department of cardiology at a large University hospital	Heart failure patients in the cardiology, internal medicine and geriatrics departments	Heart failure	80 ± 6	70+	Spain	450	Fried frailty phenotype criteria	70.2%	-	-	-	-	-	-	-	-
As above	*As above*	*As above*	*Cardiology department*	*As above*	*78.6 ± 5.2*	*As above*	*As above*	*311*	*As above*	*67.5%*	-	-	-	-	-	-	-	-

As above	*As above*	*As above*	*Internal medicine department*	*As above*	*80.2 ± 5.4*	*As above*	*As above*	*78*	*As above*	*73.1%*	-	-	-	-	-	-	-	-
As above	*As above*	*As above*	*Geriatrics department*	*As above*	*87.3 ± 5.7*	*As above*	*As above*	*61*	*As above*	*80.3%*	-	-	-	-	-	-	-	-
Wallis et al., 2018 (129)	Retrospective observational study	A large tertiary university National Health Service acute hospital in the UK	University hospital	Emergency admissions	84.6 ± 5.9	75+	United Kingdom	5,764	Clinical Frailty Scale (CFS)	56.7%	17.8%	25.6%	49.6%	19.8%	30.7%	62.2%	16.2%	21.6%
Wou et al., 2013 (130)	Observational cohort study	Queen's Medical Centre, Nottingham, and the Leicester Royal Infirmary, Leicester	Acute Medical Units	N/A	-	70+	United Kingdom	559	Frailty Index	30.9%	-	-	-	-	-	-	-	-

*=*Data not initially reported, or possible to derive from available data. Obtained, or derived, from correspondence with study authors.*

2.4.1 Methodological quality assessment

The median score of the Joanna Briggs Institute critical appraisal tool for studies reporting prevalence data for the 96 included studies was 8 out of 9 (range 7-9).

2.4.2 Pooled prevalence of frailty and pre-frailty

Ninety-six studies, comprising of data from of n=467,779 geriatric hospital inpatients, were eligible for inclusion in the overall pooled prevalence analysis of frailty (35-130); 62 studies, comprising of data from n=35,348 geriatric hospital inpatients in the overall pooled prevalence analysis of pre-frailty (35, 36, 38, 40, 41, 44, 47-49, 51-53, 55, 56, 58, 61, 62, 64, 66-70, 72, 73, 76, 78-82, 86, 87, 89, 90, 92-97, 100-103, 105-110, 112, 113, 115, 118, 119, 121, 122, 125-127, 129). The overall pooled prevalence of frailty and pre-frailty among geriatric hospital inpatients was 47.4% (95% CI 43.7-51.1%), and 25.8% (95% CI 22.0-29.6%) respectively (Figure 2.2, Supplementary Figure 2.1).

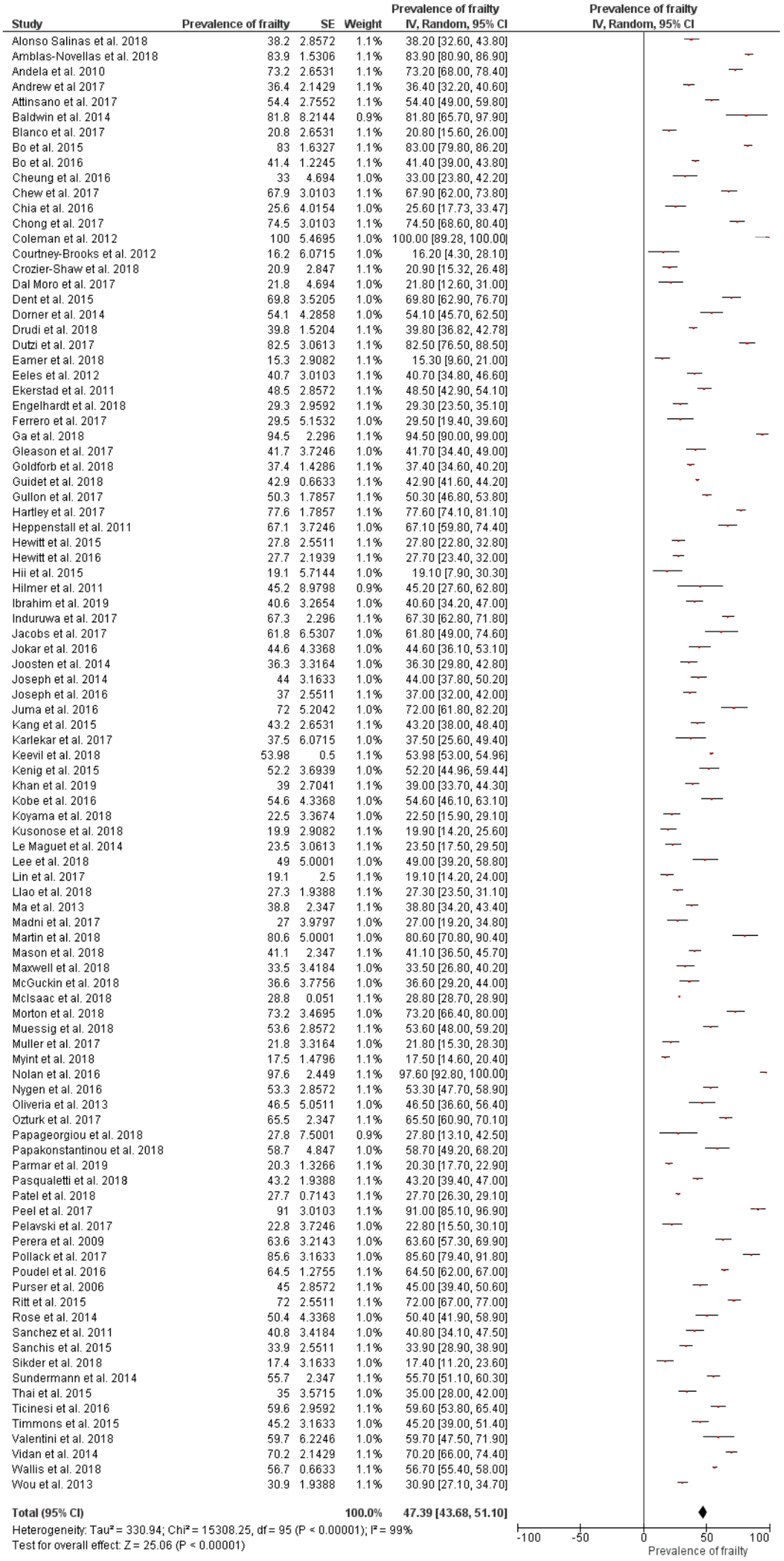


Figure 2.2. Forest plot of the prevalence of frailty in the 96 studies identified through the systematic review process, including a total of 467,779 geriatric hospital inpatients.

2.4.3 Stratified analysis

2.4.3.1 Sex

Sixty-seven studies, comprising data from n=246,241 female, and n=210,471 male geriatric hospital inpatients, were eligible for inclusion in the pooled prevalence analysis of frailty stratified by sex (35, 36, 38-41, 44, 45, 47-49, 51, 53, 55, 56, 58-62, 64, 66, 67, 70, 71, 73, 75-82, 84, 85, 87, 89, 90, 94-100, 103-106, 108-113, 115-118, 121-126, 129). Overall, the pooled prevalence of frailty was 51.9% (95% CI 46.1-57.8%) among female, and 47.0% (95% CI 43.3-50.8%) among male geriatric hospital inpatients. Differences in the prevalence of frailty between sexes were not statistically significant (p=0.17) (Supplementary Figure 2.2).

2.4.3.2 Ward / Department / Unit / Hospital type

Fifty-three studies were included in pooled analysis of the prevalence of frailty stratified by ward type (36, 37, 40, 43-48, 52, 55, 57, 64-70, 72, 73, 75-79, 81, 84-86, 88, 89, 94, 100-103, 106-108, 110, 112, 115-121, 123, 125, 128, 130). Fifteen of the included studies were specifically conducted on geriatric wards (36, 37, 43, 45, 47, 52, 66, 76, 94, 101, 110, 112, 118, 125, 128); twelve general internal medicine wards (37, 57, 65, 67, 73, 79, 86, 106, 108, 112, 119, 128); seven acute wards (36, 43, 72, 76, 116, 125, 130), seven cardiology wards (70, 85, 117, 120, 121, 123, 128); seven surgical wards (37, 44, 46, 68, 69, 75, 102); six intensive care wards (40, 64, 89, 100, 107, 115); six traumatology wards (37, 77, 78, 81, 84, 88); and, three on rehabilitation wards (48, 55, 103). The overall pooled prevalence of frailty was 93% (95% CI 81.8-100%) among geriatric hospital inpatients on rehabilitation wards; 66.5% (95% CI 54.3-78.7%) on geriatric wards; 59.3% (95% CI 50.5-68.1%) on general internal medicine wards; 52.3% (95% CI 36.2-68.4%) on intensive care wards; 51.1% (95% CI 35.9-66.2%) on acute wards; 45.6% (95% CI 35-56.2%) on cardiology wards; 45.3%

(95% CI 37.7-53.0%) on traumatology wards; and, 30.6% (95% CI 23.5-37.7%) on surgical wards (Supplementary Figure 2.3). Differences in the pooled prevalence estimates of frailty were statistically significant between ward types ($p<0.001$). Additionally, one study was specifically conducted on each of burns (93), endocrinology (53), orthopaedic (127), psychiatric (74), and pulmonary wards (37). These studies were not included in the above pooled prevalence analysis stratified by ward type due to a lack of multiple comparable data points to facilitate stratified pooled analyses in the above regard.

2.4.3.3 Prevalent morbidities

Thirty-five studies were included in pooled analysis of the prevalence of frailty stratified by prevalent morbidity (35, 37-42, 45, 46, 49, 50, 54, 55, 58, 60, 62, 63, 65, 70, 73, 74, 80, 85, 91, 92, 104, 108, 111, 114, 117, 120, 121, 123, 127, 128), which were grouped into the following categories: cardiovascular, neoplastic, pulmonary, orthopaedic (musculoskeletal), neurological, gastrointestinal, and psychiatric-related morbidities (Supplementary Figure 2.4, Supplementary Table 2.1).

2.4.3.3.1 Cardiovascular morbidities

Twenty-two of the included studies were conducted among patients identified as primarily possessing a cardiovascular-related morbidity (35, 39, 41, 42, 54, 58, 63, 65, 70, 73, 80, 85, 91, 104, 108, 111, 114, 117, 120, 121, 123, 128): seven specifically among acute coronary syndrome patients (35, 41, 58, 80, 91, 111, 121) (three among non-ST segment elevation myocardial infarction (NSTEMI) patients (58, 91, 111)); four among aortic valve stenosis patients (39, 54, 63, 85); and six among atrial fibrillation patients (42, 65, 73, 104, 108, 114). The overall pooled prevalence of frailty was 46.9% (95% CI 39.3-54.4%) among geriatric hospital inpatients identified as primarily possessing a cardiovascular-related morbidity: 34% (95% CI 27.9-40.2%) among acute coronary syndrome patients (36.3% (95% CI 27.3-45.2%)

specifically among patients with a non-ST segment elevation myocardial infarction); 45.9% (95% CI 38.3-53.5%) among aortic stenosis patients; and 62.8% (95% CI 50.4-72.5%) among atrial fibrillation patients. Additionally, one study each was specifically conducted among ST segment elevation myocardial infarction patients (111); coronary artery disease patients (117); and heart failure patients (128). These studies were not included in their own specific stratified analysis due to a lack of multiple comparable data points to facilitate stratified pooled analyses in the above regard.

2.4.3.3.2 Neoplastic morbidities

Three of the included studies were conducted among patients identified as primarily possessing a neoplastic-related morbidity (49, 50, 60): two specifically among female cancer patients (gynaecologic, and ovarian) (49, 60). The overall pooled prevalence of frailty was 22.2% (95% CI 15.9-28.6%) among geriatric hospital inpatients identified as primarily possessing a neoplastic-related morbidity; 23.2% (95% CI 10.2-36.3%) among female cancer inpatients.

2.4.3.3.3 Pulmonary morbidities

Four of the included studies were conducted among patients identified as primarily possessing a pulmonary-related morbidity (37, 38, 40, 92). The overall pooled prevalence frailty among geriatric hospital inpatients identified as primarily possessing a pulmonary-related morbidity was 55.0% (95% CI 39.9-70.1%).

2.4.3.3.4 Orthopaedic (musculoskeletal) morbidities

Two of the included studies were conducted among patients identified as primarily possessing an orthopaedic (musculoskeletal)-related morbidity (62, 127). The overall pooled prevalence of frailty among geriatric hospital inpatients identified as primarily possessing an orthopaedic (musculoskeletal)-related morbidity was 50% (95% CI 32.4-67.6%).

2.4.3.3.5 Neurological morbidities

Two of the included studies were conducted among patients identified as primarily possessing a neurological-related morbidity (45, 55). The overall pooled prevalence of frailty among geriatric hospital inpatients identified as primarily possessing a neurological-related morbidity was 75.2% (95% CI 60.9-89.5%).

2.4.3.3.6 Gastrointestinal morbidities

Two of the included studies were conducted among patients identified as primarily possessing a gastrointestinal-related morbidity (46, 50). The overall pooled prevalence of frailty among geriatric hospital inpatients identified as primarily possessing a gastrointestinal-related morbidity was 22.5% (95% CI 17.9-27%).

2.4.3.3.7 Psychiatric morbidities

Two of the included studies were conducted among patients identified as primarily possessing a psychiatric-related morbidity (45, 74). The overall pooled prevalence of frailty among patients identified as primarily possessing a psychiatric-related morbidity was 66.8% (95% CI 61.5-72.2%).

Additionally, of the 96 included studies, one study each was conducted among patients identified as primarily possessing dermal (93); oral (94); and renal (99) related morbidities. These studies were not included in the above pooled prevalence analysis stratified by prevalent morbidity due to the lack of multiple comparable data points to facilitate stratified pooled analyses in the above regards.

2.4.3.4 Operational definition

Twenty-four validated operational definitions of frailty were utilised among the 96 studies included within this review. Fourteen were eligible for inclusion in stratified analysis, and 89

studies in total were included in the pooled analysis of the prevalence of frailty stratified by these operational definition, with the most commonly utilised operational definition being the Fried frailty phenotype, followed by the clinical frailty scale, and frailty index. Twenty studies utilised the Fried frailty phenotype as the operational definition for the classification of frailty among geriatric hospital inpatients (40, 43, 46, 49, 54, 63, 72, 76, 87, 94, 101, 105, 106, 113, 115, 117, 120-122, 128); 18 the clinical frailty scale (47, 48, 55, 56, 64, 66, 73, 79, 82, 89, 99, 103, 107, 108, 112, 118, 125, 129); 13 the frailty index (38, 39, 45, 47, 57, 61, 74, 75, 77, 90, 111, 116, 130); 10 the Canadian Study on Health and Ageing (CSHA) clinical frailty scale (7-point) (58, 68, 69, 80, 92, 93, 95, 97, 102, 109); seven the reported Edmonton frailty scale (44, 70, 71, 104, 114, 119, 124); seven the FRAIL scale (47, 62, 65, 72, 81, 91, 96); five the SHARE-FI (35, 53, 100, 126, 127); three the Groningen frailty indicator (37, 42, 83); three the trauma specific and emergency general surgery specific frailty indices (59, 78, 88); two the frailty predicts death one year after cardiac surgery test (FORECAST) (85, 123); two the emergency general surgery-specific frailty index (75, 84); two the Rockwood frailty assessment (83, 117); two the study of osteoporotic fractures index (52, 76); and two the Edmonton frailty scale (51, 67).

The overall pooled prevalence of frailty among geriatric hospital inpatients was 42.9% (95% CI 35.4-50.4%) among patients assessed using the Fried frailty phenotype criteria; 64.2% (95% CI 57.3-71.0%) using the clinical frailty scale; 52.6% (95% CI 38-67.1%) using the frailty index; 32.7% (95% CI 25.8-39.7%) using the Canadian Study on Health and Ageing (CSHA) clinical frailty scale (7-point); 43.1% (95% CI 32.1-54.2%) using the reported Edmonton frailty scale; 39.2% (95% CI 30.7-47.6%) using the FRAIL scale; 49.4% (95% CI 42.0-56.8%) using the SHARE-FI; 70.5% (55.6-85.4%) using the Groningen frailty indicator; 59.4% (95% CI 51.9-66.9%) using the frailty predicts death one year after cardiac surgery test (FORECAST); 37.7% (95% CI 28.4-46.9%) using the trauma specific and emergency

general surgery specific frailty indices; 36.0% (95% CI 27.8-44.3%) using the emergency general surgery-specific frailty index; 56.6% (95% CI 44.1-69.1%) using the Rockwood frailty assessment; 51.1% (95% CI 14.4-87.7%) using the study of osteoporotic fractures index; and 44.5% (95% CI 0.2-88.9%) using the Edmonton frailty scale (Supplementary Figure 2.5).

Additionally, one study each utilised one of the ten additional validated operational definition of frailty. However, these studies were not included in the above pooled prevalence analysis stratified by operational definition due to the lack of multiple comparable data points to facilitate stratified pooled analyses in the above regard.

2.4.3.5 Geographic location

Ninety-one studies were included in the pooled analysis of the prevalence of frailty stratified by geographic location (country/continent) (35-53, 55-62, 65-84, 86-104, 106-130).

2.4.3.5.1 Continent

Fifty-two of the included studies were conducted in Europe (35-37, 39, 41-43, 48, 50, 51, 53, 55, 58, 60, 65, 66, 68, 69, 72-74, 76, 82, 83, 89-91, 94, 95, 97, 99-103, 106-110, 113, 118-121, 123, 125-130); 19 in North America (38, 40, 49, 56, 59, 62, 75, 77-79, 81, 84, 88, 93, 96, 98, 115, 117, 122); 12 Australasia (44, 52, 57, 67, 70, 71, 104, 111, 112, 114, 116, 124); eight Asia (45-47, 61, 80, 86, 87, 92); and one additional study, not included in overall pooled analysis stratified by continent, was conducted in South America (105). The overall pooled prevalence of frailty among geriatric hospital inpatients in Europe was 49.1% (95% CI 43.9-54.2%); 40.6% (95% CI 34.2-47%) in North America; 51.0% (95% CI 37.5-64.6%) in Australasia; and 48.4% (95% CI 28.5-68.3%) in Asia. There was no significant difference in pooled prevalence estimates of frailty stratified by continent (p=0.32) (Supplementary Figure 2.6).

2.5.3.5.2 Country

Fourteen of the included studies were conducted in the United States of America (40, 49, 59, 62, 75, 77, 78, 81, 84, 88, 93, 96, 115, 117); 13 the United Kingdom (66, 68, 69, 72, 73, 82, 95, 97, 99, 102, 109, 129, 130); 12 Australia (44, 52, 57, 71, 90, 104, 111, 112, 114, 116, 119, 124); nine Spain (35, 36, 65, 91, 94, 113, 120, 121, 128); eight Italy (39, 42, 43, 51, 60, 110, 125, 127); five Canada (38, 56, 79, 98, 122); five Germany (53, 55, 100, 118, 123); four Ireland (48, 50, 103, 126); three Singapore (45-47) two New Zealand (67, 70); two China (80, 92); two France (41, 89); two Greece (107, 108); two Japan (86, 87); and, two the Netherlands (37, 74). Additionally, one study was conducted in each of Belgium (76); Brazil (105); Turkey (106); Poland (83); Sweden (58); and Switzerland (101). These studies were not included in the above pooled prevalence analysis stratified by country due to a lack of multiple comparable data points to facilitate stratified pooled analyses in the above regard. The overall pooled prevalence of frailty among geriatric hospital inpatients was 43.4% (95% CI 34.6-52.2%) in the United States of America; 43.9% (95% CI 34.7-53.1%) in the United Kingdom; 49.5% (95% CI 36.2-62.7%) in Australia; 49.8% (95% CI 33.9-65.6%) in Spain; 49.2% (95% CI 35-63.5%) in Italy; 33% (95% CI 23.1-42.9%) in Canada; 63.7% (95% CI 52.5-74.8%) in Germany; 65.8% (95% CI 25.7-100%) in Ireland; 56.1% (95% CI 29.3-83%) in Singapore; 43.3% (95% CI 0-90.3%) in New Zealand; 40.8% (95% CI 36.5-45.1%) in China; 22% (95% CI 18.0-25.9%) in France; 43.8% (95% CI 13.5-74.0%) in Greece; 21.0% (95% CI 16.7-25.3%) in Japan; and, 69.1% (95% CI 58.3-79.8%) in Netherlands. Differences in the pooled prevalence estimates of frailty were statistically significant between countries ($p<0.001$) (Supplementary Figure 2.7).

2.4.3.6 Age

Seventy-eight studies were included in the pooled analysis of the prevalence of frailty, stratified by the mean age of the study sample. Six of the included studies had a mean age between 65-74 years (49, 74, 80, 84, 106, 115); 58 between 75-84 years (35, 39, 40, 42-46, 48, 51, 53-57, 59, 61-64, 67, 68, 70, 71, 75, 77-79, 81, 83, 85-91, 93, 95-97, 99, 103, 105, 107, 109, 110, 114, 116, 117, 120-123, 125-128); and 14 ≥ 85 years (36, 41, 47, 65, 66, 73, 94, 100, 104, 108, 112, 113, 119, 129). The pooled prevalence of frailty was 52.1% (95% CI 35.1-69%) among studied with a mean age between 65-74 years; 46.1% (95% CI 41.0-51.0%) with a mean age between 75-84 years; and 60.2% (95% CI 51.1-69.2%) with a mean age ≥ 85 years. Differences in the pooled prevalence estimates of frailty were statistically significant between these age groups, based on the mean age of study samples ($p<0.03$) (Supplementary Figure 2.8). Among the 35 studies with a mean age between 65-79 years, the pooled prevalence of frailty was 37.4% (95% CI, 31.8-43.1), while among the 43 studies with a mean age ≥ 80 years, the pooled prevalence of frailty was 58.3% (95% CI, 53-63.7%). Differences in the pooled prevalence estimates of frailty were also statistically significant between these alternative age group classifications based on the mean age of study samples ($p<0.001$) (Supplementary Figure 2.9).

2.4.3.7 Clinical population

Ninety-four studies were included in pooled analysis of the prevalence of frailty stratified by clinical population: a broad combination of ward type and morbidity (35-104, 106-125, 127-130). Fifty-eight of the included studies were conducted among acute patients (35-38, 41, 43, 45, 47, 52, 53, 56-59, 62, 66, 68-70, 72, 73, 75-84, 88, 91-97, 99, 101, 102, 109-111, 114, 116-120, 124, 125, 128-130) (eight specifically among acute trauma patients (37, 77, 78, 81, 84, 88, 96, 101)); twenty-six were conducted among surgical inpatients (37, 39, 44, 46, 50,

51, 56, 59, 62, 63, 68-70, 75, 83-85, 90, 95, 97, 98, 102, 109, 113, 122, 123) (seven specifically among general surgery inpatients (59, 68, 69, 75, 84, 95, 97); (of which six were specifically conducted among emergency general surgery inpatients (59, 69, 75, 84, 95, 97)); six specifically among cardiac surgery patients (39, 54, 63, 70, 85, 123) (of which five were specifically among transcatheter aortic valve replacement surgery patients (39, 54, 63, 85, 123)); four specifically among abdominal surgery patients (56, 83, 109, 122) (of which three were specifically among emergency abdominal surgery patients (56, 83, 109)); four specifically among elective surgery patients (98, 113, 122, 123); and, two specifically among colorectal surgery patients (46, 50)). Twenty-three of the included studies were conducted among cardiac patients (35, 39, 41, 42, 54, 58, 63, 65, 70, 73, 80, 85, 87, 91, 104, 108, 111, 114, 117, 120, 121, 123, 128) (seven specifically among acute coronary syndrome patients (35, 41, 58, 80, 91, 111, 121) (of which three were specifically among non-ST segment elevation myocardial infarction patients (58, 91, 111))); six specifically among atrial fibrillation patients (42, 65, 73, 104, 108, 114); and, four specifically among aortic stenosis patients (39, 54, 63, 85)); thirteen were conducted among emergency admissions patients (56, 59, 69, 75, 82-84, 95, 97, 109, 110, 120, 129); eleven among general medicine patients (37, 53, 57, 65, 73, 79, 86, 106, 108, 112, 119); eight intensive care patients (38, 40, 64, 81, 89, 100, 107, 115); five pulmonary patients (37, 38, 40, 92, 125); five post-acute delayed discharge (48, 55, 61, 67, 103); three rehabilitation patients (48, 55, 103); two oncology patients (49, 60); two neurological patients (45, 55); two fractures patients (62, 127); two urology patients (51, 71); two psychiatric patients (45, 74); and, two among pharmacology patients (71, 124).

The overall pooled prevalence of frailty was 93% (95% CI 81.8-100%) among rehabilitation patients; 88.3% (95% CI 77.7-98.3%) among post-acute delayed discharge; 75.2% (95% CI 60.9.5-89.5%) among neurological patients; 66.8% (95% CI 61.5-72.2%) among psychiatric

patients; 59.3% (95% CI 48.5-70.0%) among general (internal medicine) patients; 56% (95% CI 42.5-69.5%) among pulmonary patients; 50.0% (95% CI 32.4-67.6%) among fracture patients; 48.3% (95% CI 36.9-59.8%) among intensive care patients; 47.3% (95% CI 42.8-51.8%) among acute patients (40.9% (95% CI 33.2-48.5%) specifically among trauma patients); 45.8% (95% CI 38.3-53.4%) among cardiac patients (62.8% (95% CI 50.4-75.2%) specifically among atrial fibrillation patients; 45.9% (95% CI 38.3-53.4%) specifically among aortic stenosis patients; 34% (95% CI 27.9-40.2%) specifically among acute coronary syndrome patients (34.1% (95% CI 24.3-44%) specifically among non ST-segment elevation myocardial infarction patients)); 38.5% (95% CI 31-46.1%) among emergency admissions patients; 36.8% (95% CI 29.2-44.4%) among pharmacological patients; 32.4% (95% CI 28.9-36%) among surgical inpatients (44.1% (95% CI 36.1-52.1%) specifically among cardiac surgery patients (48% (95% CI 40-56%) specifically among transcatheter aortic valve replacement surgery patients); 34.8% (95% CI 29.7-40%) specifically among general surgery patients (36.1% (95% CI 30.5-41.6%) specifically among emergency general surgery patients); 31.3% (95% CI 17.1-45.5%) specifically among elective surgery patients; 26.1% (95% CI 13.3-38.9%) specifically among abdominal surgery patients (29% (95% CI 11.5-46.5%) specifically among emergency abdominal surgery patients); 22.5% (95% CI 17.9-27%) specifically among colorectal surgery patients); 32.3% (95% CI 9.5-55.1%) among urology patients, and; 23.2% (95% CI 10.2-36.3%) among oncology patients. Differences in the pooled prevalence estimates of frailty were statistically significant between clinical populations ($p<0.001$) (Supplementary Figure 2.10, Supplementary Table 2.2). Additionally, with regard to two of the included studies, there was insufficient data to definitively determine a specific clinical population (further to initial distinction as geriatric hospital inpatients) (105), or insufficient data regarding the prevalence of frailty for different clinical

populations within the study sample (126) to facilitate inclusion in the above pooled prevalence analysis of frailty stratified by clinical population.

2.4.4 Association between the prevalence of frailty and economic indicators

A detailed list of all 96 included studies, reporting selected relevant study characteristics regarding the prevalence of frailty and economic indicators is displayed in Table 2.2:

Table 2.1. Selected study characteristics relating to economic analysis of included studies.

Author/Year	Country	Continent	Recruitment start date	Recruitment end date	Recruitment duration	Five-year average GDP per capita PPP (current international $) (years preceding the study*)	Five-year average healthcare expenditure per capita PPP (current international $) (years preceding the study*)	Prevalence of frailty (%)	Prevalence of pre-frailty (%)
Alonso Salinas et al., 2018 (35)	Spain	Europe	October 2013	December 2015	30 months	32,520	2,914	38.2%	29.8%
Amblas-Novellas et al., 2018 (36)	Spain	Europe	January 2014	December 2014	12 months	32,208	2,913	83.9%	14.6%**
Andela et al., 2010 (37)	Netherlands	Europe	2009	2009	6 months	41,787	3,721	73.2%	N/A
Andrew et al., 2017 (38)	Canada	North America	November 2011	May 2012	7 months	39,165	3,845	36.4%	45.3%
Attinsano et al., 2017 (39)	Italy	Europe	January 2016	December 2016	12 months	35,408	-	54.4%	-
Baldwin et al., 2014 (40)	United States of America	North America	February 2012	July 2012	6 months	48,278	7,684	81.8%	18.2%
Blanco et al., 2017 (41)	France	Europe	May 2014	July 2015	15 months	38,738	4,283	20.8%	28.8%
Bo et al., 2015 (42)	Italy	Europe	January 2014	April 2014	4 months	34,839	3,195	83.0%	N/A
Bo et al., 2016 (43)	Italy	Europe	January 2012	April 2012	4 months	35,198	3,056	41.4%	-
Cheung et al., 2016 (44)	Australia	Australasia	March 2014	July 2014	5 months	43,268	3,779	33.0%	27.0%**
Chew et al., 2017 (45)	Singapore	Asia	December 2010	August 2012	21 months	65,975	1,982	67.9%	-
Chia et al., 2016 (46)	Singapore	Asia	January 2007	December 2014	84 months	62,564	2,012	25.6%	-
Chong et al., 2017 (47)	Singapore	Asia	November 2015	December 2015	2 months	78,401	2,732	74.5%	25.2%**

Coleman et al., 2012 (48)	Ireland	Europe	September 2009	December 2009	4 months	42,700	2,732	100.0%**	0%**
Courtney-Brooks et al., 2012 (49)	United States of America	North America	March 2011	December 2011	10 months	47,555	7,540	16.2%	27.0%
Crozier-Shaw et al., 2018 (50)	Ireland	Europe	2012	2016	180	47,616	4,623	20.9%	N/A
Dal Moro et al., 2017 (51)	Italy	Europe	January 2014**	April 2015**	16 months**	34,839	3,195	21.8%	16.7%**
Dent et al., 2015 (52)	Australia	Australasia	October 2010	December 2011	14 months	39,384	3,244	69.8%	26.2%
Dorner et al., 2014 (53)	Germany	Europe	June 2011	October 2011	5 months	39,305	3,877	54.1%	21.8%
Drudi et al., 2018 (54)	Multiple (United States of America, Canada, France)	Multiple (North America, Europe)	November 2011	April 2016	54 months	-	-	39.8%	-
Dutzi et al., 2017 (55)	Germany	Europe	February 2011	December 2011	11 months	39,305	3,877	82.5%**	13.0%**
Eamer et al., 2018 (56)	Canada	North America	January 2014	September 2015	21 months	42,109	4,300	15.3%	17.3%
Eeles et al., 2012 (57)	Australia	Australasia	January 2001**	June 2001**	6 months**	26,598	-	40.7%	N/A
Ekerstad et al., 2011 (58)	Sweden	Europe	October 2009	June 2010	10 months	38,869	2,388	48.5%	25.4%
Engelhardt et al., 2018 (59)	United States of America	North America	October 2016	December 2016	2.5 months	53,241	8,764	29.3%	N/A
Ferrero et al., 2017 (60)	Italy	Europe	2006	2014	108 months	33,584	2,818	29.5%	N/A
Ga et al., 2018 (61)	South Korea	Asia	March 2011	February 2017	72 months	30,504	1,911	94.5%**	2.5%**

Gleason et al., 2017 (62)	United States of America	North America	August 2015	May 2016	9 months	51,568	8,451	41.7%	41.7%
Goldforb et al., 2018 (63)	Multiple (Canada, United States of America, France)	Multiple (North America, Europe)	2012	2017	72 months	-	-	37.4%	-
Guidet et al., 2018 (64)	Multiple (Ireland, Great Britain, Portugal, Spain, France, Belgium, Denmark, Norway, Switzerland, Netherlands, Sweden, Russia, Germany, Austria, Poland, Czech Republic, Italy, Ukraine, Romania, Greece, Cyprus)	Europe	October 2016	February 2017	5 months	-	-	42.9%**	19.4%**
Gullon et al., 2017 (65)	Spain	Europe	October 2014	May 2015	8 months	32,208	2,913	50.3%	-
Hartley et al., 2017 (66)	United Kingdom	Europe	December 2014	May 2015	6 months	37,301	3,223	77.6%	10.0%**

Heppenstall et al., 2011 (67)	New Zealand	Australasia	-	-	-	-	-	67.1%**	21.5%**
Hewitt et al., 2015 (68)	United Kingdom	Europe	May 2013	June 2013	2 months	36,808	3,012	27.8%	18.6%
Hewitt et al., 2016 (69)	United Kingdom	Europe	July 2014	October 2014	4 months	37,301	3,223	27.7%	19.9%
Hii et al., 2015 (70)	New Zealand	Australasia	February 2014**	March 2014**	1 month**	32,445	3,098	19.1%	23.4%**
Hilmer et al., 2011 (71)	Australia	Australasia	February 2008	September 2009	19 months	34,406	2,713	45.2%	-
Ibrahim et al., 2019 (72)	United Kingdom	Europe	March 2014	March 2016	25 months	37,929	3,349	40.6%	46.2%
Induruwa et al., 2017 (73)	United Kingdom	Europe	January 2014	March 2014	3 months	37,301	3,223	67.3%	14.3%
Jacobs et al., 2017 (74)	Netherlands	Europe	June 2014	December 2014	7 months	46,305	4,887	61.8%	-
Jokar et al., 2016 (75)	United States of America	North America	2013	2014	24 months	49,689	8,053	44.6%	N/A
Joosten et al., 2014 (76)	Belgium	Europe	January 2010**	November 2010**	10 months**	38,015	3,360	36.3%	55.4%
Joseph et al., 2014 (77)	United States of America	North America	June 2011	February 2013	21 months	48,824	7,540	44.0%	N/A
Joseph et al., 2016 (78)	United States of America	North America	2013	2014	24 months	49,689	8,053	37.0%	37.8%
Juma et al., 2016 (79)	Canada	North America	April 2013**	February 2014**	10.5 months**	40,603	4,121	72.0%	6.7%
Kang et al., 2015 (80)	China	Asia	December 2014	May 2015	6 months	10,280	3,098	43.2%	18.8%**
Karlekar et al., 2017 (81)	United States of America	North America	March 2015	May 2015	3 months	51,568	8,451	37.5%	32.8%
Keevil et al., 2018 (82)	United Kingdom	Europe	October 2014	November 2016	26 months	38,531	3,454	54.0%	17.3%**

Kenig et al., 2015 (83)	Poland	Europe	January 2013	July 2014	19 months	21,761	1,378	52.2%	-
Khan et al., 2019 (84)	United States of America	North America	2014	2016	24 months	51,659	8,497	39.0%	-
Kobe et al., 2016 (85)	Multiple	Europe	September 2011	November 2014	39 months	-	-	54.6%	N/A
Koyama et al., 2018 (86)	Japan	Asia	November 2016	December 2017	14 months	38,756	4,191	22.5%	37.7%
Kusunose et al., 2018 (87)	Japan	Asia	December 2015	July 2016	8 months	37,755	3,958	19.9%	61.3%
Lee et al., 2018	United States of America	North America	January 2014	August 2015	20 months	50,808	8,325	49%	N/A
Le Maguet et al., 2014 (89)	France	Europe	November 2011	May 2012	7 months	36,485	3,715	23.5%	31.6%
Lin et al., 2017 (90)	Australia	Australasia	July 2014	January 2015	7 months	43,268	3,779	19.1%	36.6%
Llao et al., 2018 (91)	Spain	Europe	March 2016**	September 2016**	7 months**	33,038	2,994	27.3%	-
Ma et al., 2013 (92)	China	Asia	October 2009	September 2010	12 months	6,344	254	38.8%	13.8%
Madni et al., 2017 (93)	United States of America	North America	April 2009	December 2014	69 months	47,787	7,487	27.0%	34.1%
Martin et al., 2018 (94)	Spain	Europe	March 2014	July 2014	5 months	32,208	2,913	80.6%	19.4%
Mason et al., 2018 (95)	United Kingdom	Europe	November 2016	July 2017	9 months	40,188	3,724	41.1%	17.5%**
Maxwell et al., 2018 (96)	United States of America	North America	October 2013	March 2014	6 months	49,015	7,936	33.5%	37.8%
McGuckin et al., 2018 (97)	United Kingdom	Europe	June 2012	January 2013	8 months	36,503	2,907	36.6%	14.0%
McIsaac et al., 2018 (98)	Canada	North America	April 2002	March 2015	156 months	35,285	-	28.8%	-

Morton et al., 2018 (99)	United Kingdom	Europe	June 2017**	July 2017**	1 month**	40,781	3,850	73.2%	-
Muessig et al., 2018 (100)	Germany	Europe	October 2016	February 2017	5 months	45,468	4,944	53.6%	22.7%
Muller et al., 2017 (101)	Switzerland	Europe	March 2016	June 2016	4 months	57,295	4,944	21.8%	59.6%
Myint et al., 2018 (102)	United Kingdom	Europe	May 2013	June 2014	14 months (only recruited for 4 months within this time frame)	37,301	3,012	17.5%	12.6%
Nolan et al., 2016 (103)	Ireland	Europe	August 2013	January 2014	6 months	37,301	3,012	97.6%	2.4%
Nygen et al., 2016 (104)	Australia	Australasia	October 2012	January 2014	16 months	41,762	3,531	53.3%	-
Oliveria et al., 2013 (105)	Brazil	South America	November 2010	November 2010	1 month	12,435	1,019	46.5%	49.5%
Ozturk et al., 2017 (106)	Turkey	Europe	March 2015	October 2015	8 months	20,092	951	65.5%	26.2%
Papageorgiou et al., 2018 (107)	Greece	Europe	June 2016	May 2017	12 months	26,015	2,221	27.8%	22.2%
Papakonstantinou et al., 2018 (108)	Greece	Europe	June 2015	June 2016	12 months	26,521	2,324	58.7%**	30.8%**
Parmar et al., 2019 (109)	United Kingdom	Europe	March 2017	June 2017	3 months	40,781	3,850	20.3%	21.2%
Pasqualetti et al., 2018	Italy	Europe	May 2015	December 2016	20 months	35,300	3,235	43.4%	25.2%
Patel et al., 2018 (111)	Australia	Australasia	2009	2016	96 months	41,664	3,557	27.7%	-
Peel et al., 2017 (112)	Australia	Australasia	July 2012	June 2013	12 months	41,150	3,479	91.0%	5.6%

Pelavski et al., 2017 (113)	Spain	Europe	October 2011	October 2015	49 months	32,414	2,821	22.8%	51.2%
Perera et al., 2009 (114)	Australia	Australasia	April 2007	July 2007	4 months	34,406	2,713	63.6%	-
Pollack et al., 2017 (115)	United States of America	North America	February 2012	February 2016	49 months (only recruited for 29 months within this time frame)	50,125	8,069	85.6%	12.8%**
Poudel et al., 2016 (116)	Australia	Australasia	May 2005	July 2010	59 months	35,202	2,801	64.5%	-
Purser et al., 2006 (117)	United States of America	North America	May 2003	February 2004	10 months	35,744	-	45.0%	-
Ritt et al., 2015 (118)	Germany	Europe	-	-	-	-	-	72.0%	21.8%
Rose et al., 2014 (119)	Australia	Australasia	May 2012	June 2012	2 months	41,150	3,479	50.4%	17.3%
Sanchez et al., 2011 (120)	Spain	Europe	February 2008	March 2008	2 months	29,823	2,210	40.8%	-
Sanchis et al., 2015 (121)	Spain	Europe	October 2010	February 2012	17 months	31,869	2,622	33.9%	58.8%**
Sikder et al., 2018 (122)	Canada	North America	-	-	-	-	-	17.4%	60.4%
Sundermann et al., 2014 (123)	Germany	Europe	September 2008	March 2010	19 months	36,095	3,413	55.7%**	N/A
Thai et al., 2015 (124)	Australia	Australasia	July 2014	October 2014	2.5 months	43,268	3,779	35.0%	-
Ticinesi et al., 2016 (125)	Italy	Europe	January 2015	October 2015	10 months	35,136	3,225	59.6%**	24.1%**
Timmons et al., 2015 (126)	Ireland	Europe	May 2012	February 2013	10 months	43,849	4,308	45.2%	20.6%

Valentini et al., 2018 (127)	Italy	Europe	March 2014	March 2015	13 months	34,839	3,195	59.7%	21.0%
Vidan et al., 2014 (128)	Spain	Europe	May 2009	May 2011	25 months	31,205	2,476	70.2%	-
Wallis et al., 2018 (129)	United Kingdom	Europe	August 2013	July 2014	12 months	37,248	3,152	56.7%	17.8%
Wou et al., 2013 (130)	United Kingdom	Europe	January 2009	November 2010	23 months	34,809	2,585	30.9%	-

[*]= 5 years prior to commencement of data collection for the study. Each calendar year of the study was also be included provided recruitment continues through to > 6 months in the preceding year. [**]= Data not initially reported, or possible to derive from available data. Obtained, or derived, from correspondence with study authors.

2.4.4.1 Gross domestic product per capita purchasing power parity

As data were not normally distributed, a Spearman's rank correlation coefficient was employed to examine the association between the prevalence of frailty among geriatric hospital inpatients and GDP per capita PPP. No significant correlations were observed between the prevalence of frailty among geriatric hospital inpatients and GDP per capita PPP ($r=-0.081$, $p=0.452$), the prevalence of pre-frailty among geriatric hospital inpatients and GDP per capita PPP ($r=0.107$, $p=0.423$), or a combination of prevalence of frailty and pre-frailty, and GDP per capita PPP ($r=0.24$, $p=0.857$).

2.4.4.2 Health care expenditure per capita purchasing power parity

Similar to the GDP per capita PPP analysis, these data were not normally distributed, and as such a Spearman's rank correlation coefficient was employed to examine the association between the prevalence of frailty among geriatric hospital inpatients and healthcare expenditure per capita PPP. No significant correlations were observed between the prevalence of frailty among geriatric hospital inpatients and healthcare expenditure per capita PPP ($r=-0.197$, $p=0.071$), the prevalence of pre-frailty among geriatric hospital inpatients and healthcare expenditure per capita PPP ($r=0.220$, $p=0.097$), or a combination of prevalence of frailty and pre-frailty, and healthcare expenditure per capita PPP ($r=-0.146$, $p=0.275$).

2.5 Discussion and Conclusions

In this systematic review and meta-analysis, 96 studies were identified with an overall pooled sample of 467,779 geriatric hospital inpatients aged ≥ 65 years, which utilised a validated operational definition of frailty, attempted to assess the whole ward/clinical population, occurred in a hospital setting, in or including hospital inpatients, and reported, or provided sufficient information to allow the calculation of, the prevalence of frailty. Included studies

were conducted in 21 countries, across five continents. The overall pooled estimate of frailty was 47.4%; although this varied significantly based on prevalent morbidities, age, ward type, clinical population, and the operational definition utilised for the classification of frailty. To the author's knowledge, this is the largest and most comprehensive systematic review and meta-analysis of the prevalence of frailty among older adults conducted in any setting, and the first well-evidenced systematic review and meta-analysis among geriatric hospital inpatients.

The overall pooled prevalence estimate of frailty of 47.4%, places the prevalence of frailty among geriatric hospital inpatients between that reported for community-dwelling older adults at 10.7% (1), and older adults in nursing homes at 52.3% (7); outlining an increase in the relative prevalence of frailty with progression through the healthcare system. The overall pooled prevalence of pre-frailty of 25.8% is lower than that reported for both community-dwelling older adults at 41.6% (1), and nursing home residents at 40.2% (7); while the combined prevalence estimates of both frailty and pre-frailty increase from 52.3% among community-dwelling older adults, to 73.2% among geriatric hospital inpatients, and to 92.5% among nursing homes residents. This underlines that differences in the relative prevalence of frailty status between community, and hospital inpatient settings, are the result of an increase in the relative prevalence of frailty, and similar reductions in the relative prevalence of both pre-frailty and robustness (non-frailty). However, differences in the relative prevalence of frailty status between hospital inpatient and nursing home settings, these data show, are primarily the result of a relative increase in the prevalence of pre-frailty, and reductions in the prevalence of robustness.

The overall pooled frailty, and pre-frailty, prevalence estimates of 47.4% (95% CI 43.7-51.1%), and 25.8% (95% CI 22.0-29.6%) respectively, are relatively consistent with, though more precise than, estimates reported within a recent systematic review and meta-analysis

which examined the prevalence of frailty and pre-frailty among hospitalised older adults in 11 studies which also assessed undernutrition risk, at 47% (95% CI 37-57%) and 36% (95% CI 29-44) respectively (21). Similarly, the pooled prevalence estimates of frailty on acute wards of 51.1% (95% CI-35.9-66.2%), as well as among all acute hospital inpatients, of 47.3% (95% CI 42.8-51.8%), are relatively consistent with findings of a recent scoping review, which reported a median frailty prevalence of 49% (range 34-69%) in acute care hospital settings (20).

No significant associations were observed between the prevalence of frailty among geriatric hospital inpatients and GDP per capita PPP, and healthcare expenditure per capita PPP. This contrasts with previous research among community-dwelling older adults within 14 European countries, and Israel, conducted utilising data from the Survey of Health, Ageing, and Retirement in Europe (SHARE). This cross-sectional analysis examined the association between GDP per capita PPP, and health expenditure as a percentage of GDP, and the prevalence of frailty among community-dwelling older adults assessed by the frailty index. Fifteen observations of the weighted national prevalence of frailty for community-dwelling older adults in each country were correlated with both national economic indicators, and reported strong correlation between GDP per capita PPP ($r=-0.71$, $p< 0.01$), and healthcare expenditure as a percentage of GDP ($r=-0.63$, $p<0.05$), and the prevalence of frailty among community-dwelling older adults (22).

It is possible that these associations, while present in the community, are not present in inpatient hospital settings. Given the inherent nature of hospital inpatient settings, i.e., institutions for chronically or acutely unwell patients, this association may be more sensitive among the general population of community-dwelling older adults; however, more large-scale and comprehensive studies are required in a variety of settings. Given the lack of statistically significant differences in the pooled prevalence of frailty stratified by continent

within this present review alone, this may not be surprising, however, statistically significant differences in the prevalence of frailty were observed between countries. In this regard, an additional limitation of these analyses is that included studies were predominantly from economically-developed countries, as there is presently limited evidence regarding the prevalence of frailty in low-income countries; an issue which has been observed previously in a meta-analysis of the prevalence of frailty among community-dwelling older adults in middle-, and low-income countries (4). To the author's knowledge, this present review is the first study of any design to examine the association between the prevalence of frailty among geriatric hospital inpatients and national economic indicators. It has been postulated that increases in economic prosperity may limit the prevalence and burden of frailty within national health systems (37). However, these findings bring this postulation into question among geriatric hospital inpatients, and as such reliance of non-direct intervention such as economic development to improve the prevalence and burden of frailty on health systems alone, appears, at least partially, to be misplaced. As such the findings of this review further highlight the need for more direct interventions to address the burden of frailty among this population. Future research examining the prevalence of frailty among geriatric hospital inpatients in low-income countries may facilitate further elucidation of this relationship, as these data become available for less economically developed regions of the world. Although, it may be that this relationship does not exist in the same capacity as it appears to among community-dwelling older adults, to the authors' knowledge the study by Theou et al. (2013) is the only study to previously examine this relationship. As such, additional studies, in a variety of settings, may aid in elucidating this relationship further.

This systematic review and meta-analysis had many strengths, including extensive systematic searches of 17 databases; manual screening of the reference lists of all included articles (and relevant studies or systematic reviews captured within platform and database searches); the

screening of grey literature, including in process publications, and conference abstracts, which were followed up with study authors to ascertain if a full text relating to these data were available; employment of three independent reviewers during the screening phase of the review, ensuring high internal reliability and consistency of included articles; the utilisation of meticulously defined eligibility criteria; the employment of two independent data extractors and quality assessors; an extensive data procurement strategy, including contacting 517 authors to obtain additional information relevant to inclusion within different aspects of the review; robust analysis of the prevalence of frailty stratified by clinically useful variables; and a comprehensive record of all information pertaining to the review process available as supplementary or appendices files.

This review also had a number of important limitations that should be considered when interpreting these findings. Firstly, only studies with a full text available in the English language were eligible for inclusion, as this was the only shared language between the three independent reviewers. As such included studies may be relatively over-representative of Western nations (Europe, Australasia, and the Americas), and there is a possibility that this review does not include otherwise eligible studies whose full texts are not available in the English language. However, in this regard, any potentially eligible studies, with an English translated abstract, and full text in other languages, were followed up with study authors in an attempt to obtain an English full text to facilitate thorough screening. Secondly, high heterogeneity was reported across many analyses, and persisted across many univariate stratification analyses. Thirdly, a strength, but also a limitation of this review, was with regard to the specific eligibility criteria employed within this present review, requiring prospectively eligible studies to either assess (or attempt to assess) the whole ward, department, unit, hospital, or specific clinical population, or employ some form of randomised selection of participants. Any exclusion criteria employed within individual

studies, in order to meet this criterion, had to meet one of two stipulations: 1) the criterion was essential to defining the clinical population; 2) the criterion is related to insurmountable impracticalities which precluded inclusion of certain individuals. Provided all of a study's exclusion criteria adequately met either of these two stipulations during screening, they were deemed to have sufficiently satisfied the above eligible criterion for the review of having either assessed, or attempted to assess, the entire ward/department/unit/clinical population or employed some form of randomised selection of participants. While such comprehensive stipulations prevented inclusion of any studies with active bias in the recruitment process, those that could be not be recruited in some studies due to impracticalities of inclusion, may also in many cases, be more likely to be frail e.g., those receiving end of life care in a study utilising an objective operational definition for the classification of frailty. Finally, while contributing substantially to the obtainment of further data for these analyses, contacting several hundred authors for these additional data added to the timeline for this review beyond the initial search period, although, these may be updated prior to submission for publication.

Through providing a highly detailed analysis of the prevalence of frailty among older people within this setting, the aim of this present review was to provide a resource, which can aid in the facilitation of improvements in the planning, and orientation of organisational structures and resources, to meet the needs of this population, and ultimately enhance the care of older adults with frailty in inpatient hospital settings. Future research, particularly in developing countries, may help to further elucidate any potential relationship regarding national economic indicators and the prevalence of frailty among geriatric hospital inpatients. As frailty is a relatively new concept, particularly as an operationally defined one, with most studies cited within this review published in the past 20 years, it is the intention of the authors to update this review periodically, to examine the potential change in frailty over time,

particularly as it relates to national policy directives, and economic indicators as data become available for less developed regions of the world.

More generally the authors have several recommendations with regard to improving reporting in future frailty research among hospitalised older adults, as well as within other settings. These recommendations arise from the following issues which are persistent in the frailty literature, and were continually observed during the screening process for this review: 1) studies often reported participants as frail without a frailty assessment; 2) studies often claimed to utilise validated operational definitions for the classification of frailty, however, adapt these definitions, or classification criteria, which resulted in the definitions becoming not only non-standardised, but also non-validated; 3) the use of the nomenclature for different operational definitions of frailty varied widely, even among studies utilising the same operational definition; 4) often, useful data regarding the prevalence of frailty (such as pre-frailty, a sex breakdown of frailty, or occasionally the overall prevalence of frailty itself) were not reported.

Reporting in this regard may be improved by a brief standardised checklist for studies reporting frailty data. The authors suggest the following items for inclusion: 1) accurate citation of the validation study for the specific operational definition utilised for the classification of frailty; 2) accurate use of the nomenclature of the operational definition of frailty utilised in accordance with the initial validation study to maintain reliability and validity, or prominent subsequent study establishing the nomenclature; 3) reporting of the number of frail, pre-frail (if applicable), and robust participants; 4) a sex breakdown of the number of frail, pre-frail, and robust participants.

Given the association of frailty at the individual level with increased healthcare costs, combined with projected population demographics, future research should focus on

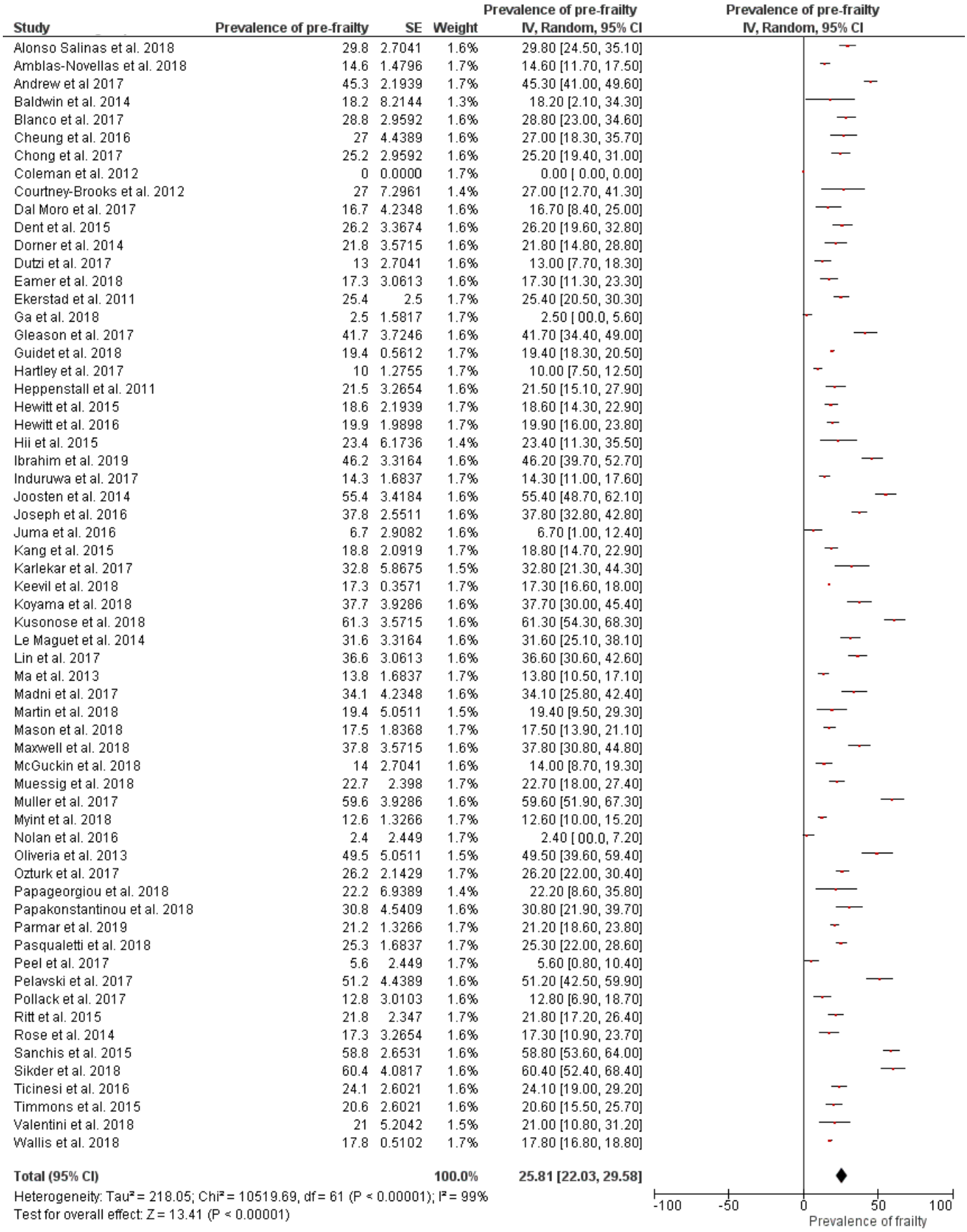
interventions to reduce the prevalence of frailty among geriatric hospital inpatients. Particularly as hospitalisation is associated with a further decline in functional capacity, interventions to mitigate this decline, and reduce the rate of subsequent rehospitalisation of older adults with frailty are important issues to be addressed. This is particularly the case as future demographic trends predict the overall number of frail older adults to increase dramatically in developed countries in the coming decades as the population ages (131). This will be further exacerbated by declining fertility rates in economically developed countries, which are projected to cause an increase in dependency ratios across the developed world (132-134). It is in this context that frailty, particularly in older age, has been described as *"without question, one of the most serious public health challenges we will face in this coming century"* (135).

In summary, this systematic review and meta-analysis found that approximately half of all hospital inpatients aged ≥ 65 years are frail, and approximately another 25% are pre-frail. These patients may benefit from interventions targeted at improving frailty status and preventing the functional decline associated with hospitalisation in this population, which can lead to further functional deterioration, recurrent readmission, and adverse health outcomes among these patients.

2.6 Acknowledgements

The authors of this review would like to thank and acknowledge Ms. Lynne Harris (Subject advisor of the Main Library at the University of Birmingham, United Kingdom) for her assistance during the formulation of the search strategy utilised within this systematic review. The authors would also like to extend a sincere gratitude to all 256 authors who responded to our inquiries, and particularly those generous enough to provide additional data for various aspects of the analysis.

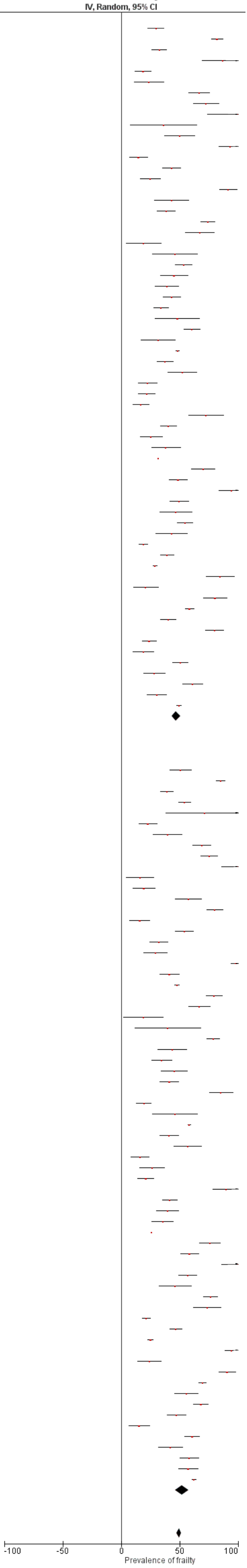
2.7 Supplementary materials



Supplementary Figure 2.1. Forest plot of the prevalence of frailty in the 62 eligible studies reporting the prevalence of pre-frailty, identified through the systematic review process, including a total of 35,348 geriatric hospital inpatients.

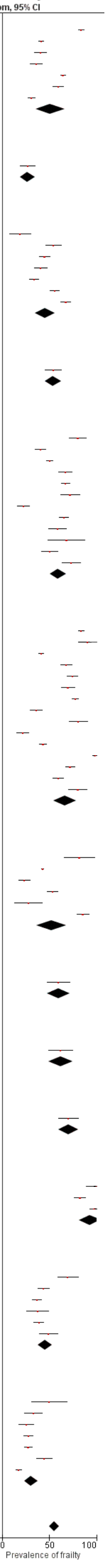
1

Study or Subgroup	Prevalence of frailty	SE	Weight	Prevalence of frailty IV, Random, 95% CI
2.2.1 Male				
Alonso Salinas et al. 2018	29.82	3.495	0.8%	29.82 [22.97, 36.67]
Amblas-Novellas et al. 2018	82.07	2.4184	0.9%	82.07 [77.33, 86.81]
Andrew et al 2017	32.69	3.2501	0.8%	32.69 [26.32, 39.06]
Baldwin et al. 2014	86.67	8.7808	0.6%	86.67 [69.46, 100.00]
Blanco et al. 2017	18.85	3.5409	0.8%	18.85 [11.91, 25.79]
Cheung et al. 2016	23.81	6.5715	0.7%	23.81 [10.93, 36.69]
Chew et al. 2017	66.67	4.6685	0.8%	66.67 [57.52, 75.82]
Chong et al. 2017	72.66	5.5715	0.7%	72.66 [61.74, 83.58]
Coleman et al. 2012	100	13.2043	0.4%	100.00 [74.12, 100.00]
Dal Moro et al. 2017	36.36	14.5042	0.3%	36.36 [7.93, 64.79]
Dorner et al. 2014	50	6.4542	0.7%	50.00 [37.35, 62.65]
Dutzi et al. 2017	93.1	4.7042	0.8%	93.10 [83.88, 100.00]
Eamer et al. 2018	14.81	3.9465	0.8%	14.81 [7.08, 22.54]
Ekerstad et al. 2011	43.31	3.9542	0.8%	43.31 [35.56, 51.06]
Engelhardt et al. 2018	25	4.5154	0.8%	25.00 [16.15, 33.85]
Ga et al. 2018	91.51	3.8266	0.8%	91.51 [84.01, 99.01]
Gleason et al. 2017	43.18	7.4644	0.6%	43.18 [28.55, 57.81]
Guidet et al. 2018	38.48	4.0103	0.8%	38.48 [30.62, 46.34]
Hartley et al. 2017	74.21	3.1735	0.8%	74.21 [67.99, 80.43]
Heppenstall et al. 2011	67.24	6.1634	0.7%	67.24 [55.16, 79.32]
Hii et al. 2015	19.23	7.7297	0.6%	19.23 [4.08, 34.38]
Hilmer et al. 2011	46.15	9.7757	0.5%	46.15 [26.99, 65.31]
Induruwa et al. 2017	53.44	3.6276	0.8%	53.44 [46.33, 60.55]
Jokar et al. 2016	45.26	6.0154	0.7%	45.26 [33.47, 57.05]
Joosten et al. 2014	39.01	5.1123	0.7%	39.01 [28.99, 49.03]
Joseph et al. 2014	43.35	3.7654	0.8%	43.35 [35.97, 50.73]
Joseph et al. 2016	34.22	3.1633	0.8%	34.22 [28.02, 40.42]
Juma et al. 2016	48.15	9.6175	0.5%	48.15 [29.30, 67.00]
Kang et al. 2015	60.59	3.4286	0.8%	60.59 [53.87, 67.31]
Karlekar et al. 2017	31.58	7.541	0.6%	31.58 [16.80, 46.36]
Keevil et al. 2018	48.19	0.7449	0.9%	48.19 [46.73, 49.65]
Khan et al. 2019	37.43	3.5358	0.8%	37.43 [30.50, 44.36]
Kobe et al. 2016	52.31	6.194	0.7%	52.31 [40.17, 64.45]
Kusonose et al. 2018	22.73	3.995	0.8%	22.73 [14.90, 30.56]
Le Maguet et al. 2014	21.88	3.6582	0.8%	21.88 [14.71, 29.05]
Lin et al. 2017	16.95	3.4541	0.8%	16.95 [10.18, 23.72]
Martin et al. 2018	72.73	7.7552	0.6%	72.73 [57.53, 87.93]
Mason et al. 2018	40.51	3.5154	0.8%	40.51 [33.62, 47.40]
Maxwell et al. 2018	25.61	4.8215	0.8%	25.61 [16.16, 35.06]
McGuckin et al. 2018	38.33	6.2756	0.7%	38.33 [26.03, 50.63]
McIsaac et al. 2018	31.86	0.1071	0.9%	31.86 [31.65, 32.07]
Morton et al. 2018	70.13	5.2144	0.7%	70.13 [59.91, 80.35]
Muessig et al. 2018	48.7	4.0256	0.8%	48.70 [40.81, 56.59]
Nolan et al. 2016	94.44	5.3981	0.7%	94.44 [83.86, 100.00]
Nygen et al. 2016	49.67	4.0715	0.8%	49.67 [41.69, 57.65]
Oliveria et al. 2013	46.94	7.1277	0.6%	46.94 [32.97, 60.91]
Ozturk et al. 2017	54.72	3.4184	0.8%	54.72 [48.02, 61.42]
Papakonstantinou et al. 2018	43.14	6.9389	0.6%	43.14 [29.54, 56.74]
Parmar et al. 2019	18.89	1.9643	0.9%	18.89 [15.04, 22.74]
Pasqualetti et al. 2018	39.33	2.8164	0.9%	39.33 [33.81, 44.85]
Patel et al. 2018	29.08	0.9388	0.9%	29.08 [27.24, 30.92]
Peel et al. 2017	84.85	6.2399	0.7%	84.85 [72.62, 97.08]
Pelavski et al. 2017	21.05	5.3981	0.7%	21.05 [10.47, 31.63]
Pollack et al. 2017	80.33	5.0919	0.7%	80.33 [70.35, 90.31]
Poudel et al. 2016	58.46	1.949	0.9%	58.46 [54.64, 62.28]
Purser et al. 2006	40.28	3.3368	0.8%	40.28 [33.74, 46.82]
Ritt et al. 2015	79.8	4.0358	0.8%	79.80 [71.89, 87.71]
Sanchis et al. 2015	23.98	3.0511	0.8%	23.98 [18.00, 29.96]
Sikder et al. 2018	18.99	4.4133	0.8%	18.99 [10.34, 27.64]
Sundermann et al. 2014	50.66	3.3164	0.8%	50.66 [44.16, 57.16]
Thai et al. 2015	28.42	4.6276	0.8%	28.42 [19.35, 37.49]
Ticinesi et al. 2016	61.29	4.3725	0.8%	61.29 [52.72, 69.86]
Timmons et al. 2015	30.36	4.347	0.8%	30.36 [21.84, 38.88]
Wallis et al. 2018	49.56	0.9949	0.9%	49.56 [47.61, 51.51]
Subtotal (95% CI)			**48.3%**	**47.04 [43.26, 50.82]**
Heterogeneity: Tau² = 211.65; Chi² = 3131.91, df = 63 (P < 0.00001); I² = 98%				
Test for overall effect: Z = 24.39 (P < 0.00001)				
2.2.2 Female				
Alonso Salinas et al. 2018	50.88	4.6838	0.8%	50.88 [41.70, 60.06]
Amblas-Novellas et al. 2018	85.25	1.9235	0.9%	85.25 [81.48, 89.02]
Andrew et al 2017	39.06	2.8317	0.9%	39.06 [33.51, 44.61]
Attinsano et al. 2017	54.38	2.7398	0.9%	54.38 [49.01, 59.75]
Baldwin et al. 2014	71.43	17.0768	0.3%	71.43 [37.96, 100.00]
Blanco et al. 2017	22.81	3.9337	0.8%	22.81 [15.10, 30.52]
Cheung et al. 2016	39.66	6.4236	0.7%	39.66 [27.07, 52.25]
Chew et al. 2017	68.94	4.0256	0.8%	68.94 [61.05, 76.83]
Chong et al. 2017	75.34	3.5664	0.8%	75.34 [68.35, 82.33]
Coleman et al. 2012	100	7.2195	0.6%	100.00 [85.85, 100.00]
Courtney-Brooks et al. 2012	16.22	6.0613	0.7%	16.22 [4.34, 28.10]
Dal Moro et al. 2017	19.4	4.8317	0.8%	19.40 [9.93, 28.87]
Dorner et al. 2014	57.53	5.7807	0.7%	57.53 [46.20, 68.86]
Dutzi et al. 2017	80	3.5766	0.8%	80.00 [72.99, 87.01]
Eamer et al. 2018	15.94	4.4082	0.8%	15.94 [7.30, 24.58]
Ekerstad et al. 2011	54	4.0715	0.8%	54.00 [46.02, 61.98]
Engelhardt et al. 2018	32.37	3.9644	0.8%	32.37 [24.60, 40.14]
Ferrero et al. 2017	29.49	5.1634	0.7%	29.49 [19.37, 39.61]
Ga et al. 2018	97.87	2.1021	0.9%	97.87 [93.75, 100.00]
Gleason et al. 2017	41.22	4.3011	0.8%	41.22 [32.79, 49.65]
Guidet et al. 2018	47.8	1.0204	0.9%	47.80 [45.80, 49.80]
Hartley et al. 2017	79.39	3.5154	0.8%	79.39 [72.50, 86.28]
Heppenstall et al. 2011	67	4.7042	0.8%	67.00 [57.78, 76.22]
Hii et al. 2015	19.05	8.5716	0.6%	19.05 [2.25, 35.85]
Hilmer et al. 2011	40	14.4084	0.3%	40.00 [11.76, 68.24]
Induruwa et al. 2017	78.7	2.7041	0.9%	78.70 [73.40, 84.00]
Jokar et al. 2016	43.9	6.3266	0.7%	43.90 [31.50, 56.30]
Joosten et al. 2014	34.71	4.3266	0.8%	34.71 [26.23, 43.19]
Joseph et al. 2014	45.45	5.6736	0.7%	45.45 [34.33, 56.57]
Joseph et al. 2016	41.26	4.1174	0.8%	41.26 [33.19, 49.33]
Juma et al. 2016	85.42	5.097	0.7%	85.42 [75.43, 95.41]
Kang et al. 2015	19.46	3.2399	0.8%	19.46 [13.11, 25.81]
Karlekar et al. 2017	46.15	9.7757	0.5%	46.15 [26.99, 65.31]
Keevil et al. 2018	58.22	0.6327	0.9%	58.22 [56.98, 59.46]
Khan et al. 2019	41.01	4.1735	0.8%	41.01 [32.83, 49.19]
Kobe et al. 2016	56.92	6.143	0.7%	56.92 [44.88, 68.96]
Kusonose et al. 2018	16.05	4.0766	0.8%	16.05 [8.06, 24.04]
Le Maguet et al. 2014	26.47	5.3521	0.7%	26.47 [15.98, 36.96]
Lin et al. 2017	21.09	3.6021	0.8%	21.09 [14.03, 28.15]
Martin et al. 2018	89.66	5.6583	0.7%	89.66 [78.57, 100.00]
Mason et al. 2018	41.67	3.1837	0.8%	41.67 [35.43, 47.91]
Maxwell et al. 2018	39.62	4.7501	0.8%	39.62 [30.31, 48.93]
McGuckin et al. 2018	35.58	4.694	0.8%	35.58 [26.38, 44.78]
McIsaac et al. 2018	26.24	0.0918	0.9%	26.24 [26.06, 26.42]
Morton et al. 2018	75.86	4.5868	0.8%	75.86 [66.87, 84.85]
Muessig et al. 2018	58.44	3.9695	0.8%	58.44 [50.66, 66.22]
Nolan et al. 2016	100	7.3012	0.6%	100.00 [85.69, 100.00]
Nygen et al. 2016	56.95	4.0256	0.8%	56.95 [49.06, 64.84]
Oliveria et al. 2013	46	7.046	0.6%	46.00 [32.19, 59.81]
Ozturk et al. 2017	76.44	2.9388	0.9%	76.44 [70.68, 82.20]
Papakonstantinou et al. 2018	73.58	6.0511	0.7%	73.58 [61.72, 85.44]
Parmar et al. 2019	21.3	1.7653	0.9%	21.30 [17.84, 24.76]
Pasqualetti et al. 2018	46.94	2.6939	0.9%	46.94 [41.66, 52.22]
Patel et al. 2018	25.13	1.1837	0.9%	25.13 [22.81, 27.45]
Peel et al. 2017	94.64	3.0052	0.8%	94.64 [88.75, 100.00]
Pelavski et al. 2017	24.29	5.1276	0.7%	24.29 [14.24, 34.34]
Pollack et al. 2017	90.63	3.648	0.8%	90.63 [83.48, 97.78]
Poudel et al. 2016	69.49	1.648	0.9%	69.49 [66.26, 72.72]
Purser et al. 2006	55.91	5.1481	0.7%	55.91 [45.82, 66.00]
Ritt et al. 2015	68.27	3.2297	0.8%	68.27 [61.94, 74.60]
Sanchis et al. 2015	47.26	4.1327	0.8%	47.26 [39.16, 55.36]
Sikder et al. 2018	15.38	4.4746	0.8%	15.38 [6.61, 24.15]
Sundermann et al. 2014	60.76	3.2705	0.8%	60.76 [54.35, 67.17]
Thai et al. 2015	42.35	5.3572	0.7%	42.35 [31.85, 52.85]
Ticinesi et al. 2016	58.22	4.0817	0.8%	58.22 [50.22, 66.22]
Timmons et al. 2015	57.35	4.2399	0.8%	57.35 [49.04, 65.66]
Wallis et al. 2018	62.19	0.8521	0.9%	62.19 [60.52, 63.86]
Subtotal (95% CI)			**51.7%**	**51.92 [46.08, 57.76]**
Heterogeneity: Tau² = 569.94; Chi² = 10984.87, df = 66 (P < 0.00001); I² = 99%				
Test for overall effect: Z = 17.42 (P < 0.00001)				
Total (95% CI)			**100.0%**	**49.47 [47.43, 51.52]**
Heterogeneity: Tau² = 119.11; Chi² = 15177.06, df = 130 (P < 0.00001); I² = 99%				
Test for overall effect: Z = 47.46 (P < 0.00001)				
Test for subgroup differences: Chi² = 1.89, df = 1 (P = 0.17), I² = 47.1%				

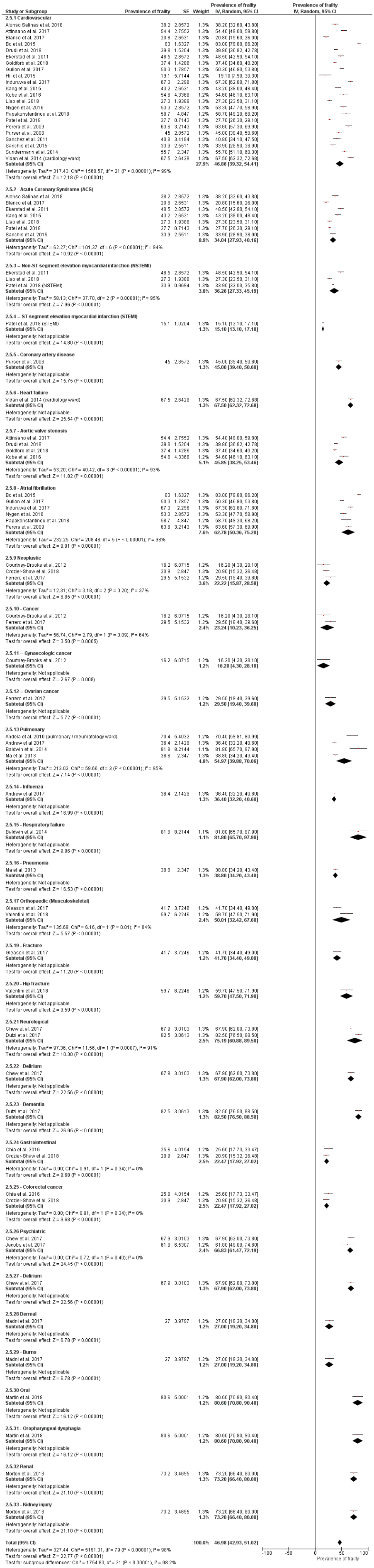


Supplementary Figure 2.2. Forest plot of the prevalence of frailty among geriatric hospital inpatients stratified by sex, including a total of 246,241 female, and 210,471 male geriatric hospital inpatients.

Study or Subgroup	Prevalence of frailty	SE	Weight	Prevalence of frailty IV, Random, 95% CI
2.4.1 Acute wards				
Amblas-Novellas et al. 2018	83.9	1.5306	1.5%	83.90 [80.90, 86.90]
Bo et al. 2016	41.4	1.2245	1.5%	41.40 [39.00, 43.80]
Ibrahim et al. 2019	40.6	3.2654	1.5%	40.60 [34.20, 47.00]
Joosten et al. 2014	36.3	3.3164	1.5%	36.30 [29.80, 42.80]
Poudel et al. 2016	64.5	1.2755	1.5%	64.50 [62.00, 67.00]
Ticinesi et al. 2016	59.6	2.9592	1.5%	59.60 [53.80, 65.40]
Wou et al. 2013	30.9	1.9388	1.5%	30.90 [27.10, 34.70]
Subtotal (95% CI)			**10.5%**	**51.09 [35.94, 66.24]**
Heterogeneity: Tau² = 412.70; Chi² = 743.50, df = 6 (P < 0.00001); I² = 99%				
Test for overall effect: Z = 6.61 (P < 0.00001)				
2.4.2 Burns wards				
Madni et al. 2017	27	3.9797	1.5%	27.00 [19.20, 34.80]
Subtotal (95% CI)			**1.5%**	**27.00 [19.20, 34.80]**
Heterogeneity: Not applicable				
Test for overall effect: Z = 6.78 (P < 0.00001)				
2.4.3 Cardiology wards				
Hii et al. 2015	19.1	5.7144	1.4%	19.10 [7.90, 30.30]
Kobe et al. 2016	54.6	4.3368	1.5%	54.60 [46.10, 63.10]
Purser et al. 2006	45	2.8572	1.5%	45.00 [39.40, 50.60]
Sanchez et al. 2011	40.8	3.4184	1.5%	40.80 [34.10, 47.50]
Sanchis et al. 2015	33.9	2.5511	1.5%	33.90 [28.90, 38.90]
Sundermann et al. 2014	55.7	2.347	1.5%	55.70 [51.10, 60.30]
Vidan et al. 2014 (cardiology ward)	67.5	2.6531	1.5%	67.50 [62.30, 72.70]
Subtotal (95% CI)			**10.4%**	**45.61 [35.00, 56.22]**
Heterogeneity: Tau² = 192.73; Chi² = 128.46, df = 6 (P < 0.00001); I² = 95%				
Test for overall effect: Z = 8.42 (P < 0.00001)				
2.4.4 Endocrinology wards				
Dorner et al. 2014	54.1	4.2858	1.5%	54.10 [45.70, 62.50]
Subtotal (95% CI)			**1.5%**	**54.10 [45.70, 62.50]**
Heterogeneity: Not applicable				
Test for overall effect: Z = 12.62 (P < 0.00001)				
2.4.5 General (internal medicine) wards				
Andela et al. 2010 (internal medicine ward)	80.3	4.5919	1.5%	80.30 [71.30, 89.30]
Eeles et al. 2012	40.7	3.0103	1.5%	40.70 [34.80, 46.60]
Gullon et al. 2017	50.3	1.7857	1.5%	50.30 [46.80, 53.80]
Heppenstall et al. 2011	67.1	3.7246	1.5%	67.10 [59.80, 74.40]
Induruwa et al. 2017	67.3	2.296	1.5%	67.30 [62.80, 71.80]
Juma et al. 2016	72	5.2042	1.4%	72.00 [61.80, 82.20]
Koyama et al. 2018	22.5	3.3674	1.5%	22.50 [15.90, 29.10]
Ozturk et al. 2017	65.5	2.347	1.5%	65.50 [60.90, 70.10]
Papakonstantinou et al. 2018	58.7	4.847	1.4%	58.70 [49.20, 68.20]
Peel et al. 2017 (general ward)	68.2	9.9492	1.3%	68.20 [48.70, 87.70]
Rose et al. 2014	50.4	4.3368	1.5%	50.40 [41.90, 58.90]
Vidan et al. 2014 (internal medicine ward)	73.1	5.0511	1.4%	73.10 [63.20, 83.00]
Subtotal (95% CI)			**17.5%**	**59.28 [50.47, 68.09]**
Heterogeneity: Tau² = 222.45; Chi² = 236.58, df = 11 (P < 0.00001); I² = 95%				
Test for overall effect: Z = 13.19 (P < 0.00001)				
2.4.6 Geriatric wards				
Amblas-Novellas et al. 2018	83.9	1.5306	1.5%	83.90 [80.90, 86.90]
Andela et al. 2010 (geriatric ward)	90.6	5.1532	1.4%	90.60 [80.50, 100.00]
Bo et al. 2016	41.4	1.2245	1.5%	41.40 [39.00, 43.80]
Chew et al. 2017	67.9	3.0103	1.5%	67.90 [62.00, 73.80]
Chong et al. 2017	74.5	3.0103	1.5%	74.50 [68.60, 80.40]
Dent et al. 2015	69.8	3.5205	1.5%	69.80 [62.90, 76.70]
Hartley et al. 2017	77.6	1.7857	1.5%	77.60 [74.10, 81.10]
Joosten et al. 2014	36.3	3.3164	1.5%	36.30 [29.80, 42.80]
Martin et al. 2018	80.6	5.0001	1.4%	80.60 [70.80, 90.40]
Muller et al. 2017	21.8	3.3164	1.5%	21.80 [15.30, 28.30]
Pasqualetti et al. 2018	43.4	1.9388	1.5%	43.40 [39.60, 47.20]
Peel et al. 2017 (geriatric ward)	98.5	1.4796	1.5%	98.50 [95.60, 100.00]
Ritt et al. 2015	72	2.5511	1.5%	72.00 [67.00, 77.00]
Ticinesi et al. 2016	59.6	2.9592	1.5%	59.60 [53.80, 65.40]
Vidan et al. 2014 (geriatric ward)	80.3	5.0511	1.4%	80.30 [70.40, 90.20]
Subtotal (95% CI)			**22.3%**	**66.48 [54.27, 78.68]**
Heterogeneity: Tau² = 570.99; Chi² = 1517.66, df = 14 (P < 0.00001); I² = 99%				
Test for overall effect: Z = 10.68 (P < 0.00001)				
2.4.7 Intensive care wards				
Baldwin et al. 2014	81.8	8.2144	1.3%	81.80 [65.70, 97.90]
Guidet et al. 2018	42.9	0.6633	1.5%	42.90 [41.60, 44.20]
Le Maguet et al. 2014	23.5	3.0613	1.5%	23.50 [17.50, 29.50]
Muessig et al. 2018	53.6	2.8572	1.5%	53.60 [48.00, 59.20]
Papageorgiou et al. 2018	27.8	7.5001	1.4%	27.80 [13.10, 42.50]
Pollack et al. 2017	85.6	3.1633	1.5%	85.60 [79.40, 91.80]
Subtotal (95% CI)			**8.7%**	**52.29 [36.16, 68.41]**
Heterogeneity: Tau² = 382.47; Chi² = 257.35, df = 5 (P < 0.00001); I² = 98%				
Test for overall effect: Z = 6.36 (P < 0.00001)				
2.4.10 Orthopaedic wards				
Valentini et al. 2018	59.7	6.2246	1.4%	59.70 [47.50, 71.90]
Subtotal (95% CI)			**1.4%**	**59.70 [47.50, 71.90]**
Heterogeneity: Not applicable				
Test for overall effect: Z = 9.59 (P < 0.00001)				
2.4.12 Psychiatric wards				
Jacobs et al. 2017	61.8	6.5307	1.4%	61.80 [49.00, 74.60]
Subtotal (95% CI)			**1.4%**	**61.80 [49.00, 74.60]**
Heterogeneity: Not applicable				
Test for overall effect: Z = 9.46 (P < 0.00001)				
2.4.13 Pulmonary wards				
Andela et al. 2010 (pulmonary / rheumatology ward)	70.4	5.4083	1.4%	70.40 [59.80, 81.00]
Subtotal (95% CI)			**1.4%**	**70.40 [59.80, 81.00]**
Heterogeneity: Not applicable				
Test for overall effect: Z = 13.02 (P < 0.00001)				
2.4.14 Rehabilitation wards				
Coleman et al. 2012	100	5.4593	1.4%	100.00 [89.30, 100.00]
Dutzi et al. 2017	82.5	3.0613	1.5%	82.50 [76.50, 88.50]
Nolan et al. 2016	97.6	2.449	1.5%	97.60 [92.80, 100.00]
Subtotal (95% CI)			**4.4%**	**93.01 [81.76, 100.00]**
Heterogeneity: Tau² = 84.76; Chi² = 16.89, df = 2 (P = 0.0002); I² = 88%				
Test for overall effect: Z = 16.21 (P < 0.00001)				
2.4.15 Traumatology wards				
Andela et al. 2010 (traumatology ward)	69.6	5.5613	1.4%	69.60 [58.70, 80.50]
Joseph et al. 2014	44	3.1633	1.5%	44.00 [37.80, 50.20]
Joseph et al. 2016	37	2.5511	1.5%	37.00 [32.00, 42.00]
Karlekar et al. 2017	37.5	6.0715	1.4%	37.50 [25.60, 49.40]
Khan et al. 2019	39	2.7041	1.5%	39.00 [33.70, 44.30]
Lee et al. 2018	49	5.0001	1.4%	49.00 [39.20, 58.80]
Subtotal (95% CI)			**8.8%**	**45.33 [37.69, 52.98]**
Heterogeneity: Tau² = 73.38; Chi² = 32.60, df = 5 (P < 0.00001); I² = 85%				
Test for overall effect: Z = 11.62 (P < 0.00001)				
2.4.16 Surgical wards				
Andela et al. 2010 (surgical ward)	50	9.4389	1.3%	50.00 [31.50, 68.50]
Cheung et al. 2016	33	4.694	1.5%	33.00 [23.80, 42.20]
Chia et al. 2016	25.6	4.0307	1.5%	25.60 [17.70, 33.50]
Hewitt et al. 2015	27.8	2.5511	1.5%	27.80 [22.80, 32.80]
Hewitt et al. 2016	27.7	2.1939	1.5%	27.70 [23.40, 32.00]
Jokar et al. 2016	44.6	4.3368	1.5%	44.60 [36.10, 53.10]
Myint et al. 2018	17.5	1.4796	1.5%	17.50 [14.60, 20.40]
Subtotal (95% CI)			**10.2%**	**30.55 [23.46, 37.65]**
Heterogeneity: Tau² = 74.43; Chi² = 58.27, df = 6 (P < 0.00001); I² = 90%				
Test for overall effect: Z = 8.44 (P < 0.00001)				
Total (95% CI)			**100.0%**	**55.19 [50.02, 60.36]**
Heterogeneity: Tau² = 456.58; Chi² = 5164.30, df = 67 (P < 0.00001); I² = 99%				
Test for overall effect: Z = 20.93 (P < 0.00001)				
Test for subgroup differences: Chi² = 152.53, df = 12 (P < 0.00001), I² = 92.1%				

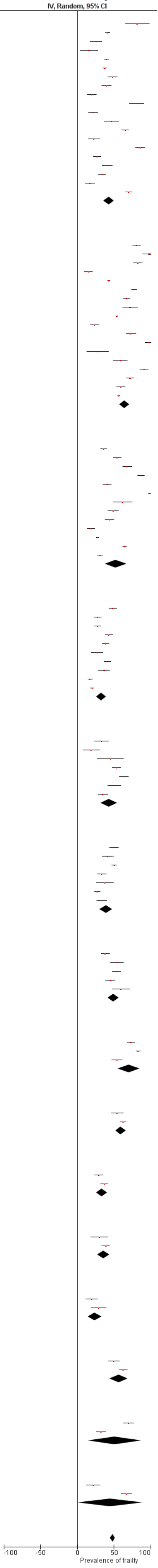


Supplementary Figure 2.3. Forest plot of the prevalence of frailty among geriatric hospital inpatients stratified by ward type.



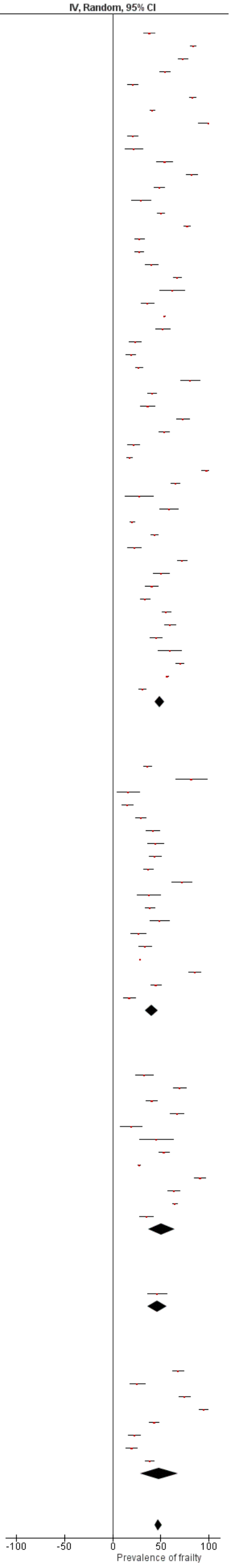
Supplementary Figure 2.4. Forest plot of the prevalence of frailty among geriatric hospital inpatients stratified by prevalent morbidity.

Study or Subgroup	Prevalence of frailty	SE	Weight	Prevalence of frailty IV, Random, 95% CI
2.3.1 Fried frailty phenotype critera				
Baldwin et al. 2014	81.8	8.2144	0.9%	81.80 [65.70, 97.90]
Bo et al. 2016	41.4	1.2245	1.1%	41.40 [39.00, 43.80]
Chia et al. 2016	25.6	4.0154	1.0%	25.60 [17.73, 33.47]
Courtney-Brooks et al. 2012	16.2	6.0715	1.0%	16.20 [4.30, 28.10]
Drudi et al. 2018	39.8	1.5204	1.1%	39.80 [36.82, 42.78]
Goldforb et al. 2018	37.4	1.4286	1.1%	37.40 [34.60, 40.20]
Ibrahim et al. 2019 (FFP)	48.17	3.3878	1.0%	48.17 [41.53, 54.81]
Joosten et al. 2014 (Fried Frailty Phenotype)	40	3.3011	1.0%	40.00 [33.53, 46.47]
Kusonose et al. 2018	19.9	2.9082	1.0%	19.90 [14.20, 25.60]
Martin et al. 2018	80.6	5.0001	1.0%	80.60 [70.80, 90.40]
Muller et al. 2017	21.8	3.3164	1.0%	21.80 [15.30, 28.30]
Oliveria et al. 2013	46.5	5.0511	1.0%	46.50 [36.60, 56.40]
Ozturk et al. 2017	65.5	2.347	1.1%	65.50 [60.90, 70.10]
Pelavski et al. 2017	22.8	3.7246	1.0%	22.80 [15.50, 30.10]
Pollack et al. 2017	85.6	3.1633	1.0%	85.60 [79.40, 91.80]
Purser et al. 2006 (Fried Frailty Phenotype)	27.18	2.5307	1.1%	27.18 [22.22, 32.14]
Sanchez et al. 2011	40.8	3.4184	1.0%	40.80 [34.10, 47.50]
Sanchis et al. 2015	33.9	2.5511	1.0%	33.90 [28.90, 38.90]
Sikder et al. 2018	17.4	3.1633	1.0%	17.40 [11.20, 23.60]
Vidan et al. 2014	70.2	2.1429	1.1%	70.20 [66.00, 74.40]
Subtotal (95% CI)			**20.6%**	**42.86 [35.37, 50.35]**
Heterogeneity: Tau² = 278.53; Chi² = 824.79, df = 19 (P < 0.00001); I² = 98%				
Test for overall effect: Z = 11.21 (P < 0.00001)				
2.3.2 Clinical Frailty Scale				
Chong et al. 2017 (Clinical Frailty Scale)	80.95	2.7092	1.0%	80.95 [75.64, 86.26]
Coleman et al. 2012	100	5.4695	1.0%	100.00 [89.28, 100.00]
Dutzi et al. 2017	82.5	3.0613	1.0%	82.50 [76.50, 88.50]
Eamer et al. 2018	15.3	2.9082	1.0%	15.30 [9.60, 21.00]
Guidet et al. 2018	42.9	0.6633	1.1%	42.90 [41.60, 44.20]
Hartley et al. 2017	77.6	1.7857	1.1%	77.60 [74.10, 81.10]
Induruwa et al. 2017	67.3	2.296	1.1%	67.30 [62.80, 71.80]
Juma et al. 2016	72	5.2042	1.0%	72.00 [61.80, 82.20]
Keevil et al. 2018	53.98	0.5	1.1%	53.98 [53.00, 54.96]
Le Maguet et al. 2014	23.5	3.0613	1.0%	23.50 [17.50, 29.50]
Morton et al. 2018	73.2	3.4695	1.0%	73.20 [66.40, 80.00]
Nolan et al. 2016	97.6	2.449	1.1%	97.60 [92.80, 100.00]
Papageorgiou et al. 2018	27.8	7.5001	0.9%	27.80 [13.10, 42.50]
Papakonstantinou et al. 2018	58.7	4.847	1.0%	58.70 [49.20, 68.20]
Peel et al. 2017	91	3.0103	1.0%	91.00 [85.10, 96.90]
Ritt et al. 2015	72	2.5511	1.0%	72.00 [67.00, 77.00]
Ticinesi et al. 2016	59.6	2.9592	1.0%	59.60 [53.80, 65.40]
Wallis et al. 2018	56.7	0.6633	1.1%	56.70 [55.40, 58.00]
Subtotal (95% CI)			**18.6%**	**64.17 [57.34, 71.00]**
Heterogeneity: Tau² = 207.07; Chi² = 1608.55, df = 17 (P < 0.00001); I² = 99%				
Test for overall effect: Z = 18.41 (P < 0.00001)				
2.3.3 Frailty Index				
Andrew et al 2017	36.4	2.1429	1.1%	36.40 [32.20, 40.60]
Attinsano et al. 2017	54.4	2.7552	1.0%	54.40 [49.00, 59.80]
Chew et al. 2017	67.9	3.0103	1.0%	67.90 [62.00, 73.80]
Chong et al. 2017 (Frailty Index)	87.14	2.3062	1.1%	87.14 [82.62, 91.66]
Eeles et al. 2012	40.7	3.0103	1.0%	40.70 [34.80, 46.60]
Ga et al. 2018 (Frailty Index)	100	1.8878	1.1%	100.00 [96.30, 100.00]
Jacobs et al. 2017	61.8	6.5307	0.9%	61.80 [49.00, 74.60]
Jokar et al. 2016 (Frailty Index)	49	3.5358	1.0%	49.00 [42.07, 55.93]
Joseph et al. 2014	44	3.1633	1.0%	44.00 [37.80, 50.20]
Lin et al. 2017	19.1	2.5	1.1%	19.10 [14.20, 24.00]
Patel et al. 2018	27.7	0.7143	1.1%	27.70 [26.30, 29.10]
Poudel et al. 2016	64.5	1.2755	1.1%	64.50 [62.00, 67.00]
Wou et al. 2013	30.9	1.9388	1.1%	30.90 [27.10, 34.70]
Subtotal (95% CI)			**13.6%**	**52.55 [38.01, 67.09]**
Heterogeneity: Tau² = 706.49; Chi² = 2254.26, df = 12 (P < 0.00001); I² = 99%				
Test for overall effect: Z = 7.08 (P < 0.00001)				
2.3.4 Canadian Study on Health and Ageing (CSHA) Clinical Frailty Scale (7-point)				
Ekerstad et al. 2011	48.5	2.8572	1.0%	48.50 [42.90, 54.10]
Hewitt et al. 2015	27.8	2.5511	1.0%	27.80 [22.80, 32.80]
Hewitt et al. 2016	27.7	2.1939	1.1%	27.70 [23.40, 32.00]
Kang et al. 2015	43.2	2.6531	1.0%	43.20 [38.00, 48.40]
Ma et al. 2013	38.8	2.347	1.1%	38.80 [34.20, 43.40]
Madni et al. 2017	27	3.9797	1.0%	27.00 [19.20, 34.80]
Mason et al. 2018	41.1	2.347	1.1%	41.10 [36.50, 45.70]
McGuckin et al. 2018	36.6	3.7756	1.0%	36.60 [29.20, 44.00]
Myint et al. 2018	17.5	1.4796	1.1%	17.50 [14.60, 20.40]
Parmar et al. 2019	20.3	1.3266	1.1%	20.30 [17.70, 22.90]
Subtotal (95% CI)			**10.5%**	**32.74 [25.78, 39.71]**
Heterogeneity: Tau² = 119.35; Chi² = 225.92, df = 9 (P < 0.00001); I² = 96%				
Test for overall effect: Z = 9.21 (P < 0.00001)				
2.3.5 Reported Edmonton Frailty Scale				
Cheung et al. 2016	33	4.694	1.0%	33.00 [23.80, 42.20]
Hii et al. 2015	19.1	5.7144	1.0%	19.10 [7.90, 30.30]
Hilmer et al. 2011	45.2	8.9798	0.9%	45.20 [27.60, 62.80]
Nygen et al. 2016	53.3	2.8572	1.0%	53.30 [47.70, 58.90]
Perera et al. 2009	63.6	3.2143	1.0%	63.60 [57.30, 69.90]
Rose et al. 2014	50.4	4.3368	1.0%	50.40 [41.90, 58.90]
Thai et al. 2015	35	3.5715	1.0%	35.00 [28.00, 42.00]
Subtotal (95% CI)			**7.0%**	**43.12 [32.10, 54.15]**
Heterogeneity: Tau² = 197.05; Chi² = 76.18, df = 6 (P < 0.00001); I² = 92%				
Test for overall effect: Z = 7.67 (P < 0.00001)				
2.3.6 FRAIL scale				
Chong et al. 2017 (FRAIL Scale)	50	3.449	1.0%	50.00 [43.24, 56.76]
Gleason et al. 2017	41.7	3.7246	1.0%	41.70 [34.40, 49.00]
Gullon et al. 2017	50.3	1.7857	1.1%	50.30 [46.80, 53.80]
Ibrahim et al. 2019 (FRAIL Scale)	33.58	3.1633	1.0%	33.58 [27.38, 39.78]
Karlekar et al. 2017	37.5	6.0715	1.0%	37.50 [25.60, 49.40]
Llao et al. 2018	27.3	1.9388	1.1%	27.30 [23.50, 31.10]
Maxwell et al. 2018	33.5	3.4184	1.0%	33.50 [26.80, 40.20]
Subtotal (95% CI)			**7.2%**	**39.15 [30.72, 47.58]**
Heterogeneity: Tau² = 117.16; Chi² = 92.48, df = 6 (P < 0.00001); I² = 94%				
Test for overall effect: Z = 9.10 (P < 0.00001)				
2.3.7 SHARE-FI				
Alonso Salinas et al. 2018	38.2	2.8572	1.0%	38.20 [32.60, 43.80]
Dorner et al. 2014	54.1	4.2858	1.0%	54.10 [45.70, 62.50]
Muessig et al. 2018	53.6	2.8572	1.0%	53.60 [48.00, 59.20]
Timmons et al. 2015	45.2	3.1633	1.0%	45.20 [39.00, 51.40]
Valentini et al. 2018	59.7	6.2246	1.0%	59.70 [47.50, 71.90]
Subtotal (95% CI)			**5.1%**	**49.38 [42.02, 56.75]**
Heterogeneity: Tau² = 55.45; Chi² = 21.89, df = 4 (P = 0.0002); I² = 82%				
Test for overall effect: Z = 13.15 (P < 0.00001)				
2.3.8 Groningen Frailty Indicator				
Andela et al. 2010	73.2	2.6531	1.0%	73.20 [68.00, 78.40]
Bo et al. 2015	83	1.6327	1.1%	83.00 [79.80, 86.20]
Kenig et al. 2015 (Groningen Frailty Indicator)	54.35	3.6735	1.0%	54.35 [47.15, 61.55]
Subtotal (95% CI)			**3.1%**	**70.48 [55.56, 85.41]**
Heterogeneity: Tau² = 166.42; Chi² = 53.57, df = 2 (P < 0.00001); I² = 96%				
Test for overall effect: Z = 9.25 (P < 0.00001)				
2.3.9 Frailty predicts dealth one yeaR after Cardiac Surgery Test (FORECAST)				
Kobe et al. 2016	54.6	4.3368	1.0%	54.60 [46.10, 63.10]
Sundermann et al. 2014 (FORECAST)	62.44	2.2807	1.1%	62.44 [57.97, 66.91]
Subtotal (95% CI)			**2.1%**	**59.39 [51.90, 66.88]**
Heterogeneity: Tau² = 18.73; Chi² = 2.56, df = 1 (P = 0.11); I² = 61%				
Test for overall effect: Z = 15.54 (P < 0.00001)				
2.3.10 Trauma Specific and Emergency General Sugery Specific Frailty Indices				
Engelhardt et al. 2018	29.3	2.9592	1.0%	29.30 [23.50, 35.10]
Joseph et al. 2016	37	2.5511	1.0%	37.00 [32.00, 42.00]
Subtotal (95% CI)			**2.1%**	**33.30 [25.76, 40.84]**
Heterogeneity: Tau² = 22.01; Chi² = 3.88, df = 1 (P = 0.05); I² = 74%				
Test for overall effect: Z = 8.65 (P < 0.00001)				
2.3.11 Emergency General Surgery-Specific Frailty Index (EGS-SFI)				
Jokar et al. 2016 (EGS-FI)	30	5.9185	1.0%	30.00 [18.40, 41.60]
Khan et al. 2019	39	2.7041	1.0%	39.00 [33.70, 44.30]
Subtotal (95% CI)			**2.0%**	**36.04 [27.75, 44.33]**
Heterogeneity: Tau² = 19.33; Chi² = 1.91, df = 1 (P = 0.17); I² = 48%				
Test for overall effect: Z = 8.52 (P < 0.00001)				
2.3.12 modified Frailty Index				
Charest-Morin et al. 2017	19.6	3.9286	1.0%	19.60 [11.90, 27.30]
Ferrero et al. 2017	29.5	5.1532	1.0%	29.50 [19.40, 39.60]
Subtotal (95% CI)			**2.0%**	**23.99 [14.35, 33.63]**
Heterogeneity: Tau² = 28.01; Chi² = 2.33, df = 1 (P = 0.13); I² = 57%				
Test for overall effect: Z = 4.88 (P < 0.00001)				
2.3.13 Rockwood frailty assessment				
Kenig et al. 2015 (Rockwood frailty assessment)	50	3.6837	1.0%	50.00 [42.78, 57.22]
Purser et al. 2006 (Rockwood frailty assessment)	62.78	2.7501	1.0%	62.78 [57.39, 68.17]
Subtotal (95% CI)			**2.1%**	**56.62 [44.11, 69.14]**
Heterogeneity: Tau² = 71.10; Chi² = 7.73, df = 1 (P = 0.005); I² = 87%				
Test for overall effect: Z = 8.87 (P < 0.00001)				
2.3.14 Study of Osteoporotic Fractures (SOF) index				
Dent et al. 2015	69.8	3.5205	1.0%	69.80 [62.90, 76.70]
Joosten et al. 2014 (SOF Frailty Index)	32.4	3.3011	1.0%	32.40 [25.93, 38.87]
Subtotal (95% CI)			**2.1%**	**51.08 [14.43, 87.73]**
Heterogeneity: Tau² = 687.73; Chi² = 60.06, df = 1 (P < 0.00001); I² = 98%				
Test for overall effect: Z = 2.73 (P = 0.006)				
2.3.15 Edmonton Frailty Scale				
Dal Moro et al. 2017	21.8	4.694	1.0%	21.80 [12.60, 31.00]
Heppenstall et al. 2011	67.1	3.7246	1.0%	67.10 [59.80, 74.40]
Subtotal (95% CI)			**2.0%**	**44.54 [0.15, 88.93]**
Heterogeneity: Tau² = 1008.09; Chi² = 57.15, df = 1 (P < 0.00001); I² = 98%				
Test for overall effect: Z = 1.97 (P = 0.05)				
Total (95% CI)			**100.0%**	**48.12 [44.40, 51.85]**
Heterogeneity: Tau² = 336.99; Chi² = 7560.98, df = 96 (P < 0.00001); I² = 99%				
Test for overall effect: Z = 25.34 (P < 0.00001)				
Test for subgroup differences: Chi² = 107.56, df = 14 (P < 0.00001), I² = 87.0%				

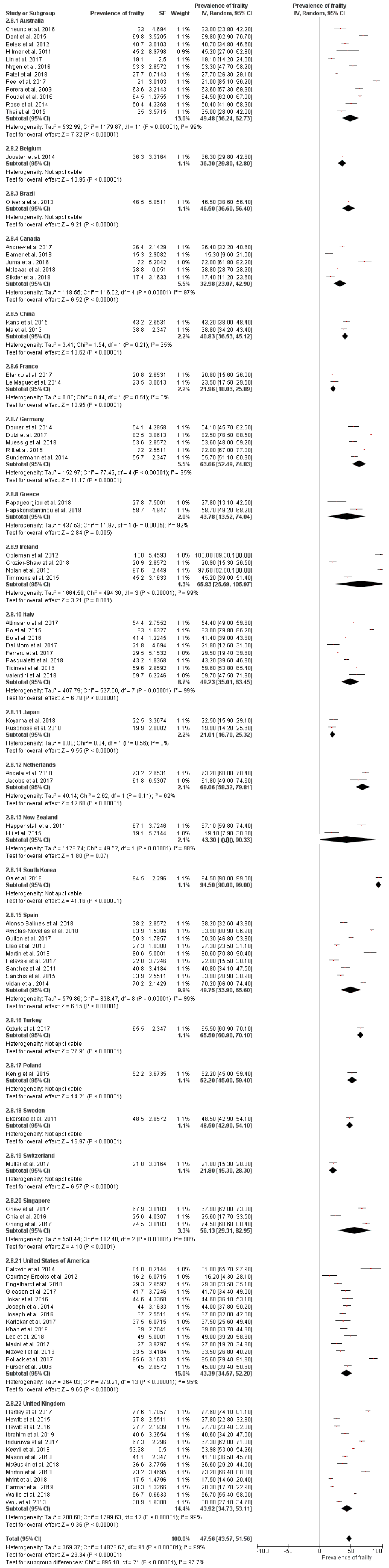


Supplementary Figure 2.5. Forest plot of the prevalence of frailty among geriatric hospital inpatients stratified by operational definition.

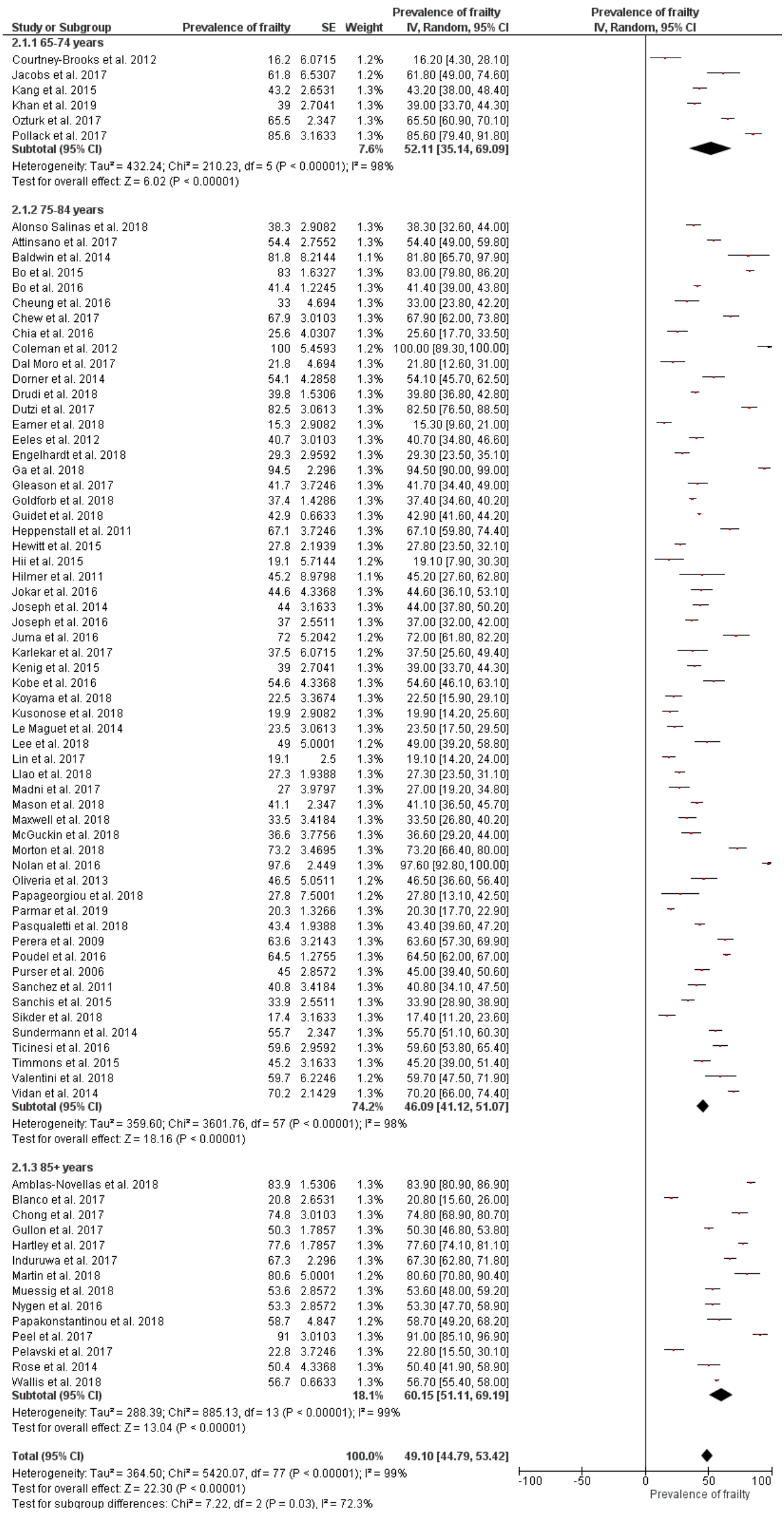
Study or Subgroup	Prevalence of frailty	SE	Weight	Prevalence of frailty IV, Random, 95% CI
2.7.1 Europe				
Alonso Salinas et al. 2018	38.2	2.8572	1.1%	38.20 [32.60, 43.80]
Amblas-Novellas et al. 2018	83.9	1.5306	1.1%	83.90 [80.90, 86.90]
Andela et al. 2010	73.2	2.6531	1.1%	73.20 [68.00, 78.40]
Attinsano et al. 2017	54.4	2.7552	1.1%	54.40 [49.00, 59.80]
Blanco et al. 2017	20.8	2.6531	1.1%	20.80 [15.60, 26.00]
Bo et al. 2015	83	1.6327	1.1%	83.00 [79.80, 86.20]
Bo et al. 2016	41.4	1.2245	1.1%	41.40 [39.00, 43.80]
Coleman et al. 2012	100	5.4593	1.0%	100.00 [89.30, 100.00]
Crozier-Shaw et al. 2018	20.9	2.8572	1.1%	20.90 [15.30, 26.50]
Dal Moro et al. 2017	21.8	4.694	1.1%	21.80 [12.60, 31.00]
Dorner et al. 2014	54.1	4.2858	1.1%	54.10 [45.70, 62.50]
Dutzi et al. 2017	82.5	3.0613	1.1%	82.50 [76.50, 88.50]
Ekerstad et al. 2011	48.5	2.8572	1.1%	48.50 [42.90, 54.10]
Ferrero et al. 2017	29.5	5.1532	1.0%	29.50 [19.40, 39.60]
Gullon et al. 2017	50.3	1.7857	1.1%	50.30 [46.80, 53.80]
Hartley et al. 2017	77.6	1.7857	1.1%	77.60 [74.10, 81.10]
Hewitt et al. 2015	27.8	2.5511	1.1%	27.80 [22.80, 32.80]
Hewitt et al. 2016	27.7	2.1939	1.1%	27.70 [23.40, 32.00]
Ibrahim et al. 2019	40.6	3.2654	1.1%	40.60 [34.20, 47.00]
Induruwa et al. 2017	67.3	2.296	1.1%	67.30 [62.80, 71.80]
Jacobs et al. 2017	61.8	6.5307	1.0%	61.80 [49.00, 74.60]
Joosten et al. 2014	36.3	3.3164	1.1%	36.30 [29.80, 42.80]
Keevil et al. 2018	53.98	0.5	1.1%	53.98 [53.00, 54.96]
Kenig et al. 2015	52.2	3.6735	1.1%	52.20 [45.00, 59.40]
Le Maguet et al. 2014	23.5	3.0613	1.1%	23.50 [17.50, 29.50]
Lin et al. 2017	19.1	2.5	1.1%	19.10 [14.20, 24.00]
Llao et al. 2018	27.3	1.9388	1.1%	27.30 [23.50, 31.10]
Martin et al. 2018	80.6	5.0001	1.1%	80.60 [70.80, 90.40]
Mason et al. 2018	41.1	2.347	1.1%	41.10 [36.50, 45.70]
McGuckin et al. 2018	36.6	3.7756	1.1%	36.60 [29.20, 44.00]
Morton et al. 2018	73.2	3.4695	1.1%	73.20 [66.40, 80.00]
Muessig et al. 2018	53.6	2.8572	1.1%	53.60 [48.00, 59.20]
Muller et al. 2017	21.8	3.3164	1.1%	21.80 [15.30, 28.30]
Myint et al. 2018	17.5	1.4796	1.1%	17.50 [14.60, 20.40]
Nolan et al. 2016	97.6	2.449	1.1%	97.60 [92.80, 100.00]
Ozturk et al. 2017	65.5	2.347	1.1%	65.50 [60.90, 70.10]
Papageorgiou et al. 2018	27.8	7.5001	1.0%	27.80 [13.10, 42.50]
Papakonstantinou et al. 2018	58.7	4.847	1.1%	58.70 [49.20, 68.20]
Parmar et al. 2019	20.3	1.3266	1.1%	20.30 [17.70, 22.90]
Pasqualetti et al. 2018	43.4	1.9388	1.1%	43.40 [39.60, 47.20]
Pelavski et al. 2017	22.8	3.7246	1.1%	22.80 [15.50, 30.10]
Ritt et al. 2015	72	2.5511	1.1%	72.00 [67.00, 77.00]
Rose et al. 2014	50.4	4.3368	1.1%	50.40 [41.90, 58.90]
Sanchez et al. 2011	40.8	3.4184	1.1%	40.80 [34.10, 47.50]
Sanchis et al. 2015	33.9	2.5511	1.1%	33.90 [28.90, 38.90]
Sundermann et al. 2014	55.7	2.347	1.1%	55.70 [51.10, 60.30]
Ticinesi et al. 2016	59.6	2.9592	1.1%	59.60 [53.80, 65.40]
Timmons et al. 2015	45.2	3.1633	1.1%	45.20 [39.00, 51.40]
Valentini et al. 2018	59.7	6.2246	1.0%	59.70 [47.50, 71.90]
Vidan et al. 2014	70.2	2.1429	1.1%	70.20 [66.00, 74.40]
Wallis et al. 2018	56.7	0.6633	1.1%	56.70 [55.40, 58.00]
Wou et al. 2013	30.9	1.9388	1.1%	30.90 [27.10, 34.70]
Subtotal (95% CI)			**56.8%**	**49.08 [43.93, 54.22]**
Heterogeneity: Tau² = 347.73; Chi² = 4533.48, df = 51 (P < 0.00001); I² = 99%				
Test for overall effect: Z = 18.69 (P < 0.00001)				
2.7.2 North America				
Andrew et al 2017	36.4	2.1429	1.1%	36.40 [32.20, 40.60]
Baldwin et al. 2014	81.8	8.2144	1.0%	81.80 [65.70, 97.90]
Courtney-Brooks et al. 2012	16.2	6.0715	1.0%	16.20 [4.30, 28.10]
Eamer et al. 2018	15.3	2.9082	1.1%	15.30 [9.60, 21.00]
Engelhardt et al. 2018	29.3	2.9592	1.1%	29.30 [23.50, 35.10]
Gleason et al. 2017	41.7	3.7246	1.1%	41.70 [34.40, 49.00]
Jokar et al. 2016	44.6	4.3368	1.1%	44.60 [36.10, 53.10]
Joseph et al. 2014	44	3.1633	1.1%	44.00 [37.80, 50.20]
Joseph et al. 2016	37	2.5511	1.1%	37.00 [32.00, 42.00]
Juma et al. 2016	72	5.2042	1.0%	72.00 [61.80, 82.20]
Karlekar et al. 2017	37.5	6.0715	1.0%	37.50 [25.60, 49.40]
Khan et al. 2019	39	2.7041	1.1%	39.00 [33.70, 44.30]
Lee et al. 2018	49	5.0001	1.1%	49.00 [39.20, 58.80]
Madni et al. 2017	27	3.9797	1.1%	27.00 [19.20, 34.80]
Maxwell et al. 2018	33.5	3.4184	1.1%	33.50 [26.80, 40.20]
McIsaac et al. 2018	28.8	0.051	1.1%	28.80 [28.70, 28.90]
Pollack et al. 2017	85.6	3.1633	1.1%	85.60 [79.40, 91.80]
Purser et al. 2006	45	2.8572	1.1%	45.00 [39.40, 50.60]
Sikder et al. 2018	17.4	3.1633	1.1%	17.40 [11.20, 23.60]
Subtotal (95% CI)			**20.4%**	**40.59 [34.18, 47.00]**
Heterogeneity: Tau² = 187.18; Chi² = 609.28, df = 18 (P < 0.00001); I² = 97%				
Test for overall effect: Z = 12.41 (P < 0.00001)				
2.7.3 Australasia				
Cheung et al. 2016	33	4.694	1.1%	33.00 [23.80, 42.20]
Dent et al. 2015	69.8	3.5205	1.1%	69.80 [62.90, 76.70]
Eeles et al. 2012	40.7	3.0103	1.1%	40.70 [34.80, 46.60]
Heppenstall et al. 2011	67.1	3.7246	1.1%	67.10 [59.80, 74.40]
Hii et al. 2015	19.1	5.7144	1.0%	19.10 [7.90, 30.30]
Hilmer et al. 2011	45.2	8.9798	0.9%	45.20 [27.60, 62.80]
Nygen et al. 2016	53.3	2.8572	1.1%	53.30 [47.70, 58.90]
Patel et al. 2018	27.7	0.7143	1.1%	27.70 [26.30, 29.10]
Peel et al. 2017	91	3.0103	1.1%	91.00 [85.10, 96.90]
Perera et al. 2009	63.6	3.2143	1.1%	63.60 [57.30, 69.90]
Poudel et al. 2016	64.5	1.2755	1.1%	64.50 [62.00, 67.00]
Thai et al. 2015	35	3.5715	1.1%	35.00 [28.00, 42.00]
Subtotal (95% CI)			**12.9%**	**51.00 [37.35, 64.64]**
Heterogeneity: Tau² = 564.32; Chi² = 1166.63, df = 11 (P < 0.00001); I² = 99%				
Test for overall effect: Z = 7.33 (P < 0.00001)				
2.7.4 South America				
Oliveria et al. 2013	46.5	5.0511	1.1%	46.50 [36.60, 56.40]
Subtotal (95% CI)			**1.1%**	**46.50 [36.60, 56.40]**
Heterogeneity: Not applicable				
Test for overall effect: Z = 9.21 (P < 0.00001)				
2.7.5 Asia				
Chew et al. 2017	67.9	3.0103	1.1%	67.90 [62.00, 73.80]
Chia et al. 2016	25.6	4.0307	1.1%	25.60 [17.70, 33.50]
Chong et al. 2017	74.5	3.0103	1.1%	74.50 [68.60, 80.40]
Ga et al. 2018	94.5	2.296	1.1%	94.50 [90.00, 99.00]
Kang et al. 2015	43.2	2.6531	1.1%	43.20 [38.00, 48.40]
Koyama et al. 2018	22.5	3.3674	1.1%	22.50 [15.90, 29.10]
Kusonose et al. 2018	19.9	2.9082	1.1%	19.90 [14.20, 25.60]
Ma et al. 2013	38.8	2.347	1.1%	38.80 [34.20, 43.40]
Subtotal (95% CI)			**8.8%**	**48.41 [28.53, 68.30]**
Heterogeneity: Tau² = 814.51; Chi² = 710.11, df = 7 (P < 0.00001); I² = 99%				
Test for overall effect: Z = 4.77 (P < 0.00001)				
Total (95% CI)			**100.0%**	**47.57 [43.57, 51.56]**
Heterogeneity: Tau² = 369.81; Chi² = 14819.65, df = 91 (P < 0.00001); I² = 99%				
Test for overall effect: Z = 23.32 (P < 0.00001)				
Test for subgroup differences: Chi² = 4.67, df = 4 (P = 0.32), I² = 14.3%				



Supplementary Figure 2.6. Forest plot of the prevalence of frailty among geriatric hospital inpatients stratified by geographic location (continent).

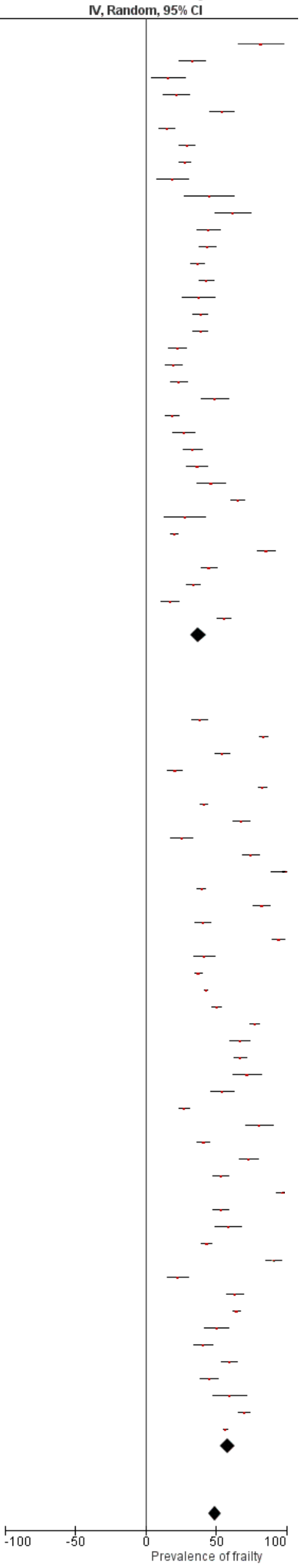


Supplementary Figure 2.7. Forest plot of the prevalence of frailty among geriatric hospital inpatients stratified by geographic location (country).



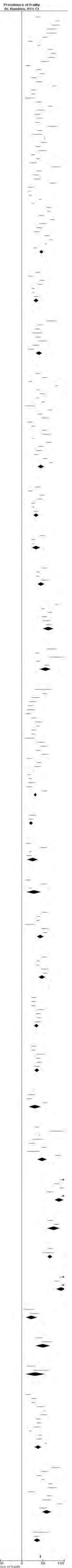
Supplementary Figure 2.8. Forest plot of the prevalence of frailty among geriatric hospital inpatients stratified by mean age of study sample.

Study or Subgroup	Prevalence of frailty	SE	Weight	Prevalence of frailty IV, Random, 95% CI
2.10.1 65-79 years				
Baldwin et al. 2014	81.8	8.2144	1.1%	81.80 [65.70, 97.90]
Cheung et al. 2016	33	4.694	1.3%	33.00 [23.80, 42.20]
Courtney-Brooks et al. 2012	16.2	6.0715	1.2%	16.20 [4.30, 28.10]
Dal Moro et al. 2017	21.8	4.694	1.3%	21.80 [12.60, 31.00]
Dorner et al. 2014	54.1	4.2858	1.3%	54.10 [45.70, 62.50]
Eamer et al. 2018	15.3	2.9082	1.3%	15.30 [9.60, 21.00]
Engelhardt et al. 2018	29.3	2.9592	1.3%	29.30 [23.50, 35.10]
Hewitt et al. 2015	27.8	2.1939	1.3%	27.80 [23.50, 32.10]
Hii et al. 2015	19.1	5.7144	1.2%	19.10 [7.90, 30.30]
Hilmer et al. 2011	45.2	8.9798	1.1%	45.20 [27.60, 62.80]
Jacobs et al. 2017	61.8	6.5307	1.2%	61.80 [49.00, 74.60]
Jokar et al. 2016	44.6	4.3368	1.3%	44.60 [36.10, 53.10]
Joseph et al. 2014	44	3.1633	1.3%	44.00 [37.80, 50.20]
Joseph et al. 2016	37	2.5511	1.3%	37.00 [32.00, 42.00]
Kang et al. 2015	43.2	2.6531	1.3%	43.20 [38.00, 48.40]
Karlekar et al. 2017	37.5	6.0715	1.2%	37.50 [25.60, 49.40]
Kenig et al. 2015	39	2.7041	1.3%	39.00 [33.70, 44.30]
Khan et al. 2019	39	2.7041	1.3%	39.00 [33.70, 44.30]
Koyama et al. 2018	22.5	3.3674	1.3%	22.50 [15.90, 29.10]
Kusonose et al. 2018	19.9	2.9082	1.3%	19.90 [14.20, 25.60]
Le Maguet et al. 2014	23.5	3.0613	1.3%	23.50 [17.50, 29.50]
Lee et al. 2018	49	5.0001	1.2%	49.00 [39.20, 58.80]
Lin et al. 2017	19.1	2.5	1.3%	19.10 [14.20, 24.00]
Madni et al. 2017	27	3.9797	1.3%	27.00 [19.20, 34.80]
Maxwell et al. 2018	33.5	3.4184	1.3%	33.50 [26.80, 40.20]
McGuckin et al. 2018	36.6	3.7756	1.3%	36.60 [29.20, 44.00]
Oliveria et al. 2013	46.5	5.0511	1.2%	46.50 [36.60, 56.40]
Ozturk et al. 2017	65.5	2.347	1.3%	65.50 [60.90, 70.10]
Papageorgiou et al. 2018	27.8	7.5001	1.2%	27.80 [13.10, 42.50]
Parmar et al. 2019	20.3	1.3266	1.3%	20.30 [17.70, 22.90]
Pollack et al. 2017	85.6	3.1633	1.3%	85.60 [79.40, 91.80]
Purser et al. 2006	45	2.8572	1.3%	45.00 [39.40, 50.60]
Sanchis et al. 2015	33.9	2.5511	1.3%	33.90 [28.90, 38.90]
Sikder et al. 2018	17.4	3.1633	1.3%	17.40 [11.20, 23.60]
Sundermann et al. 2014	55.7	2.347	1.3%	55.70 [51.10, 60.30]
Subtotal (95% CI)			**44.3%**	**37.44 [31.81, 43.07]**
Heterogeneity: Tau² = 270.43; Chi² = 966.21, df = 34 (P < 0.00001); I² = 96%				
Test for overall effect: Z = 13.04 (P < 0.00001)				
2.10.2 80+ years				
Alonso Salinas et al. 2018	38.3	2.9082	1.3%	38.30 [32.60, 44.00]
Amblas-Novellas et al. 2018	83.9	1.5306	1.3%	83.90 [80.90, 86.90]
Attinsano et al. 2017	54.4	2.7552	1.3%	54.40 [49.00, 59.80]
Blanco et al. 2017	20.8	2.6531	1.3%	20.80 [15.60, 26.00]
Bo et al. 2015	83	1.6327	1.3%	83.00 [79.80, 86.20]
Bo et al. 2016	41.4	1.2245	1.3%	41.40 [39.00, 43.80]
Chew et al. 2017	67.9	3.0103	1.3%	67.90 [62.00, 73.80]
Chia et al. 2016	25.6	4.0307	1.3%	25.60 [17.70, 33.50]
Chong et al. 2017	74.8	3.0103	1.3%	74.80 [68.90, 80.70]
Coleman et al. 2012	100	5.4593	1.2%	100.00 [89.30, 100.00]
Drudi et al. 2018	39.8	1.5306	1.3%	39.80 [36.80, 42.80]
Dutzi et al. 2017	82.5	3.0613	1.3%	82.50 [76.50, 88.50]
Eeles et al. 2012	40.7	3.0103	1.3%	40.70 [34.80, 46.60]
Ga et al. 2018	94.5	2.296	1.3%	94.50 [90.00, 99.00]
Gleason et al. 2017	41.7	3.7246	1.3%	41.70 [34.40, 49.00]
Goldforb et al. 2018	37.4	1.4286	1.3%	37.40 [34.60, 40.20]
Guidet et al. 2018	42.9	0.6633	1.3%	42.90 [41.60, 44.20]
Gullon et al. 2017	50.3	1.7857	1.3%	50.30 [46.80, 53.80]
Hartley et al. 2017	77.6	1.7857	1.3%	77.60 [74.10, 81.10]
Heppenstall et al. 2011	67.1	3.7246	1.3%	67.10 [59.80, 74.40]
Induruwa et al. 2017	67.3	2.296	1.3%	67.30 [62.80, 71.80]
Juma et al. 2016	72	5.2042	1.2%	72.00 [61.80, 82.20]
Kobe et al. 2016	54.6	4.3368	1.3%	54.60 [46.10, 63.10]
Llao et al. 2018	27.3	1.9388	1.3%	27.30 [23.50, 31.10]
Martin et al. 2018	80.6	5.0001	1.2%	80.60 [70.80, 90.40]
Mason et al. 2018	41.1	2.347	1.3%	41.10 [36.50, 45.70]
Morton et al. 2018	73.2	3.4695	1.3%	73.20 [66.40, 80.00]
Muessig et al. 2018	53.6	2.8572	1.3%	53.60 [48.00, 59.20]
Nolan et al. 2016	97.6	2.449	1.3%	97.60 [92.80, 100.00]
Nygen et al. 2016	53.3	2.8572	1.3%	53.30 [47.70, 58.90]
Papakonstantinou et al. 2018	58.7	4.847	1.2%	58.70 [49.20, 68.20]
Pasqualetti et al. 2018	43.4	1.9388	1.3%	43.40 [39.60, 47.20]
Peel et al. 2017	91	3.0103	1.3%	91.00 [85.10, 96.90]
Pelavski et al. 2017	22.8	3.7246	1.3%	22.80 [15.50, 30.10]
Perera et al. 2009	63.6	3.2143	1.3%	63.60 [57.30, 69.90]
Poudel et al. 2016	64.5	1.2755	1.3%	64.50 [62.00, 67.00]
Rose et al. 2014	50.4	4.3368	1.3%	50.40 [41.90, 58.90]
Sanchez et al. 2011	40.8	3.4184	1.3%	40.80 [34.10, 47.50]
Ticinesi et al. 2016	59.6	2.9592	1.3%	59.60 [53.80, 65.40]
Timmons et al. 2015	45.2	3.1633	1.3%	45.20 [39.00, 51.40]
Valentini et al. 2018	59.7	6.2246	1.2%	59.70 [47.50, 71.90]
Vidan et al. 2014	70.2	2.1429	1.3%	70.20 [66.00, 74.40]
Wallis et al. 2018	56.7	0.6633	1.3%	56.70 [55.40, 58.00]
Subtotal (95% CI)			**55.7%**	**58.34 [53.01, 63.66]**
Heterogeneity: Tau² = 307.43; Chi² = 3366.75, df = 42 (P < 0.00001); I² = 99%				
Test for overall effect: Z = 21.48 (P < 0.00001)				
Total (95% CI)			**100.0%**	**49.10 [44.79, 53.42]**
Heterogeneity: Tau² = 364.50; Chi² = 5420.07, df = 77 (P < 0.00001); I² = 99%				
Test for overall effect: Z = 22.30 (P < 0.00001)				
Test for subgroup differences: Chi² = 27.95, df = 1 (P < 0.00001), I² = 96.4%				



Supplementary Figure 2.9. Forest plot of the prevalence of frailty among geriatric hospital inpatients stratified by mean age of study sample (alternative stratification).

Study or Subgroup	Prevalence of frailty	SE	Weight	Prevalence of frailty IV, Random, 95% CI
2.6.1 Acute patients				
Alonso Salinas et al. 2018	38.2	2.8572	0.4%	38.20 [32.60, 43.80]
Amblas-Novellas et al. 2018	83.9	1.5306	0.5%	83.90 [80.90, 86.90]
Andela et al. 2010 (internal medicine ward)	80.3	4.5919	0.4%	80.30 [71.30, 89.30]
Andela et al. 2010 (pulmonary / rheumatology ward)	70.4	5.4083	0.3%	70.40 [59.80, 81.00]
Andela et al. 2010 (traumatology ward)	69.6	5.5613	0.3%	69.60 [58.70, 80.50]
Andrew et al 2017	54.4	2.7552	0.4%	54.40 [49.00, 59.80]
Blanco et al. 2017	20.8	2.6531	0.4%	20.80 [15.60, 26.00]
Bo et al. 2016	41.4	1.2245	0.5%	41.40 [39.00, 43.80]
Chew et al. 2017	67.9	3.0103	0.4%	67.90 [62.00, 73.80]
Chong et al. 2017	74.5	3.0103	0.4%	74.50 [68.60, 80.40]
Dent et al. 2015	69.8	3.5205	0.4%	69.80 [62.90, 76.70]
Dorner et al. 2014	54.1	4.2858	0.4%	54.10 [45.70, 62.50]
Eamer et al. 2018	15.3	2.9082	0.4%	15.30 [9.60, 21.00]
Eeles et al. 2012	40.7	3.0103	0.4%	40.70 [34.80, 46.60]
Ekerstad et al. 2011	48.5	2.8572	0.4%	48.50 [42.90, 54.10]
Engelhardt et al. 2018	29.3	2.9592	0.4%	29.30 [23.50, 35.10]
Gleason et al. 2017	41.7	3.7246	0.4%	41.70 [34.40, 49.00]
Hartley et al. 2017	77.6	1.7857	0.5%	77.60 [74.10, 81.10]
Hewitt et al. 2015	27.8	2.5511	0.5%	27.80 [22.80, 32.80]
Hewitt et al. 2016	27.7	2.1939	0.5%	27.70 [23.40, 32.00]
Hii et al. 2015	19.1	5.7144	0.3%	19.10 [7.90, 30.30]
Ibrahim et al. 2019	40.6	3.2654	0.4%	40.60 [34.20, 47.00]
Induruwa et al. 2017	67.3	2.296	0.5%	67.30 [62.80, 71.80]
Jokar et al. 2016	44.6	4.3368	0.4%	44.60 [36.10, 53.10]
Joosten et al. 2014	36.3	3.3164	0.4%	36.30 [29.80, 42.80]
Joseph et al. 2014	44	3.1633	0.4%	44.00 [37.80, 50.20]
Joseph et al. 2016	37	2.5511	0.5%	37.00 [32.00, 42.00]
Juma et al. 2016	72	5.2042	0.3%	72.00 [61.80, 82.20]
Kang et al. 2015	43.2	2.6531	0.4%	43.20 [38.00, 48.40]
Karlekar et al. 2017	37.5	6.0715	0.3%	37.50 [25.60, 49.40]
Keevil et al. 2018	53.98	0.5	0.5%	53.98 [53.00, 54.96]
Kenig et al. 2015	52.2	3.6939	0.4%	52.20 [44.96, 59.44]
Khan et al. 2019	39	2.7041	0.4%	39.00 [33.70, 44.30]
Lee et al. 2018	49	5.0001	0.3%	49.00 [39.20, 58.80]
Llao et al. 2018	27.3	1.9388	0.5%	27.30 [23.50, 31.10]
Ma et al. 2013	38.8	2.347	0.5%	38.80 [34.20, 43.40]
Madni et al. 2017	27	3.9797	0.4%	27.00 [19.20, 34.80]
Martin et al. 2018	80.6	5.0001	0.3%	80.60 [70.80, 90.40]
Mason et al. 2018	41.1	2.347	0.5%	41.10 [36.50, 45.70]
Maxwell et al. 2018	33.5	3.4184	0.4%	33.50 [26.80, 40.20]
McGuckin et al. 2018	36.6	3.7756	0.4%	36.60 [29.20, 44.00]
Morton et al. 2018	73.2	3.4695	0.4%	73.20 [66.40, 80.00]
Muller et al. 2017	21.8	3.3164	0.4%	21.80 [15.30, 28.30]
Myint et al. 2018	17.5	1.4796	0.5%	17.50 [14.60, 20.40]
Parmar et al. 2019	20.3	1.3266	0.5%	20.30 [17.70, 22.90]
Pasqualetti et al. 2018	43.2	1.9388	0.5%	43.20 [39.40, 47.00]
Patel et al. 2018	27.7	0.7143	0.5%	27.70 [26.30, 29.10]
Perera et al. 2009	63.6	3.2143	0.4%	63.60 [57.30, 69.90]
Poudel et al. 2016	64.5	1.2755	0.5%	64.50 [62.00, 67.00]
Purser et al. 2006	45	2.8572	0.4%	45.00 [39.40, 50.60]
Ritt et al. 2015	72	2.5511	0.5%	72.00 [67.00, 77.00]
Rose et al. 2014	50.4	4.3368	0.4%	50.40 [41.90, 58.90]
Sanchez et al. 2011	40.8	3.4184	0.4%	40.80 [34.10, 47.50]
Thai et al. 2015	35	3.5715	0.4%	35.00 [28.00, 42.00]
Ticinesi et al. 2016	59.6	2.9592	0.4%	59.60 [53.80, 65.40]
Vidan et al. 2014	70.2	2.1429	0.5%	70.20 [66.00, 74.40]
Wallis et al. 2018	56.7	0.6633	0.5%	56.70 [55.40, 58.00]
Wou et al. 2013	30.9	1.9388	0.5%	30.90 [27.10, 34.70]
Subtotal (95% CI)			**24.8%**	**47.28 [42.76, 51.80]**
Heterogeneity: Tau² = 297.53; Chi² = 4546.35, df = 57 (P < 0.00001); I² = 99%				
Test for overall effect: Z = 20.51 (P < 0.00001)				
2.6.2 - Acute coronary syndrome patients				
Alonso Salinas et al. 2018	38.2	2.8572	0.4%	38.20 [32.60, 43.80]
Blanco et al. 2017	20.8	2.6531	0.4%	20.80 [15.60, 26.00]
Ekerstad et al. 2011	48.5	2.8572	0.4%	48.50 [42.90, 54.10]
Kang et al. 2015	43.2	2.6531	0.4%	43.20 [38.00, 48.40]
Llao et al. 2018	27.3	1.9388	0.5%	27.30 [23.50, 31.10]
Patel et al. 2018	27.7	0.7143	0.5%	27.70 [26.30, 29.10]
Sanchis et al. 2015	33.9	2.5511	0.5%	33.90 [28.90, 38.90]
Subtotal (95% CI)			**3.2%**	**34.04 [27.93, 40.16]**
Heterogeneity: Tau² = 62.27; Chi² = 101.37, df = 6 (P < 0.00001); I² = 94%				
Test for overall effect: Z = 10.92 (P < 0.00001)				
2.6.3 - Trauma patients				
Andela et al. 2010 (traumatology ward)	69.6	5.5613	0.3%	69.60 [58.70, 80.50]
Joseph et al. 2014	44	3.1633	0.4%	44.00 [37.80, 50.20]
Joseph et al. 2016	37	2.5511	0.5%	37.00 [32.00, 42.00]
Karlekar et al. 2017	37.5	6.0715	0.3%	37.50 [25.60, 49.40]
Khan et al. 2019	39	2.7041	0.4%	39.00 [33.70, 44.30]
Lee et al. 2018	49	5.0001	0.3%	49.00 [39.20, 58.80]
Maxwell et al. 2018	33.5	3.4184	0.4%	33.50 [26.80, 40.20]
Muller et al. 2017	21.8	3.3164	0.4%	21.80 [15.30, 28.30]
Subtotal (95% CI)			**3.1%**	**40.85 [33.17, 48.54]**
Heterogeneity: Tau² = 106.50; Chi² = 66.57, df = 7 (P < 0.00001); I² = 89%				
Test for overall effect: Z = 10.42 (P < 0.00001)				
2.6.4 Cardiac patients				
Alonso Salinas et al. 2018	38.2	2.8572	0.4%	38.20 [32.60, 43.80]
Attinsano et al. 2017	54.4	2.7552	0.4%	54.40 [49.00, 59.80]
Blanco et al. 2017	20.8	2.6531	0.4%	20.80 [15.60, 26.00]
Bo et al. 2015	83	1.6327	0.5%	83.00 [79.80, 86.20]
Drudi et al. 2018	39.8	1.5204	0.5%	39.80 [36.82, 42.78]
Ekerstad et al. 2011	48.5	2.8572	0.4%	48.50 [42.90, 54.10]
Goldforb et al. 2018	37.4	1.4286	0.5%	37.40 [34.60, 40.20]
Gullon et al. 2017	50.3	1.7857	0.5%	50.30 [46.80, 53.80]
Hii et al. 2015	19.1	5.7144	0.3%	19.10 [7.90, 30.30]
Induruwa et al. 2017	67.3	2.296	0.5%	67.30 [62.80, 71.80]
Kang et al. 2015	43.2	2.6531	0.4%	43.20 [38.00, 48.40]
Kobe et al. 2016	54.6	4.3368	0.4%	54.60 [46.10, 63.10]
Kusonose et al. 2018	19.9	2.9082	0.4%	19.90 [14.20, 25.60]
Llao et al. 2018	27.3	1.9388	0.5%	27.30 [23.50, 31.10]
Nygen et al. 2016	53.3	2.8572	0.4%	53.30 [47.70, 58.90]
Papakonstantinou et al. 2018	58.7	4.847	0.4%	58.70 [49.20, 68.20]
Patel et al. 2018	27.7	0.7143	0.5%	27.70 [26.30, 29.10]
Perera et al. 2009	63.6	3.2143	0.4%	63.60 [57.30, 69.90]
Purser et al. 2006	45	2.8572	0.4%	45.00 [39.40, 50.60]
Sanchez et al. 2011	40.8	3.4184	0.4%	40.80 [34.10, 47.50]
Sanchis et al. 2015	33.9	2.5511	0.5%	33.90 [28.90, 38.90]
Sundermann et al. 2014	55.7	2.347	0.5%	55.70 [51.10, 60.30]
Vidan et al. 2014	70.2	2.1429	0.5%	70.20 [66.00, 74.40]
Subtotal (95% CI)			**10.1%**	**45.82 [38.29, 53.35]**
Heterogeneity: Tau² = 330.99; Chi² = 1706.32, df = 22 (P < 0.00001); I² = 99%				
Test for overall effect: Z = 11.93 (P < 0.00001)				
2.6.5 - Acute coronary syndrome patients				
Alonso Salinas et al. 2018	38.2	2.8572	0.4%	38.20 [32.60, 43.80]
Blanco et al. 2017	20.8	2.6531	0.4%	20.80 [15.60, 26.00]
Ekerstad et al. 2011	48.5	2.8572	0.4%	48.50 [42.90, 54.10]
Kang et al. 2015	43.2	2.6531	0.4%	43.20 [38.00, 48.40]
Llao et al. 2018	27.3	1.9388	0.5%	27.30 [23.50, 31.10]
Patel et al. 2018	27.7	0.7143	0.5%	27.70 [26.30, 29.10]
Sanchis et al. 2015	33.9	2.5511	0.5%	33.90 [28.90, 38.90]
Subtotal (95% CI)			**3.2%**	**34.04 [27.93, 40.16]**
Heterogeneity: Tau² = 62.27; Chi² = 101.37, df = 6 (P < 0.00001); I² = 94%				
Test for overall effect: Z = 10.92 (P < 0.00001)				
2.6.6 – Non ST-segment elevation myocardial infarction (NSTEMI) patients				
Ekerstad et al. 2011	48.5	2.8572	0.4%	48.50 [42.90, 54.10]
Llao et al. 2018	27.3	1.9388	0.5%	27.30 [23.50, 31.10]
Patel et al. 2018	27.7	0.7143	0.5%	27.70 [26.30, 29.10]
Subtotal (95% CI)			**1.4%**	**34.14 [24.29, 43.99]**
Heterogeneity: Tau² = 71.72; Chi² = 50.50, df = 2 (P < 0.00001); I² = 96%				
Test for overall effect: Z = 6.79 (P < 0.00001)				
2.6.7 - Aortic stenosis patients				
Attinsano et al. 2017	54.4	2.7552	0.4%	54.40 [49.00, 59.80]
Drudi et al. 2018	39.8	1.5204	0.5%	39.80 [36.82, 42.78]
Goldforb et al. 2018	37.4	1.4286	0.5%	37.40 [34.60, 40.20]
Kobe et al. 2016	54.6	4.3368	0.4%	54.60 [46.10, 63.10]
Subtotal (95% CI)			**1.8%**	**45.85 [38.25, 53.46]**
Heterogeneity: Tau² = 53.20; Chi² = 40.42, df = 3 (P < 0.00001); I² = 93%				
Test for overall effect: Z = 11.82 (P < 0.00001)				
2.6.8 - Atrial fibrillation patients				
Bo et al. 2015	83	1.6327	0.5%	83.00 [79.80, 86.20]
Gullon et al. 2017	50.3	1.7857	0.5%	50.30 [46.80, 53.80]
Induruwa et al. 2017	67.3	2.296	0.5%	67.30 [62.80, 71.80]
Nygen et al. 2016	53.3	2.8572	0.4%	53.30 [47.70, 58.90]
Papakonstantinou et al. 2018	58.7	4.847	0.4%	58.70 [49.20, 68.20]
Perera et al. 2009	63.6	3.2143	0.4%	63.60 [57.30, 69.90]
Subtotal (95% CI)			**2.6%**	**62.78 [50.36, 75.20]**
Heterogeneity: Tau² = 232.25; Chi² = 208.48, df = 5 (P < 0.00001); I² = 98%				
Test for overall effect: Z = 9.91 (P < 0.00001)				
2.6.9 Pulmonary patients				
Andela et al. 2010 (pulmonary / rheumatology ward)	70.4	5.4083	0.3%	70.40 [59.80, 81.00]
Andrew et al 2017	36.4	2.1429	0.5%	36.40 [32.20, 40.60]
Baldwin et al. 2014	81.8	8.2144	0.2%	81.80 [65.70, 97.90]
Ma et al. 2013	38.8	2.347	0.5%	38.80 [34.20, 43.40]
Ticinesi et al. 2016	59.6	2.9592	0.4%	59.60 [53.80, 65.40]
Subtotal (95% CI)			**1.9%**	**55.97 [42.45, 69.50]**
Heterogeneity: Tau² = 217.13; Chi² = 89.54, df = 4 (P < 0.00001); I² = 96%				
Test for overall effect: Z = 8.11 (P < 0.00001)				
2.6.10 Surgical inpatients				
Andela et al. 2010 (surgical ward)	50	9.4389	0.2%	50.00 [31.50, 68.50]
Attinsano et al. 2017	54.4	2.7552	0.4%	54.40 [49.00, 59.80]
Cheung et al. 2016	33	4.694	0.4%	33.00 [23.80, 42.20]
Chia et al. 2016	25.6	4.0154	0.4%	25.60 [17.73, 33.47]
Crozier-Shaw et al. 2018	20.9	2.847	0.4%	20.90 [15.32, 26.48]
Dal Moro et al. 2017	21.8	4.694	0.4%	21.80 [12.60, 31.00]
Eamer et al. 2018	15.3	2.9082	0.4%	15.30 [9.60, 21.00]
Engelhardt et al. 2018	29.3	2.9592	0.4%	29.30 [23.50, 35.10]
Gleason et al. 2017	41.7	3.7246	0.4%	41.70 [34.40, 49.00]
Goldforb et al. 2018	37.4	1.4286	0.5%	37.40 [34.60, 40.20]
Hewitt et al. 2015	27.8	2.5511	0.5%	27.80 [22.80, 32.80]
Hewitt et al. 2016	27.7	2.1939	0.5%	27.70 [23.40, 32.00]
Hii et al. 2015	19.1	5.7144	0.3%	19.10 [7.90, 30.30]
Jokar et al. 2016	44.6	4.3368	0.4%	44.60 [36.10, 53.10]
Kenig et al. 2015	52.2	3.6939	0.4%	52.20 [44.96, 59.44]
Khan et al. 2019	39	2.7041	0.4%	39.00 [33.70, 44.30]
Kobe et al. 2016	54.6	4.3368	0.4%	54.60 [46.10, 63.10]
Lin et al. 2017	19.1	2.5	0.5%	19.10 [14.20, 24.00]
Mason et al. 2018	41.1	2.347	0.5%	41.10 [36.50, 45.70]
McGuckin et al. 2018	36.6	3.7756	0.4%	36.60 [29.20, 44.00]
McIsaac et al. 2018	28.8	0.051	0.5%	28.80 [28.70, 28.90]
Myint et al. 2018	17.5	1.4796	0.5%	17.50 [14.60, 20.40]
Parmar et al. 2019	20.3	1.3266	0.5%	20.30 [17.70, 22.90]
Pelavski et al. 2017	22.8	3.7246	0.4%	22.80 [15.50, 30.10]
Sikder et al. 2018	17.4	3.1633	0.4%	17.40 [11.20, 23.60]
Sundermann et al. 2014	55.7	2.347	0.5%	55.70 [51.10, 60.30]
Subtotal (95% CI)			**10.9%**	**32.44 [28.88, 36.01]**
Heterogeneity: Tau² = 74.04; Chi² = 571.91, df = 25 (P < 0.00001); I² = 96%				
Test for overall effect: Z = 17.86 (P < 0.00001)				
2.6.11 - Colorectal surgery patients				
Chia et al. 2016	25.6	4.0154	0.4%	25.60 [17.73, 33.47]
Crozier-Shaw et al. 2018	20.9	2.847	0.4%	20.90 [15.32, 26.48]
Subtotal (95% CI)			**0.8%**	**22.47 [17.92, 27.02]**
Heterogeneity: Tau² = 0.00; Chi² = 0.91, df = 1 (P = 0.34); I² = 0%				
Test for overall effect: Z = 9.68 (P < 0.00001)				
2.6.12 - Abdominal surgery patients				
Eamer et al. 2018	15.3	2.9082	0.4%	15.30 [9.60, 21.00]
Kenig et al. 2015	52.2	3.6939	0.4%	52.20 [44.96, 59.44]
Parmar et al. 2019	20.3	1.3266	0.5%	20.30 [17.70, 22.90]
Sikder et al. 2018	17.4	3.1633	0.4%	17.40 [11.20, 23.60]
Subtotal (95% CI)			**1.8%**	**26.07 [13.28, 38.86]**
Heterogeneity: Tau² = 162.02; Chi² = 75.91, df = 3 (P < 0.00001); I² = 96%				
Test for overall effect: Z = 3.99 (P < 0.0001)				
2.6.13 -- Emergency abdominal surgery patients				
Eamer et al. 2018	15.3	2.9082	0.4%	15.30 [9.60, 21.00]
Kenig et al. 2015	52.2	3.6939	0.4%	52.20 [44.96, 59.44]
Parmar et al. 2019	20.3	1.3266	0.5%	20.30 [17.70, 22.90]
Subtotal (95% CI)			**1.3%**	**29.02 [11.52, 46.52]**
Heterogeneity: Tau² = 231.23; Chi² = 73.52, df = 2 (P < 0.00001); I² = 97%				
Test for overall effect: Z = 3.25 (P = 0.001)				
2.6.14 - Cardiac surgery patients				
Attinsano et al. 2017	54.4	2.7552	0.4%	54.40 [49.00, 59.80]
Drudi et al. 2018	39.8	1.5204	0.5%	39.80 [36.82, 42.78]
Goldforb et al. 2018	37.4	1.4286	0.5%	37.40 [34.60, 40.20]
Hii et al. 2015	19.1	5.7144	0.3%	19.10 [7.90, 30.30]
Kobe et al. 2016	54.6	4.3368	0.4%	54.60 [46.10, 63.10]
Sundermann et al. 2014	55.7	2.347	0.5%	55.70 [51.10, 60.30]
Subtotal (95% CI)			**2.6%**	**44.11 [36.10, 52.11]**
Heterogeneity: Tau² = 89.74; Chi² = 90.70, df = 5 (P < 0.00001); I² = 94%				
Test for overall effect: Z = 10.80 (P < 0.00001)				
2.6.16 – Transcatheter aortic valve replacement surgery patients				
Attinsano et al. 2017	54.4	2.7552	0.4%	54.40 [49.00, 59.80]
Drudi et al. 2018	39.8	1.5204	0.5%	39.80 [36.82, 42.78]
Goldforb et al. 2018	37.4	1.4286	0.5%	37.40 [34.60, 40.20]
Kobe et al. 2016	54.6	4.3368	0.4%	54.60 [46.10, 63.10]
Sundermann et al. 2014	55.7	2.347	0.5%	55.70 [51.10, 60.30]
Subtotal (95% CI)			**2.2%**	**48.00 [40.04, 55.96]**
Heterogeneity: Tau² = 75.61; Chi² = 73.28, df = 4 (P < 0.00001); I² = 95%				
Test for overall effect: Z = 11.82 (P < 0.00001)				
2.6.17 - General surgery patients				
Engelhardt et al. 2018	29.3	2.9592	0.4%	29.30 [23.50, 35.10]
Hewitt et al. 2015	27.8	2.5511	0.5%	27.80 [22.80, 32.80]
Hewitt et al. 2016	27.7	2.1939	0.5%	27.70 [23.40, 32.00]
Jokar et al. 2016	44.6	4.3368	0.4%	44.60 [36.10, 53.10]
Khan et al. 2019	39	2.7041	0.4%	39.00 [33.70, 44.30]
Mason et al. 2018	41.1	2.347	0.5%	41.10 [36.50, 45.70]
McGuckin et al. 2018	36.6	3.7756	0.4%	36.60 [29.20, 44.00]
Subtotal (95% CI)			**3.0%**	**34.83 [29.71, 39.95]**
Heterogeneity: Tau² = 38.78; Chi² = 35.69, df = 6 (P < 0.00001); I² = 83%				
Test for overall effect: Z = 13.33 (P < 0.00001)				
2.6.18 -- Emergency general surgery patients				
Engelhardt et al. 2018	29.3	2.9592	0.4%	29.30 [23.50, 35.10]
Hewitt et al. 2016	27.7	2.1939	0.5%	27.70 [23.40, 32.00]
Jokar et al. 2016	44.6	4.3368	0.4%	44.60 [36.10, 53.10]
Khan et al. 2019	39	2.7041	0.4%	39.00 [33.70, 44.30]
Mason et al. 2018	41.1	2.347	0.5%	41.10 [36.50, 45.70]
McGuckin et al. 2018	36.6	3.7756	0.4%	36.60 [29.20, 44.00]
Subtotal (95% CI)			**2.6%**	**36.08 [30.52, 41.64]**
Heterogeneity: Tau² = 38.86; Chi² = 28.79, df = 5 (P < 0.0001); I² = 83%				
Test for overall effect: Z = 12.72 (P < 0.00001)				
2.6.19 - Elective surgery patients				
McIsaac et al. 2018	28.8	0.051	0.5%	28.80 [28.70, 28.90]
Pelavski et al. 2017	22.8	3.7246	0.4%	22.80 [15.50, 30.10]
Sikder et al. 2018	17.4	3.1633	0.4%	17.40 [11.20, 23.60]
Sundermann et al. 2014	55.7	2.347	0.5%	55.70 [51.10, 60.30]
Subtotal (95% CI)			**1.8%**	**31.31 [17.08, 45.54]**
Heterogeneity: Tau² = 203.66; Chi² = 146.92, df = 3 (P < 0.00001); I² = 98%				
Test for overall effect: Z = 4.31 (P < 0.0001)				
2.6.21 Intensive care patients				
Andrew et al 2017	36.4	2.1429	0.5%	36.40 [32.20, 40.60]
Baldwin et al. 2014	81.8	8.2144	0.2%	81.80 [65.70, 97.90]
Guidet et al. 2018	42.9	0.6633	0.5%	42.90 [41.60, 44.20]
Karlekar et al. 2017	37.5	6.0715	0.3%	37.50 [25.60, 49.40]
Le Maguet et al. 2014	23.5	3.0613	0.4%	23.50 [17.50, 29.50]
Muessig et al. 2018	53.6	2.8572	0.4%	53.60 [48.00, 59.20]
Papageorgiou et al. 2018	27.8	7.5001	0.3%	27.80 [13.10, 42.50]
Pollack et al. 2017	85.6	3.1633	0.4%	85.60 [79.40, 91.80]
Subtotal (95% CI)			**3.1%**	**48.33 [36.90, 59.77]**
Heterogeneity: Tau² = 250.12; Chi² = 271.10, df = 7 (P < 0.00001); I² = 97%				
Test for overall effect: Z = 8.29 (P < 0.00001)				
2.6.22 Post acute delayed discharge/transfer of care patients				
Coleman et al. 2012	100	5.4695	0.3%	100.00 [89.28, 110.72]
Dutzi et al. 2017	82.5	3.0613	0.4%	82.50 [76.50, 88.50]
Ga et al. 2018	94.5	2.296	0.5%	94.50 [90.00, 99.00]
Heppenstall et al. 2011	67.1	3.7246	0.4%	67.10 [59.80, 74.40]
Nolan et al. 2016	97.6	2.449	0.5%	97.60 [92.80, 102.40]
Subtotal (95% CI)			**2.1%**	**88.26 [77.68, 98.83]**
Heterogeneity: Tau² = 133.11; Chi² = 60.62, df = 4 (P < 0.00001); I² = 93%				
Test for overall effect: Z = 16.36 (P < 0.00001)				
2.6.23 Neurological patients				
Chew et al. 2017	67.9	3.0103	0.4%	67.90 [62.00, 73.80]
Dutzi et al. 2017	82.5	3.0613	0.4%	82.50 [76.50, 88.50]
Subtotal (95% CI)			**0.9%**	**75.19 [60.88, 89.50]**
Heterogeneity: Tau² = 97.36; Chi² = 11.56, df = 1 (P = 0.0007); I² = 91%				
Test for overall effect: Z = 10.30 (P < 0.00001)				
2.6.24 Psychiatric patients				
Chew et al. 2017	67.9	3.0103	0.4%	67.90 [62.00, 73.80]
Jacobs et al. 2017	61.8	6.5307	0.3%	61.80 [49.00, 74.60]
Subtotal (95% CI)			**0.7%**	**66.83 [61.47, 72.19]**
Heterogeneity: Tau² = 0.00; Chi² = 0.72, df = 1 (P = 0.40); I² = 0%				
Test for overall effect: Z = 24.45 (P < 0.00001)				
2.6.25 Rehabilitation patients				
Coleman et al. 2012	100	5.4695	0.3%	100.00 [89.28, 110.72]
Dutzi et al. 2017	82.5	3.0613	0.4%	82.50 [76.50, 88.50]
Nolan et al. 2016	97.6	2.449	0.5%	97.60 [92.80, 102.40]
Subtotal (95% CI)			**1.2%**	**93.01 [81.76, 104.26]**
Heterogeneity: Tau² = 84.79; Chi² = 16.88, df = 2 (P = 0.0002); I² = 88%				
Test for overall effect: Z = 16.20 (P < 0.00001)				
2.6.26 Oncology patients				
Courtney-Brooks et al. 2012	16.2	6.0715	0.3%	16.20 [4.30, 28.10]
Ferrero et al. 2017	29.5	5.1532	0.3%	29.50 [19.40, 39.60]
Subtotal (95% CI)			**0.6%**	**23.24 [10.23, 36.25]**
Heterogeneity: Tau² = 56.74; Chi² = 2.79, df = 1 (P = 0.09); I² = 64%				
Test for overall effect: Z = 3.50 (P = 0.0005)				
2.6.27 Fracture patients				
Gleason et al. 2017	41.7	3.7246	0.4%	41.70 [34.40, 49.00]
Valentini et al. 2018	59.7	6.2246	0.3%	59.70 [47.50, 71.90]
Subtotal (95% CI)			**0.7%**	**50.01 [32.42, 67.60]**
Heterogeneity: Tau² = 135.69; Chi² = 6.16, df = 1 (P = 0.01); I² = 84%				
Test for overall effect: Z = 5.57 (P < 0.00001)				
2.6.28 Urology patients				
Dal Moro et al. 2017	21.8	4.694	0.4%	21.80 [12.60, 31.00]
Hilmer et al. 2011	45.2	8.9798	0.2%	45.20 [27.60, 62.80]
Subtotal (95% CI)			**0.6%**	**32.25 [9.45, 55.05]**
Heterogeneity: Tau² = 222.44; Chi² = 5.33, df = 1 (P = 0.02); I² = 81%				
Test for overall effect: Z = 2.77 (P = 0.006)				
2.6.29 Emergency admissions patients				
Eamer et al. 2018	15.3	2.9082	0.4%	15.30 [9.60, 21.00]
Engelhardt et al. 2018	29.3	2.9592	0.4%	29.30 [23.50, 35.10]
Hewitt et al. 2016	27.7	2.1939	0.5%	27.70 [23.40, 32.00]
Jokar et al. 2016	44.6	4.3368	0.4%	44.60 [36.10, 53.10]
Keevil et al. 2018	53.98	0.5	0.5%	53.98 [53.00, 54.96]
Kenig et al. 2015	52.2	3.6939	0.4%	52.20 [44.96, 59.44]
Khan et al. 2019	39	2.7041	0.4%	39.00 [33.70, 44.30]
Mason et al. 2018	41.1	2.347	0.5%	41.10 [36.50, 45.70]
McGuckin et al. 2018	36.6	3.7756	0.4%	36.60 [29.20, 44.00]
Parmar et al. 2019	20.3	1.3266	0.5%	20.30 [17.70, 22.90]
Pasqualetti et al. 2018	43.2	1.9388	0.5%	43.20 [39.40, 47.00]
Sanchez et al. 2011	40.8	3.4184	0.4%	40.80 [34.10, 47.50]
Wallis et al. 2018	56.7	0.6633	0.5%	56.70 [55.40, 58.00]
Subtotal (95% CI)			**5.8%**	**38.53 [31.00, 46.07]**
Heterogeneity: Tau² = 184.64; Chi² = 1024.61, df = 12 (P < 0.00001); I² = 99%				
Test for overall effect: Z = 10.02 (P < 0.00001)				
2.6.30 Internal (general) medicine patients				
Andela et al. 2010 (internal medicine ward)	80.3	4.5919	0.4%	80.30 [71.30, 89.30]
Dorner et al. 2014	54.1	4.2858	0.4%	54.10 [45.70, 62.50]
Eeles et al. 2012	40.7	3.0103	0.4%	40.70 [34.80, 46.60]
Gullon et al. 2017	50.3	1.7857	0.5%	50.30 [46.80, 53.80]
Induruwa et al. 2017	67.3	2.296	0.5%	67.30 [62.80, 71.80]
Juma et al. 2016	72	5.2042	0.3%	72.00 [61.80, 82.20]
Koyama et al. 2018	22.5	3.3674	0.4%	22.50 [15.90, 29.10]
Ozturk et al. 2017	65.5	2.347	0.5%	65.50 [60.90, 70.10]
Papakonstantinou et al. 2018	58.7	4.847	0.4%	58.70 [49.20, 68.20]
Peel et al. 2017	91	3.0103	0.4%	91.00 [85.10, 96.90]
Rose et al. 2014	50.4	4.3368	0.4%	50.40 [41.90, 58.90]
Subtotal (95% CI)			**4.5%**	**59.28 [48.54, 70.01]**
Heterogeneity: Tau² = 316.27; Chi² = 344.22, df = 10 (P < 0.00001); I² = 97%				
Test for overall effect: Z = 10.82 (P < 0.00001)				
2.6.31 Pharmacological patients				
Hilmer et al. 2011	45.2	8.9798	0.2%	45.20 [27.60, 62.80]
Thai et al. 2015	35	3.5715	0.4%	35.00 [28.00, 42.00]
Subtotal (95% CI)			**0.6%**	**36.77 [29.20, 44.35]**
Heterogeneity: Tau² = 5.32; Chi² = 1.11, df = 1 (P = 0.29); I² = 10%				
Test for overall effect: Z = 9.51 (P < 0.00001)				
Total (95% CI)			**100.0%**	**44.42 [43.37, 45.48]**
Heterogeneity: Tau² = 57.85; Chi² = 27407.24, df = 235 (P < 0.00001); I² = 99%				
Test for overall effect: Z = 82.50 (P < 0.00001)				
Test for subgroup differences: Chi² = 438.57, df = 29 (P < 0.00001), I² = 93.6%				



Supplementary Figure 2.10. Forest plot of the prevalence of frailty among geriatric hospital inpatients stratified by clinical population

Supplementary Table 2.1. Summary of the prevalence of frailty among geriatric hospital inpatients stratified by prevalent morbidity.

Prevalent morbidity	N of studies	Studies included	Pooled frailty prevalence (%) (95% CI)
Cardiovascular-related	22	35, 39, 41, 42, 54, 58, 63, 65, 70, 73, 80, 85, 91, 104, 108, 111, 114, 117, 120, 121, 123, 128	46.9 (39.3-54.4)
Acute coronary syndrome	7	35, 41, 58, 80, 91, 111, 121	34 (27.9-40.2)
Non-ST segment elevation myocardial infarction	3	58, 91, 111	36.3 (27.3-45.2)
Aortic valve stenosis	4	39, 54, 63, 85	45.9 (38.3-53.5)
Atrial fibrillation	6	42, 65, 73, 104, 108, 114	62.8 (50.4-72.5)
Neoplastic-related	3	49, 50, 60	22.2 (15.9-28.6)
Female (gynaecologic, and ovarian) cancer patients	2	49, 60	23.2 (10.2-36.3)
Pulmonary	4	37, 38, 40, 92	55.0 (39.9-70.1)
Orthopaedic	2	62, 127	50 (32.4-67.6)
Neurological	2	45, 55	75.2 (60.9-89.5)
Gastrointestinal	2	46, 50	22.5 (17.9-27).
Psychiatric	2	45, 74	66.8 (61.5-72.2)

Supplementary Table 2.2. Summary of the prevalence of frailty among geriatric hospital inpatients stratified by clinical population.

Clinical population	N of studies	Studies included	Pooled frailty prevalence (%) (95% CI)
Acute patients	58	35-38, 41, 43, 45, 47, 52, 53, 56-59, 62, 66, 68-70, 72, 73, 75-84, 88, 91-97, 99, 101, 102, 109-111, 114, 116-120, 124, 125, 128-130	47.3 (42.8-51.8)
Acute trauma patients	8	37, 77, 78, 81, 84, 88, 96, 101	40.9 (33.2-48.5)
Surgical inpatients	26	37, 39, 44, 46, 50, 51, 56, 59, 62, 63, 68-70, 75, 83-85, 90, 95, 97, 98, 102, 109, 113, 122, 123	32.4 (28.9-36)
General surgery inpatients	7	59, 68, 69, 75, 84, 95, 97	34.8 (29.7-40)
Emergency general surgery inpatients	6	59, 69, 75, 84, 95, 97	36.1 (30.5-41.6)
Cardiac surgery inpatients	6	59, 69, 75, 84, 95, 97	48 (40-56)
Transcatheter aortic valve replacement surgery inpatients	5	39, 54, 63, 85, 123	34.8 (29.7-40)
Abdominal surgery inpatients	4	56, 83, 109, 122	26.1 (13.3-38.9)
Emergency abdominal surgery inpatients	3	56, 83, 109	29 (11.5-46.5)
Elective surgery inpatients	4	98, 113, 122, 123	31.3 (17.1-45.5)
Colorectal surgery inpatients	2	46, 50	22.5 (17.9-27)

Cardiac patients	23	35, 39, 41, 42, 54, 58, 63, 65, 70, 73, 80, 85, 87, 91, 104, 108, 111, 114, 117, 120, 121, 123, 128	45.8 (38.3-53.4)
Acute coronary syndrome Patients	7	35, 41, 58, 80, 91, 111, 121	34 (27.9-40.2)
ST-segment elevation myocardial infarction	3	58, 91, 111	34.1 (24.3-44)
Atrial fibrillation patients	6	42, 65, 73, 104, 108, 114	62.8 (50.4-75.2)
Aortic stenosis patients	4	39, 54, 63, 85	45.9 (38.3-53.4)
Emergency admissions patients	13	56, 59, 69, 75, 82-84, 95, 97, 109, 110, 120, 129	38.5 (31-46.1)
General (Internal) medicine patients	11	37, 53, 57, 65, 73, 79, 86, 106, 108, 112, 119	59.3 (48.5-70.0)
Intensive care patients	8	38, 40, 64, 81, 89, 100, 107, 115	48.3 (36.9-59.8)
Pulmonary patients	5	37, 38, 40, 92, 125	56 (42.5-69.5)
Post-acute delayed discharge	5	48, 55, 61, 67, 103	88.3 (77.7-98.3)
Rehabilitation patients	3	48, 55, 103	93 (81.8-100)
Oncology patients	2	49, 60	23.2 (10.2-36.3)
Neurological patients	2	45, 55	75.2 (60.9.5-89.5)
Fracture's patients	2	62, 127	50.0 (32.4-67.6)
Urology patients	2	51, 71	32.3 (9.5-55.1)

Psychiatric patients	2	45, 74	66.8 (61.5-72.2)
Pharmacology patients	2	71, 124	36.8 (29.2-44.4)

Chapter 3. Seated Physical Activity in Ageing: feasibility study methodology

The contents of this chapter are partially published in BMJ Open as Doody, P., Lord, J.M., Greig, C.A. & Whittaker, A.C. 2019, "Assessing the feasibility and impact of specially adapted exercise interventions, aimed at improving the multi-dimensional health and functional capacity of frail geriatric hospital inpatients: protocol for a feasibility study", *BMJ open,* vol. 9, no. 11, pp. e031159 doi: 10.1136/bmjopen-2019-03115. Initially published in the future tense, the contents of this publication have been altered to the past tense, as appropriate, for the purposes of this thesis.

3.1 Abstract

Background: Frailty is a common and clinically significant condition in older adults, predominantly due to its association with adverse health outcomes such as hospitalisation, disability, and mortality. Exercise interventions have been shown to be a beneficial treatment for frailty. However, more high-quality studies are needed to assess the feasibility and impact of these interventions in frail geriatric populations within different settings, and their impact on broader aspects of health and wellbeing.

Methods and analysis: This study aimed to utilise a 2-week, interventional, independent measures research design in order to assess the feasibility and impact of two specially adapted exercise training interventions (a specially adapted resistance training intervention and Move It Or Lose It: an established community-based exercise intervention for older adults) aimed at improving the multi-dimensional health and functional capacity of frail geriatric hospital inpatients.

Ethics and dissemination: This study received a favourable ethical opinion by the Coventry and Warwickshire NHS Research Ethics Committee and sponsorship by the University of Birmingham after review by the sponsors research governance office. The findings will be disseminated through publication in open access scientific journals, public engagement events, online via social media, conference presentations, and directly to study participants upon request.

Trial registration: Clinicaltrials.gov: NCT03141866.

3.1.1 Strengths and limitations

- Mixed methods feasibility study employing both quantitative and qualitative research methodologies
- Specially adapted exercise interventions for frail geriatric populations

- Difficult to reach (and often excluded) participant population
- Single site study
- **Keywords:** Exercise; feasibility; frail; geriatric; hospital; inpatient; intervention; older adults; patient; physical activity.

3.2 Background

Frailty is a common and clinically significant condition within geriatric populations (1), predominantly due to its association with adverse health outcomes such as hospitalisation, disability and mortality (1-6). As outlined in Chapter 1, exercise interventions have been proposed as potentially offering the best form of treatment for frail older adults (7); with exercise shown to be a significantly beneficial treatment for this population with regard to multiple components of health, and even shown to mediate the reversal of frailty in some cases (8-11). However, while there is evidence of the benefits of exercise relating to the prevention, treatment, and reversal of frailty, it is universally noted that there needs to be more studies within this area to truly assess the impact of exercise in frail geriatric populations within different settings, particularly relating to its effects on broader aspects of health and well-being (1). This present study aimed to assess the feasibility and efficacy of short duration (2-week), intensive (five-days per week), specially adapted exercise interventions within a delayed discharge hospital ward setting. Feasibility related to the eight main areas of focus for feasibility studies (12), while efficacy was assessed through limited-efficacy testing of the impact of the interventions on the secondary dependent variables relating to multi-dimensional health and functional capacity.

Such research is very timely and pertinent, as current demographic trends indicate that by the year 2030 almost one in six of the European population will be aged 60 or over, and the number of older people will grow to 247 million by 2050, representing a 35% increase from

2017, with one in four older adults being over 85 by 2040 (13). This coupled with continual progressive declines in the rate of physical activity, at all stages of the lifespan (14), leaves the population particularly susceptible to the development of disease and co-morbidities associated with a lack of physical activity and an increase in sedentary behaviour (15). Moreover, acute hospital admission for older adults is associated with further loss of physical activity and represent a period of increased susceptibility to sarcopenia and frailty (16). Therefore, there is an urgent need to examine the effect of such interventions within this setting, and whether these interventions can be employed to improve various aspects of health in frail older populations in inpatient hospital ward settings, as well as their efficacy in specifically treating, preventing, and reversing frailty. Preliminary research has shown some success in the implementation of exercise interventions to reverse functional decline in general geriatric inpatient populations (17), however, to the authors' knowledge this present study is the first to attempt such an intervention in frail delayed discharge patients.

3.3 Research paradigms

A research paradigm can be defined as a set of common beliefs and agreements shared between scientists about how problems should be understood and addressed (18). Essentially, research paradigms comprise the philosophical underpinnings of a particular realm of thought, through which the acquisition of knowledge is sought. Each paradigm possesses its own distinct characteristics with regard to ontology: the philosophical study of the nature of being, existence, and reality; epistemology: the philosophical study of the theory of knowledge; and methodology: the utilisation of a system of methods in order to acquire knowledge. Proponents of research paradigms suggest that they are essential in the structure of scientific research in order to initially create a starting position for the seeker of knowledge's understanding as to what reality is (ontology), how it can be measured

(epistemology), and how one conducts and orientates themselves and their faculties in order to measure it (methodology).

Others argue that this position, perpetuating the necessity of research paradigms (often by proponents of a particular paradigm) is not practically useful, and even harmful or detrimental to research due to the restrictions which adherence to these paradigms place on researchers to disregard otherwise useful components to addressing particular research questions. Within this position, while research paradigms are seen to have useful components, they are more generally viewed as dogmatic in nature (and limited in practice), and due to this dogmatic nature, often impractical when applied in the real world to address a broad range of research questions. Such individuals are typically proponents of a "mixed methods" research approach, utilising both quantitative and qualitative research methods, and generally take on the philosophical approaches and stances associated with mixed methods i.e., pragmatism, critical realism, dialectics, or transformative emancipation.

In the following subsections the predominant research paradigms and philosophical approaches and stances influencing the present research study will be discussed, including, their values, virtues, vices and foibles, and why a mixed methods approach utilising a pragmatic stance has been chosen as the underpinning for this research study.

3.3.1 Positivism and post-positivism

Positivism (logical positivism) and post-positivism (logical empiricism) are philosophical perspectives characterised by the combination of the ontological viewpoint that there is a single reality/truth, the epistemological position that reality can be measured in order to obtain its true essence, and the methodological stance which places credence in the utilisation of reliable and validated tools and instruments of measure (usually quantitative) in order to obtain knowledge of this single reality.

Where these two paradigms diverge from one another is in their varying degrees of commitment to the certainty of these characteristics. Positivism places unwavering and absolute value in the scientific method and empirical evidence as the only basis through which reality can be known, rejecting any form of speculation or metaphysics which cannot be measured or observed objectively (19). Post-positivism rejects this dogmatic certainty of positivism and rather views the scientific method and empirical evidence as the basis through which the probability of reality can be known. It opposes the absolute certainty of positivism, arguing that *"no matter how faithfully the scientist adheres to the scientific method, research outcomes are neither totally objective, nor unquestionably certain"* (20). Post-positivism is influenced by the philosophy of critical realism, which similar to positivism, puts forward the perspective that reality exists and can be studied through the scientific method. However, diverges from positivism through the stance that these observations may involve error, that theories are open to modification, and, as such, that true reality cannot be known with absolute certainty, but only with probability, through the utilisation of the scientific method.

3.3.2 Constructivism

Constructivism is a philosophical position characterised by the combination of an ontological stance which perpetuates that there is no one single reality or truth, but rather that reality is created by individuals in groups, the epistemological stance that thus reality needs to be interpreted to understand its true meaning, and the methodological stance which places credence in theories and measures of interpretation (usually qualitative) in order to understand these purported multiple realities. Constructivists as such believe that reality does not exist independently of our thinking about it, as opposed to positivists who believe in the existence of a single reality independent of though. Constructivism is an inductive position which places value in the interpretation of peoples lived experiences (21).

3.3.3 Pragmatism

Pragmatism is a stance which is, to a degree, unconcerned with the dogmatic nature of research paradigms, particularly paradigmatic assumptions regarding ontology and epistemology. Rather pragmatism concerns itself with what is useful to addressing a particular issue. In this sense pragmatists believe the best method is one that solves problems, placing the research question at the centre of the pragmatic approach (22), and believing that findings and theories can be created to be contextual and generalisable through analysing them for *"transferability"* (23).

Pragmatism, similar to other approaches and stances advocating mixed methods research, separates itself from paradigms through, although offering specific ideas as to what constitutes knowledge, not claiming to have an all-encompassing worldview (24). This lends itself to the *"compatibility thesis"* of mixed methods research: perpetuating the concept of the combined use of quantitative and qualitative research modalities together to address a particular research problem, through complimenting each other's strengths and addressing each other's limitations (23).

In this study, a pragmatic mixed methods approach was utilised, combining quantitative and qualitative approaches in order to enhance their 'complementary strengths' and address their individual weaknesses (25). This was done to provide a more intricate, complete, thorough, and complex understanding of the feasibility of adapted exercise interventions among frail geriatric hospital inpatients in a delayed discharge setting, that otherwise would not have possible to the same extent through the utilisation of a single approach alone (26, 27).

3.4 Methods and analysis

3.4.1 Aims and objectives

The primary aim of this study was to assess the feasibility of a proposed future trial in this setting, which aims to assess the impact of specially adapted exercise interventions on the physiological, psychological, cognitive, social, and emotional health, and functional capacity of frail geriatric populations within a hospital ward setting; recognising health as a multi-factorial concept incorporating multiple inter-related dimensions. The secondary aim of this feasibility study was to engage in limited-efficacy testing of the interventions on the primary dependent variables of a proposed future clinical trial within this setting.

The primary and secondary aims of this study were achieved through the sequential achievement of the following objectives: 1) Recruitment of eligible participants from the Harborne Ward of the Queen Elizabeth Hospital Birmingham, Mindelsohn Way, Birmingham, United Kingdom. 2) Baseline assessment of the secondary dependent variables related to multi-dimensional health. 3) Assessment of the feasibility of the study as it relates to the eight-primary areas of focus for feasibility studies (acceptability, demand, implementation, practicality, adaptation, integration, expansion, and limited-efficacy testing) (12). 4) Post-intervention assessment of all primary and secondary dependent variables.

The research questions of this study relate to the eight aforementioned areas of focus of this feasibility study, incorporating the following questions relating to the feasibility and efficacy of the study within this setting: Can it work? Will it work? Does it work? (12) (Table 3.1). Further, this approach is consistent with the UK Medical Research Council's latest framework for the development and evaluation of complex interventions (28, 29), which encourages the use of feasibility studies, incorporating mixed-methods evaluation, following the development of the intervention based on research evidence and theory of the problem. Specifically, the framework encourages the use of feasibility studies to explore uncertainties

that have been identified at the developmental phase, in order to explore whether an intervention can be appropriately evaluated, and further the most appropriate methods for doing so (29).

3.4.2 Design overview

This feasibility study aimed to utilise a 2-week, interventional, independent measures research design (Figure 3.1).

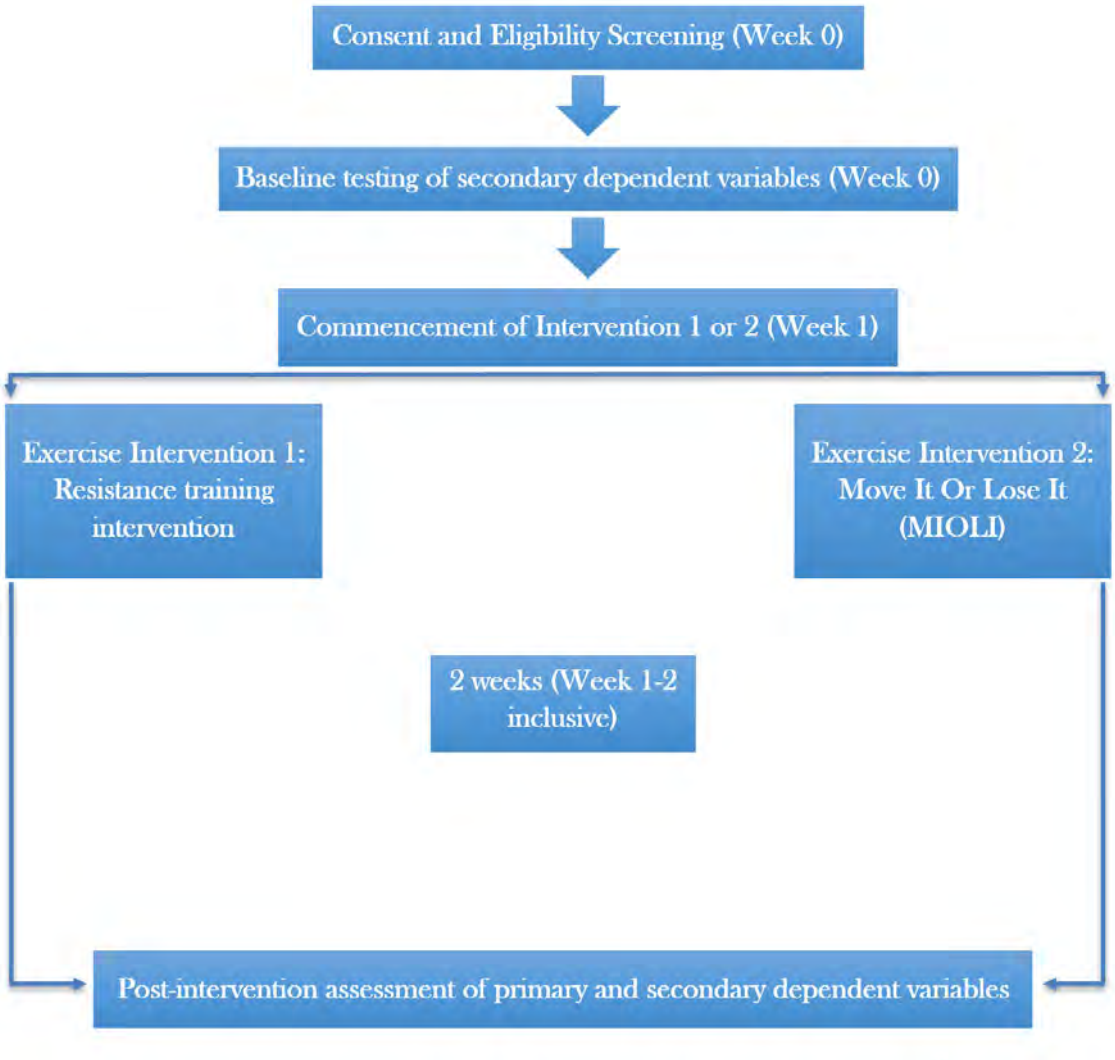


Figure 3.1. Trial schema of participant flow throughout the duration of the study.

A variation of a stepped-wedged design / rolling recruitment was utilised, with the interventions being conducted multiple times over the course of several months in order to maximise the potential sample size due to constraints of the setting: a delayed discharge hospital ward for patients prior to official discharge, with the majority of patients expected to reside on the ward for > 3 weeks, and approximately 25 patients on the ward at any given time.

The independent variables of the study comprised of two exercise training interventions: a specially adapted machine-based resistance training intervention, and Move It Or Lose It (MIOLI), an established community-based exercise intervention for older adults. A control group is proposed to be utilised within a proposed future clinical trial but was not utilised within this feasibility study as the primary purposes of this study is to assess the feasibility, and to a limited degree the efficaciousness, of the interventions within this setting (Figure 3.2).

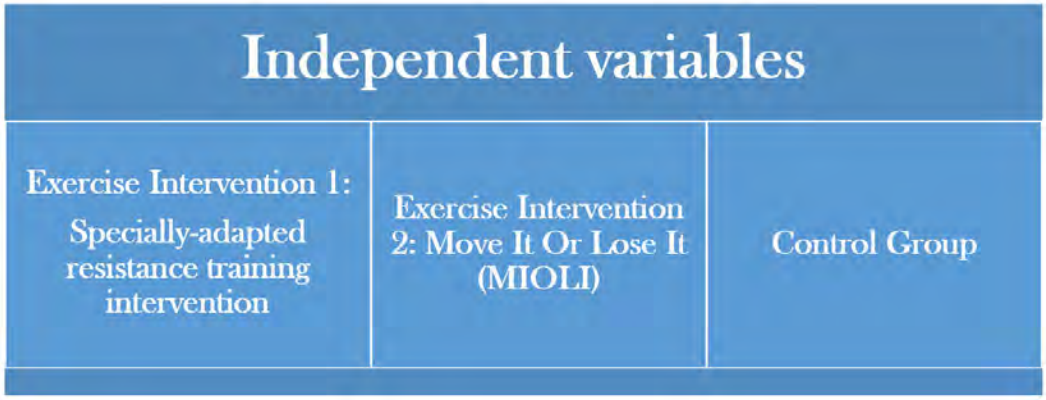


Figure 3.2. The independent variables of the proposed future clinical trial.

In order to ensure this present study was as scientifically valid as possible a number of precautions were taken to protect the internal and external validity of the study within its methodological design:

First, for each participant, all testing procedures (baseline and post-intervention (2-weeks)

were to be conducted at approximately the same time of day (+/- two hours). This was controlled in order to protect the findings of the study from changes in the dependent variables which may be attributable to circadian variation rather than manipulation of the independent variables (30). The hypothesis of the study was not to be divulged to participants prior to or during the conduction of the study in order to control for any potential degree of demand characteristics; a scenario where participants alter their behaviour and/or answers, in order to align with what they believe is potentially the 'desired' outcome of the study. All dependent variable testing sessions was to take place at least 24 hours after the cessation of the previous training session for each participant. This was implemented to ensure acute fatigue did not become a contributing factor to the results of the study, specifically relating to the secondary dependent variables, but also the feasibility of such practice during a proposed future clinical trial. The order in which dependent variables are tested were counter-balanced throughout the study at each assessment timepoint in order to attempt to protect the study from practice effects, especially order effects, where a participant has been exposed to a specific order of testing before and as such performs better on subsequent testing procedures of the same material. Additionally, only one intervention was ran at a given time, protecting against potential subconscious selection bias amongst the research team relating to group allocation of participants. Finally, in order to increase the external validity of the study, eligibility criteria was kept as minimalistic as possible (within the limits of safety and reason), in order to allow as inclusive a proportion of this population as possible, and in such producing findings applicable to not only those within the study, but to the greater population of frail geriatric hospital inpatients and particularly those within delayed discharge settings.

3.4.3 Eligibility

The study was open to both men and woman who met the following eligibility criteria: inpatient on the Harborne ward of the Queen Elizabeth hospital Birmingham, Mindelsohn Way, Birmingham, United Kingdom; ≥ 65 years of age; frail according to the Fried Frailty Phenotype criteria (2); ability to speak and read in English; not taking part in any other clinical trial which could potentially impact upon or influence the findings of the study; not terminally ill with life expectancy less than the duration of the study; no severe sensory impairment which would profoundly impact upon ability to undergo the intervention, even once appropriate adaptations had been made; anticipated by their care team to remain on the ward for approximately 21 days post enrolment into the study.

3.4.4 Interventions

All participants were to undergo 10 sessions in total throughout the two-week intervention in either one of the two interventions. All session were conducted individually under the guidance of a qualified trainer. A maximum of one session was performed each day, and sessions were not performed on any more than a maximum of three consecutive days throughout the duration of the study (Table 3.2).

3.4.4.1 Exercise Intervention 1: Specially adapted resistance training intervention

This intervention comprised of an intensive (five days per week), short duration (2-week), approximately 35 minutes per session, machine-based resistance training intervention. The exercises performed specifically targeted the lower limbs through a combination of multi-joint strength and power training utilising a leg press and leg extension machine (Figure 3.3).

Figure 3.3. Minato resistance training equipment utilised within the specially adapted resistance training intervention.

The maximal strength reference value (% one repetition maximum (1RM)), duration (35 minutes), type of exercise (multi-joint), loadings (60% 1RM (power), 80% 1RM (strength)) and volume (three sets, five to eight repetitions) are largely consistent with the

position statement from the National Strength and Conditioning Association regarding resistance training in older adults (31).

An outline of the protocol for each session can be found in Figure 3.4.

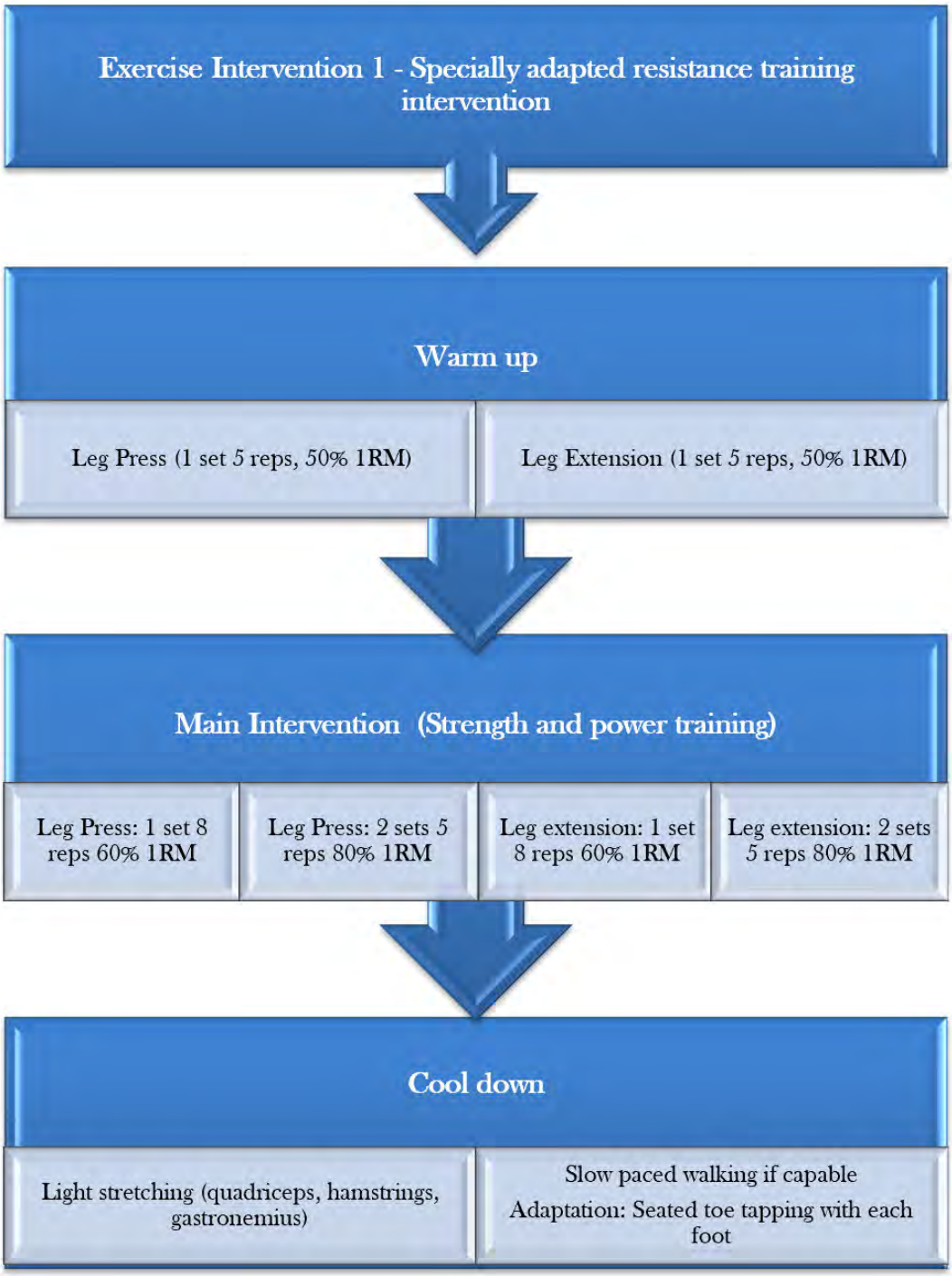


Figure 3.4. Exercise intervention 1 – Specially adapted resistance training intervention protocol.

3.4.4.2 Exercise Intervention 2: Move It Or Lose It (MIOLI)

This intervention comprised of an intensive (five days per week), short duration (2-week), approximately 35 minutes per session, chair-based exercise intervention. The exercises conducted related to strength, power, flexibility, and aerobic capacity, predominantly targeting the lower limbs, but also incorporating the upper body and core. An outline of the protocol for each session can be found in Figure 3.5.

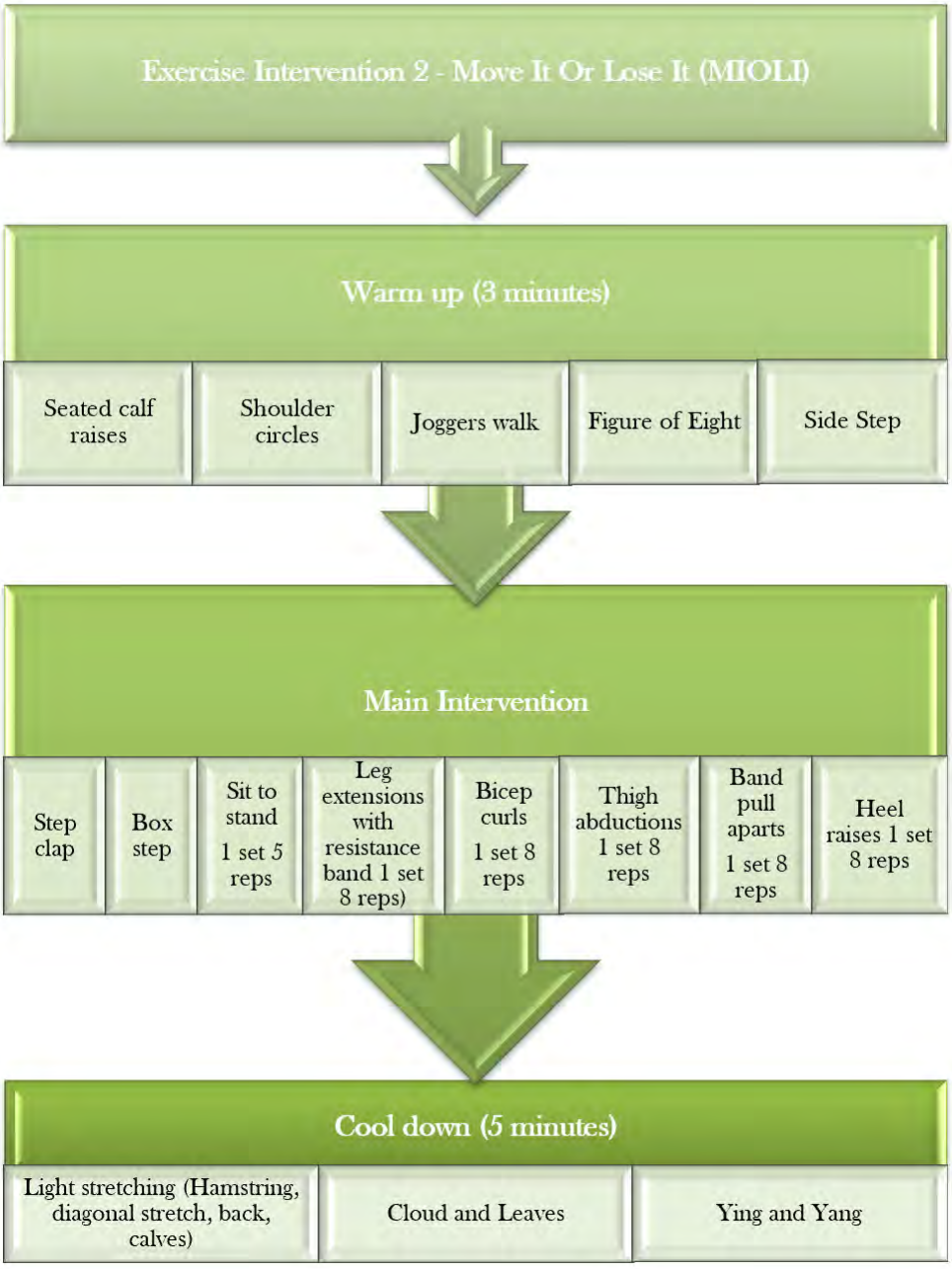


Figure 3.5. Exercise intervention 2 – Move It Or Lose It (MIOLI) chair-based exercise intervention protocol.

3.4.5 Dependent variables

3.4.5.1 Primary dependent variables

The primary dependent variables related to the eight primary areas of focus of feasibility studies (12) (utilised to establish the feasibility of a proposed future clinical trial within this setting), relating to: acceptability, demand, implementation, practicality, adaptation, integration, expansion, and limited-efficacy testing.

These dependent variables were initially to be assessed through semi-structured interviews with study participants and focus groups with ward staff post-intervention. Participant uptake and adherence records were also employed throughout. These methods sough to attain answers to the following questions and parameters relating to the eight primary areas of inquiry for this feasibility study outlined in further detail in Table 3.1.

Table 3.1. The eight primary areas of focus, outlining the research questions and methods of assessment.

Area of focus	Potential questions	Methods of Assessment
Acceptability	• Will the proposed population be interested in participating in the study? • What will the uptake be? • Will the program be judged as suitable by the delivers of the program in addition to the program participants? • Participant's opinions on hypothetically being randomised into a control group during a proposed future clinical trial?	• Participant uptake analysis (All participants approached and eligible for the study, all of those successfully recruited to the study) • Semi-structured interviews with participants • Focus groups with study support staff.
Demand	• Will the proposed population of hospital inpatients participate in the study? • What will adherence rates be? • Are the staff on the ward open to the idea of having exercise interventions potentially on the ward long term if it proves effective?	• Analysis of uptake rates • Exercise intervention adherence rates • Focus groups with study support staff/ward staff.
Implementation	• What are the possible logistical issues with the setting which will need to be addressed or accounted for prior to the clinical trial? • Can the interventions be successfully carried out within this setting? • Can a single or double bind be successfully implemented within this setting?	• Semi-structured interviews with study participants. • More in-depth with focus groups with study support staff.
Practicality	• What are the practical implications of the study with relation to time commitment of the researchers, relating to both the implementation of the interventions, and the testing of participants for the dependent variables of the proposed future clinical trial? • Is it viable to potentially conduct follow-up testing on participants in the proposed future clinical trial? • Do any alterations need to be made to the proposed primary dependent variables of the future clinical trial? • If the interventions are successful in influencing parameters of health and functional capacity, will it potentially be possible to assess if these improvements are sustained during a two-week follow-up in the proposed future clinical trial, if the same is found?	• Semi-structured interviews with study participants. Focus groups with support staff.

Integration	• How will the ward staff appraise the study? • Will the interventions be easily integrated into the existing culture, protocols and procedures within the ward seamlessly?	Focus groups with ward/support staff.
Adaptation	• Will any further adaptations be required to the existing interventions to make them more feasible or appropriate within this setting?	• Semi structured interviews with participants.
Expansion	• Can the Move It or Lose It intervention (an established chair-based exercise programme for older adults) be successfully expanded to this setting? • Can be specially adapted resistance training equipment be successfully expanded to this setting?	Semi-structured interviews / Focus group with the ward/study support staff.
Limited-efficacy testing	• Is two weeks a sufficient duration to potentially provide significant benefit to patients? • Can intensive (five-six days per week), short duration (two weeks) physical activity interventions improve markers of multi-dimensional health, in very frail individuals?	• Analysis of the secondary dependent variables within the study (primary dependant variables of the future clinical trial) • Analysis of uptake and adherence rates • Analysis of the level of satisfaction with the interventions through questionnaires with participants post-intervention.

In order to enhance trustworthiness in the qualitative component of this research, several methods were employed**:**

The researcher gathering the data maintained a reflective journal in which they recorded information about themselves, their activities and the methods used. Field notes included time, date and location, participant's actual notes, and the researcher's own questions and comments. This lent to logging and documenting what learnt about the study, the intervention, the setting, the participants, and used to refine focus for future interviews through assessing the following questions: What is important? What is it I need to find out more about? What would I want to focus on more closely if I could do the interview again, or in future interviews? (32).

Data were gathered from study participants and ward staff in order to collect data from multiple sources (triangulate information). This study also employed more than one researcher to analyse the qualitative data in order to enhance triangulation and validity.

Enough details were given about the participants and the setting to make decisions about the quality of the findings from the qualitative analysis. Detailed descriptions about the participants experiences and the setting were provided by the researcher.

In the qualitative data analysis, clarification of all possible researcher biases were made known. For example, it will be articulated that the researcher is an advocate of physical activity as a means to promote health, prescribing to the theoretical and practical concept of exercise as medicine, and hence there may be some form of unconscious subjective bias in this context. However, it should also be noted that the researcher within this study is also an advocate of science to an equal or even greater extent, and as such any such bias in subjective analysis would potentially be counteracted in this sense.

Interviews - “a conversation with a purpose” (33) were the primary method of data gathering utilised, as it enables large amounts of information to be gathered relatively quickly. Specifically, this study employed semi-structured interviews, with open questions in a conversational format. There were several pre-determined themes, topics, and questions to be discussed, specifically relating to the eight areas of focus of the primary dependent variables of this study. All interviews and focus groups were audio-recorded in order to facilitate transcription. The qualitative element of this studyalso explored opportunities for Patient and Public Involvement (PPI) in the research design of the proposed future clinical trial.

As this study utilised a mixed methods research approach, employing both qualitative and quantitative research methodologies, this facilitated the potential for elaboration and expansion of findings of individual methodologies through complementary analysis. The qualitative aspect of this feasibility study, aimed at assessing the primary dependent variables, predominantly took a phenomenological approach to understand the experiences of the individuals involved in the study (34).

3.4.5.2 Secondary Dependent Variables

The secondary dependent variables relating to multi-dimensional health (comprising the proposed primary dependent variables of a proposed future clinical trial) were:

Physiological*: Serum cortisol, dehydroepiandrosterone-sulphate (DHEAS), cortisol: DHEAS ratio, C-reactive protein (CRP), Interleukin 6 (IL-6), Tumor Necrosis Factor alpha (TNFα), Interferon gamma (IFNy)

Functional: Hand grip strength (Southampton protocol (35)), Leg strength and power output (36, 37), Short Physical Performance Battery (SPPB) (38), Katz Index of Independence in Activities of Daily Living (Katz ADL) (39), and the Fried Frailty Phenotype (2)

Psychological / Emotional: Geriatric Depression Scale (GDS) (40), Hospital Anxiety Depression Scale (HADS) (41)

Cognitive: Standardized Mini-Mental State Examination (SMMSE) (42)

Social: Interpersonal Support Evaluation List (ISEL-12) (43)

*All blood samples were obtained through venepuncture. Serum was to be analysed for the physiological dependent variables relating to cortisol, DHEAS and CRP (assessed by commercial ELISA kit). Inflammatory cytokines (IL-6, TNFα, IFNy) were to be assayed using a multiplex commercial kit (R&D Systems). These specific physiological variables were chosen to be examined due to their association with the ageing process, and previous research which have both proposed and indicated that exercise is potentially capable of altering these variables (44-49) .

3.4.6 Data collection

Data was predominantly collected at two main time points: baseline and post-intervention (Table 3.2).

Table 3.2. Study timeline of all major events during each round of recruitment (SPIRIT Schedule).

Week	**Seated Physical Activity in Ageing (SPAA) Study Timeline**						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Week 0	Identification + participant information sheet distribution	24-hour consideration period	Recruitment, eligibility screening, and pre-intervention assessments	Recruitment, eligibility screening, and pre-intervention assessments	Recruitment, eligibility screening, and pre-intervention assessments	Recruitment, eligibility screening, and pre-intervention assessments	-
Week 1	Training	Rest	Training	Training	Rest	Training	Training
Week 2	Training	Rest	Training	Training	Training	Rest	Training
Week 3	Post-Intervention Assessment	Post-Intervention Assessment	Post-Intervention Assessment	Post-Intervention Assessment	Post-Intervention Assessment	Post-Intervention Assessment	-

Baseline Assessment: Participants' baseline socio-demographic and information for the secondary dependent variables were collected between five to two days prior to intervention commencement. One repetition maximum (1RM) for the specially adapted resistance training equipment was also assessed during this time period (after all baseline testing had been completed, and at least 24 hours after baseline testing which required physical exertion, which may have impacted on the accuracy of the 1RM measurements). 1RM was calculated on estimation from participants five repetition maximum (5RM) utilising the Epley formula: $1RM = w (1 + r/30)$, where w = weight, and r = repetitions (37). The protocol for 5RM assessments was adapted from (50), and can be found in Appendix 3.1. A balance screening was also to be conducted prior to the commencement of the MIOLI intervention to determine whether participants should perform exercises standing, standing with chair support, or seated. In addition, the resistance bands which participants in the MIOLI intervention were to use were similarly to be assessed during this period; with three options corresponding to light, moderate, and high resistances, to be prescribed to participants based on initial ability and preference during their performance of the exercises in which the resistance training bands were to be utilised.

Post-intervention assessment: Primary and secondary dependent variables were assessed between one to five days post-intervention cessation. All assessments were conducted at least 24 hours post the cessation of the last training session.

Adherence rates in the intervention were recorded as the number of repetitions completed in a set (100% required for adherence to that exercise), and the number of exercises for which there was 100% adherence. If participants met these parameters for each exercise session, they were considered to be in 100% adherence to the intervention. For example, if a participant adheres to 100% of the intervention for nine sessions, but only 90% for one

session, then they had a 99% adherence rate. Adherence rates, whether high, or low, may have signified that the interventions may have been too demanding, too easy or optimal. Information was also collected throughout the study related to uptake and retention rates.

3.4.7 Data monitoring

Data were monitored by the trial management committee at monthly intervals. Prior to analysis data entry checking was conducted for accuracy on >10% of all participants, with queries resolved through discussion with the trial management committee and access to the source documents. Data management adhered to the PANINI data management plan, which was developed in accordance with national and European principles as part of the University research governance and European Commission research governance guidelines. Thus, data management for this project adhered to the FAIR principles (51).

3.4.8 Sample size

This study aimed to recruit a convenience sample of n = ~ 30 participants: 15 in each intervention. No formal power calculations were conducted due to the feasibility nature of this study. This sample size was based on initial expectations related to the obtainment of data saturation in the qualitative component of the study given its phenomenological approach (52, 53).

3.4.9 Identification, consent and recruitment

Identification: Patients on the ward at the commencement of the study were initially screened by their care team for the known presence of any severe sensory impairments which would exclude them from participation. Due to the study's rolling recruitment, this initial screening continued throughout the study as additional patients were admitted to the

ward. Participant information sheets were not distributed to patients who were deemed to be medically unfit or due for imminent discharge as identified by their care team. All other aspects of the screening process occured after consent had been obtained. After identification, potential participants were approached by the researcher with an information sheet related to the study and asked if they would be interested in participating, or if they would like to receive more information about the study. The information sheet contained all the most pertinent information relating to the study and specifically what it would require from potential participants. Potential participants were given ≥ 24 hours to consider whether or not they would like to participate.

Consent: At this stage potential participants were also provided with an informed consent form and asked if they would be interested in participating. If it was deemed that a potential participant lacked the capacity to consent, a personal consultee was sought. A personal consultee is someone who cares for the patient or is interested in their welfare (but not a paid professional), and who is prepared to be consulted and give advice on what they believe the patient's wishes would be, were they to have the capacity to consent for themselves. If a personal consultee could not be found, a nominated consultee was sought. A nominated consultee is someone who is familiar with the patient in a professional context and can adequately advise on whether they believe participation would be in the patients' best interest. These processes were informed by the UK Department of Health's guidance on nominating a consultee for research involving adults who lack the capacity to consent (54); in accordance with section 32(3) of the Mental Capacity Act 2005 (55). All efforts possible were made in this regard to include participants who lacked the capacity to consent, as intrinsically within the research team from a personal and professional perspective we would have considered it unethical to exclude potential participants from participating in a study,

which could potentially benefit them and their overall health status, due to the fact that they lack the capacity to consent.

Recruitment: Following consent being obtained from the participant themselves, or the obtainment of a declaration from a consultee, all consented participants were screened for the remaining eligibility criteria.

3.4.10 Data analysis

3.4.10.1 Primary dependent variables

Analysis of the primary dependent variables was based on an inductive process utilising Interpretative phenomenological analysis (thematic analysis). Two researchers were employed to analyse the data to increase triangulation from the analysis perspective, having already triangulated data acquisition through obtainment from multiple sources (study participants and ward staff). All semi-structured interviews and focus groups were audio recorded. Data synthesis was performed through verbatim transcription. The three main steps of interpretative phenomenological analysis were followed (34): 1) The generation of themes from transcripts within the areas of feasibility inquiry. As an iterative process, these themes were continuously reviewed and adapted based on the emergence of information in subsequent transcripts; 2) The collation and separation of these themes within each of the areas of feasibility inquiry; 3) Written interpretation of the resultant themes within each of the areas of feasibility and their relationship to one another. At all stages within this process, reflective journal entries and field notes were utilised to provide a more comprehensive understanding of the findings, in addition to incorporating additional feasibility information related to uptake and retention rates and attempted limited-efficacy testing of the secondary dependent variables in the final analysis to provide a comprehensive assessment of the feasibility of the study.

3.4.10.2 Secondary dependent variables

Statistical analyses of the secondary dependent variables were to be performed using IBM Statistical Package for Social Sciences (SPSS) software. These analyses were to be performed as part of the limited-efficacy testing regarding the potential impact of the interventions on the secondary dependent variables (proposed primary dependent variables of the future clinical trial). These analyse were to provide an estimation of efficacy and provide valuable insight regarding feasibility; useful to informing the design of the future powered clinical trial. Specifically, the following statistical analysis which were to be utilised: 2x2 way independent measures ANOVA's (analysis' of variance consisting of two independent variables; the specially adapted resistance training intervention, and the Move It Or Lose It (MIOLI) intervention, each with two levels: baseline and post-intervention. A subsequent post-hoc test was to be utilised if a significant main effect or interactions were found. Pearson product correlations were also to be utilised between various socio-demographic variables (such as age and sex) and the secondary dependent variables of this study, to assess possible relationships between differences in socio-demographic factors and changes in the secondary dependent variables.

Central tendency and variability measurements consisting of parameters such as the mean, median and mode, and standard deviation and range of scores respectively, were also to be utilised during the analysis of data for illustrative purpose. Significance levels were to be set at 0.05 ($p \leq 0.05$), and effect sizes reported for all analyses. In order to establish if the assumptions of parametric statistics were met regarding the assumption that there was a normal distribution of data, the data were to be analysed for skewness and kurtosis. In the event data did not fulfil the assumptions of parametric statistics, the non-parametric equivalent of the aforementioned statistical analyses were to be employed, namely the Scheirer-Ray-Hare test, and Spearman's rank-order correlations. As the quantitative

component of this study was not powered given the feasibility nature of the study, the examination of the efficacy of the intervention to impact these secondary dependent variables is limited; and interpretation of these results should be treated with caution pending the future powered clinical trial. All results for analysis of secondary dependent variables were to be reported with effect size and 95% confidence intervals.

3.4.11 Data storage and protection

Participants' identity or other personal information was kept confidential. Participants were assigned a unique ID number under which all study information was stored in a secure file on an encrypted and password protected computer and laptop at the University of Birmingham (UoB). Physical data (e.g., Case Report Forms (CRFs)) were identifiable only by ID number and stored in a locked filing cabinet at the School of Sport, Exercise, and Rehabilitation Sciences at UoB, accessible only by the research team. Participants' personal data (name, date of birth) and consent forms matching them to their ID number, was stored securely in a locked filing cabinet, separate from all other data and/or in a password protected master sheet on an encrypted and password protected computer and laptop at UoB. All serum samples were stored in Human Tissue Act compliant facilities at UoB for three years then destroyed.

All hard copy data collected on CRFs stored in a linked-anonymised format securely, and will be destroyed after 10 years. All personal data (consent forms, master sheet linking participant IDs to names and contact details) are to be stored for 10 years then destroyed. All computerised data was archived on UoB servers in anonymised form for 10 years in the first instance in accordance with the UoB Code of Practice for Research, and the Data Protection Act (2018).

Following analysis for this specific study, all data was anonymised and entered into a European 'PANINI' open access database that this project is part of and may be analysed in future

ethically approved research across the PANINI network. The PANINI shared dataset was made open access at the conclusion of the funding for the PANINI network including this study in 2020 and stored for at least 10 years as an open access searchable published dataset.

3.4.12 Patient and public involvement

All authors are strong proponents of patient and public involvement and engagement with research and believe the findings of the study will be important to aid the facilitation of improvements in the care of frail older hospital inpatients. Given the feasibility nature of this research, the qualitative element of this study explored opportunities for Patient and Public Involvement (PPI) in the research design of future trials. The findings of this study are available for disseminated to participants upon request, and our patient and public involvement groups.

3.5 Ethics and dissemination

3.5.1 Ethical approval and consent to participate

This study was granted a favourable ethical opinion by the Coventry and Warwickshire NHS Research Ethics Committee (REC) (17/WM/0390) on the 12/03/2018. This study was also sponsored by the University of Birmingham, after review by the sponsor's research governance office (sponsor registration number: RG_17-108).

3.5.2 Dissemination

The findings of this study will be disseminated through publication of scientific papers in open access scientific journals, public engagement events, online via social media (Twitter, Instagram) and the PANINI project website (56, 57), presentation at various conferences, and to study participants upon request.

3.6 Safety reporting and monitoring

Adverse events (AE) and serious adverse events (SAE) were monitored and if applicable recorded, by the primary researcher at each testing or exercise session and reported weekly to the local principle investigator (PI) and reviewed in the case of AEs. SAEs were to be reported immediately to the local PI who would complete an SAE form indicating causality and severity. The chief investigator (CI) was to then submit this to the sponsor's research governance office, the Research Ethics Committee (REC), and University Hospitals Birmingham (UHB) research governance office, within 24 hours. UHB local policies and Standard Operating Procedures (SOP's) for all safety reporting were also be followed by the research team. SAEs related to pre-existing conditions were not reported. Actions following an AE or SAE were as standard, i.e., direct referral to their clinical care team, who then may wish to treat the AE or SAE themselves or where appropriate refer the participant to another relevant medical professional, and to recommend that the participant withdraw from the study unless they had been cleared to continue exercise by their attending physician.

3.7 Trial registration

This study has been registered on ClinicalTrials.gov under the identifier number: NCT03141866.

3.8 Trial status

This trial commenced on the 03/09/2018 on the Harborne ward of the Queen Elizabeth Hospital Birmingham, with completion of data collection on 09/08/2019.

3.9 Footnotes

Author contributions: PD designed the study protocol, and associated manuscript for publication, with supervision, input and feedback from AW at all stages of the design and writing process. JL and CG reviewed and revised the manuscript prior to publication. All authors have read and approved the final manuscript.

Funding: This study was funded by the European Commission's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement (675003); of which PD was a Marie Sklodowska-Curie Doctoral Research Fellow, AW, JL and CG doctoral supervisors, and AW the grant's Principal Investigator.

.

Chapter 4. Seated Physical Activity in Ageing: feasibility study results

4.1 Abstract

Exercise interventions have been shown to be a beneficial treatment for frailty, however, more research is needed to assess the feasibility and impact of exercise interventions among frail geriatric populations in different settings. This study aimed to assess the feasibility of a potential future clinical trial in a delayed discharge hospital ward setting, which aimed to utilise an interventional, independent measures research design to assess the efficacy of two adapted exercise training interventions: an adapted resistance training intervention, and an established community-based exercise intervention for older adults. This present study was a pragmatic, mixed methods feasibility study. Primary dependent variables were the eight areas of feasibility inquiry: acceptability, demand, implementation, practicality, adaptation, integration, expansion, and limited-efficacy testing. These areas of inquiry were informed through patient eligibility and uptake, participant retention and exercise session adherence, attempted limited-efficacy testing, and interpretative phenomenological analysis (IPA) of semi-structured participant post-intervention, and ward staff post-study, interviews. Recruitment was conducted over several months between September 2018-August 2019 on the Harborne ward of the Queen Elizabeth Hospital Birmingham. Seven hundred and seventy-three initial participant screenings were conducted by ward staff over this period, resulting in 104 participants being identified as eligible for approach regarding recruitment. Participant information sheets were accepted by 75 patients (35 of which expressed immediate interest in participation). Forty-six of these patients (including 29 of those expressing immediate interest) were imminently discharged within 24 hours following participant information sheet receipt, while twenty-two expressed a lack of interest in participation, and one was subsequently declared medically unfit. The remaining six patients were recruited to the study. Five ward staff were also recruited for post-study semi-structured interviews. Semi-structured interviews were audio-recorded, transcribed verbatim, and

analysed by two researchers utilising IPA. Superordinate themes originating from IPA were *changing dynamics*, *impracticalities*, *population and setting appropriateness*, and *future directions*. Written interpretation of these themes within each of the areas of feasibility inquiry was performed and triangulated with patient eligibility and uptake, participant retention and exercise session adherence, and limited-efficacy testing data.
Impracticalities regarding the dynamics of the setting, and the profile of the patients in this setting, resulted in the interpretation of a potential future clinical trial being unfeasible within this setting, and better suited to more stable environments, either within increasing 'hospital at home' settings, intermediate care facilities, or residential care facilities, including assisted living facilities, and nursing homes.

Keywords: dementia; exercise; feasibility; frailty; mixed methods; older adults; interpretative phenomenological analysis; intervention; hospital; delayed discharge.

4.2 Introduction

Frailty is a common and clinically significant condition within geriatric populations (1), due to its association with adverse health outcomes such as hospitalisation, disability and mortality (1-6). As elucidated in Chapter 2 of this thesis, the prevalence of frailty among geriatric hospital inpatients is approximately 47.4% (95% CI 43.7-51.1%), increasing to 88.3% (95% CI 77.7-98.3%) specifically among post-acute delayed discharge patients. Exercise interventions have been proposed as potentially offering the best form of treatment for frail older adults (7). However, while there is evidence of the benefits of exercise relating to the prevention, treatment, and reversal of frailty, it is universally noted that there needs to be more studies within this area to assess the feasibility and impact of exercise interventions

among frail geriatric populations within different settings, particularly relating to its effects on broader aspects of health and well-being (1).

This present study assesses the feasibility of short duration, intensive, specially adapted exercise interventions within a delayed discharge hospital ward setting. The primary aim of the present study was to assess the feasibility of a proposed future trial in this setting, which aims to assess the impact of specially adapted exercise interventions on the physiological, psychological, cognitive, social and emotional health, and functional capacity of frail geriatric populations within a delayed discharge hospital ward setting. Feasibility related to the eight main areas of feasibility inquiry: acceptability, demand, implementation, practicality, adaptation, integration, expansion. and limited-efficacy testing (8). The secondary aim of this feasibility study was to attempt to engage in limited-efficacy testing of the interventions on the primary dependent variables of a proposed future clinical trial within this setting.

Preliminary research has shown some success in the implementation of exercise interventions to reverse functional decline among general geriatric inpatient populations (9). However, to the authors' knowledge, this study is the first to attempt to assess the feasibility of an exercise intervention among geriatric inpatients within a delayed discharge, and the first study to attempt to exclusively recruit operationally defined frail geriatric inpatients in any hospital setting.

4.3 Methods

As a comprehensive methodology is provided in the preceding chapter, the methodological description within this chapter will be limited to a brief summary of main points, and discussion of any methodological amendments to the protocol. The aims of this study were achieved through the sequential achievement of the following objectives: 1) attempted

recruitment of eligible participants from the Harborne delayed discharge ward of the Queen Elizabeth Hospital Birmingham, United Kingdom; 2) attempted baseline assessment of secondary dependent variables related to multi-dimensional health; 3) assessment of the feasibility of the study as it relates to the eight-primary areas of focus for feasibility studies (8); 4) post-intervention and post-study assessment of primary and secondary dependent variables relating to feasibility. The research questions of this study relate to the eight aforementioned areas of feasibility, incorporating the following broad questions relating to the feasibility of a potential clinical trial within this setting: Can it work? Will it work? Does it work? (8). As stated in Chapter 3, this pragmatic, mixed-methods, feasibility study approach is consistent with the UK Medical Research Council's latest framework for developing and evaluating complex interventions (10, 11). The primary dependent variables regarding the eight areas of feasibility were assessed through a detailed analysis of patient eligibility and uptake; participant retention and exercise session adherence; attempted limited-efficacy testing of the proposed dependent variables of a potential larger future clinical trial; and interpretative phenomenological analysis (IPA) of participant post-intervention, and ward staff post-study, semi-structured interviews (Table 4.1).

Table 4.1. The eight primary areas of feasibility focus, outlining the research questions and methods of assessment within each area.

Area of focus	Potential questions	Methods of Assessment
Acceptability	• Will the proposed population be interested in participating in the study? • What will the uptake be? • Will the program be judged as suitable by the delivers of the program in addition to the program participants? • Participant's opinions on hypothetically being randomized into a control group during a proposed future clinical trial?*	• Participant uptake analysis (All participants approached and eligible for the study, all of those successfully recruited to the study) • Semi-structured interviews with participants • Semi-structured interviewers with study support staff
Demand	• Will the proposed population of delayed discharge hospital inpatients participate in the study? • What will adherence rates be? • Are the staff on the ward open to the idea of having exercise interventions potentially on the ward long term if it proves effective?	• Analysis of uptake rates • Exercise intervention adherence rates • Semi-structured interviewers with ward staff.
Implementation	• What are the possible logistical issues with the setting? Can these be addressed or accounted for prior any proposed clinical trial within the setting? • Can the interventions be successfully carried out within this setting? • Can a single or double bind be successfully implemented within this setting?	• Semi-structured interviews with study participants. • More in-depth with semi-structured interviews with study support staff.
Practicality	• What are the practical implications of the study with relation to time commitment of the researchers and participants relating to both the implementation of the interventions, and the testing of participants for the dependent variables of a proposed future clinical trial? • Is it viable to potentially conduct follow-up testing on participants in a proposed future clinical trial? • Do any alterations need to be made to the proposed primary dependent variables of a future clinical trial within the setting? • If the interventions are successful in influencing parameters of health and functional capacity, will it potentially be possible to assess if these improvements are sustained during a follow-up in a proposed future clinical trial, if the same is found?	• Semi-structured interviews with study participants. Semi-structured interviews with ward staff.

Integration	• How will the ward staff appraise the suitability of the study for the setting? • Will the interventions be easily integrated into the existing culture, protocols and procedures within the ward seamlessly?	• Semi-structured interviews with ward staff post study.
Adaptation	• Will any further adaptations be required to the existing interventions to make them more feasible or appropriate within this setting?	• Semi structured interviews with participants. • Semi-structured interviews with ward staff • Supplemented with reflective journal entries.
Expansion	• Can an established chair-based exercise programme for community-swelling older adults be successfully expanded to this setting for frail geriatric delayed discharge patients? • Can specially adapted resistance training equipment be successfully expanded to this setting?	• Semi-structured interviews with ward staff. • Supplemented with reflective journal entries.
Limited-efficacy testing	• Is the setting suitable for adequate data collection regarding the proposed primary dependent variables of a future clinical trial? • Is two weeks a sufficient duration to potentially provide significant benefit to patients? • Can intensive (five-six days per week), short duration (two weeks) physical activity interventions improve markers of multi-dimensional health, in very frail individuals?	• Analysis of the secondary dependent variables within the study (primary dependant variables of a proposed future clinical trial) • Analysis of uptake and adherence rates • Semi-structured interviews with ward staff • Reflective journal entries and field notes as supplementary to provide more comprehensive understanding of the findings

4.3.1 Data analysis

Analysis of participant post-intervention, and ward staff post-study interviews were based on an inductive process utilising IPA. Two researchers analysed these data to increase triangulation from the analysis perspective. All semi-structured interviews were audio-recorded, and data synthesis performed through verbatim transcription, with all coding being performed utilising NVivo 12.1 (Appendix 4.1). The three main steps of IPA were followed: 1) The generation of superordinate and subordinate themes. As an iterative process, these themes were continuously reviewed and adapted based on the emergence of information in subsequent transcripts; 2) The collation, separation, and integration of these themes within each of the areas of feasibility inquiry; 3) Written interpretation of the resultant themes within each of the areas of feasibility inquiry and their relationship to one another. At all stages within this process, reflective journal entries and field notes (Appendix 4.2) were utilised to provide a more comprehensive understanding of the findings; in addition to incorporating triangulation of feasibility information related to patient eligibility and uptake rates, participant retention and adherence rates, and attempted limited-efficacy testing in the final analysis to provide a comprehensive assessment of feasibility within the setting. The consolidated criteria for reporting qualitative research (COREQ), was used during the design of this study (12). The protocol of this feasibility study has previously been published elsewhere (13).

4.3.2 Changes to recruitment and timing from the original protocol

Due to sudden organisational alterations within the research site, directly prior to commencement, and throughout the duration, of the study, two protocol amendments were submitted to the NHS Research Ethics Committee. The first of these amendments related to obtaining permission to attempt to recruit patients who lacked capacity to consent, through a personal or nominated consultee. This amendment was submitted as a result of organisational

alterations within the trust which resulted in a substantially higher prevalence of those lacking capacity within the setting than during study conception and design. A second amendment was submitted to obtain permission to recruit those who were not expected to remain on the ward for the entire duration of the study, but for whom *some* data could be collected. This amendment was submitted due to the increasingly expedited discharge of patients eligible for recruitment throughout the course of the study, as progressively the setting evolved from maintaining delayed discharge patients on the ward, to accelerating discharges to newly evolving transitional care settings, or patients' homes. A favourable ethical opinion for this study was granted by the Coventry and Warwickshire NHS Research Ethics Committee. Data collection was initially to be conducted for several months between September 2018-March 2019, however extended to August 2019 in an attempt to obtain more data.

4.4 Results

4.4.1 Patient eligibility and uptake

Seven hundred and seventy-three initial patient screenings were performed by ward staff during the recruitment period. From these 104 patients were identified as suitable to approach regarding potential participation in the study and offered a participant information sheet. 75 initially accepted the participant information sheet, while 29 refused. The reasons for participant information sheet refusal were lack of interest in participation (n=19), and patient anxiety regarding imminent discharge (n=10). Of the 75 patients initially accepting the participant information sheet, upon receipt, 35 expressed an immediate initial interest in participation. Of these 35 patients, 29 were subsequently discharged, or scheduled for imminent discharge, less than 24 hours after receiving the participant information sheet. The remaining six patients expressing initial interest, who remained on the ward 24 hours after receipt of the participant information sheet were recruited to the study. Reasons for non-

participation among patients initially accepting the participant information sheet, were discharge (n=46); non-interest in participation (n=22); and subsequently being declared medically unfit to participate by the ward staff (n=1) (Figure 4.1). In total 86.6% of all 773 patient screenings resulted in patients being identified as ineligible by ward staff: 62.0%% due to the patient being identified as medically unfit as it relates to potential participation in the study; 22.3% due to the patient being identified as planned for imminent discharge from the ward; and 2.3% primarily for other reasons (in country illegally, excessively violent behaviour, below the minimum age for participation).

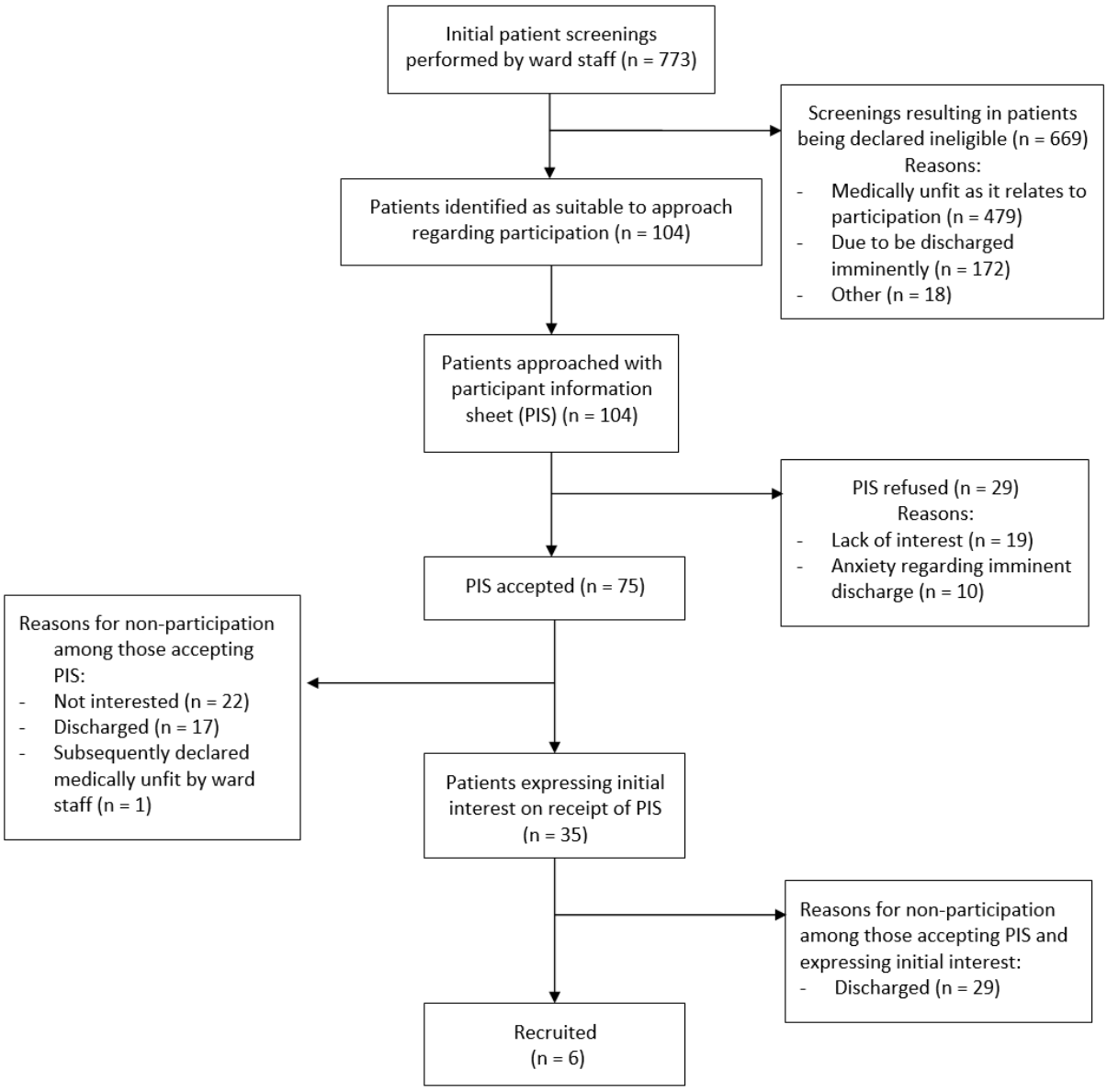


Figure 4.1. Flow diagram of participant identification and recruitment.

4.4.2 Participant retention and exercise session adherence

The length of stay for recruited participants in the study ranged from less than 1 to 24 days. Three participants were discharged without notice to the research team within 48 hours of commencing baseline assessments, while one participant was declared medically unfit by ward staff during baseline assessments and discharged shortly thereafter. Of the two remaining participants who underwent the exercise intervention, exercise adherence was 79%, and 80% respectively. One participant was discharged without notice following the completion of seven exercise sessions, prior to the completion post-intervention assessments. Post-intervention assessments, including semi-structured interview were conducted with the sole participant who remained on the ward for the entirety of the study. Five semi-structured interviews were also completed with ward staff post-study completion. Participant and ward staff demographics and selected baseline characteristics are displayed in Tables 4.2, and 4.3.

Table 4.2. Participant (delayed discharge patient) demographics and selected baseline characteristics (n=6).

Variable	**Mean (SD) / N (%)**
Sex (female)	2 (33.3)
Ethnicity (British)	6 (100)
Occupation (retired)	6 (100)
Age (years)	83.2 (7.7)
BMI	25.9 (3.6)
No. of medications during hospitalisation	19.6 (6.5)
No. of medications at discharged	10.1 (4.4)
No. of days in hospital (including prior to delayed discharge)	36 (16)
No. of days in study prior to discharge	8.3 (9.3)
Frail* (≥ 3 positive Fried frailty phenotype criteria)	(83.3)
5/5 positive criteria	3 (50)
4/5 positive criteria	1 (16.7)
3/5 positive criteria	1 (16.7)
Discharged prior	1 (16.7)
Marital status	
Married	1 (16.7)
Separated/Divorced	1 (16.7)
Widowed	1 (16.7)
Never married	1 (16.7)
Discharged prior	2 (33.3)
Discharged to assisted-living facility	6 (100)
Deceased during subsequent readmission prior to study end	2 (33.3)

*=*One participant discharged prior to completion of all five elements of frailty assessment.*

Table 4.3. Delayed discharge ward staff demographic characteristics (n=5).

Variable	**Mean (SD) / N (%)**
Sex (female)	5 (100)
Ethnicity	
British	3 (60)
Pakistani	1 (20)
Filipino	1 (20)
Occupation	
Geriatrician	2 (40)
Senior nurse	2 (40)
Specialist registrar	1 (20)

4.4.3 Interpretative phenomenological analysis of semi-structured interviews

The four superordinate themes arising from interpretative phenomenological analysis of participant (1), and ward staff (5), semi-structured interviews were "*changing dynamics"; "impracticalities"; "population and setting appropriateness"; and "future directions".* These themes were identified within all interview transcripts (Appendix 4.1) and were persistent within researcher reflective journal entries (Appendix 4.2). Sub-themes within each of these superordinate themes are outlined in Figure 4.2.

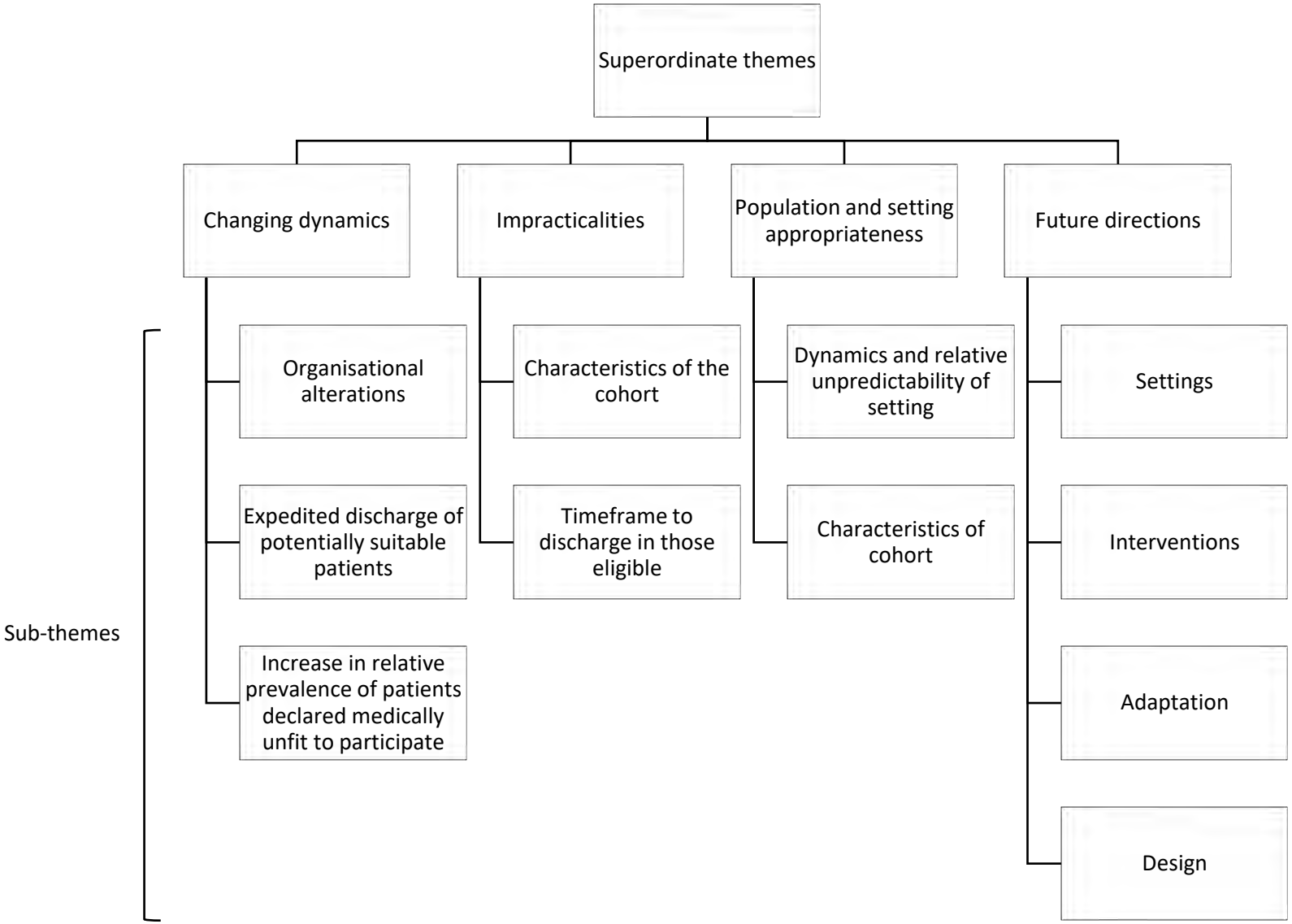


Figure 4.2 Tree diagram of superordinate themes and sub-themes arising from interpretative phenomenological analysis.

4.4.4 Primary dependent variables

Both researchers endeavoured to come to an understanding of the superordinate and subordinate themes from semi-structured interviews as they related to the research questions within each of the eight areas of feasibility inquiry, with further triangulation with patient eligibility and uptake, participant retention and adherence records, and limited-efficacy testing data.

4.4.4.1 Acceptability

There was a moderate level of interest among those initially identified as eligible by ward staff for approach regarding participation; 72% of those identified as suitable for approach accepted the participant information sheet, while 47% of these expressed an immediate initial interest in participation. However, of those identified as suitable for approach and who expressed interest, 83% were discharged, or scheduled for imminent discharge, 24 hours after participant information sheet receipt. This was reflected in the superordinate IPA themes of *population and setting appropriateness* and *changing dynamics* within analysis of semi-structured interviews, exemplified in the following quote from a member of ward staff:

"It's difficult as well, each week we've got some, kind of, good turnovers (Interviewer: Mmm-hmm), we might have a patient that's suitable to go for it, or all of a sudden, then none… Previously, patients used to be here for a very good, long period of time (Interviewer: Mmm-hmm), but now with social services moving a little bit more faster (Interviewer: Mmm-hmm), we are moving along the patient towards discharge much more quicker" (Ward staff 1004, Specialist registrar, female)

The uptake rate was 15% for those identified as suitable to approach and who remained on the ward 24 hours after participant information sheet distribution. Ward staff interviews further outlined the *impracticalities* and the *changing dynamics* of the setting in terms of turnover of those identified as eligible:

"*So, the turnover has increased… and they will be the one who will be going first as well, because they are not challenging, they are functionally well (Interviewer: Yeah) cognitively well (Interviewer: Mmm-hmm) they are medically fit, they can take part, so those are the one who should be going."* (Ward staff 1004, Specialist registrar, female)

"If we were sitting here five years ago (Interviewer: Mmm-hmm), we'd have been able to… recruit, I think, much more successfully. (Interviewer: Mmm-hmm) There would have been people still within the hospital environment who would have been able to take part, em, and really benefited from it, and it would have all been much more straightforward (Interviewer: Mmm-hmm) but, em, because of the changes in which we're delivering health and social care to older adults, and particularly in Birmingham where we've been very, very backwards (Interviewer: Mmm) compared to other parts of the country, changing the way we do things has really accelerated over the last, em, eighteen months or so (Interviewer: Mmm-hmm) which has had a direct impact on the piece of work (Interviewer: Mmm) So, for example, all of the em people who would have been able to participate, now aren't in hospital waiting for their, em next step in their social care or em planning to go home (Interviewer: Mmm). They're either in their own homes, and that's something that we've been able to achieve more of over the last six months, or they're out em in one of the off-site units which is where we now provide EAB, which stands for Enhanced Assessment (transitional care)" (Ward staff 1003, Geriatrician, female)

"when we started talking about this research, this ward was entirely for people who were delayed transfer of care (delayed discharge) (Interviewer: Mmm-hmm). So, medically ready to leave hospital. A unilateral decision by the division made just over a year ago, em, introduced acute patients, em, on to the ward (Interviewer: Mmm-hmm) and it would be without accompanied changes in staffing levels. So, it would be fair to say that's impacted (Interviewer: Mmm-hmm) how even those who are delayed transfers are able to be looked after by the nursing staff in a negative way (Interviewer: Mmm), Em, that's actually led to us really accelerating the, the work out of hospital with the aim of being able to get those people out"
(Ward staff 1004, Geriatrician, female)

Among participants who were identified as eligible and who did remain on the ward long enough to undergo the exercise intervention, limited-efficiency testing assessments, or post-intervention interview, the exercise sessions were found to be acceptable, with an 80% adherence rate for exercise sessions:

"Well, I think it's good, as far as I can see. (Interviewer: Mmm-hmm) Em, and because em, I'm having to do exercises, I'm just hoping that it'll do, do me good… I think this is important."
(Participant 1003, male, aged 76 years)

Within the superordinate theme of *future directions*, there was reduced acceptability expressed regarding participation in a *future* clinical trial in any setting which may potentially result in randomisation into a control group:

"I don't mind doing the exercise (Interviewer: Mmm-hmm). I quite enjoy doing that. (Interviewer: Yeah? Ah okay, but if you were in the study and the exercise wasn't part of it, do you still think you'd be interested in doing the, the assessments before and after?)
Participant: Probably not as keen" (Participant 1003, male, aged 76 years)

Conversely, for other patients identified as eligible for approach, admission to the ward represented a disconcerting moment in their lives, where some would move from some degree of independent living to dependent living. Often this was exacerbated by family disappointments, and 34.5% of patients who did not accept the participant information sheet expressed this when being approached with regard to the study: that they felt they would not be on the ward long enough but also did not know where they were going, causing considerable uncertainty and anxiety, and as such did not want to agree to anything new as everything was changing around them. This was further supported by interviews with ward staff who reiterated this point with regard to the *appropriateness* of the specific ward for such interventions and expressed that the study may be more suited in a more stable nursing home or transitional care setting, and perhaps with patients with less challenging circumstances and in many cases, significant behavioural issues.

"It might be better in a more EAB(transitional care)-type setting, not a hospital setting (Interviewer: Mmm-Hmm), where perhaps people are there for a longer period of time, because the people who were on that ward who were there for a long period of time, were the more challenging patients that couldn't take part" (Ward staff 1001, Senior nurse, female)

However, the degree of acceptability toward the study from those identified as eligible to approach regarding participation, was superseded by the substantial number of patients on the

ward who were initially assessed as ineligible to approach regarding participation in the study by ward staff, which accounted for 86.6% of all patients on the ward over the recruitment period: 62% of which was due to patients being deemed medically unfit as it related to potential participation, and 22.3% due to imminent discharge from the setting. *Impracticality* of the setting and patient population, compounded by the *changing dynamics* of the setting, resulted in ward staff interviews and reflective journal appraisal that this likely was not the right place to have the intervention long-term. *Future directions* for the research may be better suited to more stable and *appropriate settings*, and while ward staff positively appraised exercise interventions for frail geriatric populations, they believed that the current iteration of the ward after the structural alteration, likely was not the appropriate place for the intervention:

"I just, em, I thought it was difficult because of the type of patients, really. At first, I was, like, thinking, "Oh, this'd be really great" but then when we started looking at, it and there were so many patients with dementia who couldn't be that compliant, or you couldn't measure the outcomes." (Ward staff 1001, Senior nurse, female)

4.4.4.2 Demand

In terms of the demand for a larger clinical trial, and interventions of this nature on the ward long term, triangulation of patient eligibility and uptake records, and semi-structured interviews with ward staff identified that this is unlikely to be a feasible or *appropriate setting* for such interventions, which may be better suited to more stable environments, which have more eligible potential participants remaining in the setting for longer durations to facilitate inclusion:

"I'd even say the right place for, you know, any specialist equipment, or any classes or groups, is going to be out in those care centres, of which Norman Power (a newly opened enhanced assessment (transitional care) unit) is one, but, prospectively, with people who are receiving the bulk of their therapy in their own homes, actually then coming in, you know (Interviewer: Mmm-hmm), and using the equipment. So, coming in to one of those centres, using the equipment and going out, as well as it being used for people who are (Interviewer: Mmm-hmm) staying in one of those intermediate care centres." (Ward staff 1003, Consultant geriatrician, female)

Demand within the delayed discharge setting was substantially undercut by patient eligibility, which were recorded within the superordinate themes of both *changing dynamics* and *future directions.* While there was a relatively reasonable demand for the study, among those identified as eligible, with 47% expressing interest in participation, this was affected by accelerated discharge of potentially eligible patients, which was captured within the superordinate theme of *impracticalities*:

"I think we, we were good, as we could in our own limitations, it's not that easy. When we see from the outlook, we can plan a lot of things, but when we look into the type of the patients and all limitations, at the end of the day, we'll be recruiting a very few… because with really challenging patients on Harborne, I don't think so they are suitable at all (Interviewer: Mmm-hmm). Em, we can hardly do their very basic stuff, so getting something like that (Interviewer: Yeah, yeah) will be nearly impossible" (Ward staff 1004, Specialist registrar, female).

4.4.4.3 Implementation

There were substantial logistic and paradoxical issues within the setting, which made implementation of a *future* clinical trial of this nature, within this *setting, impractical,* which was progressively exacerbated within this feasibility study over time due to the *changing dynamics* of the setting:

"When you say Harborne ward, this is our medically fit patients, who just are waiting for placement or package of care. But then it will be, kind of, "Oh yeah, this is, eh I think much suitable because they might stay here longer on the ward (Interviewer: Mmm-hmm) because they're just waiting for how many weeks? How many days?" And at least then having this, kind of, programme it will be, kind of, divert for their mind. But then in reality when you look after this patient and when they give you the actual information, what is the patient like? Although medically fit, but in reality, because of some kind of cognitive impairment they might not be able to follow what you wanted for them to do when you take them to that equipment or what instruction you're going to tell them because it's either they suffer with dementia, they, kind of, really having memory problem. So, that's the things but when you actually only saying medically fit ward, sounds suitable (Interviewer: Yeah), isn't it, for them? But in reality, is something, kind of, giving them the, you know, the hindrance of how they, are they able to follow instruction?" (Ward staff 1002, Senior nurse, female)

"The general notion is throughout the hospital, it's a dementia specialist ward (Interviewer: Mmm-hmm), which in a way, it is. So, most of the patients who are here are having their diagnosis of dementia, they've been made already or in the process of getting it done formally. They do have their limited cognition, limited functioning, in terms of their mental and psychological health, and many of them do depict challenging behaviour (Interviewer: Mmm-

hmm) so, they are difficult, to… handle, if we say (Interviewer: Yeah) in various ways, from medics' point of view, from nursing point of view and from therapist point of view as well. Because their cognition is quite limited along various areas (Interviewer: Mmm-hmm), it's difficult to communicate with them, eh, so it's much more relying on very simple, basic language. Em, sometimes just prompting them or using other clues or body language or, em, sometimes we mostly rely on relatives because they know, or the carers who know the patient best (Interviewer: Mmm-hmm) to be there because they could be really anxious or angry or unpredictable. So, in Harborne, the main difficulty with the patients is their unpredictability (Interviewer : Mmm-hmm) in terms of mood and, getting their trust and cooperation is quite difficult (Interviewer: Mmm-hmm) and challenging… So, simple things like when changing them, feeding them, examining them from doctors' point of view could be really hard." (Ward staff 1004, Specialist registrar, female)

4.4.4.4 Practicality

Impracticality was one of the superordinate themes identified within IPA. In terms of *impracticality* a paradoxical situation existed regarding recruitment, in that while patients were on the ward, and expected to remain for an extended period of time, they were almost exclusively deemed by the medical team to possess characteristics (typically acute illness, severe sensory and cognitive impairments, or terminal illness, and end of life care) which resulted in them being unfit to participate in the study. In contrast, patients who were slightly *'heathier'*, though still with many of the aforementioned conditions to a lesser extent, identified as suitable for approach regarding participation by the care team had a shorter stay, which was progressively expedited over the course of the study, with discharge relatively soon post-admission. This resulted in the prevention of participation for 83% of those identified as eligible who expressed initial interest in the study, and 93% of all those on the ward over the

study duration. This paradoxical situation was further triangulated in the superordinate theme of *population and setting appropriateness:*

"they will be the one who will be going first as well, because they are not challenging, they are functionally well (Interviewer: Yeah) cognitively well (Interviewer: Mmm-hmm) they are medically fit, they can take part, so those are the one who should be going anyway". (Ward staff 1004, Specialist registrar, female)

"Again, it's a bit difficult (Interviewer: Mmm-hmm) with this kind of patient (Interviewer: Yeah). It's unpredictability of their behaviour (Interviewer: Mmm-hmm), so it can be really challenging… because with really challenging patients on Harborne, I don't think so they are suitable at all (Interviewer: Mmm-hmm). Em, we can hardly do their very basic stuff, so getting something like that (Interviewer: Yeah, yeah) will be nearly impossible" (Ward staff 1004, Specialist registrar, female)

"Because I think on that ward, there were more challenging patients, than anywhere else in the hospital. (Interviewer: Yeah) I think that's where they, kind of, were cohorted, in that area…. I think Harborne had patients that, kind of, cohorted a lot of the very challenging patients from across the medical wards at the Queen Elizabeth Hospital and the patients that were really difficult to place and find placements for. So, I think they had a higher percentage of challenging patients (Interviewer: Mmm-hmm) than other medical units or EAB settings" (Ward staff 1001, Senior nurse, female)

Regarding assessments, ward staff semi-structured interviews and reflective journal entries suggested that assessments may be too long in duration for participants' concentration:

"for a lot of our patient cohort that that's probably, em, more than they could manage (Interviewer: Mmm-hmm, yeah. Just in terms of the time, or?) Yeah, probably in terms of the, em, both the concentration that's required to fill in the assessments and then for the physical bit. If, I think if it was a different group, then potentially you'd have more patients that would be eligible (Interviewer: Mmm-hmm) or would manage it… because I work on the surgical wards as well and a lot of those patients will take part in research studies, but their time commitment is quite short… although it's not a physical intervention" (Ward staff 1005, Geriatrician, female)

This was supported by reflective journal entries, where multiple entries recounted participants becoming fatigued during assessments, which required a break, continuing later that day, or the following day. Follow-up testing was identified as being extremely difficult and *impractical* because of the *changing dynamics* of the setting, which affected its *appropriateness* for the study:

"*Previously, patients used to be here for a very good, long period of time (Interviewer: Mmm-hmm), but now with social services moving a little bit more faster (Interviewer: Mmm-hmm), we are moving along the patient towards discharge much more quicker"* (Ward staff 1004, Specialist registrar, female)

"So, it would be fair to say that (recent structural changes on the ward)'s impacted (Interviewer: Mmm-hmm) how even those who are delayed transfers (discharges) are able to be looked after…that's actually led to us really accelerating the, the work out of hospital with the aim of being able to get those people out." (Ward staff 1003, Geriatrician, female)

Additionally, of those identified as eligible to approach and initially expected to remain on the ward, 61.5% were discharged, or scheduled for imminent discharge, 24 hours after receipt of the participant information sheet. This was further triangulated with staff interviews in the superordinate themes of *changing dynamics*, and *setting and population appropriateness*:

"how soon they are going be discharged is beyond our control, as well. Because sometimes, eh, we are waiting, awaiting a nursing home or a care home (assisted living facility) will be coming to assess them, there are funding issues, budgeting issues, em, social services won't keep us updated, and all of a sudden we come to know that there is a place available for them. Within few hours, matter of a few hours, even over the weekend, they are gone. (Interviewer: Yeah, mmm-hmm) So, ugh we are not even prepared for that discharge at that time (Interviewer: Mmm-hmm), so similar is with any studies. If we are thinking that we'll be taking some readings or we'll be taking them again, by the time you'll be back, they have gone (Interviewer: Yeah, mmm-hmm). So, it's the unpredictability of not just only the patient, but the discharge planning as well, which is beyond our control due to various factors" (Ward staff 1004, Specialist registrar, female)

High turn-over of potentially eligible patients, which was noted in patient eligibility and uptake records, was compounded by a substantial number of patients being initially identified as unsuitable for participation:

"It's difficult as well, each week we've got some, kind of, good turnovers (Interviewer: Mmm-hmm), we might have a patient that's suitable to go for it, or all of a sudden, then none." (Ward staff 1004, Specialist registrar, female)

"I worked in other acute wards as well, in there we would be sending any patients which is a bit difficult in terms of behaviour (Interviewer: Mmm-hmm) straight away to Harborne ward… rather than medical issues, it's much more their behaviour issues (Interviewer: Mmm-hmm). Em, and social issues." (Ward staff 1004, Specialist registrar, female)

"It's not that easy. When we see from the outlook, we can plan a lot of things, but when we look into the type of the patients and all limitations, at the end of the day, we'll be recruiting a very few." (Ward staff 1004, Specialist registrar, female)

Further, issues regarding the unpredictability of the setting were noted in retention of participants, with the majority of recruited patients being discharged without prior notice to the research team, and of those distributed the participant information sheet and expressing interest in participation, 82.9% being discharged or planned for imminent discharge within 24 hours of receipt:

"Yeah, so, we can easily lose, and they will be the one who will be going first as well, because they are not challenging, they are functionally well (Interviewer: Yeah) cognitively well (Interviewer: Mmm-hmm) they are medically fit, they can take part, so those are the one who should be going anyway" (Ward staff 1004, Specialist registrar, female)

This was also noted in the discharge of recruited participants, with three participants being discharged without notice within several days of recruitment. To address this, an attempt was made to recruit patients irrespective of how long they would be expected to remain on the ward, 24 hours after participant information sheet consideration. However, this amendment,

while it did marginally increase those identified as suitable to approach regarding participation, was hampered by progressively expedited discharge of such eligible patients from the ward. Further illustration of this issue can be observed in the average length of stay in the study, which was less than 1 day for all participants recruited during recruitment months in 2019, compared to 12 days for those recruited in the latter half of 2018. Following-up testing was discussed as being extremely difficult in this regard, as a result of the *changing dynamics* of the *setting*:

"I think, em it depends what outcomes you're looking for, doesn't it? (Interviewer: Mmm-hmm). Cause I think it's really hard to measure, and like I say, if people hadn't been so cognitively impaired, you might have seen some improvement, but I think it's hard to measure the improvement, and perhaps they weren't long enough there for you to measure that improvement (Interviewer: Mmm-hmm). So, I don't think it's a bad idea, but it might be better in a more EAB-type setting, not a hospital setting (Interviewer: Mmm-Hmm), where perhaps people are there for a longer period of time, because the people who were on that ward who were there for a long period of time, were the more challenging patients that couldn't take part" (Ward staff 1001, Senior nurse, female)

Regarding the superordinate themes of *impracticalities* with the setting, and *future directions*, it was expressed that impracticalities of the setting may be ameliorated within more stable *settings* containing more *suitable* potential participants:

"Because I think on that ward, there were more challenging patients, than anywhere else in the hospital. (Interviewer: Yeah) I think that's where they, kind of, were cohorted, in that area… I think Harborne had patients that, kind of, cohorted a lot of the very challenging patients from

across the medical wards at the Queen Elizabeth Hospital and the patients that were really difficult to place and find placements for. So, I think they had a higher percentage of challenging patients (Interviewer: Mmm-hmm) than other medical units or EAB settings…but somewhere like Norman Power (a newly opened enhanced assessment unit, where the Senior nurse now works) we've got physios, OT's, social workers on site, we're pushing patients to get home. We're really, kind of, pushing this home first ethos. So, we would have less challenging patients and probably, less patients without capacity, or more patients with capacity, than there was on Harborne." (Ward staff 1001, Senior nurse, female)

Further, regarding the superordinate themes of *population and setting appropriateness* within the delayed discharge setting:

"most of them are just like, it's either mildly confused or just really confused, (Interviewer: Mmm-hmm) because the patient that we were having, the majority has dementia, Alzheimer's, or vascular dementia even. So, some of them yeah. But you think that they might able to follow but then I don't think with the time frame that you need to be with them in there, might not be able to, kind of, complete…. we've got some, kind of, good turnovers (Interviewer: Mmm-hmm), we might have a patient that's suitable to go for it, or all of a sudden, then none." (Ward staff 1002, Senior nurse, female)

4.4.4.5 Integration

Triangulation of semi-structured ward staff interviews, reflective journal entries and patient eligibility records, identified substantial logistical issues with *patient and setting suitability:*

"how soon they are going be discharged is beyond our control, as well. Because sometimes, eh, we are waiting, awaiting a nursing home or a care home will be coming to assess them, there are funding issues, budgeting issues, em, social services won't keep us updated, and all of a sudden we come to know that there is a place available for them. Within few hours, matter of a few hours, even over the weekend, they are gone. (Interviewer: Yeah, mmm-hmm)So, ugh we are not even prepared for that discharge at that time (Interviewer: Mmm-hmm), so similar is with any studies." (Ward staff 1004, Senior nurse, female)

Further, triangulation illustrated that the current *setting* was not suitable for a *future* clinical trial, which may be better suited to other more stable settings:

"I don't think this is the right place" (Ward staff 1002, Senior nurse, female)

"Because with really challenging patients on Harborne, I don't think so they are suitable at all (Interviewer: Mmm-hmm). Em, we can hardly do their very basic stuff, so getting something like that (Interviewer: Yeah, yeah) will be nearly impossible" (Ward staff 1004, Specialist registrar, female)

"I'd even say the right place for, you know, any specialist equipment, or any classes or groups, is going to be out in those care centres, of which Norman Power is one, but, prospectively, with people who are receiving the bulk of their therapy in their own homes, actually then coming in, you know (Interviewer: Mmm-hmm), and using the equipment. So, coming in to one of those centres, using the equipment and going out, as well as it being used for people who are (Interviewer: Mmm-hmm) staying in one of those intermediate care centres." (Ward staff 1003, Geriatrician, female)

Integration of the interventions and assessments was hampered in this regard by the *changing dynamics* of the setting, although the positivity of having the interventions in close proximity, and discussions regarding participation were reflected in participant eligibility and retention, and ward staff semi-structured interview:

"*So, the turnover has increased… and they will be the one who will be going first as well, because they are not challenging, they are functionally well (Interviewer: Yeah) cognitively well (Interviewer: Mmm-hmm) they are medically fit, they can take part, so those are the one who should be going."* (Ward staff 1004, Specialist registrar, female)

"the good thing is that it was within the ward (Interviewer: Mmm-hmm), taking them off the ward might be, em, a little bit, they feel a bit more apprehensive (Interviewer: Mmm-hmm) and so it has its, probably, pros and cons, but, I think it was well suited being in the ward with their familiar staff surrounding them around" (Ward staff 1004, Specialist registrar, female)

"I think from a patient point of view the days on the ward can be quite long and monotonous, and actually I think a lot of them embraced having a discussion, about something, for them, a little bit off the wall, something they possibly weren't expecting when they came into hospital, em, and the few that were cognitively able to engage, I think quite enjoyed it." (Ward staff 1005, Geriatrician, female)

However, reflective diary entries did note having a core member of the ward staff who is intricately involved in the research may aid in navigating the *dynamic nature of the setting*,

which was supported in thematic analysis of ward staff interviews, however, noted this appears difficult irrespective:

"they will be the one who will be going first as well, because they are not challenging, they are functionally well (Interviewer: Yeah) cognitively well (Interviewer: Mmm-hmm) they are medically fit, they can take part, so those are the one who should be going anyway" (Ward staff 1004, Specialist registrar, female)

"If patients are well enough to take place in this, part in this, study, they are too well to be in hospital" (Ward staff 1003, Geriatrician, female)

4.4.4.6 Adaptation

The overwhelming majority of patients on the ward were identified by ward staff as medically unfit specifically relating to involvement in the study, for example, unresponsive to attempts at communication, profound sensory or cognitive impairments which impaired ability to be involved in the study, or due for imminent discharge. Additionally, many were completely bedbound and unable to transfer to the resistance training machine intervention. In this regard the machine-based intervention, in its current iteration, is largely not suitable to this setting. Interventions, if they are to be used in majority of patients within this setting will be required to be capable of being implemented in bed as most of the patients in the setting, by the end of the study, were completely bedbound, and often with significant cognitive deficits.
Conversely, however, some patients actively expressed little interest in the intervention utilising resistance bands and stress balls, which could be performed in the bed. It appeared in this regard based on reasons given for non-participation in this form of intervention, triangulated with reflective journal entries, that patients may perceive the machines to be more

prestigious and better, if they could use them. This raises an interesting aspect around future adaption of interventions for the setting, in that while machine-based interventions appear to be better received as being the superior more prestigious intervention, they are largely *impractical* for the bedbound patient within the setting. In this regard, particularly in this setting, for bedbound patients, with profound cognitive and functional deficits, a machine-based piece of exercise equipment which would be attached to the hospital bed, in the form of for example a leg press, or exercise bike, in particular for the lower limbs, may be of interest regarding adaption to facilitate participation. For example, hypothetically a concept of a resistance training machine that can be attached to the beds in the form of a leg press machine or cycling bike, which are pneumatic, and adapted for both active and passive movement, may be possible to adapt for implementation in the setting, as noted in reflective journal entries.

Additionally, while allowing active movement against a pneumatic load in patients more cognitively aware, the passive movement component may be more navigable to non-cognitively aware patients or patients that find it difficult to engage. With encouragement, this passive movement may encourage at least a degree of effort to be employed. A core aspect of the passive setting of the machine should be that it can measure the effort of the participant as well in real time so that encouragement can be given accordingly, and measurements of actual loading obtained. Due to the loss of mobility and muscle mass associated with bed stay, even these passive movements if they encourage any degree of effort may be beneficial to these bed bound patients with difficulty engaging. However, even if this were possible, these patients do represent an extremely difficult population to facilitate engagement with, in general, and especially when it comes to these forms of interventions:

"I've seen some, this is years ago with the physios. They've got this, kind of, err,

even just a little bit of like a bike rolling thing… Rather than go and taking them away from the bedside" (Ward staff 1002, Senior nurse, female)

"It's different and difficult (Interviewer: Mmm-hmm), em, and it's the unpredictability, you really, if you're planning anything and things are not according to your plan (Interviewer: Mmm-hmm), you have a back-up plan somewhere, but for such, kind of, patients, at times you really can't design a back-up plan, even." (Ward staff 1004, Specialist registrar, female)

4.4.4.7 Expansion

With regard to the expansion of the exercise interventions to this setting, the superordinate themes of *impracticalities* and *patient and setting appropriateness* were noted:

"If patients are well enough to take place in this, part in this, study, they are too well to be in hospital" (Ward staff 1003, Geriatrician, female)

However, with regard to expansion as it related to the superordinate theme of the *future directions* for such research, expansion to more stable environments with more potentially eligible participants were perceived as being more feasible. For, example, on the feasibility of the study in more general geriatric hospital inpatient populations, or other more stable settings:

"It certainly should, yes (be more feasible among general geriatric hospital inpatients), because most of them are quite keen that, if they get a, kind of, em little bit targets to, em, walk or get out of the bed, which is not always possible with the staff, because they're so much busy in their own routines… I think they will be quite keen… certainly, and by looking at such patients, either would be quite motivated and I would say that's something really interesting

(Interviewer: Mmm-hmm), would be beneficial for them in terms of their motivation." (Ward staff, 1004, Specialist registrar, female)

"I'd even say the right place for, you know, any specialist equipment, or any classes or groups, is going to be out in those care centres, of which Norman Power is one, but, prospectively, with people who are receiving the bulk of their therapy in their own homes, actually then coming in, you know (Interviewer: Mmm-hmm), and using the equipment. So, coming in to one of those centres, using the equipment and going out, as well as it being used for people who are (Interviewer: Mmm-hmm) staying in one of those intermediate care centres." (Ward staff 1003, Geriatrician, female)

"I think that would work better (among more general geriatric hospital inpatients), yes, yeah, but again, if it was more on a general ward, the length of stay might be shorter than what you'd need it for (Interviewer: Mmm-hmm, yeah)… So, I don't think it's a bad idea, but it might be better in a more EAB-type setting, not a hospital setting (Interviewer: Mmm-Hmm), where perhaps people are there for a longer period of time, because the people who were on that ward who were there for a long period of time, were the more challenging patients that couldn't take part" (Ward staff 1001, Senior nurse, female)

Similarly, with regard to the superordinate theme of *future directions* and *setting and population appropriateness*, there were perceptions that a future study would be more appropriate in a more 'hospital at home', or nursing home setting:

"There would be absolutely no reason that wouldn't be possible. So, it (expansion of exercise interventions to 'hospital at home' settings) would be similar on here really. So, you'd want the

community teams, the teams in, in the em intermediate care beds, you know, identifying people who are likely to be suitable. Um, no, I see that it would be entirely achievable… and it would be a really exciting piece of work. So, you've got the same aim, so, we want to be able to deliver resistance training (Interviewer: Mmm) for older adults… that would be really, really interesting." (Ward staff 1003, Geriatrician, female)

4.4.4.8 Limited-efficacy testing

Due to expedited patient turnover, five of the recruited participants were discharged without prior notice, before post-intervention assessments were complete. Three participants were discharged before all baseline assessments were completed. These issues were triangulated in semi structured interviews with ward staff:

"how soon they are gonna be discharged is beyond our control, as well. Because sometimes, eh, we are waiting, awaiting a nursing home or a care home (assisted living facility) will be coming to assess them, there are funding issues, budgeting issues, em, social services won't keep us updated, and all of a sudden we come to know that there is a place available for them. Within few hours, matter of a few hours, even over the weekend, they are gone. We are not even prepared for that discharge at that time (Interviewer: Mmm-hmm), so similar is with any studies. If we are thinking that we'll be taking some readings or we'll be taking them again, by the time you'll be back, they have gone" (Ward staff 1004, Specialist registrar, female)

"changing the way we do things has really accelerated over the last, em, eighteen months or so (Interviewer: Mmm-hmm) which has had a direct impact on the piece of work (Interviewer: Mmm) So, for example, all of the em people who would have been able to participate, now aren't in hospital waiting for their, em next step in their social care or em planning to go home

(Interviewer: Mmm). They're either in their own homes, and that's something achieve more of over the last six months, or they're out em in one of the off-site units which is where we now provide EAB, which stands for Enhanced Assessment (transitional care)" (Ward staff, 1003, Consultant geriatrician, female)

"when we started talking about this research, this ward was entirely for people who were delayed transfer of care (Interviewer: Mmm-hmm… A unilateral decision by the division made just over a year ago, em, introduced acute patients, em, on to the ward (Interviewer: Mmm-hmm) and it would be without accompanied changes in staffing levels. So, it would be fair to say that's impacted (Interviewer: Mmm-hmm) how even those who are delayed transfers are able to be looked after…that's actually led to us really accelerating the, the work out of hospital with the aim of being able to get those people out." (Ward staff, 1003, Consultant geriatrician, female)

There is some limited evidence of promise for these interventions among suitable frail individuals in other areas of hospital settings, or more stable research environments outside of hospitals, in terms of intermediate care facilities, assisted living facilities, nursing homes, or 'hospital at home' settings. The participant who remained on the ward and was not discharged before completion of the intervention and all post-intervention assessments, was unusual for patients on this ward, as he was someone who was in the delayed discharge setting due to a sudden change in relationship status during his hospital stay. This participant moved from frail (4/5) on the Fried frailty phenotype criteria, to pre-frail (2/5), in the two-week period of the intervention. All baseline scores for each participant are available in Appendix 4.3, and baseline and post-intervention data for this participant who completed testing is displayed in Table 4.3. This positive change was also noted during his post-intervention interview, where

the participant expressed that participation in the study, was a catalyst that encouraged him to join a gym upon discharge:

"I think it's helped a lot, getting me out of that room (Interviewer: Mmm-hmm), doing exercises, and em, being helped to do them; proving to you that it's things you can do (Interviewer: Mmm-hmm), you know, where you'd think "Oh, I don't know whether I can do that" (Interviewer: Yeah) but I know now I can, (Interviewer: Mmm-hmm). That helps your confidence." (Participant 1003, male, aged 76 years).

"I think it's been good! (Interviewer: Mmm-hmm) and I hope I can carry it on, because (participant names one of his children) has shown me a gym. (Interviewer: Yeah, you were saying that actually, yeah), and he said we could go there, £20 a month (Interviewer: Mmm-hmm), which is pretty good (Interviewer: Yeah, very good, yeah.), and what I'll do is start doing what I'm doing here… It's given me more confidence to do it" (Participant 1003, male, aged 76 years).

Table 4.3. Case study 1003 (Frail, 76-year-old male, delayed discharge patient, undergoing eight exercise intervention sessions over two-weeks).

Measure	**Baseline**	**Post-intervention**
Leg press one repetition maximum (kg)	87.5	112
Leg extension one repetition maximum (kg)	23.3	32
Fried frailty phenotype score (/5)	4	2
Short Physical Performance Battery (/12)	9	11
Balance (/4)	2	3
Gait speed (/4)	3	4
Chair stand (/4)	4	4
Katz index of activities of daily living (/6)	6	6
Geriatric Depression Scale (/30)	15	7
Hospital Anxiety and Depression Scale (/42)	8	7
Standardised mini-mental state examination (/30)	24	26
Interpersonal Support Evaluation List (/30)	22	25

**Blood assays not performed due to limited numbers.*

4.5 Summary and conclusions

To the authors knowledge, this was the first study to assess the feasibility of exercise intervention among geriatric hospital inpatients within in a delayed discharge setting, and also the first study which exclusively attempted to recruit operationally defined frail geriatric hospital inpatients into an exercise intervention in any inpatient hospital-based setting. Interpretative phenomenological analysis of participant and ward staff interviews, triangulated with patient eligibility and uptake, patient retention and adherence record, attempted limited-efficacy testing data, supplemented with reflective journal entries produced four superordinate themes: *changing dynamics, impracticalities, population and setting appropriateness*, and *future directions*. Interpretation of these data addressing research questions within each of the eight areas of feasibility concluded that the due to impracticalities regarding the appropriateness of the setting and patient cohort, a future clinical trial was likely not feasible within the setting. However, such a trial may be better suited for more stable settings, or those with a less challenging cohort of patients such as general geriatric hospital settings, transitional care settings, and nursing home and assisted living facility setting. Exercise interventions have been shown to be effective at reducing functional decline among general hospital inpatients (9), however, to date no research has been conducted among specifically frail inpatients. Within transitional care/residential care facilities the setting dynamic is more stable and may represent an ideal setting for such an intervention (14). The findings of this study, in so much as a case report, do also present some promise regarding the feasibility of exercising interventions for frail geriatric hospital inpatients in general, however, improvements over such a short duration of time may be minimal. To measure significant improvements, participants would require follow-up post-discharge in any future clinical trial. A promising aspect however of having the intervention in an inpatient hospital setting is it may motivate patients, and act as a catalyst for behaviour

change post-discharge. Patients such as the patient who completed the intervention are likely more representative of the general frail patient in hospital settings, and unusual for the Harborne delayed discharge ward in that this patient had no profound cognitive deficits, could communicate relatively well, and no major psychological or behavioural issues which made communication profoundly difficult. These issues were the case for the majority of patients on the ward, as exhibited by 87% of patient being identified as ineligible for participation by ward staff based on these criteria during initial screening. As such, this may be a suitable case study of a frail general hospital inpatient, and the potential benefits they can gain from engaging in exercise while in hospital, and potentially carrying this behaviour on outside of the setting. This is of interest to future studies in more feasible settings, or if possible, to follow patients post-discharge, particularly those leaving for community-based living arrangements or placement. Particularly, as it is the continuity of this exercise behaviour which is really of most importance, to both support, and measure with regard to its potential benefit and how this can be encouraged or implemented over time, in those, for whom primary and secondary frailty prevention has failed to be effectively maintained. This is further supported by mild improvements which this participant had in frailty status (moving from frail to pre-frail) and other multi-dimensional health measures (Table 4.3). However, feasibility analysis revealed a study of this nature is likely best suited primarily in more stable environments such as an intermediate care facilities, assisted living facilities, or nursing home settings, or in a 'hospital at home' type setting, which was outlined as the ideal form of discharge goal for these patients, and one which is becoming more widely recognised due to the benefits it can provide (15).

4.5.1 Strengths and Limitations

A strength of this study is that it is the first study to address the feasibility of a proposed exercise intervention based clinical trial within this setting, and the first study to exclusively recruit frail geriatric hospital inpatients to an exercise intervention within any inpatient hospital setting. A limitation of this study is its single site design, which may limit the degree of generalisability of the feasibility results to other delayed discharge hospital ward settings. Moreover, this setting may have represented a more challenging environment than other delayed discharge settings, particularly those such as transitional care facilities, which may be more suitable sites for a proposed hypothetical clinical trial. While difficult, a proposed future clinical trial utilising an exercise interventions for frail geriatric hospital inpatients, or discharged patients in their own homes, or assisted living facility may be feasible, however, not in a hospital delayed discharge setting where patients have substantial functional, cognitive, and behavioural/social issues. These issues as they relate to feasibility become further compounded by the rapidly changing dynamics of the setting, results in non-feasibility across all eight areas of feasibility inquiry (8).

4.5.2 Future directions

A future clinical trial appears to be unfeasible within a delayed discharge setting due to poor suitability of patients residing in the setting, combined with rapid discharge of any potentially eligible patients. Such a study is likely to be more feasible among less challenging populations of frail geriatric hospital inpatients, but likely best suited for more stable environments in the form of ‘hospital at home’ settings, transitional care facilities, or residential care settings, including assisted living facilities and nursing homes. While for more challenging patients, adaptions may be achievable in these more stable settings with

significant assistance from a larger study support team who are integrated and deeply embedded within the study setting.

Chapter 5. Keeping Active in Residential Elderly: feasibility study protocol

The contents of this chapter are published in BMC Pilot and Feasibility studies as Doody, P., Lord, J.M. & Whittaker, A.C. 2019, "Assessing the feasibility and impact of an adapted resistance training intervention, aimed at improving the multi-dimensional health and functional capacity of frail older adults in residential care settings: protocol for a feasibility study", Pilot and Feasibility Studies, vol. 5, no. 1, pp. 86. doi: 10.1186/s40814-019-0470-1.

5.1 Chapter summary

This chapter is a protocol manuscript of my other feasibility study, Keeping Active in Residential Elderly (KARE). This study was advanced by myself, with the guidance of my primary supervisor, through the initial idea conceptualisation, protocol development, University sponsorship approval, and NHS ethical approval phase during the first 14 months of my PhD, along with its sister study, Seated Physical Activity in Ageing (SPAA), and due to commence the first week of November 2017. However, approximately 10 days prior to the planned commencement of the study we were informed by our contacts at BUPA UK of the imminent, albeit unexpected and previously undisclosed sale of the research site. Unfortunately, the contracts team at BUPA UK would no longer agree to the study taking place during the sale-period, despite the year of planning that had gone into its development, and the fact that all the equipment had been transported to and installed in the research site (Figure 5.1). We were assured that it was likely that the project could commence once the new management of the site were in place and settled in the New Year.

In the succeeding months, subsequent attempts to rectify the situation or locate an alternative research site with BUPA UK proved unfruitful, and our two main contacts at the organisation, the Head of Research and Development (Paul Edwards), and a local events coordinator (Linda Patel)) were made redundant shortly after the sale of the site. During this time, it was decided that I would focus on getting my other study, Seated Physical Activity in Ageing (SPAA), up and running in the time being as there was no guarantee of a prompt resolution relating to KARE's research site. After several months of liaising with the new owner and BUPA UK, it was decided by my supervisory team that the study could no longer realistically be completed during the timeframe of my PhD but would be written up as a protocol chapter.

Several months after the initial research site fell through, another appropriate research site was located by the PANINI project PI, and initial visits and agreements took place to set up the research at an alternative BUPA home in Bromsgrove. However, several months later, after unexplained delays in signing a contract between BUPA UK and the University, we were informed that the management of the region had changed and that they were no longer sure that this home included the right type of residents for the proposed trial. Given the lack of assurances from BUPA UK, the PANINI project PI decided to no longer attempt to go forward with BUPA UK. In the months succeeding this the PANINI project PI contacted a local Christadelphian assisted living facility organisation about their specific assisted living facility, Olivet, in the Birmingham area. Although personal contacts have been obliging with providing a research site for the KARE study, this would now not be feasible within the timeframe of my PhD, so was passed on to a new PhD student to complete utilising the protocol described in this chapter. This protocol has been published in BMC pilot and feasibility studies (1).

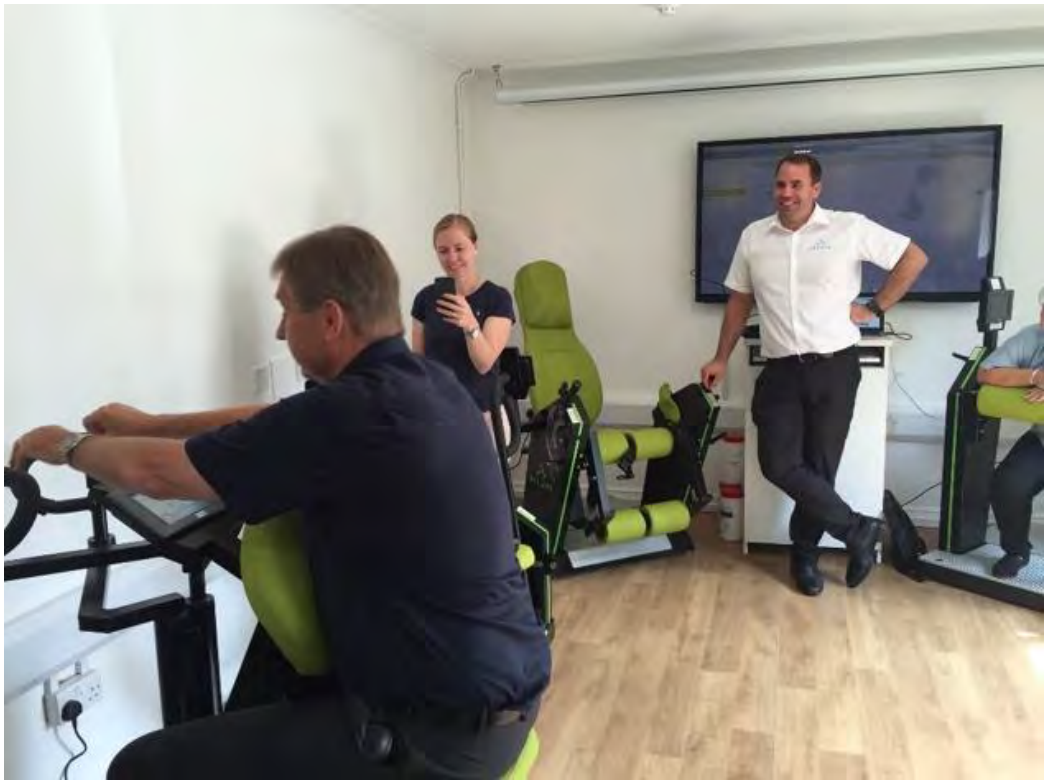


Figure 5.1 Demonstration of exercise equipment with PANINI industrial partners HUR Ltd, following installation at the Ryland View BUPA UK assisted living facility, Tipton, United Kingdom, July 2017

5.2 Abstract

Background: Frailty is a common and clinically significant condition in older adults, predominantly due to its association with adverse health outcomes such as hospitalisation, disability and mortality. Exercise interventions have been shown to be a beneficial treatment for frail older adults. However, more high-quality studies are needed within this area to assess the feasibility and impact of these interventions in frail geriatric populations within different settings, and with regards to their impact on broader aspects of health and wellbeing.

Methods: This study will utilise an interventional, randomised, controlled research design in order to assess the feasibility (acceptability, demand, implementation, practicality, adaptation, integration, expansion) and potential impact (limited-efficacy testing) of a specially adapted resistance training intervention; aimed at improving the multi-dimensional health and functional capacity of frail geriatric assisted living facility residents.

Discussion: The most immediate implication of this research from a scientific perspective is informing the feasibility, and potential efficacy, of a proposed future clinical trial within this setting. Additionally, if the study proves feasible, and the limited-efficacy testing proves positive, this study also has the potential to lead to advancement in the care for frail geriatric populations within residential care settings; and the ability to measurably improve various aspects of health and functional capacity within this population. This study has been granted a favourable ethical opinion by the London Harrow NHS Research Ethics Committee and is sponsored by the University of Birmingham. The findings of this study will be disseminated through publication in open access scientific journals, public engagement events, online via social media, conference presentations, and directly to study participants.

Trial registration: ClinicalTrials.gov: NCT03141879. Registered 5th May 2017, https://clinicaltrials.gov/ct2/show/NCT03141879

Keywords: Assisted living facility; exercise; feasibility; frail; functional capacity; geriatric; health, intervention; older adults; physical activity; residential care.

5.3 Background

Frailty is a common and clinically significant condition within geriatric populations (2); the latter predominantly due to its association with adverse health outcomes such as hospitalisation, disability and mortality (2-7). While there is evidence of the benefits of exercise relating to the prevention, treatment, and reversal of frailty, it is universally noted that there needs to be more high quality studies within this area to truly assess the feasibility and impact of exercise in frail geriatric populations, particularly relating to its effects on broader aspects of health and well-being (2). This present study will assess the feasibility and potential efficacy of a specialised exercise intervention, in the form of a 12-week, three to four days per week, resistance training programme for frail older adults within a residential care setting. Although the proposed future clinical trial which this feasibility study will inform will be 24 weeks in duration (12 weeks of intervention, with a 12 -week follow-up), this present feasibility study will be 12 weeks in duration (six-weeks of intervention, with a six-week follow-up), as it was determined that the full 24-weeks of the proposed future clinical trial will not be necessary to determine its feasibility. Similar to Chapter 4, this pragmatic, mixed methods, feasibility study approach is consistent with the UK Medical Research Council's latest framework for developing and evaluating complex interventions (8, 9). Feasibility will relate to the eight main areas of focus for feasibility studies (10), while potential efficacy will be assessed through the limited-efficacy testing of the impact of the intervention on the patient-centred outcomes relating to multi-dimensional health and functional capacity.

5.4 Methods

5.4.1 Aims and objectives

The primary aim of this study is to assess the feasibility of a proposed future clinical trial in this setting, which aims to assess the impact of a specially adapted resistance training intervention on the physiological, psychological, cognitive, social, and emotional health and functional capacity of frail geriatric populations within a residential care setting; recognising health as a multi-factorial concept incorporating multiple inter-related dimensions. The secondary aim of this feasibility study is to assess the potential efficacy of the intervention on the primary dependent variables of the proposed future clinical trial within this setting.

The primary and secondary aims of this study will be achieved through the sequential achievement of the following objectives: 1) Recruitment of eligible participants from the Olivet Christadelphian assisted living facility, Acocks Green, Birmingham, United Kingdom. 2) Baseline assessment of the patient-centred outcomes related to multi-dimensional health. 3) Assessment of the feasibility of the study as it relates to the eight-primary area of focus for feasibility studies (10). 4) Post-intervention assessment of all feasibility (primary) and patient-centred (secondary) outcomes.

The research questions of this study relate to the eight aforementioned areas of focus of this feasibility study, incorporating the following questions relating to the feasibility and potential efficacy of the study within this setting: Can it work? Will it work? Does it work? (10) (Table 5.1).

5.4.2 Design overview

This feasibility study will utilise a 12-week, interventional, randomised, independent measures research design (Figure 5.2).

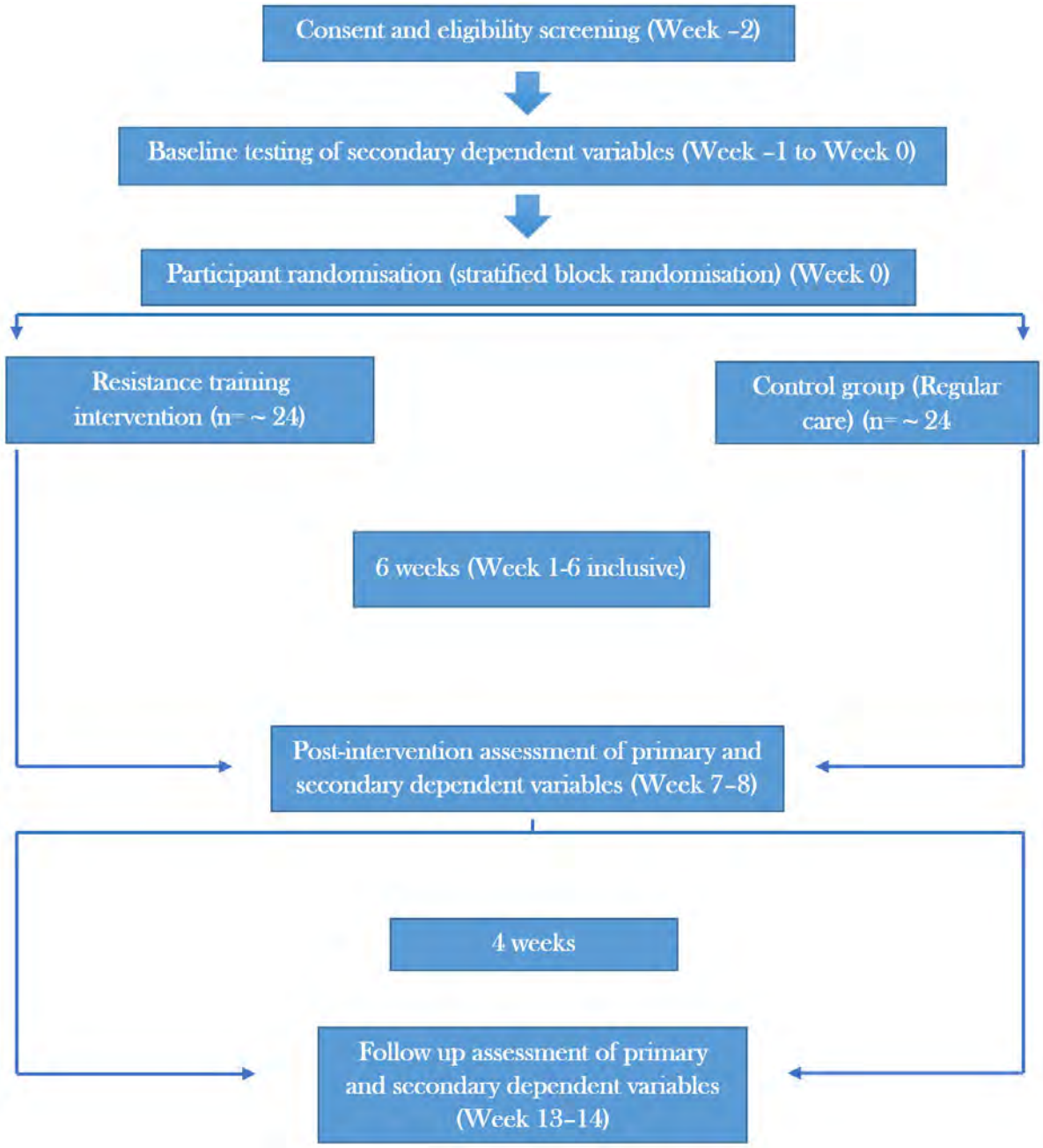


Figure 5.2. Trial schema of participant flow through the duration of the study.

The independent variables of the study will comprise of a specially adapted resistance training intervention, and a control group which will receive regular care. A wait-list control group will be utilised within the proposed future clinical trial, but a concurrent control group will be utilised within this feasibility study.

In order to ensure this present study is as scientifically valid as possible a number of precautions have been taken to protect the internal and external validity of the study within its methodological design:

First, for each participant, all testing procedures (baseline, post-intervention (six-weeks) and follow-up (12-weeks)) will be conducted at approximately the same time of day (+/- two hours). This will be controlled in order to protect the findings of the study from changes in the patient-centred outcomes which may be attributable to circadian variation rather than manipulation of the independent variable (11). The hypothesis of the study will not be divulged to participants prior to or during the conduction of the study in order to control for any potential degree of demand characteristics; a scenario where participants alter their behaviour and/or answers, in order to align with what they believe is potentially the 'desired' outcome of the study. All testing sessions related to patient-centred outcomes will take place at least 24 hours after the cessation of the previous training session for each participant. This will be implemented in order to ensure acute fatigue does not become a contributing factor to the results of the study, specifically relating to the patient-centred outcomes, but also the feasibility of such practice during a proposed future clinical trial. All participants will also be asked to refrain from any relatively high intensity exercise training up to 24 hours prior to each testing session. Due to an independent measures research design being employed, a control group will be employed in order to increase the internal validity of the study i.e., increase the likelihood that any potential changes in the patient-centred outcomes of the intervention group are due to the intervention and not additional external factors. The order in which patient-centred outcomes are tested will be counter-balanced throughout the study at each assessment timepoint in order to attempt to protect the study from practice effects, especially in the form of order effects, where a participant has been exposed to a specific order of testing before and as such performs better on subsequent testing procedures of the same material. Stratified-block randomization of participants (based on frailty score and age)

will also be implemented in order to reduce any differences between participants within each of the independent variable groups at baseline. This will also allow for protection against additional threats to the internal validity of the study, such as the influence of passing time (unrelated to the intervention) on participants within the study (maturation), and also protects against potential subconscious selection bias amongst the research team relating to group allocation of participants. Finally, in order to increase the external validity of the study, the eligibility criteria of this present study will be kept as minimalistic as possible (within the limits of safety and reason), in order to allow as inclusive a proportion of this population as possible, and in such producing findings which are applicable to not only those within the study, but to the greater population of frail geriatric older adults within residential care settings.

5.4.3 Eligibility

This study is open to both men and woman whom meet the following eligibility criteria: Presently a resident within the Olivet Christadelphian assisted living facility, Acocks Green, Birmingham, United Kingdom; ≥ 65 years of age; frail according to the Fried Frailty Phenotype criteria (3); have the capacity to speak and read in English; not currently taking part in any other clinical trial which could potentially impact upon or influence the findings of this present study; not currently terminally ill with life expectancy which is less than the duration of the follow-up of the study; does not have any severe sensory impairment which would profoundly impact upon their capacity to undergo the intervention, even once appropriate adaptations have been made.

5.4.4 Intervention

The intervention within this study will be comprised of a moderately intensive, 35 minute per session, three-four sessions per week, six-week, machine-based resistance training intervention. The sessions will be conducted in groups of approximately six individuals in the form of a group exercise circuit. Study participants will perform exercises predominantly targeting the lower limbs (but also upper limbs and core) on six separate pieces of resistance training equipment: leg extension, leg curl, leg press, chest press, back row, seated abdominal crunch, and thigh abduction / adduction training machines (HUR Ltd, Helsinki) (Figure 5.3).

Figure 5.3. HUR Ltd resistance training equipment utilised within the interventional arm of the study.

All sessions will be performed under the guidance of a qualified trainer, and all participants will undergo 21 sessions in total throughout the six-week intervention. An outline of the protocol for each session can be found in Figure 5.4.

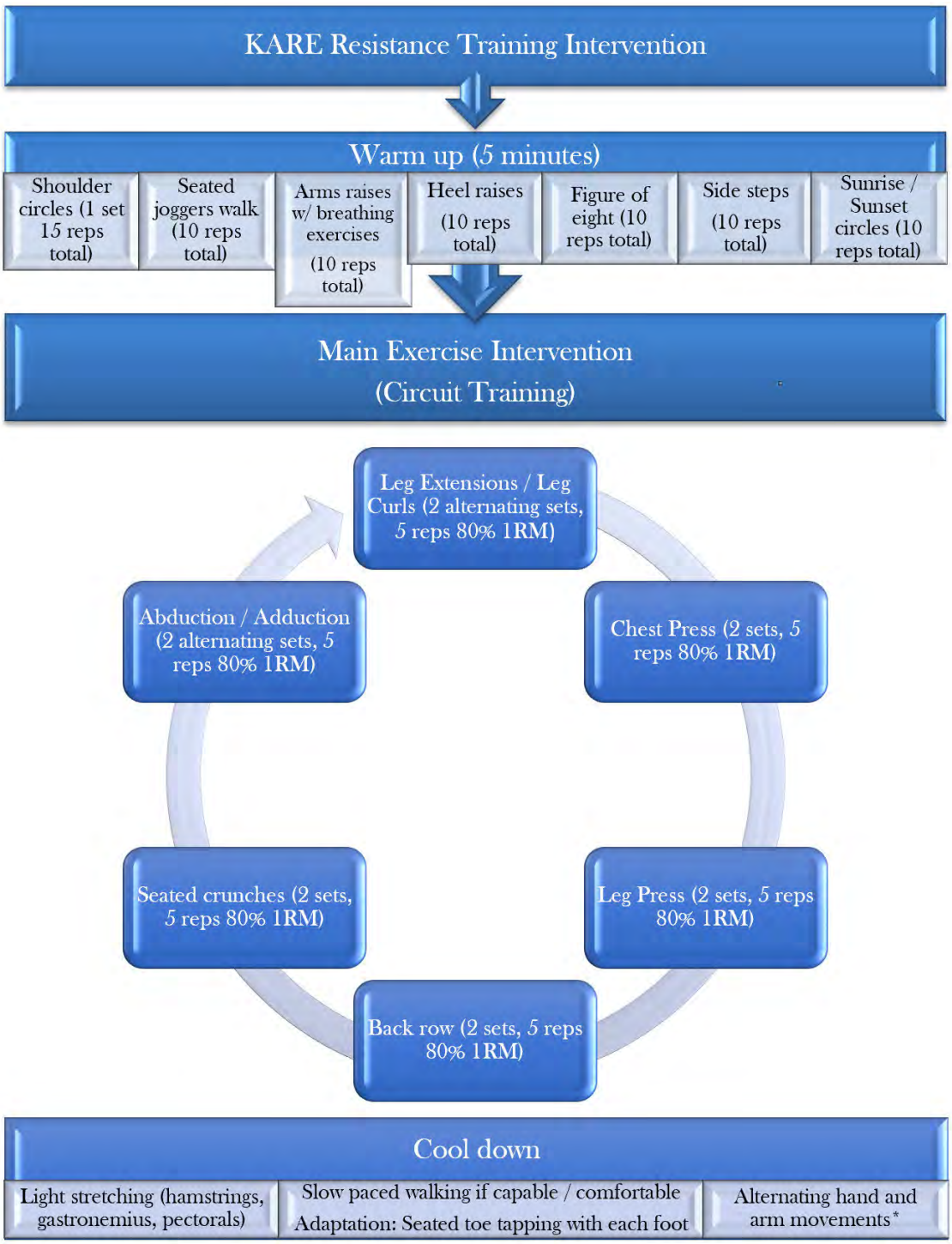


Figure 5.4. Interventional exercise session protocol.

The intervention will commence with three sessions per week for the first week, followed by four sessions per week for the second week. This pattern will alternate throughout the duration of the study (Table 5.2). A maximum of one session will be performed each day, and sessions will not be performed on any more than a maximum of two consecutive days

throughout the duration of the study to reduce fatigue and the risk of delayed onset muscle soreness or injury. As previously mentioned, sessions within the resistance training intervention group can facilitate a maximum of six participants per session (limited by the number of resistance training machines). As such dependent on recruitment numbers, the intervention will be conducted in multiple different sessions during each training day and separated into different groups if necessary. These individual groups will not be compared to one another.

Additionally, all participants within the intervention will have continual access to the resistance training equipment between the end of the post-intervention assessments, and the follow-up assessments. Between the post-intervention assessments and follow-up assessments, participants and care staff will be encouraged to have participants utilise the machines as much as possible during this period, and although no formal exercise programme will be in place, participants will have access to the machines and the session protocol previously utilised. The unique aspect of these machines is that they require participants to scan an ID card prior to use and all user data (the number of repetitions, sets, and the loads lifted) is stored on an electronic database accessible to the researcher at any time. As such this will provide interesting feasibility data relating to the continued use of the equipment after the formal study-based intervention has concluded.

5.4.5 Outcome Measures

5.4.5.1 Feasibility outcomes

The feasibility outcomes of this study will relate to the eight primary areas of focus of feasibility studies (10) (utilised to establish the feasibility of a proposed future clinical trial within this setting), relating to: acceptability, demand, implementation, practicality, adaptation, integration expansion and limited-efficacy testing.

These feasibility outcomes will be assessed through semi-structured interviews with study participants and focus with intervention implementers and study support staff post-intervention. Participant uptake and adherence records will also be employed throughout, as will questionnaires with study participants, intervention implementers and study support staff. These methods will seek to attain answers to the following questions and parameters relating to the eight primary areas of enquiry for this feasibility study outlined in further detail in Table 5.1.

Table 5.1. The eight primary areas of focus, outlining the research questions and methods of assessment.

Area of focus	Research questions	Methods of Assessment
Acceptability	• Will the proposed population be interested in participating in the study? • What will the uptake be? • Will the program be judged as suitable by the delivers of the program in addition to the program participants? • What are participant's opinions on hypothetically being randomised into a control group during a proposed future clinical trial? * *Participants within the feasibility study will not be recruited as participants within the proposed future clinical trial in order to protect the scientific validity of a future clinical trial, as the participants within the feasibility will already have undergone the interventions. Additionally, the intervention may be altered after being informed by this feasibility study as well as utilising Patient and Public Involvement (PPI)).	• Participant uptake analysis (All participants approached and eligible for the study / all of those successfully recruited to the study) • Semi-structured interviews with participants • Focus groups with intervention implementers and study support staff.
Demand	• Will the proposed population of assisted living facility residents participate in the study? • What will adherence rates be? • Are the staff in the home open to the idea of having an exercise intervention potentially on the ward long term if it proves effective?	• Analysis of uptake rates • Exercise intervention adherence rates • Focus groups with study support staff/ assisted living facility staff.
Implementation	• What are the possible logistical issues with the setting which will need to be addressed or accounted for prior to the clinical trial? • Can the interventions be successfully carried out within this setting? • Can a single or double bind be successfully implemented within the setting?	• Semi-structured interviews with study participants. • More in-depth with focus groups with intervention implementers and study support staff.

Practicality	• What are the practical implications of the study with relation to the time commitment of the researchers, relating to both the implementation of the intervention, and the testing of participants for the dependent variables of the proposed future clinical trial? • Is it viable to potentially conduct follow-up testing on participants in the proposed future clinical trial 12-weeks after the intervention at 24-weeks? • Do any alterations need to be made to the proposed primary dependent variables of the future clinical trial? • If the intervention is successful in influencing parameters of health and functional capacity, will it potentially be possible to assess if these improvements are sustained during a 12-week follow-up in the proposed future clinical trial, if the same is found?	• Semi-structured interviews with study participants. • Focus groups with support staff and intervention implementers.
Integration	• How will the assisted living facility staff appraise the study? • Will the intervention be easily integrated into the existing culture, protocols and procedures within the assisted living facility seamlessly?	• Focus groups with support staff and intervention implementers.
Adaptation	• Will any further adaptations be required to the existing intervention to make it more feasible or appropriate within this setting?	• Focus groups with intervention implementers. • Semi-structured interviews with participants.
Expansion	• Can the HUR equipment be successfully utilised in (and its use expanded to) this setting?	• Semi-structured interviews with study participants • Focus group with intervention implementers.
Limited-efficacy testing	• Is six weeks (or potentially 12-weeks in the case of the proposed future clinical trial) a sufficient duration to potentially provide significant benefit to patients? (This will inform the time points at which testing will occur within the future clinical trial) • Can a moderately intensive (three-four days per week), six-week (12-weeks potentially in the case of the proposed future clinical trial) specially adapted resistance training intervention improve markers of multi-dimensional health, in frail elderly individuals?	• Analysis of the patient-centred outcomes within the study (primary dependent variables of the proposed future clinical trial) • Analysis of uptake and adherence rates • Analysis of the level of satisfaction with the interventions through semi-structured interviews and focus groups with participants and intervention implementers respectively, post-intervention.

In order to enhance trustworthiness in the qualitative component of this research, several methods will be employed**:**

The researcher gathering the data will keep a reflective journal in which they will record information about themselves, their activities and the methods used. Field notes will include time, date and location, participant's actual notes, the researcher's own questions and comments. This will lend to logging and documenting what is learned about the study, the intervention, the setting, the participants, and used to refine focus for future interviews through assessing the following questions: What is important? What is it I need to find out more about? What would I want to focus on more closely if I could do the interview again, or in future interviews? (12).

Data will be gathered from study participants, study support staff and intervention implementers in order to collect data from multiple sources (triangulate information). This study will also employ more than one researcher to analyse the qualitative data in order to enhance triangulation and validity.

Enough details will be given about the participants and the setting to make decisions about the quality of the findings from the qualitative analysis. Detailed descriptions about the participants experiences and the setting will be provided by the researcher.

In the qualitative data analysis, clarification of all possible researcher biases will be made known. For example, it will be articulated that the researcher is an advocate of physical activity as a means to promote health, prescribing to the theoretical and practical concept of exercise as medicine, and hence there may be some form of unconscious subjective bias in this context. However, it should also be noted that the researcher within this study is also an advocate of science to an equal or even greater extent, and as such any such bias in subjective analysis would potentially be counteracted in this sense.

Interviews - “a conversation with a purpose” (13) will be the primary method of data gathering utilised within this feasibility study, as it enables large amounts of information to be gathered relatively quickly. Specifically, this study will employ semi-structured interviews, with open questions in a conversational format. There will be a number of pre-determined themes, topics and questions to be discussed, specifically relating to the eight areas of focus of the feasibility outcomes of this study. All interviews will be audio-recorded in order to facilitate future transcription. This will also be the case with focus groups with study support staff and intervention implementers. The qualitative element of this study will also explore opportunities for Patient and Public Involvement (PPI) in the research design of the proposed future clinical trial.

As this study will utilise a mixed methods research approach, employing both qualitative (feasibility outcomes) and quantitative (patient-centred outcomes) research methods, this will provide researchers with the opportunity of not only gathering the individual data needed from each method of data collection, but will also facilitate the potential for elaboration and expansion of these findings through complementary analysis of each approach. The qualitative aspect of this feasibility study, aimed at assessing the feasibility outcomes, will predominantly take a phenomenological approach to understand the experiences of individuals involved in the study (14).

5.4.5.2 Patient-centred outcomes

The patient-centred outcomes of this feasibility study relating to multi-dimensional health (and comprising the proposed primary dependent variables of a proposed future clinical trial), are as follows:

Physiological*: Serum Cortisol, Dehydroepiandrosterone (DHEAS), cortisol: DHEAS ratio, C-reactive proteins (CRP), Interleukin 6 (IL-6), Tumor Necrosis Factor alpha (TNFα), Interferon gamma (IFNy)

Functional: Hand grip strength (Southampton protocol (15)), Leg strength and power output (16, 17), Short Physical Performance Battery (SPPB) (18), Katz Index of Independence in Activities of Daily Living (Katz ADL) (19), Fried Frailty Phenotype (3)

Psychological / Emotional: Geriatric Depression Scale (GDS) (20), Hospital Anxiety Depression Scale (HADS) (21), Perceived Stress Scale (PSS) (22)

Cognitive: Standardized Mini-Mental State Examination (SMMSE) (23)

Social: Interpersonal Support Evaluation List (ISEL-12) (24)

*All blood samples will be obtained through the process of phlebotomy (venepuncture). Serum will be analysed for the physiological patient-centred outcomes relating to cortisol and DHEAS (assessed by commercial ELISA kit). C-reactive protein and inflammatory cytokines (IL-6, TNFα, IFNy) will be assayed using a multiplex commercial kit (R&D Systems).

5.4.6 Identification, Consent and Recruitment

Identification: To identify potential participants, residents will initially be screened by their care team for the following criteria: aged ≥ 65 years; no severe sensory impairments that would profoundly impact upon their ability to participate; able to speak and read the English language; not currently taking part in any other clinical trial which could potentially affect the results of this current study and with a life expectancy which is greater than the length of the study. Potential participants will first be approached by a member of their regular care team at the assisted living facility with an information sheet related to the study and asked if they would either be interested in participating in the study, or if they would like to receive more

information. The information sheets will contain all of the most pertinent information relating to the study and in particular what it would require from potential participants. Potential participants will be given approximately one week, after receipt of the information sheet, to consider whether or not they would like to participate in the study. If potential participants express their interest in the study, a member of the research team will meet with them to provide them with more information on the study, and to address any queries which they may have.

Consent: At this stage potential participants will also be provided with an informed consent form and asked if they would be interested in participating. If it is deemed that a potential participant lacks the capacity to consent, a personal consultee will be sought. If a personal consultee cannot be found, then a nominated consultee will be sought. All efforts possible will be made in this regard to include participants whom lack the capacity to consent within the study, as intrinsically within the research team from a personal and professional perspective we would consider it unethical to exclude potential participants from participating in a study, which can potentially benefit them and their overall health status, simply due to the fact that they lack the capacity to consent.

Recruitment: Following consent being obtained from the participant themselves, or the obtainment of a declaration from a consultee, all consented potential participants will be screened for the remaining eligibility criteria relating to frailty status.

5.4.7 Randomisation and concealment

To restrict the chances of imbalance between the intervention and control groups within this present study (in addition to the proposed future clinical trial) a stratified block randomisation strategy will be employed (25), in order to achieve balance relating to participant baseline characteristics (covariates) for frailty score and age (26). This randomisation procedure will

be carried out through a computer-generated programme (27), by a competent staff member, otherwise unrelated to the study, and the project as whole. Allocation concealment will be employed where the researcher responsible for recruiting participants and gathering data from the participants will be unaware of the group to which each participant will be allocated initially until initial data collection is complete, avoiding both conscious and subconscious selection bias (28-30).

5.4.8 Data collection

Data within this feasibility study will predominantly be collected at three main time points: baseline, post-intervention and follow-up (Table 5.2).

Table 5.2. Study timeline of all major events throughout the duration of the study (SPIRIT Schedule).

Week	Keeping Active in Residential Elderly (KARE) Study Timeline						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Week – 2	Consent and Eligibility Screening	Consent and Eligibility Screening	Consent and Eligibility Screening	Consent and Eligibility Screening	Consent and Eligibility Screening	Consent and Eligibility Screening	-
Week -1	Pre-Intervention Assessments	Pre-Intervention Assessments	Pre-Intervention Assessments	Pre-Intervention Assessments	Pre-Intervention Assessments	Pre-Intervention Assessments	Rest
Week 0	Pre-Intervention Assessments	Pre-Intervention Assessments	Pre-Intervention Assessments	Pre-Intervention Assessments	Pre-Intervention Assessments	Pre-Intervention Assessments	Rest
Week 1	Training	Rest	Training	Rest	Training	Rest	Rest
Week 2	Training	Rest	Training	Rest	Training	Training	Rest
Week 3	Training	Rest	Training	Rest	Training	Rest	Rest
Week 4	Training	Rest	Training	Rest	Training	Training	Rest
Week 5	Training	Rest	Training	Rest	Training	Rest	Rest
Week 6	Training	Rest	Training	Rest	Training	Training	Rest

Week 7	Post-Intervention Assessment	Post-Intervention Assessment	Post-Intervention Assessment	Post-Intervention Assessment	Post-Intervention Assessment	Post-Intervention Assessment	-
Week 8	Post-Intervention Assessment	Post-Intervention Assessment	Post-Intervention Assessment	Post-Intervention Assessment	Post-Intervention Assessment	Post-Intervention Assessment	-
Week 9 - 12	Participants within the resistance training intervention group will have access to the machines but no formal exercise program will be in place. (All activity within this period will be automatically recorded on an electronic database for each participant)						
Week 13	Follow-up assessment	Follow-up assessment	Follow-up assessment	Follow-up assessment	Follow-up assessment	Follow-up assessment	-
Week 14	Follow-up Assessment	Follow-up Assessment	Follow-up Assessment	Follow-up Assessment	Follow-up Assessment	Follow-up assessment	-

Baseline Assessment: Participant's baseline socio-demographic and information for the patient-centred outcomes of the study will be collected between 12 days-36 hours prior to the commencement of the six-week intervention. One repetitions maximum (1RM) for all of the resistance training equipment utilised within the resistance training intervention will also be assessed during this time period (after all baseline testing has been completed, and at least 18 hours after baseline testing which requires physical exertion, which may impact on the accuracy of the 1RM measurements).

Post-intervention assessment: The feasibility and patient-centred outcomes of the study will be assessed between 10 hours-12 days post the cessation of the six-week intervention. All assessment will take place at least 24 hours post the cessation of the last exercise training session.

Follow–up testing: Follow-up testing will be conducted six weeks post-intervention cessation for the feasibility and patient-centred outcomes of the study. All data will be gathered within a period of approximately 12 days from all participants.

Adherence rates in the intervention group will be recorded as the number of repetitions completed in a set (90% required for adherence to that exercise), and then the number of exercises for which there was a 90% adherence. If participants meet these parameters for each exercise session, they will be considered to be in 100% adherence to the intervention. For example, if a participant performs 95% of all exercises in one session then they will be considered to be in adherence for that session. If they then continue this level of adherence for the remaining 41 sessions, they will have a 100% adherence. If a participant adheres to 95% of the intervention for 36 sessions, but only 80% for six sessions, then they will have an 86% adherence rate. 90% of all exercises performed within that session will signify adherence to that session. Adherence rates, whether very high, or somewhat low may signify

that the intervention may have been too demanding, too easy, or optimal. Information will also be collected throughout the study related to uptake and retention rates.

5.4.9 Data monitoring

Data will be monitored by the trial management committee at monthly intervals. Prior to analysis data entry checking will be conducted for accuracy on 10% of all participants, and queries will be resolved through discussion with the trial management committee and access to the source documents held at the University. Data management will adhere to the PANINI data management plan, which was developed in accordance with national and European principles as part of the University research governance and European Commission research governance principles. Thus, data management for this project adheres to the FAIR principles (31).

5.4.10 Sample size

This study aims to recruit a convenience sample of n = ~ 48 participants: 24 intervention, 24 regular care control. No formal power calculations were conducted due to the feasibility nature of this study. This estimated sample size is based on optimistic projections following preliminary discussion with assisted living facility residents with regard to potential uptake.

5.4.11 Statistical methods

5.4.11.1 Qualitative analysis

Analysis of the feasibility outcomes of this study will be based on an inductive process, which utilises interpretative phenomenological analysis (thematic analysis). Two researchers will be employed to analyse the data acquired in order to increase triangulation from the analysis perspective, having already triangulated data acquisition through data obtainment

from multiple sources (i.e., study participants, intervention implementers and study support staff). All semi-structured interviews and focus groups will be audio-recorded. Data synthesis will be performed through verbatim transcription of the semi-structured interviews and focus groups. The three main steps of interpretative phenomenological analysis will be followed (14): 1) The generation of themes from transcripts within the areas of feasibility inquiry. As an iterative process, these themes will be continuously reviewed and adapted based on the emergence of information in subsequent transcripts. 2) The collation and separation of these themes within each of the areas of feasibility inquiry. 3) Written interpretation of the resultant themes within each of the areas of feasibility and their relationship to one another. At all stages within this process, reflective journal entries and field notes will be utilised to provide a more comprehensive understanding of the findings, in addition to incorporating additional feasibility information related to uptake and retention rates, and limited-efficacy testing of the patient-centred outcomes in the final analysis to provide a comprehensive assessment of the feasibility of the study.

5.4.11.2 Quantitative analysis

Statistical analysis of the patient-centred outcomes will be performed using IBM SPSS (Statistical Package for Social Sciences) software. These analyse will be performed as part of the limited-efficacy testing regarding the potential impact of the intervention on the patient-centred outcomes (proposed primary dependent variables of a proposed future clinical trial). Specifically, for this research the type of statistical analysis which will be used will be as follows: 2x3 way independent measures ANOVA's (analysis' of variance consisting of a two independent variables; the specialised resistance training intervention, and control group, each with three levels: baseline, post-intervention (6-weeks), and follow-up (12-weeks) will be carried out for all patient-centred outcomes. A subsequent post-hoc test will be utilised if a

significant main effect or interactions are found. Pearson product correlations will also be utilised between various socio-demographic variables (such as age and sex) and the patient-centred outcomes of this study, to assess possible relationships between differences in these socio-demographic factors and changes in the patient-centred outcomes of the study.

Central tendency and variability measurements consisting of the measurement of parameters such as the mean, median, and mode, and standard deviation and range of scores respectively, will also be utilised during the analysis of data for illustrative purpose. Significance levels will be set at 0.05 ($p \leq 0.05$), and effect sizes will be reported for all analyses. Additionally, in order to establish if the assumptions of parametric statistics have been met in relation to the assumption that there is a normal distribution of data, the data will be analysed for skewness and kurtosis. As the quantitative component of this study has not been powered given the feasibility nature of the study, the examination of the efficacy of the intervention to impact these variables is limited and interpretation should be treated with caution pending the results from the future powered clinical trial. All results will be reported with 95% confidence intervals.

5.5 Data storage and protection

Participants' identity or other personal information will be kept confidential. Participants will be assigned a unique ID number under which all study information will be stored in a secure file and saved on an encrypted and password protected computer and laptop at the University of Birmingham (UoB). Physical data (e.g., Case Report Forms (CRFs)) will be identifiable only by ID number and stored in a locked filing cabinet at the School of Sport, Exercise, and Rehabilitation Sciences at the University of Birmingham, accessible only by the research team. Participants personal data (name, date of birth) and consent forms matching them to their ID number, will be stored securely in a locked filing cabinet, separate from all other data

and/or in a password protected master sheet on an encrypted and password protected computer and laptop at the University of Birmingham.

All serum samples will be stored in Human Tissue Act complaint facilities at the University of Birmingham for up to 3 years then destroyed. Anonymised whole blood samples will be transferred to the University of Bologna for DNA methylation analysis on candidate genes related to nutrition and physical activity effects on the ageing process as part of an already ethically approved study which is part of the PANINI network, then destroyed at the end of the PANINI trial in Bologna (end of 2019).

All hard copy data collected on CRFs will be stored in a linked-anonymised format securely for 10 years then destroyed. All personal data (consent forms, master sheet linking participant IDs to names and contact details) will be stored for 10 years then destroyed. All computerised data will be archived on UOB servers in anonymised form for 10 years in the first instance in accordance with the UoB Code of Practice for Research, and the Data Protection Act (1998).

Following analysis for this specific study, all data will be anonymised and also entered into a European 'PANINI' open access database that this project is part of, and optionally may be analysed in future ethically approved research across the PANINI network. The PANINI shared dataset will be made open access at the conclusion of the funding for the PANINI network including this study in 2020 and stored for at least 10 years as an open access searchable published dataset.

5.6 Discussion

5.6.1 Implication of the research

As this is a feasibility study, the most immediate implication from a research prospective is the assessment of the feasibility of the proposed future clinical trial within this setting; which

will allow for a more detailed, informative and robust understanding of the influences of the specially adapted resistance training intervention on the primary dependent variables of the future clinical trial (the multi-dimensional health and functional capacity of frail older adults within residential care settings). Additionally, frailty can also have an enormous impact on an individual's life, in addition to the lives of their loved ones, and even an impact on society as a whole (32). As such, if the study does prove feasible, and the limited-efficacy testing proves positive, this study also has the potential to have far reaching implications; most importantly leading to the advancement of care for frail geriatric populations within residential care settings and the ability to measurably improve various aspects of their overall health and functional ability, as well as benefitting the lives of their loved ones.

5.6.2 Dissemination

The findings of this study will be disseminated through publication in the form of scientific papers in open access scientific journals, public engagement events within the United Kingdom and Europe (a core element of the PANINI project's aims and objectives), online via social media (Twitter, Instagram) and the PANINI project website (33), presentation at various conferences within the UK, Europe and the rest of the world, and to study participants upon request, as they become available.

5.7 Safety reporting and monitoring

Adverse events (AE) and serious adverse events (SAE) will be monitored and recorded. AE will be reviewed, while SAE will be reported immediately through completion of a SAE form indicating causality and severity (in liaison with an appropriate expert) and submitted to the study sponsor and REC within 24 hours. SAE related to pre-existing conditions will not be reported. Standard actions following an AE or SAE would be referral to a general practitioner

or accident and emergency services, and to recommend that the participant withdraw from the study unless they have been cleared to continue exercise by their attending physician.

5.8 Trial registration

This study has been registered on ClinicalTrials.gov under the identifier number: NCT03141879.

5.9 Trial status

The trial has received ethical approval and is due to be conducted in 2019 at the Olivet assisted living facility, Sherbourne Road, Acocks Green, Birmingham, with completion of data collection scheduled prior to 01/12//2019.

5.10 List of abbreviations

KARE: Keeping Active in Residential Elderly; PANINI: Physical Activity and Nutritional INfluences In ageing; PI: Principal Investigator; NHS: National Health Service; REC: Research Ethics Committee; 1RM: One repetition maximum; PPI: Patient and public involvement; DHEAS: Dehydroepiandrosterone; CRP: C-reactive proteins; IL-6: Interleukin-6; TNFα: Tumor necrosis factor alpha; IFNy: Interferon gamma; SPPB: Short physical performance battery; ADL: Activities of daily living; GDS: Geriatric depression scale; HADS: Hospital anxiety and depression scale; PSS: Perceived stress scale; SMMSE: Standardized mini-mental state examination; ISEL-12: Interpersonal support evaluation list-12; ELISA: Enzyme-linked immunosorbent assay; SPSS: Statistical package for social sciences; ANOVA: Analysis of variance; IPA: Interpretive phenomenological analysis; CRF: Case report form; AE: Adverse events; SAE: Serious adverse events.

5.11 Declarations

5.11.1 Ethical approval and consent to participate

This study has been granted a favourable ethical opinion by the London Harrow NHS Research Ethics Committee (17/LO/1613) on the 18/10/2017. This study has also been sponsored by the University of Birmingham, Edgbaston, Birmingham, United Kingdom, after review by the sponsor's research governance office, and given the sponsor registration number: RG_17-108.

5.11.2 Competing interests

The authors have no competing interests to declare.

5.11.3 Funding

This study has been funded by the European Commission's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement (675003); of which PD is a Marie Sklodowska-Curie Doctoral Research Fellow, AW and JL doctoral supervisors, and AW the grants Principal Investigator.

5.11.4 Author contributions

PD designed the study protocol, and associated manuscript for publication, with supervision, input and feedback from AW at all stage of the design and writing process. JL reviewed and revised the manuscript prior to publication. All authors have read and approved the final manuscript.

5.12 Acknowledgements

The authors of this article would like to acknowledge and thank Dr. Thomas Jackson (University of Birmingham) for his assistance with the NHS ethical approval process with respect to obtaining the ability to recruit participants lacking the capacity to consent.

Chapter 6. General Discussion

6.1 Chapter Summary

As outlined in Chapter 1, the purpose of this thesis was to address five main research questions: 1) what is the prevalence of frailty among geriatric hospital inpatients? 2) what is the prevalence of frailty among geriatric hospital inpatients stratified by age, sex, operational frailty definition, ward type, clinical population, and geographic location? 3) what is the association between the prevalence of frailty among geriatric hospital inpatients and national economic indicators (gross domestic product per capita purchasing power parity (PPP), and healthcare expenditure per capacity PPP)? 4) are adapted exercise interventions feasible among frail geriatric hospital inpatients in a delayed discharge hospital ward setting? 5) is an adapted resistance training intervention feasible among frail older adults in a residential assisted living facility setting? In this chapter the key novel findings, strengths and limitations, implications, and future research directions, arising from the examination of each of these research questions in Chapters 2-5 of this thesis, are discussed.

6.2 Key findings

6.2.1 The prevalence of frailty among geriatric hospital inpatients

This thesis produced the first well-evidenced pooled estimates of the overall prevalence of frailty among geriatric hospital inpatients. This was achieved through the design and implementation of a comprehensive and robust systematic review and meta-analysis, which included ninety-six eligible studies, from twenty-one countries, across five continents, with an overall pooled sample of n=467,779 geriatric hospital inpatients.

The overall pooled prevalence estimate of 47.4% reported in this review, places the prevalence of frailty among geriatric hospital inpatients between that reported for community-dwelling older adults at 10.7% (11), and older adults in nursing homes at 52.3% (17); outlining a progression in the relative prevalence of frailty with progression through the

healthcare system. The overall pooled prevalence of pre-frailty among geriatric hospital inpatients of 25.8%, is lower than that reported for both community-dwelling older adults at 41.6% (1), and nursing home residents at 40.2% (2). While the combined prevalence estimates of both frailty and pre-frailty increases from 52.3% among community-dwelling older adults, to 73.2% among geriatric hospital inpatients, and 92.5% among nursing homes residents. This suggests that differences in the relative prevalence of frailty status between community, and hospital inpatient settings, are the result of an increase in the relative prevalence of frailty, and reductions of a similar magnitude in both the relative prevalence of pre-frailty and robustness (non-frailty). However, these data show that changes in the relative prevalence of frailty status between hospital inpatient and nursing home settings, appear to be primarily the result of a relative increase in the prevalence of pre-frailty, and a reduction in the prevalence of robustness. The overall pooled frailty, and pre-frailty, prevalence estimates of 47.4% and 25.8% respectively, are relatively consistent with, though more precise than, estimates reported within a recent systematic review and meta-analysis which examined the prevalence of frailty and pre-frailty among hospitalised older adults in 11 studies which also assessed undernutrition risk, at 47% and 36% respectively (32).

6.2.2 The prevalence of frailty among geriatric hospital inpatients stratified by age, sex, operational frailty definition, ward type, clinical population, and geographic location.

Further, to the authors' knowledge, this thesis produced the most comprehensive stratified analysis of the prevalence of frailty within any setting within the literature thus far. Stratified analysis of the prevalence of frailty among geriatric hospital inpatients was conducted by age, sex, operational frailty definition, prevalent morbidity, ward type, clinical population, and geographic location. Significant differences were observed in the prevalence of frailty

stratified by age, ward type, prevalent morbidity, clinical population, and the operational definition utilised for the classification of frailty. This is consistent with previous research examining the prevalence of frailty among community-dwelling older adults which reported significant differences in stratified analysis by age (1), and operational frailty definition (1, 4). Conversely, no significant differences were observed in the prevalence of frailty stratified by sex; although there was a slightly higher prevalence among female geriatric hospital inpatients compared to males. This is in contrast to previous research among community-dwelling older adults which reported a significantly higher prevalence of frailty among female community-dwelling older adults, when compared to their male counterparts (1, 4). The pooled prevalence estimates of frailty on acute wards of 51.1%, identified in stratified analysis by ward type, as well as among all acute hospital inpatients, of 47.3%, identified in stratified analysis by clinical population, are relatively consistent with findings of a recent scoping review, which reported a median frailty prevalence of 49% in acute care hospital settings (5).

6.2.3. The association between the prevalence of frailty among geriatric hospital inpatients and gross domestic product per capita purchasing power parity (PPP), and healthcare expenditure per capacity PPP

This thesis also contains the first analysis of the association between the prevalence of frailty among geriatric hospital inpatients and national economic indicators i.e., gross domestic product (GDP) per capita purchasing power parity (PPP), and healthcare expenditure per capita PPP. No significant associations were observed between the prevalence of frailty among geriatric hospital inpatients and GDP per capita PPP, or healthcare expenditure per capita PPP. This contrasts with previous research among community-dwelling older adults within 14 European countries, and Israel, conducted utilising data from the Survey of Health,

Ageing, and Retirement in Europe (SHARE) (4). This cross-sectional analysis examined the association between GDP per capita PPP, and health expenditure as a percentage of GDP, and the prevalence of frailty among community-dwelling older adults assessed by the frailty index. Fifteen observations of the weighted national prevalence of frailty for community-dwelling older adults in each country were correlated with both national economic indicators and reported strong negative correlations between GDP per capita PPP ($r=-0.71$, $p< 0.01$), and healthcare expenditure as a percentage of GDP ($r=-0.63$, $p<0.05$), and the prevalence of frailty among community-dwelling older adults (4). To date, this study by Theou et al. (2013) is the only study to previously examine this relationship. As such, additional studies, in a variety of settings, may aid in elucidating this relationship further. It is possible that these associations, while present in the community, are not present in inpatient hospital settings. Given the inherent nature of hospital inpatient settings i.e., institutions for chronically or acutely unwell patients, this association may be more sensitive among the general population of community-dwelling older adults, however, more large scale and comprehensive studies are required in a variety of settings. In this regard, as outlined in Chapter 2, while it has been postulated that increased economic prosperity may limit the prevalence and burden on frailty on national health systems, the findings of this present review, bring this into question among geriatric hospital inpatients. As such reliance of non-direct intervention such as economic development to improve the prevalence and burden of frailty on health systems alone, appears, at least partially, to be misplaced; highlighting the need for more direct interventions.

6.2.4 The feasibility and efficacy of adapted exercise interventions among frail geriatric hospital inpatients in a delayed discharge hospital ward setting

This thesis also includes the first feasibility analysis of exercise interventions among geriatric inpatients within a delayed discharge setting to the authors' knowledge, and the first study to attempt to exclusively recruit operationally defined frail geriatric inpatients to an exercise intervention in any hospital setting. Interpretative phenomenological analysis of participant and ward staff interviews, triangulated with patient eligibility and uptake, patient retention and adherence record, and attempted limited-efficacy testing data, supplemented with reflective journal entries produced four superordinate themes: *changing dynamics, impracticalities, population and setting appropriateness*, and *future directions*. Interpretation of these data addressing the research questions within each of the eight areas of feasibility inquiry (acceptability, demand, implementation, practicality, adaptation, integration, expansion. and limited-efficacy testing) (7) concluded that the due to impracticalities regarding the appropriateness of the setting and patient cohort, a future clinical trial is likely not feasible within this setting. Feasibility analysis further revealed a study of this nature is likely better suited for more stable environments, such as a intermediate care facilities, assisted living facilities, or nursing home, settings, or in a 'hospital at home' type setting. This was outlined as the ideal form of discharge location goal for these patients, and one which is becoming more widely recognised due to the benefits it can provide (36).

6.2.5 The feasibility and efficacy of a specially adapted resistance training intervention among frail older adults in a residential care setting.

Following the conceptualisation, development, obtainment of ethical approval, and publication of the protocol (8), outlined in Chapter 5, of a mixed methods study assessing the feasibility and efficacy of a specially adapted resistance training intervention among frail older adults in a residential care setting, this protocol was successfully implemented within this setting. The main feasibility results produced through the utilisation of this protocol are

presently in press as Swales, B., Ryde, G. & Whittaker, A.C. (*In press*) "Keeping Active in Residential Elderly (KARE): assessing the feasibility and impact of an adapted resistance training intervention for multi-dimensional health among older adults in residential care", *Journal of Aging and Physical Activity*.

6.3 Strengths

All five research questions addressed within this thesis produced novel findings and contain important and practically useful contributions to the field.

The systematic review and meta-analysis addressing research questions 1-3 of this thesis, was the largest and most comprehensive systematic review and meta-analysis of the prevalence of frailty among older adults conducted in any setting to date, and the first well-evidenced systematic review and meta-analysis among geriatric hospital inpatients. Further, this review and meta-analysis included extensive systematic searches of 17 databases; manual screening of the reference lists of all included articles (and relevant studies or systematic reviews captured within platform and database searches); the screening of grey literature, including in process publications, and conference abstracts, which were followed up with study authors to ascertain if a full text relating to these data were available; employment of three independent reviewers during the screening phase of the review, ensuring high internal reliability and consistency of included articles; the utilisation of meticulously defined eligibility criteria; the employment of two independent data extractors and quality assessors; an extensive data procurement strategy, including contacting 517 authors to obtain additional information relevant to inclusion within different aspects of the review; robust analysis of the prevalence of frailty stratified by clinically useful variables; and a comprehensive and transparent record of all information pertaining to the review process available as supplementary materials. Moreover, this systematic review and meta-analysis was the first study of any design to examine the association between the prevalence of frailty among geriatric hospital inpatients and national economic indicators i.e., gross domestic product per capita purchasing power parity (PPP), and healthcare expenditure per capita PPP.

Another strength of this thesis was the utilisation of a mixed methods approach within the design and implementation of both feasibility studies, allowing for the obtainment of richer feasibility data, and a more intricate, complete, thorough, and complex understanding of the feasibility of adapted exercise interventions among frail geriatric populations in hospital inpatient delayed discharge, and assisted living facility, settings. Further, a comprehensive discussion is provided regarding the paradigms, and philosophical approaches and stances, influencing the utilisation of a mixed methods approach in Chapters 3, 4, and 5 of this thesis, specifically with regard to the paradigms of post-positivism and constructivism, and the philosophical approaches and stances of pragmatism and critical realism, respectively. This thesis also contains the first study to assess the feasibility of exercise interventions among geriatric inpatients within a delayed discharge hospital ward setting, and further the first study to attempt to exclusively recruit operationally defined frail geriatric inpatients to an exercise intervention in any hospital setting. A further overall strength of this thesis is the rigor of the methodology outlined in Appendix 2.1, and Chapters 3 and 5 of this thesis, all three of which have been published, with the results manuscript of these protocols, comprising Chapters 2 and 4 of this thesis, being prepared for submission for publication post-thesis submission.

A comprehensive summary of the background literature and contextualisation of the research questions addressed within this thesis are also provided in Chapter 1; regarding the provision of a broad overview of frailty, exploring its pathophysiology, theoretical and operational definitions(s), impact, prevalence, management, and prevention, in addition to its emergence as a major public health challenge in an increasingly economically developed and ageing world. Further, in this regard, in addition to the primary research questions addressed in this thesis, broader issues outlined in Chapter 1 and 2 of this thesis regarding reporting in the

academic field of frailty, were sought to be improved within this thesis through establishment of a proposed checklist for studies reporting frailty data.

6.4 Limitations

The research presented within this thesis also had a number of limitations which should be considered when interpreting these findings. Firstly, with regard to the systematic review and meta-analysis, only studies with a full text available in the English language were eligible for inclusion, as this was the only shared language between the three independent reviewers. As such included studies may be relatively over-representative of Western nations (Europe, Australasia, and the Americas), and there is a possibility that these findings do not include otherwise eligible studies whose full texts are not available in the English language. However, in this regard, any potentially eligible studies, with an English translated abstract, and full text in other languages, were followed up with study authors in an attempt to obtain an English full text to facilitate thorough screening. Secondly, high heterogeneity was reported across many analyses, and persisted across many univariate stratification analyse.

Thirdly, a strength, but also a limitation of this review, was with regard to the specific eligibility criteria employed within this present review, requiring prospectively eligible studies to either assess (or attempt to assess) the whole ward, department, unit, hospital, or specific clinical population, or employ some form of randomised selection of participants. Any exclusion criteria employed within individual studies, in order to meet this criterion, had to meet one of two stipulations: 1) the criterion was essential to defining the clinical population; 2) the criterion is related to insurmountable impracticalities which precluded inclusion of certain individuals. Provided all of a study's exclusion criteria adequately met either of these two stipulations during screening, they were deemed to have sufficiently satisfied the above eligible criterion for the review of having either assessed, or attempted to

assess, the entire ward/department/unit/clinical population or employed some form of randomised selection of participants. While such comprehensive stipulations prevented inclusion of any studies with active bias in the recruitment process, those that could be not be recruited in some studies due to impracticalities of inclusion, may also in many cases, be more likely to be frail e.g., those receiving end of life care in a study utilising an objective operational definition for the classification of frailty.

An additional limitation of the findings presented in this thesis, with regard to analysis of the association between the prevalence of frailty among geriatric hospital inpatients and gross domestic product per capita PPP, and healthcare expenditure per capita PPP, is that included studies in these analyse were predominantly from economically-developed countries, as there is presently limited evidence regarding the prevalence of frailty in low-income countries; an issue which has been observed previously in a meta-analysis of the prevalence of frailty among community-dwelling older adults in middle-, and low-income countries (5).

A limitation of the mixed method feasibility study was its single site design, which may limit the degree of application of feasibility results to other delayed discharge hospital ward settings. Moreover, as discussed in Chapter 4, this setting may have represented a more challenging environment that other delayed discharge settings, particularly those such as transitional care facilities, which may be more suitable sites for a proposed future clinical trial examining the efficacy of interventions among frail geriatric delayed discharge populations.

6.5 Implications

An enhanced understanding regarding the prevalence of any condition within a specific setting, has a number of important consequential utilities, including the enhanced ability to

contribute to improvements in the planning and orientation of organisational structures and resources, to meet population needs. This is particularly true regarding the ability to tailor services within specific settings to the needs of service users. For example, specifically with regard to frailty, the potential implementation of exercise rehabilitation treatments within suitable settings; with physical activity and exercise being proposed as potentially offering the best form of treatment for frail older adults (10). Through providing a highly detailed analysis of the prevalence of frailty among older adults within this setting, this thesis provides a comprehensive and robust resource, consultation with which can be utilised to aid in the facilitation of improvements in the planning, and orientation of organisational structures and resources, to meet the needs of this population, and ultimately enhance the care of older adults with frailty in inpatient hospital settings. The implications of the findings of the mixed methods feasibility study among frail geriatric hospital inpatients in a delayed discharge setting, is that a future clinical trial may be more feasible among less challenging populations of frail geriatric hospital inpatients, and likely best suited for more stable environments in the form of 'hospital at home' settings, transitional care facilities, or residential care facilities, including assisted living facilities and nursing homes. For more challenging patients adaptions may be achievable in these more stable settings but would likely need significant assistance from a larger study support team who are integrated and deeply embedded within the study setting.

6.6 Future directions and recommendations

A number of research directions and recommendations arise directly, and indirectly, from the findings presented within this PhD thesis. Firstly, as frailty is a relatively new concept, particularly as an operationally defined one, with most studies cited within the systematic review and meta-analysis presented within this thesis, published in the past 20 years, it is the

intention of the authors to update this review periodically, to examine the potential change in frailty over time, particularly as it relates to national policy directives, and economic indicators as data become available for less developed regions of the world. Although at the individual level, there is evidence of the association between socio-economic status and frailty onset and progression (11), at the societal level the association between economic variables and frailty is less well evidenced. More large scale and comprehensive research is needed in this regard to better understand this relationship between macro-economic indicators and the prevalence of frailty in a variety of settings. Further, more comprehensive systematic analysis of this association between frailty and national economic indicators among community-dwelling, and institutionalised older adults, may further elucidate this relationship.

Further, with regard to the provision of well-evidenced estimates of the prevalence of frailty within various settings, presently there are no well-evidenced pooled estimates of the prevalence of frailty amongst older adults in assisted living facility settings. It could be postulated that this prevalence would likely be higher than that of community-dwelling older adults, given that older adults living in assisted living facilities typically tend to be chronologically older, and often exhibit a greater number of comorbidities and a reduced functional capacity. However, these differences routinely become non-significant once standardised for age (12). While additionally, the estimated prevalence of frailty in nursing homes (where qualified nursing care is required, in addition to care assistance) is approximately 52.3% (2). As such, the prevalence of frailty in assisted living facilities likely lies somewhere in between that of community-dwelling older adults and nursing home residents; given the inherent nature of these respective settings, and the demographics of the individuals who occupy them. However, further research is required to fully elucidate the prevalence of frailty among older adults in assisted living facilities.

Adapted exercise interventions among suitable cohorts of frail hospital inpatients are also of interest for future research. Particularly, the continuation of these activities and assessments following patient discharge from hospital over a prolonged period of time, and the impact on these activities on measures of multi-dimensional health and other health outcomes, such as readmissions. Exercise interventions have been shown to be effective at reducing functional decline among general hospital inpatients during hospitalisation (32), however, to date no research has been conducted among specifically frail inpatients, or providing continuity of the interventions, post-inpatient discharge. Further, exercise interventions among geriatric hospital inpatients in delayed discharge appears to be largely non-feasible due to a combination of the dynamics of the setting and the characteristics of the patients which reside within the setting. However, adaptions may be possible to at least address some of these issues, such as those identified in Chapter 4, regarding the potential development of resistance training machines which can be attached to hospital beds in the form of a leg press machine or cycling bike, which are pneumatic, and adapted for both active and more passive movement. Additionally, while allowing active movement against a pneumatic load in patients more cognitively aware, the passive movement component may be more navigable to non-cognitively aware patients or patients that find it difficult to engage. With encouragement this passive movement may encourage at least a degree of effort to be employed. A core aspect of the passive setting of the machine should be that it can measure the effort of the participant in real time so that encouragement can be given accordingly, and measurements of actual loading obtained. Due to the loss of mobility and muscle mass associated with bed stay, even these passive movements if they encourage any degree of effort may be beneficial to bed bound patients with difficulty engaging. However, these bedbound patients, with profound neurological disabilities, do represent an extremely difficult patient population to facilitate engagement with, in general, and especially when it

comes to these forms of interventions. Therefore, following the potential development of such piece of equipment, an analysis of feasibility within this setting should be assessed. However, adapted exercise interventions are likely more ideally suited for more stable environments, such as intermediate care facilities, assisted living facilities, and nursing homes, or 'hospital at home' settings, and future research on the efficacy of adapted exercise interventions for frail geriatric populations should focus predominantly on these more stable settings. A practical illustration of this findings is that the protocol developed in Chapter 5 of this thesis, has now been implemented in the assisted living facility setting with good initial eligibility of residents identified by assisted living facility staff, and similar levels of uptake and adherence (Swales et al., in press). This highlights the differences between settings in terms of feasibility regarding patient eligibility and setting appropriateness, and validates the conclusions established in Chapter 4 regarding such studies likely being best suited for more stable environments in the form of 'hospital at home' settings, transitional care facilities, or residential care settings, including assisted living facilities and nursing homes.

This thesis has also produced several recommendations with regard to improving reporting in future frailty research among hospitalised older adults, as well as within other settings. These recommendations arise from the following issues which are persistent in the frailty literature: 1) studies often report participants as frail without a frailty assessment; 2) studies often claim to utilise validated operational definitions for the classification of frailty, however, adapt these definitions, or classification criteria, which result in the definitions becoming not only non-standardised, but also non-validated; 3) the use of the nomenclature for different operational definitions of frailty varies widely, even among studies utilising the same operational definition; 4) often, useful data regarding the prevalence of frailty (such as pre-frailty, a sex breakdown of frailty, or occasionally the overall prevalence of frailty itself) are not reported. Reporting may be improved by a brief standardised checklist for studies

reporting frailty data, which include the following items: 1) accurate citation of the validation study for the specific operational definition utilised for the classification of frailty; 2) accurate use of the nomenclature of the operational definition of frailty utilised in accordance with the initial validation study to maintain reliability and validity, or prominent subsequent study establishing the nomenclature; 3) reporting of the number of frail, pre-frail (if applicable) and robust participants; 4) a sex breakdown of the number of frail, pre-frail, and robust participants.

More generally within the frailty field, further work towards a universally accepted operational definition of the construct, to practically complement the theoretical definition (13) is of paramount interest to the field. Additionally, the association between frailty and other related composite measures such as allostatic load (14-16) and intrinsic capacity (17, 18), and the potential utilisation of these constructs as inexpensive proxy measures for biological ageing (identified through associations with the pattern of DNA methylation at different cytosine-phospho-guanine (CpG) sites which correlate with mortality and time (19, 20), morbidity and lifespan (21-24), and the pace of ageing (25)) is of interest for future research. The initial validation of cost-effective assessments as valid proxy measures of biological ageing may allow for a better understanding of ageing, not only in economically developed nations, but throughout the globe, and especially among less economically developed areas of the world. The lack of data in these regions in particular will become increasingly important from a global perspective, given that these are the regions of the world projected to undergo the largest population growth in the coming century (e.g., the population of sub-Saharan Africa is projected to grow 298% from 2017-2100, from 1.03 to 3.07 billion), while conversely many economically developed regions are projected to experience marked population decline (e.g., Europe's population is projected to decline 19.2% from 2017-2100,

from 758 to 613 million, and China's population is projected to decline 48% over the same period, from 1.41 billion to 732 million) (26).

6.7 Conclusion

This PhD thesis has presented several novel findings, which provide important contributions to the field of frailty research. Well-evidenced pooled estimates of the prevalence of frailty among geriatric hospital inpatients were elucidated for the first time within this thesis, as well as the association between the prevalence of frailty among geriatric hospital inpatients and national economic indicators. Further, this thesis contains the first assessment of the feasibility of exercise interventions for frail geriatric hospital inpatients in a delayed discharge setting. These findings will aid future research and policy planning in this increasingly important field of research, which, if present global demographic trends persist, will continue to grow in contemporary and future importance as the population ages.

References

Chapter 1

1. Mack CA. Fifty years of moore's law. IEEE Trans Semicond Manuf [Internet]. 2011;24(2):202-7.

2. Heath G, Colburn WA. An evolution of drug development and clinical pharmacology during the 20th century. The Journal of Clinical Pharmacology [Internet]. 2000;40(9):918-29.

3. Mackenbach J. The contribution of medical care to mortality decline: McKeown revisited. J Clin Epidemiol [Internet]. 1996;49(11):1207-13.

4. Human Mortality Database. Human mortality database. university of california, berkeley (USA), and max planck institute for demographic research (germany). available at www.mortality.org (data downloaded on 22/02/2020). [Internet]. 2020

5. Christensen K, Doblhammer G, Rau R, Vaupel JW. Ageing populations: The challenges ahead. The lancet [Internet]. 2009;374(9696):1196-208.

6. Wang H, Abajobir AA, Abate KH, Abbafati C, Abbas KM, Abd-Allah F, Abera SF, Abraha HN, Abu-Raddad LJ, Abu-Rmeileh NM. Global, regional, and national under-5 mortality, adult mortality, age-specific mortality, and life expectancy, 1970–2016: A systematic analysis for the global burden of disease study 2016. The Lancet [Internet]. 2017;390(10100):1084-150.

7. Cutler D, Miller G. The role of public health improvements in health advances: The twentieth-century united states. Demography [Internet]. 2005;42(1):1-22.

8. Roser M, Ortiz-Ospina E, Ritchie H. Life expectancy. Our World in Data [Internet]. 2013

9. United Nations, Department of Economic and Social Affairs, Population Division. United Nations Population Prospects 2019 (ST/ESA/SER.A/423), URL: https://population.un.org/wpp/Publications/Files/WPP2019_Highlights.pdf . Accessed: 2nd March 2020. 2019

10. Murray CJ, Callender CS, Kulikoff XR, Srinivasan V, Abate D, Abate KH, Abay SM, Abbasi N, Abbastabar H, Abdela J. Population and fertility by age and sex for 195 countries and territories, 1950–2017: A systematic analysis for the global burden of disease study 2017. The Lancet [Internet]. 2018;392(10159):1995-2051.

11. United Nations, Department of Economic and Social Affairs, Population Division. World Population Ageing 2017 (ST/ESA/SER.A/408). URL: https://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2017_Report.pdf. Accessed: 17th April 2019. 2017 Available from: https://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2017_Report.pdf

12. Omran AR. The epidemiologic transition: A theory of the epidemiology of population change. Milbank Q [Internet]. 2005;83(4):731-57.

13. Ford ES, Caspersen CJ. Sedentary behaviour and cardiovascular disease: A review of prospective studies. Int J Epidemiol. 2012:dys078.

14. Lee I, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT, Lancet Physical Activity Series Working Group. Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and life expectancy. The lancet [Internet]. 2012;380(9838):219-29.

15. Caspersen CJ, Pereira MA, Curran KM. Changes in physical activity patterns in the united states, by sex and cross-sectional age. Med Sci Sports Exerc. 2000;32(9):1601-9.

16. Vos T, Allen C, Arora M, Barber RM, Bhutta ZA, Brown A, Carter A, Casey DC, Charlson FJ, Chen AZ. Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990–2015: A systematic analysis for the global burden of disease study 2015. The Lancet [Internet]. 2016;388(10053):1545-602.

17. Dent E, Martin FC, Bergman H, Woo J, Romero-Ortuno R, Walston JD. Management of frailty: Opportunities, challenges, and future directions. The Lancet [Internet]. 2019;394(10206):1376-86.

18. Xue Q. The frailty syndrome: Definition and natural history. Clinics in Geriatric Medicine [Internet]. 2011 February [cited Jan 21, 2017];27(1):1-15. Available from: //www.sciencedirect.com/science/article/pii/S0749069010000832

19. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly people. The Lancet [Internet]. 2013 March 8, [cited Jan 21, 2017];381(9868):752-62. Available from: //www.sciencedirect.com/science/article/pii/S0140673612621679

20. Taffett GE. Physiology of aging In: Geriatric Medicine. [Internet]. Springer; 2003 p. 27-35.

21. Ferrucci L, Cavazzini C, Corsi A, Bartali B, Russo CR, Lauretani F, Corsi AM, Bandinelli S, Guralnik JM. Biomarkers of frailty in older persons. J Endocrinol Invest [Internet]. 2002;25(10 Suppl):10-5.

22. Rodriguez-Mañas L, Fried LP. Frailty in the clinical scenario. The Lancet [Internet]. 2015 /02/14 [cited Nov 12, 2016];385(9968):e7-9. Available from: /journals/lancet/article/PIIS0140-6736(14)61595-6/abstract

23. Shamliyan T, Talley KM, Ramakrishnan R, Kane RL. Association of frailty with survival: A systematic literature review. Ageing research reviews [Internet]. 2013;12(2):719-36.

24. Sourial N, Bergman H, Karunananthan S, Wolfson C, Payette H, Gutierrez-Robledo LM, Béland F, Fletcher JD, Guralnik J. Implementing frailty into clinical practice: A cautionary tale. J Gerontol A Biol Sci Med Sci [Internet]. 2013 -05-02 [cited Jan 21, 2017]:glt053. Available from: http://biomedgerontology.oxfordjournals.org/content/early/2013/05/01/gerona.glt053

25. Sternberg SA, Schwartz AW, Karunananthan S, Bergman H, Mark Clarfield A. The identification of frailty: A systematic literature review. J Am Geriatr Soc. 2011;59(11):2129-38.

26. Gill TM, Gahbauer EA, Allore HG, Han L. Transitions between frailty states among community-living older persons. Arch Intern Med. 2006;166(4):418-23.

27. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, Seeman T, Tracy R, Kop WJ, Burke G. Frailty in older adults evidence for a phenotype. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences. 2001;56(3):M146-57.

28. Hanlon P, Nicholl BI, Jani BD, Lee D, McQueenie R, Mair FS. Frailty and pre-frailty in middle-aged and older adults and its association with multimorbidity and mortality: A prospective analysis of 493 737 UK biobank participants. The Lancet Public Health [Internet]. 2018;3(7):e323-32.

29. Bagshaw SM, Majumdar SR, Rolfson DB, Ibrahim Q, McDermid RC, Stelfox HT. A prospective multicenter cohort study of frailty in younger critically ill patients. Critical Care [Internet]. 2016;20(1):175.

30. Mendonça N, Kingston A, Granic A, Jagger C. Protein intake and transitions between frailty states and to death in very old adults: The newcastle 85 study. Age Ageing [Internet]. 2019;49(1):32-8.

31. Feng Z, Lugtenberg M, Franse C, Fang X, Hu S, Jin C, Raat H. Risk factors and protective factors associated with incident or increase of frailty among community-dwelling older adults: A systematic review of longitudinal studies. PLoS One [Internet]. 2017;12(6):e0178383.

32. Gale CR, Westbury L, Cooper C. Social isolation and loneliness as risk factors for the progression of frailty: The english longitudinal study of ageing. Age Ageing [Internet]. 2018;47(3):392-7.

33. Stolz E, Mayerl H, Waxenegger A, Rásky É, Freidl W. Impact of socioeconomic position on frailty trajectories in 10 european countries: Evidence from the survey of health, ageing and retirement in europe (2004–2013). J Epidemiol Community Health [Internet]. 2017;71(1):73-80.

34. Bandeen-Roche K, Seplaki CL, Huang J, Buta B, Kalyani RR, Varadhan R, Xue Q, Walston JD, Kasper JD. Frailty in older adults: A nationally representative profile in the united states. The Journals of Gerontology: Series A [Internet]. 2015;70(11):1427-34.

35. Hoogendijk EO, Afilalo J, Ensrud KE, Kowal P, Onder G, Fried LP. Frailty: Implications for clinical practice and public health. The Lancet [Internet]. 2019;394(10206):1365-75.

36. Pollack LR, Litwack-Harrison S, Cawthon PM, Ensrud K, Lane NE, Barrett-Connor E, Dam T. Patterns and predictors of frailty transitions in older men: The osteoporotic fractures in men study. J Am Geriatr Soc [Internet]. 2017;65(11):2473-9.

37. Trevisan C, Veronese N, Maggi S, Baggio G, Toffanello ED, Zambon S, Sartori L, Musacchio E, Perissinotto E, Crepaldi G. Factors influencing transitions between frailty states in elderly adults: The progetto veneto anziani longitudinal study. J Am Geriatr Soc [Internet]. 2017;65(1):179-84.

38. Fried LP, Xue Q, Cappola AR, Ferrucci L, Chaves P, Varadhan R, Guralnik JM, Leng SX, Semba RD, Walston JD. Nonlinear multisystem physiological dysregulation associated with frailty in older women: Implications for etiology and treatment. Journals of Gerontology Series A: Biomedical Sciences and Medical Sciences [Internet]. 2009;64(10):1049-57.

39. Puts MTE, Toubasi S, Andrew MK, Ashe MC, Ploeg J, Atkinson E, Ayala AP, Roy A, Rodríguez Monforte M, Bergman H. Interventions to prevent or reduce the level of frailty in community-dwelling older adults: A scoping review of the literature and international policies. Age Ageing [Internet]. 2017;46(3):383-92.

40. Mousa A, Savva GM, Mitnitski A, Rockwood K, Jagger C, Brayne C, Matthews FE. Is frailty a stable predictor of mortality across time? evidence from the cognitive function and ageing studies. Age Ageing [Internet]. 2018;47(5):721-7.

41. Yu R, Wong M, Chong KC, Chang B, Lum CM, Auyeung TW, Lee J, Lee R, Woo J. Trajectories of frailty among chinese older people in hong kong between 2001 and 2012: An age-period-cohort analysis. Age Ageing [Internet]. 2018;47(2):254-61.

42. Yang Y, Lee LC. Dynamics and heterogeneity in the process of human frailty and aging: Evidence from the US older adult population. Journals of Gerontology Series B: Psychological Sciences and Social Sciences [Internet]. 2010;65(2):246-55.

43. Rockwood K, Song X, MacKnight C, Bergman H, Hogan DB, McDowell I, Mitnitski A. A global clinical measure of fitness and frailty in elderly people. Can Med Assoc J. 2005;173(5):489-95.

44. Rockwood K, Mitnitski A. Frailty in relation to the accumulation of deficits. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences. 2007;62(7):722-7.

45. Mitnitski AB, Mogilner AJ, Rockwood K. Accumulation of deficits as a proxy measure of aging. The Scientific World Journal [Internet]. 2001;1:323-36.

46. Jones DM, Song X, Rockwood K. Operationalizing a frailty index from a standardized comprehensive geriatric assessment. J Am Geriatr Soc [Internet]. 2004;52(11):1929-33.

47. Rolfson DB, Majumdar SR, Tsuyuki RT, Tahir A, Rockwood K. Validity and reliability of the edmonton frail scale. Age Ageing [Internet]. 2006;35(5):526-9.

48. Hilmer SN, Perera V, Mitchell S, Murnion BP, Dent J, Bajorek B, Matthews S, Rolfson DB. The assessment of frailty in older people in acute care. Australasian journal on ageing [Internet]. 2009;28(4):182-8.

49. Morley JE, Malmstrom TK, Miller DK. A simple frailty questionnaire (FRAIL) predicts outcomes in middle aged african americans. J Nutr Health Aging [Internet]. 2012;16(7):601-8.

50. Romero-Ortuno R, Walsh CD, Lawlor BA, Kenny RA. A frailty instrument for primary care: Findings from the survey of health, ageing and retirement in europe (SHARE). BMC geriatrics [Internet]. 2010;10(1):57.

51. Stevernik N, Slaets J, Schuurmans H, Van Lis M, Steverink N, Slaets J, Lis CM. Measuring frailty: Development and testing the GFI (groningen frailty indicator). [Internet]. 2001

52. Tsiouris A, Hammoud ZT, Velanovich V, Hodari A, Borgi J, Rubinfeld I. A modified frailty index to assess morbidity and mortality after lobectomy. J Surg Res [Internet]. 2013;183(1):40-6.

53. Gobbens RJ, van Assen MA, Luijkx KG, Wijnen-Sponselee MT, Schols JM. The tilburg frailty indicator: Psychometric properties. Journal of the American Medical Directors Association [Internet]. 2010;11(5):344-55.

54. Ensrud KE, Ewing SK, Taylor BC, Fink HA, Stone KL, Cauley JA, Tracy JK, Hochberg MC, Rodondi N, Cawthon PM. Frailty and risk of falls, fracture, and mortality in older women: The study of osteoporotic fractures. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences [Internet]. 2007;62(7):744-51.

55. Pilotto A, Ferrucci L, Franceschi M, D'Ambrosio LP, Scarcelli C, Cascavilla L, Paris F, Placentino G, Seripa D, Dallapiccola B. Development and validation of a multidimensional prognostic index for one-year mortality from comprehensive geriatric assessment in hospitalized older patients. Rejuvenation research [Internet]. 2008;11(1):151-61.

56. Joseph B, Pandit V, Zangbar B, Kulvatunyou N, Tang A, O'Keeffe T, Green DJ, Vercruysse G, Fain MJ, Friese RS. Validating trauma-specific frailty index for geriatric trauma patients: A prospective analysis. J Am Coll Surg [Internet]. 2014;219(1):10,17. e1.

57. Jokar TO, Ibraheem K, Rhee P, Kulavatunyou N, Haider A, Phelan HA, Fain M, Mohler MJ, Joseph B. Emergency general surgery specific frailty index: A validation study. Journal of Trauma and Acute Care Surgery [Internet]. 2016;81(2):254-60.

58. Rockwood K, Stadnyk K, MacKnight C, McDowell L, HÃ©bert R. A brief clinical instrument to classify frailty in elderly people. Lancet (British edition) [Internet]. 1999;353(9148):205-6.

59. Satake S, Senda K, Hong Y, Miura H, Endo H, Sakurai T, Kondo I, Toba K. Validity of the K ihon checklist for assessing frailty status. Geriatrics & gerontology international [Internet]. 2016;16(6):709-15.

60. Tomata Y, Hozawa A, Ohmori-Matsuda K, Nagai M, Sugawara Y, Nitta A, Kuriyama S, Tsuji I. Validation of the kihon checklist for predicting the risk of 1-year incident long-term care insurance certification: The ohsaki cohort 2006 study. [Nihon koshu eisei zasshi] Japanese journal of public health [Internet]. 2011;58(1):3-13.

61. McIsaac DI, Wong CA, Huang A, Moloo H, van Walraven C. Derivation and validation of a generalizable preoperative frailty index using population-based health administrative data. Ann Surg [Internet]. 2019;270(1):102-8.

62. Sündermann S, Dademasch A, Praetorius J, Kempfert J, Dewey T, Falk V, Mohr F, Walther T. Comprehensive assessment of frailty for elderly high-risk patients undergoing cardiac surgery. European Journal of Cardio-Thoracic Surgery [Internet]. 2011;39(1):33-7.

63. Sündermann S, Dademasch A, Rastan A, Praetorius J, Rodriguez H, Walther T, Mohr F, Falk V. One-year follow-up of patients undergoing elective cardiac surgery assessed with the comprehensive assessment of frailty test and its simplified form. Interactive cardiovascular and thoracic surgery [Internet]. 2011;13(2):119-23.

64. Robinson TN, Wu DS, Pointer L, Dunn CL, Cleveland Jr JC, Moss M. Simple frailty score predicts postoperative complications across surgical specialties. The American Journal of Surgery [Internet]. 2013;206(4):544-50.

65. Velanovich V, Antoine H, Swartz A, Peters D, Rubinfeld I. Accumulating deficits model of frailty and postoperative mortality and morbidity: Its application to a national database. J Surg Res [Internet]. 2013;183(1):104-10.

66. Guralnik JM, Simonsick EM, Ferrucci L, Glynn RJ, Berkman LF, Blazer DG, Scherr PA, Wallace RB. A short physical performance battery assessing lower extremity function: Association with self-reported disability and prediction of mortality and nursing home admission. J Gerontol. 1994;49(2):M85-94.

67. Podsiadlo D, Richardson S. The timed "Up & go": A test of basic functional mobility for frail elderly persons. J Am Geriatr Soc. 1991;39(2):142-8.

68. Joseph B, Toosizadeh N, Orouji Jokar T, Heusser MR, Mohler J, Najafi B. Upper-extremity function predicts adverse health outcomes among older adults hospitalized for ground-level falls. Gerontology. 2017;63(4):299-307. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85006251449&doi=10.1159%2f000453593&partnerID=40&md5=c0f7150e6560daa475a6990bd74fda96

69. Matsuzawa Y, Konishi M, Akiyama E, Suzuki H, Nakayama N, Kiyokuni M, Sumita S, Ebina T, Kosuge M, Hibi K. Association between gait speed as a measure of frailty and risk of cardiovascular events after myocardial infarction. J Am Coll Cardiol [Internet]. 2013;61(19):1964-72.

70. Syddall H, Cooper C, Martin F, Briggs R, Sayer AA. Is grip strength a useful single marker of frailty? Age Ageing. 2003;32(6):650-6.

71. Bellera CA, Rainfray M, Mathoulin-Pelissier S, Mertens C, Delva F, Fonck M, Soubeyran PL. Screening older cancer patients: First evaluation of the G-8 geriatric screening tool. Annals of Oncology [Internet]. 2012;23(8):2166-72.

72. McCusker J, Bellavance F, Cardin S, Trepanier S, Verdon J, Ardman O. Detection of older people at increased risk of adverse health outcomes after an emergency visit: The ISAR screening tool. J Am Geriatr Soc [Internet]. 1999;47(10):1229-37.

73. Saliba D, Elliott M, Rubenstein LZ, Solomon DH, Young RT, Kamberg CJ, Carol Roth RN, MacLean CH, Shekelle PG, Sloss EM. The vulnerable elders survey: A tool for

identifying vulnerable older people in the community. J Am Geriatr Soc [Internet]. 2001;49(12):1691-9.

74. Tocchi C, Dixon J, Naylor M, Jeon S, McCorkle R. Development of a frailty measure for older adults: The frailty index for elders. J Nurs Meas [Internet]. 2014;22(2):223-40.

75. Pijpers E, Ferreira I, Van de Laar R, Stehouwer C, Kruseman AN. Predicting mortality of psychogeriatric patients: A simple prognostic frailty risk score. Postgrad Med J [Internet]. 2009;85(1007):464-9.

76. Gilbert T, Neuburger J, Kraindler J, Keeble E, Smith P, Ariti C, Arora S, Street A, Parker S, Roberts HC. Development and validation of a hospital frailty risk score focusing on older people in acute care settings using electronic hospital records: An observational study. The Lancet [Internet]. 2018;391(10132):1775-82.

77. Raîche M, Hébert R, Dubois M. PRISMA-7: A case-finding tool to identify older adults with moderate to severe disabilities. Arch Gerontol Geriatr [Internet]. 2008;47(1):9-18.

78. Beard JR, Jotheeswaran AT, Cesari M, de Carvalho IA. The structure and predictive value of intrinsic capacity in a longitudinal study of ageing. BMJ open [Internet]. 2019;9(11):e026119.

79. Cesari M, Araujo de Carvalho I, Amuthavalli Thiyagarajan J, Cooper C, Martin FC, Reginster J, Vellas B, Beard JR. Evidence for the domains supporting the construct of intrinsic capacity. The Journals of Gerontology: Series A [Internet]. 2018;73(12):1653-60.

80. Belloni G, Cesari M. Frailty and intrinsic capacity: Two distinct but related constructs. Frontiers in medicine [Internet]. 2019;6:133.

81. Theou O, Cann L, Blodgett J, Wallace LM, Brothers TD, Rockwood K. Modifications to the frailty phenotype criteria: Systematic review of the current literature and investigation of 262 frailty phenotypes in the survey of health, ageing, and retirement in europe. Ageing research reviews [Internet]. 2015;21:78-94.

82. He B, Ma Y, Wang C, Jiang M, Geng C, Chang X, Ma B, Han L. Prevalence and risk factors for frailty among community-dwelling older people in china: A systematic review and meta-analysis. J Nutr Health Aging [Internet]. 2019;23(5):442-50.

83. Siriwardhana DD, Hardoon S, Rait G, Weerasinghe MC, Walters KR. Prevalence of frailty and prefrailty among community-dwelling older adults in low-income and middle-income countries: A systematic review and meta-analysis. BMJ open [Internet]. 2018;8(3):e018195.

84. Kojima G, Iliffe S, Taniguchi Y, Shimada H, Rakugi H, Walters K. Prevalence of frailty in japan: A systematic review and meta-analysis. Journal of epidemiology [Internet]. 2017;27(8):347-53.

85. Verlaan S, Ligthart-Melis GC, Wijers SL, Cederholm T, Maier AB, de van der Schueren, Marian AE. High prevalence of physical frailty among community-dwelling malnourished

older adults–a systematic review and meta-analysis. Journal of the American Medical Directors Association [Internet]. 2017;18(5):374-82.

86. Handforth C, Clegg A, Young C, Simpkins S, Seymour MT, Selby PJ, Young J. The prevalence and outcomes of frailty in older cancer patients: A systematic review. Annals of Oncology. 2015;26(6):1091-101. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84938084559&doi=10.1093%2fannonc%2fmdu540&partnerID=40&md5=d336d64f91780ef753465a49d51d2397

87. Hewitt J, Moug SJ, Middleton M, Chakrabarti M, Stechman MJ, McCarthy K. Prevalence of frailty and its association with mortality in general surgery. Am J Surg [Internet]. 2015 Feb [cited Jan 21, 2017];209(2):254-9.

88. Kojima G. Prevalence of frailty in nursing homes: A systematic review and meta-analysis. Journal of the American Medical Directors Association. 2015;16(11):940-5.

89. Collard RM, Boter H, Schoevers RA, Oude Voshaar RC. Prevalence of frailty in community-dwelling older persons: A systematic review. J Am Geriatr Soc [Internet]. 2012 Aug [cited Nov 12, 2016];60(8):1487-92.

90. Theou O, Stathokostas L, Roland KP, Jakobi JM, Patterson C, Vandervoort AA, Jones GR. The effectiveness of exercise interventions for the management of frailty: A systematic review. Journal of aging research. 2011;2011

91. Ofori-Asenso R, Chin KL, Mazidi M, Zomer E, Ilomaki J, Zullo AR, Gasevic D, Ademi Z, Korhonen MJ, LoGiudice D. Global incidence of frailty and prefrailty among community-dwelling older adults: A systematic review and meta-analysis. JAMA network open [Internet]. 2019;2(8):e198398.

92. Shah SM, Carey IM, Harris T, DeWilde S, Cook DG. Quality of chronic disease care for older people in care homes and the community in a primary care pay for performance system: Retrospective study. BMJ. 2011;342:d912.

93. Melo RC, Cipolli GC, Buarque G, Yassuda MS, Cesari M, Oude Voshaar RC, Aprahamian I. Prevalence of frailty in brazilian older adults: A systematic review and meta-analysis. J Nutr Health Aging [Internet]. 2020;24:708-16.

94. Marinus N, Vigorito C, Giallauria F, Haenen L, Jansegers T, Dendale P, Feys P, Meesen R, Timmermans A, Spildooren J. Frailty is highly prevalent in specific cardiovascular diseases and females, but significantly worsens prognosis in all affected patients: A systematic review. Ageing Research Reviews [Internet]. 2020:101233.

95. Hanlon P, Fauré I, Corcoran N, Butterly E, Lewsey J, McAllister D, Mair FS. Frailty measurement, prevalence, incidence, and clinical implications in people with diabetes: A systematic review and study-level meta-analysis. The Lancet Healthy Longevity [Internet]. 2020

96. Hewitt J, Moug SJ, Middleton M, Chakrabarti M, Stechman MJ, McCarthy K. Prevalence of frailty and its association with mortality in general surgery; 25173599. Am J Surg.

2015;209(2):254-9. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84922595941&doi=10.1016%2fj.amjsurg.2014.05.022&partnerID=40&md5=f99478598b9f8bf0d9d23691cc4a

97. Joosten E, Demuynck M, Detroyer E, Milisen K. Prevalence of frailty and its ability to predict in hospital delirium, falls, and 6-month mortality in hospitalized older patients. BMC geriatrics. 2014;14(1):1.

98. Maguet PL, Roquilly A, Lasocki S, Asehnoune K, Carise E, Martin MS, Mimoz O, Gac GL, Somme D, Cattenoz C, Feuillet F, Malledant Y, Seguin P. Prevalence and impact of frailty on mortality in elderly ICU patients: A prospective, multicenter, observational study. Intensive Care Med [Internet]. 2014 /05/01 [cited Jan 22, 2017];40(5):674-82. Available from: http://link.springer.com/article/10.1007/s00134-014-3253-4

99. Oliveira DR, Bettinelli LA, Pasqualotti A, Corso D, Brock F, Erdmann AL, Oliveira DR, Bettinelli LA, Pasqualotti A, Corso D, Brock F, Erdmann AL. Prevalence of frailty syndrome in old people in a hospital institution. Revista Latino-Americana de Enfermagem [Internet]. 2013 08/ [cited Jan 21, 2017];21(4):891-8. Available from: http://www.scielo.br/scielo.php?script=sci_abstract&pid=S0104-11692013000400891&lng=en&nrm=iso&tlng=en

100. Khandelwal D, Goel A, Kumar U, Gulati V, Narang R, Dey AB. Frailty is associated with longer hospital stay and increased mortality in hospitalized older patients. J Nutr Health Aging [Internet]. 2012 /10/01 [cited Jan 21, 2017];16(8):732-5. Available from: http://link.springer.com/article/10.1007/s12603-012-0369-5

101. Ekerstad N, Swahn E, Janzon M, Alfredsson J, Löfmark R, Lindenberger M, Carlsson P. Frailty is independently associated with short-term outcomes for elderly patients with non-ST-segment elevation myocardial infarction. Circulation [Internet]. 2011 Nov 29, [cited Jan 21, 2017];124(22):2397-404.

102. Andela, Richt M R N, Dijkstra AE, Slaets JPJ, Sanderman R. Prevalence of frailty on clinical wards: Description and implications. Int J Nurs Pract. 2010 February;16(1):14-9. Available from: http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=ovftk&AN=00063413-201002000-00003 http://sfxeu07.hosted.exlibrisgroup.com/bham?sid=OVID:ovftdb&id=pmid:&id=doi:10.1111%2Fj.1440-172X.2009.01807.x&issn=1322-7114&isbn=&volume=16&issue=1&spage=14&pages=14-19&date=2010&title=International+Journal+of+Nursing+Practice&atitle=Prevalence+of+frailty+on+clinical+wards%3A+Description+and+implications.&aulast=Andela&pid=%3Cauthor%3EAndela%2C+Richt%3C%2Fauthor%3E%3CAN%3E00063413-201002000-00003%3C%2FAN%3E%3CDT%3EArticle%3C%2FDT%3E

103. Purser JL, Kuchibhatla MN, Fillenbaum GG, Harding T, Peterson ED, Alexander KP. Identifying frailty in hospitalized older adults with significant coronary artery disease. Journal of the American Geriatrics Society [Internet]. 2006 November 1, [cited Jan 21, 2017];54(11):1674-81. Available from: http://onlinelibrary.wiley.com/doi/10.1111/j.1532-5415.2006.00914.x/abstract

104. Theou O, Squires E, Mallery K, Lee JS, Fay S, Goldstein J, Armstrong JJ, Rockwood K. What do we know about frailty in the acute care setting? A scoping review. BMC geriatrics [Internet]. 2018;18(1):139.

105. Ligthart-Melis GC, Luiking YC, Kakourou A, Cederholm T, Maier AB, de van der Schueren, Marian AE. Frailty, sarcopenia, and malnutrition frequently (co-) occur in hospitalized older adults: A systematic review and meta-analysis. Journal of the American Medical Directors Association [Internet]. 2020

106. Kojima G, Iliffe S, Walters K. Frailty index as a predictor of mortality: A systematic review and meta-analysis. Age Ageing [Internet]. 2018;47(2):193-200.

107. Kojima G. Frailty as a predictor of future falls among community-dwelling older people: A systematic review and meta-analysis. Journal of the American Medical Directors Association [Internet]. 2015;16(12):1027-33.

108. Soysal P, Veronese N, Thompson T, Kahl KG, Fernandes BS, Prina AM, Solmi M, Schofield P, Koyanagi A, Tseng P. Relationship between depression and frailty in older adults: A systematic review and meta-analysis. Ageing research reviews [Internet]. 2017;36:78-87.

109. Robertson DA, Savva GM, Kenny RA. Frailty and cognitive impairment—a review of the evidence and causal mechanisms. Ageing research reviews [Internet]. 2013;12(4):840-51.

110. Kojima G, Taniguchi Y, Iliffe S, Walters K. Frailty as a predictor of alzheimer disease, vascular dementia, and all dementia among community-dwelling older people: A systematic review and meta-analysis. Journal of the American Medical Directors Association [Internet]. 2016;17(10):881-8.

111. Kojima G. Frailty as a predictor of fractures among community-dwelling older people: A systematic review and meta-analysis. Bone [Internet]. 2016;90:116-22.

112. Jin H, Liu X, Xue Q, Chen S, Wu C. The association between frailty and healthcare expenditure among chinese older adults. Journal of the American Medical Directors Association [Internet]. 2020;21(6):780-5.

113. Kim DH, Glynn RJ, Avorn J, Lipsitz LA, Rockwood K, Pawar A, Schneeweiss S. Validation of a claims-based frailty index against physical performance and adverse health outcomes in the health and retirement study. The Journals of Gerontology: Series A [Internet]. 2019;74(8):1271-6.

114. Ensrud KE, Kats AM, Schousboe JT, Taylor BC, Cawthon PM, Hillier TA, Yaffe K, Cummings SR, Cauley JA, Langsetmo L. Frailty phenotype and healthcare costs and utilization in older women. J Am Geriatr Soc [Internet]. 2018;66(7):1276-83.

115. Bock J-, König H-, Brenner H, Haefeli WE, Quinzler R, Matschinger H, Saum K-, Schöttker B, Heider D. Associations of frailty with health care costs - results of the ESTHER cohort study; 27074800. BMC Health Services Research. 2016;16(1) Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-

84963891927&doi=10.1186%2fs12913-016-1360-3&partnerID=40&md5=026aea5402d3d84663f44864c55d299e

116. Hajek A, Bock J, Saum K, Matschinger H, Brenner H, Holleczek B, Haefeli WE, Heider D, König H. Frailty and healthcare costs—longitudinal results of a prospective cohort study. Age Ageing [Internet]. 2018;47(2):233-41.

117. Kojima G, Iliffe S, Jivraj S, Walters K. Association between frailty and quality of life among community-dwelling older people: A systematic review and meta-analysis. J Epidemiol Community Health [Internet]. 2016;70(7):716-21.

118. Hoogendijk EO, Suanet B, Dent E, Deeg DJ, Aartsen MJ. Adverse effects of frailty on social functioning in older adults: Results from the longitudinal aging study amsterdam. Maturitas [Internet]. 2016;83:45-50.

119. Theou O, Brothers TD, Rockwood MR, Haardt D, Mitnitski A, Rockwood K. Exploring the relationship between national economic indicators and relative fitness and frailty in middle-aged and older europeans. Age Ageing [Internet]. 2013;42(5):614-9.

120. Landi F, Abbatecola AM, Provinciali M, Corsonello A, Bustacchini S, Manigrasso L, Cherubini A, Bernabei R, Lattanzio F. Moving against frailty: Does physical activity matter? Biogerontology [Internet]. 2010 /10/01 [cited Jan 21, 2017];11(5):537-45. Available from: http://link.springer.com/article/10.1007/s10522-010-9296-1

121. Peterson MJ, Giuliani C, Morey MC, Pieper CF, Evenson KR, Mercer V, Cohen HJ, Visser M, Brach JS, Kritchevsky SB, Goodpaster BH, Rubin S, Satterfield S, Newman AB, Simonsick EM, Health FT, Group, Aging and Body Composition Study Research. Physical activity as a preventative factor for frailty: The health, aging, and body composition study. J Gerontol A Biol Sci Med Sci [Internet]. 2009 -01-01 [cited Jan 21, 2017];64A(1):61-8. Available from: http://biomedgerontology.oxfordjournals.org/content/64A/1/61

122. Fiatarone MA, O'Neill EF, Ryan ND, Clements KM, Solares GR, Nelson ME, Roberts SB, Kehayias JJ, Lipsitz LA, Evans WJ. Exercise training and nutritional supplementation for physical frailty in very elderly people. N Engl J Med. 1994;330(25):1769-75.

123. Arrieta H, Rezola-Pardo C, Gil SM, Virgala J, Iturburu M, Antón I, González-Templado V, Irazusta J, Rodriguez-Larrad A. Effects of multicomponent exercise on frailty in Long-Term nursing homes: A randomized controlled trial. J Am Geriatr Soc [Internet]. 2019

124. Ng TP, Feng L, Nyunt MSZ, Feng L, Niti M, Tan BY, Chan G, Khoo SA, Chan SM, Yap P. Nutritional, physical, cognitive, and combination interventions and frailty reversal among older adults: A randomized controlled trial. Am J Med. 2015;128(11):1225,1236. e1.

125. Tarazona-Santabalbina FJ, Gmez-Cabrera MC, Prez-Ros P, Martnez-Arnau FM, Cabo H, Tsaparas K, Salvador-Pascual A, Rodriguez-Maas L, Via J. A multicomponent exercise intervention that reverses frailty and improves cognition, emotion, and social networking in the community-dwelling frail elderly: A randomized clinical trial. Journal of the American Medical Directors Association. 2016;17(5):426-33.

126. McPhee JS, French DP, Jackson D, Nazroo J, Pendleton N, Degens H. Physical activity in older age: Perspectives for healthy ageing and frailty. Biogerontology [Internet]. 2016 /03/02 [cited Oct 11, 2016];17(3):567-80. Available from: http://link.springer.com/article/10.1007/s10522-016-9641-0

127. Fried LP. Interventions for human frailty: Physical activity as a model. Cold Spring Harbor perspectives in medicine [Internet]. 2016;6(6):a025916.

128. Scheerman K, Raaijmakers K, Otten RHJ, Meskers CGM, Maier AB. Effect of physical interventions on physical performance and physical activity in older patients during hospitalization: A systematic review. BMC geriatrics [Internet]. 2018;18(1):1-13.

129. He J, Morales DR, Guthrie B. Exclusion rates in randomized controlled trials of treatments for physical conditions: A systematic review. Trials [Internet]. 2020;21(1):1-11.

130. Nagai K, Miyamato T, Okamae A, Tamaki A, Fujioka H, Wada Y, Uchiyama Y, Shinmura K, Domen K. Physical activity combined with resistance training reduces symptoms of frailty in older adults: A randomized controlled trial. Arch Gerontol Geriatr [Internet]. 2018;76:41-7.

131. Romera-Liebana L, Orfila F, Segura JM, Real J, Fabra ML, Möller M, Lancho S, Ramirez A, Marti N, Cullell M. Effects of a primary care-based multifactorial intervention on physical and cognitive function in frail, elderly individuals: A randomized controlled trial. The Journals of Gerontology: Series A [Internet]. 2018;73(12):1668-74.

132. Serra-Prat M, Sist X, Domenich R, Jurado L, Saiz A, Roces A, Palomera E, Tarradelles M, Papiol M. Effectiveness of an intervention to prevent frailty in pre-frail community-dwelling older people consulting in primary care: A randomised controlled trial. Age Ageing [Internet]. 2017;46(3):401-7.

133. Arrieta H, Rezola-Pardo C, Zarrazquin I, Echeverria I, Yanguas JJ, Iturburu M, Gil SM, Rodriguez-Larrad A, Irazusta J. A multicomponent exercise program improves physical function in long-term nursing home residents: A randomized controlled trial. Exp Gerontol [Internet]. 2018;103:94-100.

134. Ferreira CB, Teixeira PdS, Alves dos Santos G, Dantas Maya AT, Americano do Brasil P, Souza VC, Córdova C, Ferreira AP, Lima RM, Nóbrega OdT. Effects of a 12-week exercise training program on physical function in institutionalized frail elderly. Journal of aging research [Internet]. 2018;2018

135. Liu J, Reijnierse EM, Ancum J, Verlaan S, Meskers C, Maier AB. Acute inflammation is associated with lower muscle strength, muscle mass and dependency in activities of daily living in male hospitalised older patients. In: AUSTRALASIAN JOURNAL ON AGEING [Internet]2018WILEY 111 RIVER ST, HOBOKEN 07030-5774, NJ USA; 2018. p. 58.

136. Hao Q, Zhou L, Dong B, Yang M, Dong B, Weil Y. The role of frailty in predicting mortality and readmission in older adults in acute care wards: A prospective study. Scientific reports [Internet]. 2019;9(1):1207.

137. Martínez-Velilla N, Casas-Herrero A, Zambom-Ferraresi F, de Asteasu, Mikel L Sáez, Lucia A, Galbete A, García-Baztán A, Alonso-Renedo J, González-Glaría B, Gonzalo-Lázaro M. Effect of exercise intervention on functional decline in very elderly patients during acute hospitalization: A randomized clinical trial. JAMA internal medicine [Internet]. 2019;179(1):28-36.

138. McCullagh R, O'Connell E, O'Meara S, Dahly D, O'Reilly E, O'Connor K, Horgan NF, Timmons S. Augmented exercise in hospital improves physical performance and reduces negative post hospitalization events: A randomized controlled trial. BMC geriatrics [Internet]. 2020;20(1):1-11.

139. McCullagh R, Dillon C, Dahly D, Horgan NF, Timmons S. Walking in hospital is associated with a shorter length of stay in older medical inpatients. Physiol Meas [Internet]. 2016;37(10):1872.

Chapter 2

1. Collard RM, Boter H, Schoevers RA, Oude Voshaar RC. Prevalence of frailty in community-dwelling older persons: A systematic review. J Am Geriatr Soc [Internet]. 2012 Aug [cited Nov 12, 2016];60(8):1487-92.

2. Verlaan S, MSc, Ligthart-Melis GC, PhD, Wijers SLJ, PhD, Cederholm, Tommy, MD, PhD, Maier, Andrea B., MD, PhD, de van der Schueren, Marian A.E., PhD. High prevalence of physical frailty among community-dwelling malnourished older Adults–A systematic review and meta-analysis. Journal of the American Medical Directors Association [Internet]. 2017 May 1,;18(5):374-82. Available from: https://www.clinicalkey.es/playcontent/1-s2.0-S1525861016306788

3. Kojima G, Iliffe S, Taniguchi Y, Shimada H, Rakugi H, Walters K. Prevalence of frailty in japan: A systematic review and meta-analysis. Journal of epidemiology [Internet]. 2017 Aug;27(8):347-53. Available from: https://dx.doi.org/10.1016/j.je.2016.09.008

4. Siriwardhana DD, Hardoon S, Rait G, Weerasinghe MC, Walters KR. Prevalence of frailty and prefrailty among community-dwelling older adults in low-income and middle-income countries: A systematic review and meta-analysis. BMJ open [Internet]. 2018 Mar;8(3):e018195. Available from: http://dx.doi.org/10.1136/bmjopen-2017-018195

5. He B, Ma Y, Wang C, Jiang M, Geng C, Chang X, Ma B, Han L. Prevalence and risk factors for frailty among community-dwelling older people in china: A systematic review and meta-analysis. J Nutr Health Aging [Internet]. 2019 May;23(5):442-50. Available from: https://www.ncbi.nlm.nih.gov/pubmed/31021361

6. Melo RC, Cipolli GC, Buarque GLA, Yassuda MS, Cesari M, Oude Voshaar RC, Aprahamian I. Prevalence of frailty in brazilian older adults: A systematic review and meta-analysis. The Journal of nutrition, health & aging [Internet]. 2020 Jul 1,;24(7):708-16. Available from: https://www.narcis.nl/publication/RecordID/oai:pure.rug.nl:publications%2F3ac4bff6-0ece-432a-8e78-9ac40a332c57

7. Kojima G, MD. Prevalence of frailty in nursing homes: A systematic review and meta-analysis. Journal of the American Medical Directors Association [Internet]. 2015;16(11):940-5. Available from: https://www.clinicalkey.es/playcontent/1-s2.0-S1525861015004466

8. Marinus N, Vigorito C, Giallauria F, Haenen L, Jansegers T, Dendale P, Feys P, Meesen R, Timmermans A, Spildooren J, Hansen D. Frailty is highly prevalent in specific cardiovascular diseases and females, but significantly worsens prognosis in all affected patients: A systematic review. Ageing research reviews [Internet]. 2021 Mar;66:101233. Available from: https://dx.doi.org/10.1016/j.arr.2020.101233

9. Handforth C, Clegg A, Young C, Simpkins S, Seymour MT, Selby PJ, Young J. The prevalence and outcomes of frailty in older cancer patients: A systematic review. Annals of Oncology. 2015;26(6):1091-101. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84938084559&doi=10.1093%2fannonc%2fmdu540&partnerID=40&md5=d336d64f91780ef753465a49d51d2397

10. Hanlon P, Fauré I, Corcoran N, Butterly E, Lewsey J, McAllister D, Mair FS. Frailty measurement, prevalence, incidence, and clinical implications in people with diabetes: A systematic review and study-level meta-analysis. The Lancet Healthy Longevity [Internet]. 2020 Dec;1(3):e106-16. Available from: https://dx.doi.org/10.1016/S2666-7568(20)30014-3

11. Hewitt, Moug SJ, Middleton M, Chakrabarti M, Stechman MJ, McCarthy K. Prevalence of frailty and its association with mortality in general surgery; 25173599. Am J Surg. 2015;209(2):254-9. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84922595941&doi=10.1016%2fj.amjsurg.2014.05.022&partnerID=40&md5=f99478598b9f8bf0d9d23691cc4a

12. Purser JL, Kuchibhatla MN, Fillenbaum GG, Harding T, Peterson ED, Alexander KP. Identifying frailty in hospitalized older adults with significant coronary artery disease. Journal of the American Geriatrics Society [Internet]. 2006 November 1, [cited Jan 21, 2017];54(11):1674-81. Available from: http://onlinelibrary.wiley.com/doi/10.1111/j.1532-5415.2006.00914.x/abstract

13. Andela, Richt M R N, Dijkstra AE, Slaets JPJ, Sanderman R. Prevalence of frailty on clinical wards: Description and implications. Int J Nurs Pract. 2010 February;16(1):14-9. Available from: http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=ovftk&AN=00063413-201002000-00003 http://sfxeu07.hosted.exlibrisgroup.com/bham?sid=OVID:ovftdb&id=pmid:&id=doi:10.1111%2Fj.1440-172X.2009.01807.x&issn=1322-7114&isbn=&volume=16&issue=1&spage=14&pages=14-19&date=2010&title=International+Journal+of+Nursing+Practice&atitle=Prevalence+of+frailty+on+clinical+wards%3A+Description+and+implications.&aulast=Andela&pid=%3Cauthor%3EAndela%2C+Richt%3C%2Fauthor%3E%3CAN%3E00063413-201002000-00003%3C%2FAN%3E%3CDT%3EArticle%3C%2FDT%3E

14. Ekerstad N, Swahn E, Janzon M, Alfredsson J, Löfmark R, Lindenberger M, Carlsson P. Frailty is independently associated with short-term outcomes for elderly patients with non-ST-segment elevation myocardial infarction. Circulation [Internet]. 2011 Nov 29, [cited Jan 21, 2017];124(22):2397-404.

15. Khandelwal D, Goel A, Kumar U, Gulati V, Narang R, Dey AB. Frailty is associated with longer hospital stay and increased mortality in hospitalized older patients. J Nutr Health Aging [Internet]. 2012 /10/01 [cited Jan 21, 2017];16(8):732-5. Available from: http://link.springer.com/article/10.1007/s12603-012-0369-5

16. Oliveira DR, Bettinelli LA, Pasqualotti A, Corso D, Brock F, Erdmann AL, Oliveira DR, Bettinelli LA, Pasqualotti A, Corso D, Brock F, Erdmann AL. Prevalence of frailty syndrome in old people in a hospital institution. Revista Latino-Americana de Enfermagem [Internet]. 2013 08/ [cited Jan 21, 2017];21(4):891-8. Available from: http://www.scielo.br/scielo.php?script=sci_abstract&pid=S0104-11692013000400891&lng=en&nrm=iso&tlng=en

17. Le Maguet P, Roquilly A, Lasocki S, Asehnoune K, Carise E, Saint Martin M, Mimoz O, Le Gac G, Somme D, Cattenoz C, Feuillet F, Malledant Y, Seguin P. Prevalence and impact of frailty on mortality in elderly ICU patients: A prospective, multicenter, observational

study. Intensive Care Med [Internet]. 2014 May;40(5):674-82. Available from: https://www.ncbi.nlm.nih.gov/pubmed/24651884

18. Joosten E, Demuynck M, Detroyer E, Milisen K. Prevalence of frailty and its ability to predict in hospital delirium, falls, and 6-month mortality in hospitalized older patients. BMC geriatrics. 2014;14(1):1.

19. Hewitt J, Moug SJ, Middleton M, Chakrabarti M, Stechman MJ, McCarthy K. Prevalence of frailty and its association with mortality in general surgery. Am J Surg [Internet]. 2015 Feb [cited Jan 21, 2017];209(2):254-9.

20. Theou O, Squires E, Mallery K, Lee JS, Fay S, Goldstein J, Armstrong JJ, Rockwood K. What do we know about frailty in the acute care setting? A scoping review. BMC geriatrics [Internet]. 2018 Jun 11,;18(1):139. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29898673

21. Ligthart-Melis GC, Luiking YC, Kakourou A, Cederholm T, Maier AB, de van der Schueren, Marian A.E. Frailty, sarcopenia, and malnutrition frequently (co-)occur in hospitalized older adults: A systematic review and meta-analysis. Journal of the American Medical Directors Association [Internet]. 2020 Sep;21(9):1216-28. Available from: https://dx.doi.org/10.1016/j.jamda.2020.03.006

22. Theou O, Brothers TD, Rockwood MR, Haardt D, Mitnitski A, Rockwood K. Exploring the relationship between national economic indicators and relative fitness and frailty in middle-aged and older europeans. Age and ageing [Internet]. 2013 Sep;42(5):614-9. Available from: https://www.ncbi.nlm.nih.gov/pubmed/23443511

23. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. PLoS medicine [Internet]. 2009 Jul 21,;6(7):e1000097. Available from: https://www.ncbi.nlm.nih.gov/pubmed/19621072

24. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, Shamseer L, Tetzlaff JM, Moher D. Updating guidance for reporting systematic reviews: Development of the PRISMA 2020 statement. Journal of clinical epidemiology [Internet]. 2021 Jun;134:103-12. Available from: https://dx.doi.org/10.1016/j.jclinepi.2021.02.003

25. Doody P, Aunger J, Asamane E, Greig CA, Lord J, Whittaker A. Frailty levels in geriatric hospital paTients (FLIGHT)—the prevalence of frailty among geriatric populations within hospital ward settings: A systematic review protocol. BMJ open [Internet]. 2019;9(8):e030147. Available from: http://dx.doi.org/10.1136/bmjopen-2019-030147

26. International Monetary Fund (. World Economic Outlook (April 2019) [Internet]. cited 02/05/2019]. Available from: https://www.imf.org/external/datamapper/PPPPC@WEO/ADVEC/WEOWORLD

27. World Health Organisation (. Global Health Expenditure Database (GHED) [Internet]. cited (02/05/2019)]. Available from: http://apps.who.int/nha/database/Home/Index/en

28. Munn Z, Moola S, Lisy K, Riitano D, Tufanaru C. Methodological guidance for systematic reviews of observational epidemiological studies reporting prevalence and

cumulative incidence data. International journal of evidence-based healthcare [Internet]. 2015 Sep;13(3):147-53. Available from: https://www.ncbi.nlm.nih.gov/pubmed/26317388

29. Higgins JPT, Thompson SG. Quantifying heterogeneity in a meta-analysis. Statistics in medicine [Internet]. 2002 Jun 15,;21(11):1539-58. Available from: https://api.istex.fr/ark:/67375/WNG-0GZR71QC-D/fulltext.pdf

30. Higgins JPT, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. BMJ [Internet]. 2003 Sep;327(7414):557-60. Available from: http://dx.doi.org/10.1136/bmj.327.7414.557

31. Borenstein M, Hedges LV, Higgins JPT, Rothstein HR. A basic introduction to fixed-effect and random-effects models for meta-analysis. Research synthesis methods [Internet]. 2010;1(2):97-111. Available from: https://api.istex.fr/ark:/67375/WNG-QCVDDPFS-F/fulltext.pdf

32. Purser JL, Kuchibhatla MN, Fillenbaum GG, Harding T, Peterson ED, Alexander KP. Identifying frailty in hospitalized older adults with significant coronary artery disease. J Am Geriatr Soc. 2006;54(11):1674-81. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-33750500932&doi=10.1111%2fj.1532-5415.2006.00914.x&partnerID=40&md5=f2b41d72f7e0185cf13daae241805cca

33. Santos-Eggimann B, Cuénoud P, Spagnoli J, Junod J. Prevalence of frailty in middle-aged and older community-dwelling europeans living in 10 countries. The journals of gerontology. Series A, Biological sciences and medical sciences [Internet]. 2009 Mar 10,;64A(6):675-81. Available from: https://api.istex.fr/ark:/67375/HXZ-8KZ0Z9WH-Z/fulltext.pdf

34. Andela RM, Dijkstra A, Slaets JPJ, Sanderman R. Prevalence of frailty on clinical wards: Description and implications. Int J Nurs Pract. 2010;16(1):14-9. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-77952293949&doi=10.1111%2fj.1440-172X.2009.01807.x&partnerID=40&md5=7dd3b67d924c129fd4f226679d1ffa33

35. Alonso Salinas G, Sanmartin M, Pascual Izco M, Rincon L, Martin-Acuna A, Pastor Pueyo P, del Val Martín D, Marco del Castillo Á, Recio-Mayoral A, Martin-Asenjo R, Garcia-Guerrero A, Caravaca-Perez P, Camino Lopez A, Jimenez-Mena M, Zamorano J. The role of frailty in acute coronary syndromes in the elderly. Gerontology [Internet]. 2018;64(5):422-9. Available from: https://www.karger.com/Article/FullText/488390

36. Amblàs-Novellas J, Martori JC, Espaulella J, Oller R, Molist-Brunet N, Inzitari M, Romero-Ortuno R. Frail-VIG index: A concise frailty evaluation tool for rapid geriatric assessment. BMC geriatrics [Internet]. 2018;18(1):1-12. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29373968

37. Andela RM, Dijkstra A, Slaets JP, Sanderman R. Prevalence of frailty on clinical wards: Description and implications. Int J Nurs Pract [Internet]. 2010;16(1):14-9.

38. Andrew MK, Shinde V, Ye L, Hatchette T, Haguinet F, Dos Santos G, McElhaney JE, Ambrose A, Boivin G, Bowie W, Chit A, ElSherif M, Green K, Halperin S, Ibarguchi B,

Johnstone J, Katz K, Langley J, Leblanc J, Loeb M, MacKinnon-Cameron D, McCarthy A, McGeer A, Powis J, Richardson D, Semret M, Stiver G, Trottier S, Valiquette L, Webster D, McNeil SA. The importance of frailty in the assessment of influenza vaccine effectiveness against influenza-related hospitalization in elderly people. J Infect Dis [Internet]. 2017;216(4):405-14. Available from: https://www.ncbi.nlm.nih.gov/pubmed/28931244

39. Attisano T, Silverio A, Di Lorenzo E, Tesorio T, Di Girolamo D, Golino P, Giordano A, Valva G, Esposito G, Cappelli Bigazzi M, Briguori C, Monteforte I, Dialetto G, Rubino P, Vigorito F, Giudice P, Mauro C. SICI-GISE commuNity CAmpania survey doNna TAVI (INCANTA): Perioperative and short-term outcome of transcatheter aortic valve implantation in women. Giornale italiano di cardiologia (2006) [Internet]. 2017;18(6 Suppl 1):27S-32S. Available from: https://www.ncbi.nlm.nih.gov/pubmed/28652630

40. Baldwin MR, Reid MC, Westlake AA, Rowe JW, Granieri EC, Wunsch H, Dam T, Rabinowitz D, Goldstein NE, Maurer MS, Lederer, David J., MD, MS. The feasibility of measuring frailty to predict disability and mortality in older medical intensive care unit survivors. J Crit Care [Internet]. 2014;29(3):401-8. Available from: https://www.clinicalkey.es/playcontent/1-s2.0-S0883944114000045

41. Blanco S, Ferrières J, Bongard V, Toulza O, Sebai F, Billet S, Biendel C, Lairez O, Lhermusier T, Boudou N, Campelo-Parada F, MD, Roncalli, Jérôme, MD, PhD, Galinier, Michel, MD, PhD, Carrié, Didier, MD, PhD, Elbaz, Meyer, MD, PhD, Bouisset F, MD. Prognosis impact of frailty assessed by the edmonton frail scale in the setting of acute coronary syndrome in the elderly. Can J Cardiol [Internet]. 2017;33(7):933-9. Available from: https://www.clinicalkey.es/playcontent/1-s2.0-S0828282X17301782

42. Bo M, Li Puma F, Badinella Martini M, Falcone Y, Iacovino M, Grisoglio E, Bonetto M, Isaia G, Ciccone G, Isaia GC, Gaita F. Health status, geriatric syndromes and prescription of oral anticoagulant therapy in elderly medical in-patients with atrial fibrillation: A prospective observational study. Int J Cardiol [Internet]. 2015;187:123-5. Available from: https://www.clinicalkey.es/playcontent/1-s2.0-S0167527315005926

43. Bo M, Fonte G, Pivaro F, Bonetto M, Comi C, Giorgis V, Marchese L, Isaia G, Maggiani G, Furno E, Falcone Y, Isaia GC. Prevalence of and factors associated with prolonged length of stay in older hospitalized medical patients. Geriatrics & gerontology international [Internet]. 2016;16(3):314-21. Available from: https://api.istex.fr/ark:/67375/WNG-VB45KLNF-T/fulltext.pdf

44. Cheung S, Hilmer S, Ahmad LA, Hardy J. A prospective cohort study of older surgical inpatients examining the prevalence and implications of frailty. Journal of Clinical Gerontology and Geriatrics [Internet]. 2017;8(2)

45. Chew J, Lim WS, Chong MS, Ding YY, Tay L. Impact of frailty and residual subsyndromal delirium on 1-year functional recovery: A prospective cohort study. Geriatrics & gerontology international [Internet]. 2017;17(12):2472-8. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/ggi.13108

46. Chia CLK, Mantoo SK, Tan KY. 'Start to finish trans-institutional transdisciplinary care': A novel approach improves colorectal surgical results in frail elderly patients. Colorectal

disease [Internet]. 2016 Jan;18(1):O43-50. Available from: https://api.istex.fr/ark:/67375/WNG-D54NQ19H-R/fulltext.pdf

47. Chong E, MBChB, Ho E, MBBS, Baldevarona-Llego J, MD, Chan, Mark, MB, BCh, BAO, Wu L, BSc (Hons), Tay L, MBBS. Frailty and risk of adverse outcomes in hospitalized older adults: A Comparison of different frailty measures. Journal of the American Medical Directors Association [Internet]. 2017;18(7):638.e7,638.e11. Available from: https://www.clinicalkey.es/playcontent/1-s2.0-S1525861017302347

48. Coleman SA, Cunningham CJ, Walsh JB, Coakley D, Harbison J, Casey M, Murphy N, Horgan NF. Outcomes among older people in a post-acute inpatient rehabilitation unit. Disability and rehabilitation [Internet]. 2012 Jul;34(15):1333-8. Available from: http://www.tandfonline.com/doi/abs/10.3109/09638288.2011.636136

49. Courtney-Brooks M, Tellawi AR, Scalici J, Duska LR, Jazaeri AA, Modesitt SC, Cantrell LA. Frailty: An outcome predictor for elderly gynecologic oncology patients. Gynecologic oncology [Internet]. 2012;126(1):20-4. Available from: https://www.clinicalkey.es/playcontent/1-s2.0-S0090825812002740

50. Crozier-Shaw G, Joyce WP. Too frail for surgery? A frailty index in major colorectal surgery. ANZ journal of surgery [Internet]. 2018 Dec;88(12):1302-5.

51. Dal Moro FD, Morlacco A, Motterle G, Barbieri L, Zattoni F. Frailty and elderly in urology: Is there an impact on post-operative complications? Central European journal of urology [Internet]. 2017 Jun 30,;70(2):197-205. Available from: https://www.ncbi.nlm.nih.gov/pubmed/28721290

52. Dent E, Chapman I, Howell S, Piantadosi C, Visvanathan R. Frailty and functional decline indices predict poor outcomes in hospitalised older people. Age and ageing [Internet]. 2014 Jul;43(4):477-84. Available from: https://www.ncbi.nlm.nih.gov/pubmed/24257468

53. Dorner T, Luger E, Tschinderle J, Stein K, Haider S, Kapan A, Lackinger C, Schindler K. Association between nutritional status (MNA®-SF) and frailty (SHARE-FI) in acute hospitalised elderly patients. J Nutr Health Aging [Internet]. 2014 Mar;18(3):264-9. Available from: https://www.ncbi.nlm.nih.gov/pubmed/24626753

54. Drudi LM, Ades M, Turkdogan S, Huynh C, Lauck S, Webb JG, Piazza N, Martucci G, Langlois Y, Perrault LP, Asgar AW, Labinaz M, Lamy A, Noiseux N, Peterson MD, Arora RC, Lindman BR, Bendayan M, Mancini R, Trnkus A, Kim DH, Popma JJ, Afilalo J. Association of depression with mortality in older adults undergoing transcatheter or surgical aortic valve replacement. JAMA cardiology [Internet]. 2018 Jan 17,;3(3):191-7. Available from: http://dx.doi.org/10.1001/jamacardio.2017.5064

55. Dutzi I, Schwenk M, Kirchner M, Bauer JM, Hauer K. Cognitive change in rehabilitation patients with dementia: Prevalence and association with rehabilitation success. J Alzheimer's Dis [Internet]. 2017;60(3):1171-82. Available from: https://www.ncbi.nlm.nih.gov/pubmed/28984597

56. Eamer GJ, Clement F, Pederson JL, Churchill TA, Khadaroo RG. Analysis of postdischarge costs following emergent general surgery in elderly patients. Canadian journal

of surgery [Internet]. 2018 Feb;61(1):19-27. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29368673

57. Eeles EMP, White SV, O'Mahony SM, Bayer AJ, Hubbard RE. The impact of frailty and delirium on mortality in older inpatients. Age and ageing [Internet]. 2012 May;41(3):412-6. Available from: https://www.ncbi.nlm.nih.gov/pubmed/22391613

58. Ekerstad N, Swahn E, Janzon M, Alfredsson J, Löfmark R, Lindenberger M, Carlsson P. Frailty is independently associated with short-term outcomes for elderly patients with non–ST-segment elevation myocardial infarction. Circulation [Internet]. 2011;124(22):2397-404.

59. Engelhardt KE, Reuter Q, Liu J, Bean JF, Barnum J, Shapiro MB, Ambre A, Dunbar A, Markzon M, Reddy TN, Schilling C, Posluszny J, Joseph A. Frailty screening and a frailty pathway decrease length of stay, loss of independence, and 30-day readmission rates in frail geriatric trauma and emergency general surgery patients. The journal of trauma and acute care surgery [Internet]. 2018 Jul;85(1):167-73. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29659475

60. Ferrero A, Fuso L, Tripodi E, Tana R, Daniele A, Zanfagnin V, Perotto S, Gadducci A. Ovarian cancer in elderly patients: Patterns of care and treatment outcomes according to age and modified frailty index. International journal of gynecological cancer [Internet]. 2017 Nov;27(9):1863-71. Available from: https://www.ncbi.nlm.nih.gov/pubmed/28763363

61. Ga H, Won CW, Jung H. Use of the frailty index and FRAIL-NH scale for the assessment of the frailty status of elderly individuals admitted in a long-term care hospital in korea. Annals of geriatric medicine and research [Internet]. 2018 Mar 31,;22(1):20-5. Available from: https://search.proquest.com/docview/2430098019

62. Gleason LJ, Benton EA, Alvarez-Nebreda ML, Weaver MJ, Harris MB, Javedan H. FRAIL questionnaire screening tool and short-term outcomes in geriatric fracture patients. Journal of the American Medical Directors Association [Internet]. 2017 Dec 1,;18(12):1082-6. Available from: https://dx.doi.org/10.1016/j.jamda.2017.07.005

63. Goldfarb M, Lauck S, Webb J, Asgar A, Perrault L, Piazza N, Martucci G, Lachapelle K, Noiseux N, Kim D, Popma J, Lefèvre T, Labinaz M, Lamy A, Peterson M, Arora R, Morais J, Morin J, Rudski L, Afilalo J. Malnutrition and mortality in frail and non-frail older adults undergoing aortic valve replacement. Circulation (New York, N.Y.) [Internet]. 2018 Nov 13,;138(20):2202-11. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29976568

64. Guidet B, Flaatten H, Boumendil A, Morandi A, Andersen F, Artigas A, Bertolini G, Cecconi M, Christensen S, Faraldi L, Fjølner J, Jung C, Marsh B, Moreno R, Oeyen S, Öhman C, Pinto B, Soliman I, Szczeklik W, Valentin A, Watson X, Zafeiridis T, De Lange D. Withholding or withdrawing of life-sustaining therapy in older adults (≥ 80 years) admitted to the intensive care unit. Intensive Care Med [Internet]. 2018 Jul;44(7):1027-38. Available from: https://www.narcis.nl/publication/RecordID/oai:pure.rug.nl:publications%2Fc058a6bf-0846-482d-b6b1-3f846f507f84

65. Gullón A, Formiga F, Camafort M, Mostaza JM, Díez-Manglano J, Cepeda JM, Novo-Veleiro I, Pose A, Suárez Fernández C. Baseline functional status as the strongest predictor

of in-hospital mortality in elderly patients with non-valvular atrial fibrillation: Results of the NONAVASC registry. European journal of internal medicine [Internet]. 2018 Jan;47:69-74. Available from: https://dx.doi.org/10.1016/j.ejim.2017.09.020

66. Hartley P, Adamson J, Cunningham C, Embleton G, Romero-Ortuno R. Clinical frailty and functional trajectories in hospitalized older adults: A retrospective observational study. Geriatrics & gerontology international [Internet]. 2017 Jul;17(7):1063-8.

67. Heppenstall CP, Wilkinson TJ, Hanger HC, Keeling S, Pearson J. Factors related to care home admission in the year following hospitalisation in frail older adults. Age and ageing [Internet]. 2011 Jul;40(4):513-6. Available from: https://www.ncbi.nlm.nih.gov/pubmed/21622672

68. Hewitt J, Moug SJ, Middleton M, Chakrabarti M, Stechman MJ, McCarthy K, Older Persons Surgical Outcomes Collaboration. Prevalence of frailty and its association with mortality in general surgery. The American Journal of Surgery [Internet]. 2015;209(2):254-9.

69. Hewitt J, McCormack C, Tay HS, Greig M, Law J, Tay A, Asnan NH, Carter B, Myint PK, Pearce L. Prevalence of multimorbidity and its association with outcomes in older emergency general surgical patients: An observational study. BMJ open [Internet]. 2016;6(3):e010126.

70. Hii TBK, MBCHB, Lainchbury JG, MD, Bridgman PG, MD. Frailty in acute cardiology: Comparison of a quick clinical assessment against a validated frailty assessment tool. Heart, lung & circulation [Internet]. 2014;24(6):551-6. Available from: https://www.clinicalkey.es/playcontent/1-s2.0-S1443950614008099

71. Hilmer SN, Tran K, Rubie P, Wright J, Gnjidic D, Mitchell SJ, Matthews S, Carroll PR. Gentamicin pharmacokinetics in old age and frailty. British journal of clinical pharmacology [Internet]. 2011 Feb;71(2):224-31.

72. Ibrahim K, Howson FFA, Culliford DJ, Sayer AA, Roberts HC. The feasibility of assessing frailty and sarcopenia in hospitalised older people: A comparison of commonly used tools. BMC geriatrics [Internet]. 2019 Feb 15,;19(1):42. Available from: https://www.ncbi.nlm.nih.gov/pubmed/30770722

73. Induruwa I, Evans NR, Aziz A, Reddy S, Khadjooi K, Romero-Ortuno R. Clinical frailty is independently associated with non-prescription of anticoagulants in older patients with atrial fibrillation. Geriatrics & gerontology international [Internet]. 2017 Nov;17(11):2178-83.

74. Jacobs A, Benraad CEM, Wetzels JFM, Olde Rikkert, M. G. M, Kramers C. Clinical relevance of differences in glomerular filtration rate estimations in frail older people by creatinine- vs. cystatin C-based formulae. Drugs & aging [Internet]. 2017;34(6):445-52. Available from: https://www.narcis.nl/publication/RecordID/oai:repository.ubn.ru.nl:2066%2F174230

75. Jokar OT, Ibraheem K, Rhee P, Kulavatunyou N, Haider A, Phelan HA, Fain M, Mohler MJ, Joseph B. Emergency general surgery specific frailty index: A validation study. The

journal of trauma and acute care surgery [Internet]. 2016 Aug;81(2):254-60. Available from: https://www.ncbi.nlm.nih.gov/pubmed/27257694

76. Joosten E, Demuynck M, Detroyer E, Milisen K. Prevalence of frailty and its ability to predict in hospital delirium, falls, and 6-month mortality in hospitalized older patients. BMC geriatrics [Internet]. 2014;14(1):1-9.

77. Joseph B, Pandit V, Zangbar B, Kulvatunyou N, Hashmi A, Green DJ, O'Keeffe T, Tang A, Vercruysse G, Fain MJ, Friese RS, Rhee P. Superiority of frailty over age in predicting outcomes among geriatric trauma patients: A prospective analysis. JAMA surgery [Internet]. 2014 Jun 11,;149(8):766-72. Available from: http://dx.doi.org/10.1001/jamasurg.2014.296

78. Joseph B, Phelan H, Hassan A, Orouji Jokar T, O'Keeffe T, Azim A, Gries L, Kulvatunyou N, Latifi R, Rhee P. The impact of frailty on failure-to-rescue in geriatric trauma patients: A prospective study. The journal of trauma and acute care surgery [Internet]. 2016 Dec;81(6):1150-5. Available from: https://www.ncbi.nlm.nih.gov/pubmed/27602908

79. Juma S, Taabazuing M, Montero-Odasso M. Clinical frailty scale in an acute medicine unit: A simple tool that predicts length of stay. Canadian geriatrics journal CGJ [Internet]. 2016 Jun;19(2):34-9. Available from: https://www.ncbi.nlm.nih.gov/pubmed/27403211

80. Kang L, Zhang S, Zhu W, Pang H, Zhang L, Zhu M, Liu X, Liu Y. Is frailty associated with short-term outcomes for elderly patients with acute coronary syndrome? Journal of geriatric cardiology : JGC [Internet]. 2015;12(6):662-7. Available from: http://lib.cqvip.com/qk/88644X/201506/668663361.html

81. Karlekar MB, Maxwell CA, Dietrich MS, Miller RS. Creating new opportunities to educate families on the impact of frailty and cognitive impairment in a trauma intensive care unit: Results of a quality improvement project. Journal of palliative medicine [Internet]. 2017 Feb 1,;20(2):193-6. Available from: https://www.liebertpub.com/doi/abs/10.1089/jpm.2016.0244

82. Keevil VL, Martin GJ, Biram R, Wallis S, Romero-Ortuno R. Care home residents admitted to hospital through the emergency pathway: Characteristics and associations with inpatient mortality. The Journal of the Royal College of Physicians of Edinburgh [Internet]. 2018 Sep;48(3):202-9. Available from: https://www.ncbi.nlm.nih.gov/pubmed/30191907

83. Kenig J, Zychiewicz B, Olszewska U, Barczynski M, Nowak W. Six screening instruments for frailty in older patients qualified for emergency abdominal surgery. Archives of gerontology and geriatrics [Internet]. 2015;61(3):437-42. Available from: https://www.clinicalkey.es/playcontent/1-s2.0-S0167494315300248

84. Khan M, Jehan F, Zeeshan M, Kulvatunyou N, Fain MJ, Saljuqi AT, O'Keeffe T, Joseph B. Failure to rescue after emergency general surgery in geriatric patients: Does frailty matter? The Journal of surgical research [Internet]. 2019 Jan;233:397-402. Available from: https://dx.doi.org/10.1016/j.jss.2018.08.033

85. Kobe AR, Meyer A, Elmubarak H, Kempfert J, Pavicevic J, Maisano F, Walther T, Falk V, Sündermann SH. Frailty assessed by the forecast is a valid tool to predict short-term outcome after transcatheter aortic valve replacement. Innovations (Philadelphia, Pa.)

[Internet]. 2016 Nov;11(6):407-13. Available from: https://journals.sagepub.com/doi/full/10.1097/imi.0000000000000321

86. Koyama S, Katata H, Ishiyama D, Komatsu T, Fujimoto J, Suzuki M, Yamada M, Yamatoku M. Preadmission frailty status as a powerful predictor of dependency after discharge among hospitalized older patients: A clinical-based prospective study. Geriatrics & gerontology international [Internet]. 2018 Dec;18(12):1609-13. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/ggi.13537

87. Kusunose K, Okushi Y, Yamada H, Nishio S, Torii Y, Hirata Y, Saijo Y, Ise T, Yamaguchi K, Yagi S, Soeki T, Wakatsuki T, Sata M. Prognostic value of frailty and diastolic dysfunction in elderly patients. Circulation journal : official journal of the Japanese Circulation Society [Internet]. 2018 Jul 25,;82(8):2103-10. Available from: https://www.jstage.jst.go.jp/article/circj/82/8/82_CJ-18-0017/_article/-char/en

88. Lee H, Joseph B, Enriquez A, Najafi B. Toward using a smartwatch to monitor frailty in a hospital setting: Using a single wrist-wearable sensor to assess frailty in bedbound inpatients. Gerontology (Basel) [Internet]. 2018 Jun;64(4):389-400. Available from: https://www.karger.com/Article/FullText/484241

89. Le Maguet P, Roquilly A, Lasocki S, Asehnoune K, Carise E, Saint Martin M, Mimoz O, Le Gac G, Somme D, Cattenoz C, Feuillet F, Malledant Y, Seguin P. Prevalence and impact of frailty on mortality in elderly ICU patients: A prospective, multicenter, observational study. Intensive Care Med [Internet]. 2014 May;40(5):674-82. Available from: https://www.ncbi.nlm.nih.gov/pubmed/24651884

90. Lin H, Peel NM, Scott IA, Vardesh DL, Sivalingam P, McBride RL, Morong JJ, Nelson MJ, Hubbard RE. Perioperative assessment of older surgical patients using a frailty index - feasibility and association with adverse postoperative outcomes. Anaesthesia and intensive care [Internet]. 2017 Nov 1,;45(6):676-82. Available from: https://search.informit.org/documentSummary;dn=373224119118332;res=IELHEA

91. Llaó I, Ariza-Solé A, Sanchis J, Alegre O, López-Palop R, Formiga F, Marín F, Vidán MT, Martínez-Sellés M, Sionis A, Vives-Borrás M, Gómez-Hospital JA, Gómez-Lara J, Roura G, Díez-Villanueva P, Núñez-Gil I, Maristany J, Asmarats L, Bueno H, Abu-Assi E, Cequier À. Invasive strategy and frailty in very elderly patients with acute coronary syndromes. EuroIntervention : journal of EuroPCR in collaboration with the Working Group on Interventional Cardiology of the European Society of Cardiology [Internet]. 2018 Jun 8,;14(3):e336-42. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29616624

92. Ma HM, Yu RHY, Woo J. Recurrent hospitalisation with pneumonia is associated with higher 1-year mortality in frail older people. Internal medicine journal [Internet]. 2013 Nov;43(11):1210-5. Available from: https://api.istex.fr/ark:/67375/WNG-HPD99ZH6-5/fulltext.pdf

93. Madni TD, Nakonezny PA, Wolf SE, Joseph B, Mohler MJ, Imran JB, Clark AT, Arnoldo BD, Phelan HA. The relationship between frailty and the subjective decision to conduct a goals of care discussion with burned elders. Journal of burn care & research [Internet]. 2018 Jan 1,;39(1):82-8. Available from: https://www.ncbi.nlm.nih.gov/pubmed/28574881

94. Martín A, Ortega O, Roca M, Arús M, Clavé Civit P. Effect of a minimal-massive intervention in hospitalized older patients with oropharyngeal dysphagia: A proof of concept study. J Nutr Health Aging [Internet]. 2018 Jun;22(6):739-47. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29806864

95. Mason MC, Crees AL, Dean MR, Bashir N. Establishing a proactive geriatrician led comprehensive geriatric assessment in older emergency surgery patients: Outcomes of a pilot study. International journal of clinical practice (Esher) [Internet]. 2018 May;72(5):e13096,n/a. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/ijcp.13096

96. Maxwell CA, Dietrich MS, Miller RS. The FRAIL questionnaire: A useful tool for bedside screening of geriatric trauma patients. Journal of trauma nursing [Internet]. 2018 Jul;25(4):242-7. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29985858

97. McGuckin DG, Mufti S, Turner DJ, Bond C, Moonesinghe SR. The association of peri-operative scores, including frailty, with outcomes after unscheduled surgery. Anaesthesia [Internet]. 2018 Jul;73(7):819-24. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/anae.14269

98. McIsaac D, Wong C, Huang A, Moloo H, van Walraven C. Derivation and validation of a generalizable preoperative frailty index using population-based health administrative data. Annals of surgery [Internet]. 2019 Jul;270(1):102-8. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29672410

99. Morton S, Isted A, Avery P, Wang J. Is frailty a predictor of outcomes in elderly inpatients with acute kidney injury? A prospective cohort study. The American journal of medicine [Internet]. 2018 Oct;131(10):1251,1256.e2. Available from: https://dx.doi.org/10.1016/j.amjmed.2018.03.012

100. Muessig JM, Nia AM, Masyuk M, Lauten A, Sacher AL, Brenner T, Franz M, Bloos F, Ebelt H, Schaller SJ, Fuest K, Rabe C, Dieck T, Steiner S, Graf T, Jánosi RA, Meybohm P, Simon P, Utzolino S, Rahmel T, Barth E, Schuster M, Kelm M, Jung C. Clinical frailty scale (CFS) reliably stratifies octogenarians in german ICUs: A multicentre prospective cohort study. BMC geriatrics [Internet]. 2018 Jul 13,;18(1):162. Available from: https://www.ncbi.nlm.nih.gov/pubmed/30005622

101. Müller FS, Meyer OW, Chocano-Bedoya P, Schietzel S, Gagesch M, Freystaetter G, Neuhaus V, Simmen H, Langhans W, Bischoff-Ferrari HA. Impaired nutritional status in geriatric trauma patients. European journal of clinical nutrition [Internet]. 2017 May;71(5):602-6. Available from: https://www.ncbi.nlm.nih.gov/pubmed/28327565

102. Myint PK, Owen S, McCarthy K, Pearce L, Moug SJ, Stechman MJ, Hewitt J, Carter B. Is anemia associated with cognitive impairment and delirium among older acute surgical patients? Geriatrics & gerontology international [Internet]. 2018 Jul;18(7):1025-30. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/ggi.13293

103. Nolan M, Power D, Long J, Horgan F. Frailty and its association with rehabilitation outcomes in a post-acute older setting. International journal of therapy and rehabilitation [Internet]. 2016 Jan;23(1):33-40.

104. Nguyen TN, Cumming RG, Hilmer SN. Atrial fibrillation in older inpatients: Are there any differences in clinical characteristics and pharmacological treatment between the frail and the non-frail? Internal medicine journal [Internet]. 2016 Jan;46(1):86-95. Available from: https://api.istex.fr/ark:/67375/WNG-GZRCHGQ9-2/fulltext.pdf

105. Oliveira DR, Bettinelli LA, Pasqualotti A, Corso D, Brock F, Erdmann AL. Prevalence of frailty syndrome in old people in a hospital institution. Revista latino-americana de enfermagem [Internet]. 2013 Jul;21(4):891-8. Available from: https://www.ncbi.nlm.nih.gov/pubmed/23970225

106. Öztürk ZA, Özdemir S, Türkbeyler İH, Demir Z. Quality of life and fall risk in frail hospitalized elderly patients. Turkish journal of medical sciences [Internet]. 2017 Nov 13,;47(5):1377-83. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29151307

107. Papageorgiou D, Gika E, Kosenai K, Tsironas K, Avramopoulou L, Sela E, Mandila C. Frailty in elderly ICU patients in greece: A prospective, observational study. Annals of translational medicine [Internet]. 2018 Apr;6(7):111. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29955571

108. Papakonstantinou PE, Asimakopoulou NI, Papadakis JA, Leventis D, Panousieris M, Mentzantonakis G, Hoda E, Panagiotakis S, Gikas A. Frailty status affects the decision for long-term anticoagulation therapy in elderly patients with atrial fibrillation. Drugs & aging [Internet]. 2018 Oct;35(10):897-905. Available from: https://www.ncbi.nlm.nih.gov/pubmed/30203312

109. Parmar K, Law J, Carter B, Hewitt J, Boyle J, Casey P, Maitra I, Farrell I, Pearce L, Moug S. Frailty in older patients undergoing emergency laparotomy: Results from the UK observational emergency laparotomy and frailty (ELF) study. Annals of surgery [Internet]. 2019 Jun 7,;273(4):709-18. Available from: https://www.ncbi.nlm.nih.gov/pubmed/31188201

110. Pasqualetti G, Calsolaro V, Bernardini S, Linsalata G, Bigazzi R, Caraccio N, Monzani F. Degree of peripheral thyroxin deiodination, frailty, and long-term survival in hospitalized older patients. The journal of clinical endocrinology and metabolism [Internet]. 2018 May;103(5):1867-76. Available from: http://ovidsp.ovid.com/ovidweb.cgi?T=JS&NEWS=n&CSC=Y&PAGE=fulltext&D=ovft&AN=00004678-201805000-00015

111. Patel A, Goodman SG, Yan AT, Alexander KP, Wong CL, Cheema AN, Udell JA, Kaul P, D'Souza M, Hyun K, Adams M, Weaver J, Chew DP, Brieger D, Bagai A. Frailty and outcomes after myocardial infarction: Insights from the CONCORDANCE registry. Journal of the American Heart Association [Internet]. 2018 Sep 18,;7(18):e009859. Available from: https://www.ncbi.nlm.nih.gov/pubmed/30371219

112. Ranasinghe C, Fleury A, Peel NM, Hubbard RE. Frailty and adverse outcomes: Impact of multiple bed moves for older inpatients. International psychogeriatrics [Internet]. 2017 Feb;29(2):345-9. Available from: https://dx.doi.org/10.1017/S1041610216001605

113. Pelavski A, De Miguel M, Alcaraz Garcia-Tejedor G, Villarino L, Lacasta A, Señas L, Rochera M. Mortality, geriatric, and nongeriatric surgical risk factors among the eldest old: A

prospective observational study. Anesthesia and analgesia [Internet]. 2017 Oct;125(4):1329-36. Available from: https://www.ncbi.nlm.nih.gov/pubmed/28786844

114. Perera V, Bajorek BV, Matthews S, Hilmer SN. The impact of frailty on the utilisation of antithrombotic therapy in older patients with atrial fibrillation. Age Ageing [Internet]. 2009 Mar;38(2):156-62. Available from: https://api.istex.fr/ark:/67375/HXZ-MW3MTS06-M/fulltext.pdf

115. Pollack LR, Goldstein NE, Gonzalez WC, Blinderman CD, Maurer MS, Lederer DJ, Baldwin MR. The frailty phenotype and palliative care needs of older survivors of critical illness. Journal of the American Geriatrics Society (JAGS) [Internet]. 2017 Jun;65(6):1168-75. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/jgs.14799

116. Poudel A, PhD, Peel NM, PhD, Nissen LM, PhD, Mitchell CA, MBBS, Gray LC, PhD, Hubbard RE, MD. Adverse outcomes in relation to polypharmacy in robust and frail older hospital patients. Journal of the American Medical Directors Association [Internet]. 2016;17(8):767.e9,767.e13. Available from: https://www.clinicalkey.es/playcontent/1-s2.0-S1525861016301736

117. Purser JL, Kuchibhatla MN, Fillenbaum GG, Harding T, Peterson ED, Alexander KP. Identifying frailty in hospitalized older adults with significant coronary artery disease. J Am Geriatr Soc [Internet]. 2006;54(11):1674-81.

118. Ritt M, Schwarz C, Kronawitter V, Delinic A, Bollheimer L, Gassmann K-, Sieber C. Analysis of rockwood et al's clinical frailty scale and fried et al's frailty phenotype as predictors of mortality and other clinical outcomes in older patients who were admitted to a geriatric ward. J Nutr Health Aging [Internet]. 2015 Dec;19(10):1043-8. Available from: https://www.ncbi.nlm.nih.gov/pubmed/26624218

119. Rose M, Pan H, Levinson MR, Staples M. Can frailty predict complicated care needs and length of stay? Internal medicine journal [Internet]. 2014 Aug;44(8):800-5. Available from: https://api.istex.fr/ark:/67375/WNG-LT9H4HH2-V/fulltext.pdf

120. Sánchez E, Vidán MT, Serra JA, Fernández-Avilés F, Bueno H. Prevalence of geriatric syndromes and impact on clinical and functional outcomes in older patients with acute cardiac diseases. Heart (British Cardiac Society) [Internet]. 2011 Oct;97(19):1602-6. Available from: http://dx.doi.org/10.1136/hrt.2011.227504

121. Sanchis, Juan, MD, PhD, Núñez E, MD, Ruiz V, PhD, Bonanad C, MD, Fernández J, PhD, Cauli O, PhD, García-Blas S, MD, Mainar, Luis, MD, PhD, Valero E, MD, Rodríguez-Borja E, MD, Chorro, Francisco J., MD, PhD, Hermenegildo, Carlos, MD, PhD, Núñez, Julio, MD, PhD. Usefulness of clinical data and biomarkers for the identification of frailty after acute coronary syndromes. Canadian journal of cardiology [Internet]. 2015;31(12):1462-8. Available from: https://www.clinicalkey.es/playcontent/1-s2.0-S0828282X15013197

122. Sikder T, Sourial N, Maimon G, Tahiri M, Teasdale D, Bergman H, Fraser S, Demyttenaere S, Bergman S. Postoperative recovery in frail, pre-frail, and non-frail elderly patients following abdominal surgery. World J Surg [Internet]. 2019 Feb 15,;43(2):415-24. Available from: https://www.ncbi.nlm.nih.gov/pubmed/30229382

123. Sündermann SH, Dademasch A, Seifert B, Rodriguez Cetina Biefer H, Emmert MY, Walther T, Jacobs S, Mohr F, Falk V, Starck CT. Frailty is a predictor of short- and mid-term mortality after elective cardiac surgery independently of age. Interactive cardiovascular and thoracic surgery [Internet]. 2014 May;18(5):580-5. Available from: https://www.ncbi.nlm.nih.gov/pubmed/24497604

124. Thai M, Hilmer S, Pearson S, Reeve E, Gnjidic D. Prevalence of potential and clinically relevant Statin–Drug interactions in frail and robust older inpatients. Drugs Aging [Internet]. 2015 Oct;32(10):849-56. Available from: https://www.ncbi.nlm.nih.gov/pubmed/26442861

125. Ticinesi A, Lauretani F, Nouvenne A, Mori G, Chiussi G, Maggio M, Meschi T. Lung ultrasound and chest x-ray for detecting pneumonia in an acute geriatric ward. Medicine (Baltimore) [Internet]. 2016 Jul;95(27):e4153. Available from: https://www.ncbi.nlm.nih.gov/pubmed/27399134

126. Timmons S, Manning E, Barrett A, Brady NM, Browne V, O'Shea E, Molloy DW, O'Regan NA, Trawley S, Cahill S, O'Sullivan K, Woods N, Meagher D, Ni Chorcorain AM, Linehan JG. Dementia in older people admitted to hospital: A regional multi-hospital observational study of prevalence, associations and case recognition. Age and ageing [Internet]. 2015 Nov;44(6):993-9. Available from: https://www.ncbi.nlm.nih.gov/pubmed/26420638

127. Valentini A, Federici M, Cianfarani MA, Tarantino U, Bertoli A. Frailty and nutritional status in older people: The mini nutritional assessment as a screening tool for the identification of frail subjects. Clinical interventions in aging [Internet]. 2018;13:1237-44. Available from: https://www.ncbi.nlm.nih.gov/pubmed/30034227

128. Vidán MT, Sánchez E, Fernández-Avilés F, Serra-Rexach JA, Ortiz J, Bueno H. FRAIL-HF, a study to evaluate the clinical complexity of heart failure in nondependent older patients: Rationale, methods and baseline characteristics. Clinical cardiology (Mahwah, N.J.) [Internet]. 2014 Dec;37(12):725-32. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1002/clc.22345

129. Wallis SJ, Wall J, Biram RWS, Romero-Ortuno R. Association of the clinical frailty scale with hospital outcomes. QJM : monthly journal of the Association of Physicians [Internet]. 2015 Dec;108(12):943-9. Available from: https://www.ncbi.nlm.nih.gov/pubmed/25778109

130. Wou F, Gladman JRF, Bradshaw L, Franklin M, Edmans J, Conroy SP. The predictive properties of frailty-rating scales in the acute medical unit. Age and ageing [Internet]. 2013 Nov;42(6):776-81. Available from: https://www.ncbi.nlm.nih.gov/pubmed/23666406

131. Hoogendijk EO, Afilalo J, Ensrud KE, Kowal P, Onder G, Fried LP. Frailty: Implications for clinical practice and public health. The Lancet (British edition) [Internet]. 2019 Oct 12,;394(10206):1365-75. Available from: https://dx.doi.org/10.1016/S0140-6736(19)31786-6

132. United Nations, Department of Economic and Social Affairs, Population Division. United Nations Population Prospects 2019 (ST/ESA/SER.A/423). 2019 Available from: https://population.un.org/wpp/Publications/Files/WPP2019_Highlights.pdf.

133. Murray CJL, Callender, Charlton S. K. H, Kulikoff XR, Srinivasan V, Geleijnse JM. Population and fertility by age and sex for 195 countries and territories, 1950–2017 : A systematic analysis for the global burden of disease study 2017. The Lancet (British edition) [Internet]. 2018;392(10159):1995-2051. Available from: https://www.narcis.nl/publication/RecordID/oai:library.wur.nl:wurpubs%2F555355

134. Vollset SE, Goren E, Yuan C, Cao J, Smith AE, Hsiao T, Bisignano C, Azhar GS, Castro E, Chalek J, Dolgert AJ, Frank T, Fukutaki K, Hay SI, Lozano R, Mokdad AH, Nandakumar V, Pierce M, Pletcher M, Robalik T, Steuben KM, Wunrow HY, Zlavog BS, Murray CJL. Fertility, mortality, migration, and population scenarios for 195 countries and territories from 2017 to 2100: A forecasting analysis for the global burden of disease study. The Lancet (British edition) [Internet]. 2020 Oct 17,;396(10258):1285-306. Available from: https://dx.doi.org/10.1016/S0140-6736(20)30677-2

135. Dent E, Martin FC, Bergman H, Woo J, Romero-Ortuno R, Walston JD. Management of frailty: Opportunities, challenges, and future directions. The Lancet (British edition) [Internet]. 2019 Oct 12,;394(10206):1376-86. Available from: https://dx.doi.org/10.1016/S0140-6736(19)31785-4

Chapter 3

1. Rodriguez-Mañas L, Fried LP. Frailty in the clinical scenario. The Lancet [Internet]. 2015 /02/14 [cited Nov 12, 2016];385(9968):e7-9. Available from: /journals/lancet/article/PIIS0140-6736(14)61595-6/abstract

2. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, Seeman T, Tracy R, Kop WJ, Burke G, McBurnie MA. Frailty in older adults: Evidence for a phenotype. The journals of gerontology. Series A, Biological sciences and medical sciences [Internet]. 2001 Mar;56(3):M146-57. Available from: https://www.ncbi.nlm.nih.gov/pubmed/11253156

3. Gill TM, Gahbauer EA, Allore HG, Han L. Transitions between frailty states among community-living older persons. Arch Intern Med. 2006;166(4):418-23.

4. Clegg A, Dr, Young J, Prof, Iliffe S, Prof, Rikkert MO, Prof, Rockwood K, Prof. Frailty in elderly people. The Lancet (British edition) [Internet]. 2013;381(9868):752-62. Available from: https://www.clinicalkey.es/playcontent/1-s2.0-S0140673612621679

5. Sternberg SA, Schwartz AW, Karunananthan S, Bergman H, Mark Clarfield A. The identification of frailty: A systematic literature review. Journal of the American Geriatrics Society (JAGS) [Internet]. 2011 Nov;59(11):2129-38. Available from: https://api.istex.fr/ark:/67375/WNG-TCTFS38N-J/fulltext.pdf

6. Sourial N, Bergman H, Karunananthan S, Wolfson C, Payette H, Gutierrez-Robledo LM, Béland F, Fletcher JD, Guralnik J. Implementing frailty into clinical practice: A cautionary tale. The journals of gerontology. Series A, Biological sciences and medical sciences [Internet]. 2013 Dec;68(12):1505-11. Available from: https://www.ncbi.nlm.nih.gov/pubmed/23640761

7. Theou O, Stathokostas L, Roland KP, Jakobi JM, Patterson C, Vandervoort AA, Jones GR. The effectiveness of exercise interventions for the management of frailty: A systematic review. Journal of aging research [Internet]. 2011 Dec 1,;2011:569194-19. Available from: https://www.airitilibrary.com/Publication/alDetailedMesh?DocID=P20151210007-201112-201704070007-201704070007-674-692

8. Arrieta H, Rezola-Pardo C, Gil SM, Virgala J, Iturburu M, Antón I, González-Templado V, Irazusta J, Rodriguez-Larrad A. Effects of multicomponent exercise on frailty in Long-Term nursing homes: A randomized controlled trial. J Am Geriatr Soc [Internet]. 2019

9. Tarazona-Santabalbina, Francisco José, MD, PhD, Gómez-Cabrera MC, PhD, Pérez-Ros P, PhD, Martínez-Arnau FM, PhD, Cabo H, PhD, Tsaparas K, PhD, Salvador-Pascual A, PhD, Rodriguez-Mañas, Leocadio, MD, PhD, Viña, José, MD, PhD. A multicomponent exercise intervention that reverses frailty and improves cognition, emotion, and social networking in the community-dwelling frail elderly: A randomized clinical trial. Journal of the American Medical Directors Association [Internet]. 2016;17(5):426-33. Available from: https://www.clinicalkey.es/playcontent/1-s2.0-S1525861016000578

10. Ng TP, Feng L, Nyunt MSZ, Feng L, Niti M, Tan BY, Chan G, Khoo SA, Chan SM, Yap P. Nutritional, physical, cognitive, and combination interventions and frailty reversal among older adults: A randomized controlled trial. Am J Med. 2015;128(11):1225,1236. e1.

11. Fiatarone MA, Marks EC, Ryan ND, Meredith CN, Lipsitz LA, Evans WJ. High-intensity strength training in nonagenarians: Effects on skeletal muscle. ResearchGate [Internet]. 1990 /07/01 [cited Oct 22, 2016];263(22):3029-34. Available from: https://www.researchgate.net/publication/20814302_High-Intensity_Strength_Training_in_Nonagenarians_Effects_on_Skeletal_Muscle

12. Bowen DJ, Kreuter M, Spring B, Cofta-Woerpel L, Linnan L, Weiner D, Bakken S, Kaplan CP, Squiers L, Fabrizio C. How we design feasibility studies. Am J Prev Med. 2009;36(5):452-7.

13. United Nations, Department of Economic and Social Affairs, Population Division. World Population Ageing 2017 (ST/ESA/SER.A/408). URL: https://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2017_Report.pdf. Accessed: 17th April 2019. 2017 Available from: https://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2017_Report.pdf

14. Caspersen CJ, Pereira MA, Curran KM. Changes in physical activity patterns in the united states, by sex and cross-sectional age. Med Sci Sports Exerc. 2000;32(9):1601-9.

15. Ford ES, Caspersen CJ. Sedentary behaviour and cardiovascular disease: A review of prospective studies. Int J Epidemiol. 2012:dys078.

16. Liu J, Reijnierse EM, Ancum J, Verlaan S, Meskers C, Maier AB. Acute inflammation is associated with lower muscle strength, muscle mass and dependency in activities of daily living in male hospitalised older patients. In: AUSTRALASIAN JOURNAL ON AGEING [Internet]2018WILEY 111 RIVER ST, HOBOKEN 07030-5774, NJ USA; 2018. p. 58.

17. Martínez-Velilla N, Casas-Herrero A, Zambom-Ferraresi F, López Sáez de Asteasu, Mikel, Lucia A, Galbete A, García-Baztán A, Alonso-Renedo J, González-Glaría B, Gonzalo-Lázaro M, Apezteguía Iráizoz I, Gutiérrez-Valencia M, Rodríguez-Mañas L, Izquierdo M. Effect of exercise intervention on functional decline in very elderly patients during acute hospitalization: A randomized clinical trial. JAMA internal medicine [Internet]. 2018 Nov 12,;179(1):28-36. Available from: http://dx.doi.org/10.1001/jamainternmed.2018.4869

18. Kuhn, T. The structure of scientific revolutions. [Internet]. Princeton University Press; 2021

19. Ritzer, G, Smart, B. Handbook of social theory. [Internet]. Sage; 2000

20. Crotty, M, Crotty, MF. The foundations of social research: Meaning and perspective in the research process. [Internet]. Sage; 1998

21. Gelo O, Braakmann D, Benetka G. Quantitative and qualitative research: Beyond the debate. Integrative psychological and behavioral science [Internet]. 2008;42(3):266-90.

22. Tashakkori, A, Teddlie, C. Sage handbook of mixed methods in social and behavioral research. [Internet]. SAGE publications; 2010

23. Shannon-Baker P. Making paradigms meaningful in mixed methods research. Journal of mixed methods research [Internet]. 2016;10(4):319-34.

24. Biesta G. Pragmatism and the philosophical foundations of mixed methods research. Sage handbook of mixed methods in social and behavioral research [Internet]. 2010;2:95-118.

25. Morgan DL. Paradigms lost and pragmatism regained: Methodological implications of combining qualitative and quantitative methods. Journal of mixed methods research [Internet]. 2007;1(1):48-76.

26. Creswell JW, Klassen AC, Plano Clark VL, Smith KC. Best practices for mixed methods research in the health sciences. Bethesda (Maryland): National Institutes of Health [Internet]. 2011;2013:541-5.

27. Morse, JM. Mixed method design: Principles and procedures. [Internet]. Routledge; 2016

28. Skivington K, Matthews L, Simpson SA, Craig P, Baird J, Blazeby JM, Boyd KA, Craig N, French D, McIntosh E, Petticrew M, Rycroft-Malone J, White M, Moore L. Framework for the development and evaluation of complex interventions: gap analysis, workshop and consultation-informed update. NIHR Journals Library; 2021. 1 p. Report No.: 25 Available from: https://www.journalslibrary.nihr.ac.uk/hta/hta25570#/full-report

29. Skivington K, Matthews L, Simpson SA, Craig P, Baird J, Blazeby JM, Boyd KA, Craig N, French DP, McIntosh E. A new framework for developing and evaluating complex interventions: Update of medical research council guidance. BMJ [Internet]. 2021;374

30. Atkinson G, Reilly T. Circadian variation in sports performance. Sports medicine. 1996;21(4):292-312.

31. Fragala MS, Cadore EL, Dorgo S, Izquierdo M, Kraemer WJ, Peterson MD, Ryan ED. Resistance training for older adults: Position statement from the national strength and conditioning association. The Journal of Strength & Conditioning Research [Internet]. 2019;33(8)

32. Ortlipp M. Keeping and using reflective journals in the qualitative research process. The qualitative report. 2008;13(4):695-705.

33. Kahn RL, Cannell CF. The dynamics of interviewing; theory, technique, and cases. . 1957

34. Smith JA, Osborn M. Interpretative phenomenological analysis. Doing social psychology research [Internet]. 2004:229-54.

35. Roberts HC, Denison HJ, Martin HJ, Patel HP, Syddall H, Cooper C, Sayer AA. A review of the measurement of grip strength in clinical and epidemiological studies: Towards a standardised approach. Age Ageing [Internet]. 2011 07/01/ [cited Oct 22, 2016];40(4):423-9. Available from: http://ageing.oxfordjournals.org/content/40/4/423

36. Haff G, Triplett NT. Essentials of strength training and conditioning. [Internet]. 2015:453.

37. Epley B. Poundage chart. Boyd Epley Workout.Lincoln, NE: Body Enterprises, 2985 [Internet]. 1985;86:p. 86.

38. Guralnik JM, Simonsick EM, Ferrucci L, Glynn RJ, Berkman LF, Blazer DG, Scherr PA, Wallace RB. A short physical performance battery assessing lower extremity function: Association with self-reported disability and prediction of mortality and nursing home admission. J Gerontol. 1994;49(2):M85-94.

39. Katz S, Chinn AB, Cordrey L. Multidisciplinary studies of illness in aged persons II: A new classification of functional status in activities of daily living. J Chronic Dis. 1959;9(1):55-62.

40. Yesavage JA, Brink TL, Rose TL, Lum O, Huang V, Adey M, Leirer VO. Development and validation of a geriatric depression screening scale: A preliminary report. J Psychiatr Res. 1983;17(1):37-49.

41. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatr Scand. 1983;67(6):361-70.

42. Molloy DW, Alemayehu E, Roberts R. Reliability of a standardized mini-mental state examination compared with the traditional mini-mental state examination. Am J Psychiatry. 1991;148(1):102-5.

43. Cohen S, Mermelstein R, Kamarck T, Hoberman HM. Measuring the functional components of social support In: Social support: Theory, research and applications. Springer; 1985; p. 73-94.

44. Heaney JL, Carroll D, Phillips AC. DHEA, DHEA-S and cortisol responses to acute exercise in older adults in relation to exercise training status and sex. Age [Internet]. 2013;35(2):395-405.

45. Córdova C, Lopes-e-Silva J, Pires AS, Souza VC, Brito CJ, Moraes CF, Sposito AC, Nóbrega OT. Long-term resistance training is associated with reduced circulating levels of IL-6, IFN-gamma and TNF-alpha in elderly women. Neuroimmunomodulation [Internet]. 2011 /02/09 [cited Dec 4, 2016];18(3):165-70. Available from: http://www.karger.com/Article/Abstract/323396

46. Smart NA, Larsen AI, Le Maitre JP, Ferraz AS. Effect of exercise training on interleukin-6, tumour necrosis factor alpha and functional capacity in heart failure. Cardiology research and practice [Internet]. 2011;2011

47. Fischer CP. Interleukin-6 in acute exercise and training: What is the biological relevance. Exerc Immunol Rev. 2006;12(6-33):41.

48. Petersen AMW, Pedersen BK. The anti-inflammatory effect of exercise. J Appl Physiol [Internet]. 2005;98(4):1154-62.

49. Goldhammer E, Tanchilevitch A, Maor I, Beniamini Y, Rosenschein U, Sagiv M. Exercise training modulates cytokines activity in coronary heart disease patients. Int J Cardiol. 2005;100(1):93-9.

50. Haff, GG, Triplett, NT. Essentials of strength training and conditioning 4th edition. [Internet]. Human kinetics; 2015

51. Wilkinson MD, Dumontier M, Aalbersberg IJ, Appleton G, Axton M, Baak A, Blomberg N, Boiten J, da Silva Santos, Luiz Bonino, Bourne PE. The FAIR guiding principles for scientific data management and stewardship. Scientific data [Internet]. 2016;3

52. Morse JM. Designing funded qualitative research. [Internet]. 1994

53. Creswell, JW, Poth, CN. Qualitative inquiry and research design: Choosing among five approaches. [Internet]. Sage publications; 2017

54. United Kingdom. Department of Health. Guidance on nominating a consultee for research involving adults who lack capacity to consent (8953). URL: https://webarchive.nationalarchives.gov.uk/20130123193236/http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_083131. Accessed: 5th July 2019. 2008 Available from: https://webarchive.nationalarchives.gov.uk/20130123193236/http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_083131

55. United Kingdom Mental Capacity Act, 2005. URL: https://www.legislation.gov.uk/ukpga/2005/9/section/32. Accessed 5th July 2019.

56. Whittaker AC, Delledonne M, Finni T, Garagnani P, Greig C, Kallen V, Kokko K, Lord J, Maier AB, Meskers CG. Physical activity and nutrition INfluences in ageing (PANINI): Consortium mission statement. Aging clinical and experimental research [Internet]. 2018:1-8.

57. University of Birmingham. Physical Activity and Nutritional INfluences In ageing (PANINI) [Internet]. cited 6th February 2019]. Available from: http://www.birmingham.ac.uk/generic/panini/index.aspx

Chapter 4

1. Rodriguez-Mañas L, Fried LP. Frailty in the clinical scenario. The Lancet [Internet]. 2015 /02/14 [cited Nov 12, 2016];385(9968):e7-9. Available from: /journals/lancet/article/PIIS0140-6736(14)61595-6/abstract

2. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, Seeman T, Tracy R, Kop WJ, Burke G, McBurnie MA. Frailty in older adults: Evidence for a phenotype. The journals of gerontology. Series A, Biological sciences and medical sciences [Internet]. 2001 Mar;56(3):M146-57. Available from: https://www.ncbi.nlm.nih.gov/pubmed/11253156

3. Gill TM, Gahbauer EA, Allore HG, Han L. Transitions between frailty states among community-living older persons. Arch Intern Med. 2006;166(4):418-23.

4. Clegg A, Dr, Young J, Prof, Iliffe S, Prof, Rikkert MO, Prof, Rockwood K, Prof. Frailty in elderly people. The Lancet (British edition) [Internet]. 2013;381(9868):752-62. Available from: https://www.clinicalkey.es/playcontent/1-s2.0-S0140673612621679

5. Sternberg SA, Schwartz AW, Karunananthan S, Bergman H, Mark Clarfield A. The identification of frailty: A systematic literature review. Journal of the American Geriatrics Society (JAGS) [Internet]. 2011 Nov;59(11):2129-38. Available from: https://api.istex.fr/ark:/67375/WNG-TCTFS38N-J/fulltext.pdf

6. Sourial N, Bergman H, Karunananthan S, Wolfson C, Payette H, Gutierrez-Robledo LM, Béland F, Fletcher JD, Guralnik J. Implementing frailty into clinical practice: A cautionary tale. The journals of gerontology. Series A, Biological sciences and medical sciences [Internet]. 2013 Dec;68(12):1505-11. Available from: https://www.ncbi.nlm.nih.gov/pubmed/23640761

7. Theou O, Stathokostas L, Roland KP, Jakobi JM, Patterson C, Vandervoort AA, Jones GR. The effectiveness of exercise interventions for the management of frailty: A systematic review. Journal of aging research [Internet]. 2011 Dec 1,;2011:569194-19. Available from: https://www.airitilibrary.com/Publication/alDetailedMesh?DocID=P20151210007-201112-201704070007-201704070007-674-692

8. Bowen DJ, Kreuter M, Spring B, Cofta-Woerpel L, Linnan L, Weiner D, Bakken S, Kaplan CP, Squiers L, Fabrizio C. How we design feasibility studies. Am J Prev Med. 2009;36(5):452-7.

9. Martínez-Velilla N, Casas-Herrero A, Zambom-Ferraresi F, López Sáez de Asteasu, Mikel, Lucia A, Galbete A, García-Baztán A, Alonso-Renedo J, González-Glaría B, Gonzalo-Lázaro M, Apezteguía Iráizoz I, Gutiérrez-Valencia M, Rodríguez-Mañas L, Izquierdo M. Effect of exercise intervention on functional decline in very elderly patients during acute hospitalization: A randomized clinical trial. JAMA internal medicine [Internet]. 2018 Nov 12,;179(1):28-36. Available from: http://dx.doi.org/10.1001/jamainternmed.2018.4869

10. Skivington K, Matthews L, Simpson SA, Craig P, Baird J, Blazeby JM, Boyd KA, Craig N, French D, McIntosh E, Petticrew M, Rycroft-Malone J, White M, Moore L. Framework for the development and evaluation of complex interventions: gap analysis, workshop and

consultation-informed update. NIHR Journals Library; 2021. 1 p. Report No.: 25 Available from: https://www.journalslibrary.nihr.ac.uk/hta/hta25570#/full-report

11. Skivington K, Matthews L, Simpson SA, Craig P, Baird J, Blazeby JM, Boyd KA, Craig N, French DP, McIntosh E. A new framework for developing and evaluating complex interventions: Update of medical research council guidance. BMJ [Internet]. 2021;374

12. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): A 32-item checklist for interviews and focus groups. International journal for quality in health care [Internet]. 2007;19(6):349-57.

13. Doody P, Lord JM, Greig CA, Whittaker AC. Assessing the feasibility and impact of specially adapted exercise interventions, aimed at improving the multi-dimensional health and functional capacity of frail geriatric hospital inpatients: Protocol for a feasibility study. BMJ open [Internet]. 2019;9(11):e031159. Available from: http://dx.doi.org/10.1136/bmjopen-2019-031159

14. Doody P, Lord JM, Whittaker AC. Assessing the feasibility and impact of an adapted resistance training intervention, aimed at improving the multi-dimensional health and functional capacity of frail older adults in residential care settings: Protocol for a feasibility study. Pilot and Feasibility Studies [Internet]. 2019;5(1):86.

15. Ramsey KA, Loveland P, Rojer AG, Denehy L, Goonan R, Marston C, Kay JE, Brenan J, Trappenburg MC, Lim WK. Geriatric rehabilitation inpatients roam at home! A matched cohort study of objectively measured physical activity and sedentary behavior in home-based and hospital-based settings. Journal of the American Medical Directors Association [Internet]. 2021

Chapter 5

1. Doody P, Lord JM, Whittaker AC. Assessing the feasibility and impact of an adapted resistance training intervention, aimed at improving the multi-dimensional health and functional capacity of frail older adults in residential care settings: Protocol for a feasibility study. Pilot and Feasibility Studies [Internet]. 2019;5(1):86.

2. Rodriguez-Mañas L, Fried LP. Frailty in the clinical scenario. The Lancet [Internet]. 2015 /02/14 [cited Nov 12, 2016];385(9968):e7-9. Available from: /journals/lancet/article/PIIS0140-6736(14)61595-6/abstract

3. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, Seeman T, Tracy R, Kop WJ, Burke G, McBurnie MA. Frailty in older adults: Evidence for a phenotype. The journals of gerontology. Series A, Biological sciences and medical sciences [Internet]. 2001 Mar;56(3):M146-57. Available from: https://www.ncbi.nlm.nih.gov/pubmed/11253156

4. Gill TM, Gahbauer EA, Allore HG, Han L. Transitions between frailty states among community-living older persons. Arch Intern Med. 2006;166(4):418-23.

5. Clegg A, Dr, Young J, Prof, Iliffe S, Prof, Rikkert MO, Prof, Rockwood K, Prof. Frailty in elderly people. The Lancet (British edition) [Internet]. 2013;381(9868):752-62. Available from: https://www.clinicalkey.es/playcontent/1-s2.0-S0140673612621679

6. Sourial N, Bergman H, Karunananthan S, Wolfson C, Payette H, Gutierrez-Robledo LM, Béland F, Fletcher JD, Guralnik J. Implementing frailty into clinical practice: A cautionary tale. The journals of gerontology. Series A, Biological sciences and medical sciences [Internet]. 2013 Dec;68(12):1505-11. Available from: https://www.ncbi.nlm.nih.gov/pubmed/23640761

7. Sternberg SA, Schwartz AW, Karunananthan S, Bergman H, Mark Clarfield A. The identification of frailty: A systematic literature review. Journal of the American Geriatrics Society (JAGS) [Internet]. 2011 Nov;59(11):2129-38. Available from: https://api.istex.fr/ark:/67375/WNG-TCTFS38N-J/fulltext.pdf

8. Skivington K, Matthews L, Simpson SA, Craig P, Baird J, Blazeby JM, Boyd KA, Craig N, French D, McIntosh E, Petticrew M, Rycroft-Malone J, White M, Moore L. Framework for the development and evaluation of complex interventions: gap analysis, workshop and consultation-informed update. NIHR Journals Library; 2021. 1 p. Report No.: 25 Available from: https://www.journalslibrary.nihr.ac.uk/hta/hta25570#/full-report

9. Skivington K, Matthews L, Simpson SA, Craig P, Baird J, Blazeby JM, Boyd KA, Craig N, French DP, McIntosh E. A new framework for developing and evaluating complex interventions: Update of medical research council guidance. BMJ [Internet]. 2021;374

10. Bowen DJ, Kreuter M, Spring B, Cofta-Woerpel L, Linnan L, Weiner D, Bakken S, Kaplan CP, Squiers L, Fabrizio C. How we design feasibility studies. Am J Prev Med. 2009;36(5):452-7.

11. Atkinson G, Reilly T. Circadian variation in sports performance. Sports medicine. 1996;21(4):292-312.

12. Ortlipp M. Keeping and using reflective journals in the qualitative research process. The qualitative report. 2008;13(4):695-705.

13. Kahn RL, Cannell CF. The dynamics of interviewing; theory, technique, and cases. . 1957

14. Smith JA, Osborn M. Interpretative phenomenological analysis. Doing social psychology research [Internet]. 2004:229-54.

15. Roberts HC, Denison HJ, Martin HJ, Patel HP, Syddall H, Cooper C, Sayer AA. A review of the measurement of grip strength in clinical and epidemiological studies: Towards a standardised approach. Age Ageing [Internet]. 2011 07/01/ [cited Oct 22, 2016];40(4):423-9. Available from: http://ageing.oxfordjournals.org/content/40/4/423

16. Haff G, Triplett NT. Essentials of strength training and conditioning. [Internet]. 2015:453.

17. Epley B. Poundage chart. Boyd Epley Workout.Lincoln, NE: Body Enterprises, 2985 [Internet]. 1985;86:p. 86.

18. Guralnik JM, Simonsick EM, Ferrucci L, Glynn RJ, Berkman LF, Blazer DG, Scherr PA, Wallace RB. A short physical performance battery assessing lower extremity function: Association with self-reported disability and prediction of mortality and nursing home admission. J Gerontol. 1994;49(2):M85-94.

19. Katz S, Chinn AB, Cordrey L. Multidisciplinary studies of illness in aged persons II: A new classification of functional status in activities of daily living. J Chronic Dis. 1959;9(1):55-62.

20. Yesavage JA, Brink TL, Rose TL, Lum O, Huang V, Adey M, Leirer VO. Development and validation of a geriatric depression screening scale: A preliminary report. J Psychiatr Res. 1983;17(1):37-49.

21. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatr Scand. 1983;67(6):361-70.

22. Cohen S, Kamarck T, Mermelstein R. Perceived stress scale. Measuring stress: A guide for health and social scientists. 1994

23. Molloy DW, Alemayehu E, Roberts R. Reliability of a standardized mini-mental state examination compared with the traditional mini-mental state examination. Am J Psychiatry. 1991;148(1):102-5.

24. Cohen S, Mermelstein R, Kamarck T, Hoberman HM. Measuring the functional components of social support In: Social support: Theory, research and applications. Springer; 1985; p. 73-94.

25. Em B, V G, Ac K. Randomisation in clinical trials. Med J Aust [Internet]. 2002 /11, [cited Nov 4, 2016];177(10):565-7. Available from: http://europepmc.org/abstract/med/12429008

26. Suresh KP. An overview of randomization techniques: An unbiased assessment of outcome in clinical research. J Hum Reprod Sci [Internet]. 2011 [cited Nov 4, 2016];4(1):8-11. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3136079/

27. Graphpad.com. Graphpad.com [Internet]. cited 6th February 2019]. Available from: www.graphpad.com/quickcalcs/

28. Schulz KF, Chalmers I, Hayes RJ, Altman DG. Empirical evidence of bias: Dimensions of methodological quality associated with estimates of treatment effects in controlled trials. JAMA [Internet]. 1995 /02/01 [cited Nov 6, 2016];273(5):408-12. Available from: http://jamanetwork.com/journals/jama/fullarticle/386770

29. Schulz KF, Grimes DA. Allocation concealment in randomised trials: Defending against deciphering. The Lancet. 2002;359(9306):614-8.

30. Moher D, Pham B, Jones A, Cook DJ, Jadad AR, Moher M, Tugwell P, Klassen TP. Does quality of reports of randomised trials affect estimates of intervention efficacy reported in meta-analyses? The Lancet [Internet]. 1998 /08/22 [cited Nov 6, 2016];352(9128):609-13. Available from: /journals/lancet/article/PIIS0140-6736(98)01085-X/abstract

31. Wilkinson MD, Dumontier M, Aalbersberg IJ, Appleton G, Axton M, Baak A, Blomberg N, Boiten J, da Silva Santos, Luiz Bonino, Bourne PE. The FAIR guiding principles for scientific data management and stewardship. Scientific data [Internet]. 2016;3

32. Theou O, Stathokostas L, Roland KP, Jakobi JM, Patterson C, Vandervoort AA, Jones GR. The effectiveness of exercise interventions for the management of frailty: A systematic review. Journal of aging research [Internet]. 2011 Dec 1,;2011:569194-19. Available from: https://www.airitilibrary.com/Publication/alDetailedMesh?DocID=P20151210007-201112-201704070007-201704070007-674-692

33. University of Birmingham. Physical Activity and Nutritional INfluences In ageing (PANINI) [Internet]. cited 6th February 2019]. Available from: http://www.birmingham.ac.uk/generic/panini/index.aspx

Chapter 6

1. Collard RM, Boter H, Schoevers RA, Oude Voshaar RC. Prevalence of frailty in community-dwelling older persons: A systematic review. J Am Geriatr Soc [Internet]. 2012 Aug [cited Nov 12, 2016];60(8):1487-92.

2. Kojima G. Prevalence of frailty in nursing homes: A systematic review and meta-analysis. Journal of the American Medical Directors Association. 2015;16(11):940-5.

3. Ligthart-Melis GC, Luiking YC, Kakourou A, Cederholm T, Maier AB, de van der Schueren, Marian AE. Frailty, sarcopenia, and malnutrition frequently (co-) occur in hospitalized older adults: A systematic review and meta-analysis. Journal of the American Medical Directors Association [Internet]. 2020

4. Siriwardhana DD, Hardoon S, Rait G, Weerasinghe MC, Walters KR. Prevalence of frailty and prefrailty among community-dwelling older adults in low-income and middle-income countries: A systematic review and meta-analysis. BMJ open [Internet]. 2018;8(3):e018195.

5. Theou O, Squires E, Mallery K, Lee JS, Fay S, Goldstein J, Armstrong JJ, Rockwood K. What do we know about frailty in the acute care setting? A scoping review. BMC geriatrics [Internet]. 2018;18(1):139.

6. Theou O, Brothers TD, Rockwood MR, Haardt D, Mitnitski A, Rockwood K. Exploring the relationship between national economic indicators and relative fitness and frailty in middle-aged and older europeans. Age Ageing [Internet]. 2013;42(5):614-9.

7. Bowen DJ, Kreuter M, Spring B, Cofta-Woerpel L, Linnan L, Weiner D, Bakken S, Kaplan CP, Squiers L, Fabrizio C. How we design feasibility studies. Am J Prev Med. 2009;36(5):452-7.

8. Ramsey KA, Loveland P, Rojer AG, Denehy L, Goonan R, Marston C, Kay JE, Brenan J, Trappenburg MC, Lim WK. Geriatric rehabilitation inpatients roam at home! A matched cohort study of objectively measured physical activity and sedentary behavior in home-based and hospital-based settings. Journal of the American Medical Directors Association [Internet]. 2021

9. Doody P, Lord JM, Whittaker AC. Assessing the feasibility and impact of an adapted resistance training intervention, aimed at improving the multi-dimensional health and functional capacity of frail older adults in residential care settings: Protocol for a feasibility study. Pilot and Feasibility Studies [Internet]. 2019;5(1):86.

10. Siriwardhana DD, Hardoon S, Rait G, Weerasinghe MC, Walters KR. Prevalence of frailty and prefrailty among community-dwelling older adults in low-income and middle-income countries: A systematic review and meta-analysis. BMJ open [Internet]. 2018;8(3):e018195.

11. Theou O, Stathokostas L, Roland KP, Jakobi JM, Patterson C, Vandervoort AA, Jones GR. The effectiveness of exercise interventions for the management of frailty: A systematic review. Journal of aging research. 2011;2011

12. Stolz E, Mayerl H, Waxenegger A, Rásky É, Freidl W. Impact of socioeconomic position on frailty trajectories in 10 european countries: Evidence from the survey of health, ageing and retirement in europe (2004–2013). J Epidemiol Community Health [Internet]. 2017;71(1):73-80.

13. Shah SM, Carey IM, Harris T, DeWilde S, Cook DG. Quality of chronic disease care for older people in care homes and the community in a primary care pay for performance system: Retrospective study. BMJ. 2011;342:d912.

14. Martínez-Velilla N, Casas-Herrero A, Zambom-Ferraresi F, de Asteasu, Mikel L Sáez, Lucia A, Galbete A, García-Baztán A, Alonso-Renedo J, González-Glaría B, Gonzalo-Lázaro M. Effect of exercise intervention on functional decline in very elderly patients during acute hospitalization: A randomized clinical trial. JAMA internal medicine [Internet]. 2019;179(1):28-36.

15. Xue Q. The frailty syndrome: Definition and natural history. Clinics in Geriatric Medicine [Internet]. 2011 February [cited Jan 21, 2017];27(1):1-15. Available from: //www.sciencedirect.com/science/article/pii/S0749069010000832

16. Seeman TE, Singer BH, Rowe JW, Horwitz RI, McEwen BS. Price of adaptation—allostatic load and its health consequences: MacArthur studies of successful aging. Arch Intern Med [Internet]. 1997;157(19):2259-68.

17. Seeman TE, McEwen BS, Rowe JW, Singer BH. Allostatic load as a marker of cumulative biological risk: MacArthur studies of successful aging. Proceedings of the National Academy of Sciences [Internet]. 2001;98(8):4770-5.

18. Castagné R, Garès V, Karimi M, Chadeau-Hyam M, Vineis P, Delpierre C, Kelly-Irving M. Allostatic load and subsequent all-cause mortality: Which biological markers drive the relationship? findings from a UK birth cohort. Eur J Epidemiol [Internet]. 2018;33(5):441-58.

19. Belloni G, Cesari M. Frailty and intrinsic capacity: Two distinct but related constructs. Frontiers in medicine [Internet]. 2019;6:133.

20. Beard JR, Jotheeswaran AT, Cesari M, de Carvalho IA. The structure and predictive value of intrinsic capacity in a longitudinal study of ageing. BMJ open [Internet]. 2019;9(11):e026119.

21. Horvath S. DNA methylation age of human tissues and cell types. Genome Biol [Internet]. 2013;14(10):1-20.

22. Hannum G, Guinney J, Zhao L, Zhang L, Hughes G, Sadda S, Klotzle B, Bibikova M, Fan J, Gao Y. Genome-wide methylation profiles reveal quantitative views of human aging rates. Mol Cell [Internet]. 2013;49(2):359-67.

23. McCrory C, Fiorito G, Hernandez B, Polidoro S, O'Halloran AM, Hever A, Ni Cheallaigh C, Lu AT, Horvath S, Vineis P. GrimAge outperforms other epigenetic clocks in the prediction of age-related clinical phenotypes and all-cause mortality. The Journals of Gerontology: Series A [Internet]. 2020

24. Lu AT, Quach A, Wilson JG, Reiner AP, Aviv A, Raj K, Hou L, Baccarelli AA, Li Y, Stewart JD. DNA methylation GrimAge strongly predicts lifespan and healthspan. Aging (Albany NY) [Internet]. 2019;11(2):303.

25. Levine ME, Lu AT, Quach A, Chen BH, Assimes TL, Bandinelli S, Hou L, Baccarelli AA, Stewart JD, Li Y. An epigenetic biomarker of aging for lifespan and healthspan. Aging (Albany NY) [Internet]. 2018;10(4):573.

26. Li X, Ploner A, Wang Y, Magnusson PK, Reynolds C, Finkel D, Pedersen NL, Jylhävä J, Hägg S. Longitudinal trajectories, correlations and mortality associations of nine biological ages across 20-years follow-up. Elife [Internet]. 2020;9:e51507.

27. Belsky DW, Caspi A, Arseneault L, Baccarelli A, Corcoran DL, Gao X, Hannon E, Harrington HL, Rasmussen LJ, Houts R. Quantification of the pace of biological aging in humans through a blood test, the DunedinPoAm DNA methylation algorithm. Elife [Internet]. 2020;9:e54870.

28. Vollset SE, Goren E, Yuan C, Cao J, Smith AE, Hsiao T, Bisignano C, Azhar GS, Castro E, Chalek J. Fertility, mortality, migration, and population scenarios for 195 countries and territories from 2017 to 2100: A forecasting analysis for the global burden of disease study. The Lancet [Internet]. 2020;396(10258):1285-306.

Appendices

Appendix 2.1. Systematic review protocol

The contents of this appendix are published in British Medical Journal (BMJ) Open as Doody, P., Aunger, J., Asamane, E., Greig, C.A., Lord, J., Whittaker, A., 2019, "Frailty Levels in Geriatric Hospital paTients (FLIGHT) — The prevalence of frailty amongst geriatric populations within hospital ward settings: a systematic review protocol", BMJ Open, vol. 9, no. 8, pp. e030147, doi: 10.1136/bmjopen-2019-030147.

Abstract

Introduction: Frailty is a common and clinically significant condition in geriatric populations, associated with adverse health outcomes such as hospitalisation, disability, and mortality. Although there are systematic reviews/meta-analyses assessing the prevalence of frailty in community-dwelling older adults, nursing home residents, and cancer and general surgery patients, there are none assessing the overall prevalence of frailty in geriatric hospital inpatients.

Methods and analysis: This review will systematically search and analyse the prevalence of frailty within geriatric hospital inpatients within the literature. A search will be employed on the platforms of Ovid, Web of Science, and databases of CINAHL Plus, Scopus, and the Cochrane Library. Any observational or experimental study design which utilises a validated operational definition of frailty, reports the prevalence of frailty, has a minimum age ≥ 65 years, attempts to assess the whole ward/clinical population, and occurs in hospital inpatients, will be included. Title and abstract and full text screenings will be conducted by three reviewers. Methodological quality of eligible studies will be assessed utilising the Joanna Briggs Institute critical appraisal tool. Data extraction will be performed by two reviewers. If sufficient data are available, a meta-analysis synthesising pooled estimates of the prevalence of frailty and pre-frailty, as well as the prevalence of frailty stratified by age, sex, operational

frailty definition, prevalent morbidities, ward type, and location, among older hospitalised inpatients will be conducted. Clinical heterogeneity will be assessed by two reviewers. Statistical heterogeneity will be assessed through a Cochran Q test, and an I^2 test performed to assess its magnitude.

Ethics and dissemination: Ethical approval was not required as primary data will not be collected. Findings will be disseminated through publication in peer reviewed open access scientific journals, public engagement events, conference presentations, and social media**.**

Trial Registration number: This study has been registered on PROSPERO (registration number 79202).

Strengths and limitations

- First review to systematically or exclusively assess the overall prevalence of frailty in geriatric hospital inpatients
- Will seek to provide stratified analysis of the prevalence of frailty based on age, sex, operational frailty definition, prevalent morbidities, ward type, and geographic location
- Three independent reviewers during screening phase; ensuring high internal reliability and consistency of included studies
- Will include only studies for which the full text is available in English, therefore will likely be relatively over-representative of Western nations (Europe, Australasia, and the Americas); although this is true of scientific publications in general.

Keywords: department; frail; geriatric; hospital; inpatient; meta-analysis; older adult; prevalence; systematic review; ward.

Introduction

Frailty is a common and clinically significant condition within geriatric populations (1), predominantly due to its association with adverse health outcomes such as hospitalisation, disability and mortality (1-6). Although there are systematic reviews and meta-analyses assessing the prevalence of frailty amongst community-dwelling older adults (7-10), nursing home residents (11), and cancer (12) and general surgery patients (13), presently there are no systematic reviews or meta-analyses which assess the overall prevalence of frailty among geriatric hospital inpatients. This constitutes an important gap in the literature which needs to be addressed and has important consequences. Such consequences include the tailoring of services within this setting to the needs of service users, for example, the potential implementation of exercise rehabilitation treatments within this setting for this cohort; with physical activity and exercise being proposed as potentially offering the best form of treatment for frail older adults (14), and shown to be capable of reducing, and even reversing frailty within older adults (15,16). Through providing a highly detailed analysis of the prevalence of frailty amongst older population within this setting, this review has the potential to aid in the facilitation of improvements in the planning and orientation of organisational structures and resources, to meet the needs of this population, and enhance the care of frail older adults in inpatient hospital settings.

Methods and design

Review aim

The aim of this review is to systematically search and analyse the prevalence of frailty amongst geriatric populations (aged ≥ 65 years) within inpatient hospital settings within the literature. If a meta-analysis proves possible, the aim of this study is also to synthesise pooled estimates of the prevalence of frailty and pre-frailty, as well as the prevalence of frailty

stratified by age, sex, operational frailty definition, prevalent morbidities, ward type, and geographic location (country and continent), among hospital inpatients.

Review objectives

1) To identify and compare studies reporting the prevalence of frailty within hospital ward settings.
2) To combine the extracted data to calculate the pooled overall prevalence of frailty in hospitalised geriatric inpatients.
3) To perform stratified analysis of the prevalence of frailty based on age, sex, operational frailty definition, prevalent morbidity, ward type, and geographic location in order to assess the relationship between frailty and these factors.

Eligibility criteria

Inclusion criteria: all studies must have a minimum age of ≥ 65 years, use a clearly defined and validated operational definition for the classification of frailty (i.e., one which takes into consideration the multi-dimensional nature of the condition, and has been specifically validated for the assessment of frailty; either through comparison with existing validated tools or its predictive value regarding negative health outcomes aligned with frailty), either assess (or attempt to assess) the whole ward, department, unit, hospital or specific clinical population, or employ some form of randomised selection of participants, occur within a hospital setting, in, or including, hospital inpatients (operationally defined as any patient admitted to hospital who remains overnight, or were initially expected to remain overnight), report the prevalence of frailty or provide sufficient data to allow the calculation of the prevalence of frailty. If a study examines a mixed cohort, only data relating to hospital inpatients will be included in the review.

Exclusion criteria: all studies not written in English, studies where the sample are not hospital inpatients (i.e., outpatients, day patients, or community-dwelling individuals).

Information sources

Searches will be conducted on the platforms of Ovid (incorporating the databases of Journals @Ovid full text, EMBASE, CAB abstracts, Ovid MEDLINE ® In process and other non-indexed citations, Ovid MEDLINE ®, and PsychINFO) and Web of Science (incorporating the databases of Science Citation Index Expanded (SCI-Expanded), Conference Proceedings Citation Index – Science (CRI-S), and Emerging Sources Citation Index (ESCI)), and the databases of CINAHL Plus, Scopus, and the Cochrane Library databases (the Cochrane Database of Systematic Reviews (CDSR), the Cochrane Central Register of Controlled Trials (CENTRAL), the Cochrane Methodology Register (CMR), the Database of Abstracts of Reviews of Effect (DARE), Health Technology Assessment database (HTA), and the NHS Economic Evaluation Database (EED)).

Types of studies

Any form of observational or experimental study design which assesses the prevalence of frailty and meets the above eligibility criteria. For longitudinal observational studies, and experimental studies, frailty scores and additional data will be extracted from baseline data, provided baseline data meets the above eligibility criteria.

Search strategy

The search strategy will be conducted on the two platforms of Ovid and Web of Science, as well as the databases of SCOPUS, CINAHL Plus, and the Cochrane Library databases (Appendix 2.1.1). These searches will encompass all available literature published prior to 21/11/2018.

Screening

Prior to the commencement of title and abstract screening by the three independent reviewers, duplicates will be removed utilising EndNote X8.2. The reduced list of studies will be manually screened for the removal of any remaining duplicates. All reviewers will be provided with an instructional screening form (Appendix 2.1.2), and a .ris file containing all studies captured within database searches. The screening form will list the eligibility criteria and instructions on setting up the .ris file for screening within a reference manager.

The title and abstract of all studies will then be independently screened by the three reviewers, with each reviewer placing potentially eligible studies into a separate folder. Upon completion, potentially eligible studies from all three reviewers will be placed into a "master folder" and the results collated. Duplicates will be removed, leaving the final combined list of studies for the full text screening phase. All reviewers will then independently screen the full text of remaining studies utilising the screening form and maintain separate files for included and excluded studies (including reasons), as well as for studies for which the reviewer feels the need to contact the authors for clarification or additional information.

Upon completion, a full text screening master file (Appendix 2.1.3) will be formulated by the lead reviewer displaying each reviewer's full text screening decision for each study. All three reviewers will then meet to discuss the decisions of each study and endeavour to come to an agreement on studies for which there is not initial unanimous consensus. During this process,

a full list of included and excluded studies (with reasons), and studies for which reviewers agree to contact authors for additional information or clarification will be formed by the lead reviewer. The lead reviewer will then contact study authors and, upon receipt of clarification or additional information, will meet with reviewers to discuss the inclusion/exclusion of the study.

Manual screening will also be employed by reviewers and include the reference lists of all included studies, as well as excluded but potentially relevant studies or systematic reviews captured within the screening. As part of the grey literature search of this review, in process publications will also be searched and conference abstracts will be followed up with authors to ascertain if a full text relating to this data is available. Studies of the same cohort will be included only once, using the study which provides the most information about the cohort relevant to this review.

Assessment of methodological quality

The quality of eligible studies from full text screening will be assessed by two reviewers independently using the Joanna Briggs Institute (JBI) critical appraisal tool for studies reporting prevalence data (17) (Appendix 2.1.4). In the event of any discrepancies between the two reviewers, a consensus will be attempted to be reached by discussion. In the event a full consensus cannot be reached between the two reviewers after an exhaustive discussion, the opinion of a third reviewer will be obtained, and the proceeding majority consensus will be taken.

Data extraction

Data extraction will be performed by two reviewers independently. In the event of any discrepancies between the two reviewers, a consensus will be attempted to be reached by

discussion. In the event that a full consensus cannot be reached between the two reviewers after an exhaustive discussion, the opinion of a third reviewer will be obtained, and the proceeding majority consensus will be taken.

The following data, where available, will be extracted from all eligible studies (see Appendix 2.1.5 for template). If any data are not immediately available, the authors of the studies in question will be contacted in an attempt to retrieve all applicable data:

Study details: authors, year of publication, study title, journal of publication, aim. Study methods: setting, ward/department/unit/hospital type/clinical population, study design, recruitment duration, subject characteristics (age of participants (mean and standard deviation, range)), sex (proportion of male / female participants), country / continent, sample size, diagnosis / prevalent morbidity (if applicable), any other relevant characteristics), criteria utilised for the operational definition of frailty. Results: Number of frail participants, number of "pre-frail" participants, number of robust / non-frail participants, prevalence of frailty, prevalence of pre-frailty, prevalence of robustness / non-frailty, number of male participants, number of frail male participants, number of pre-frail male participants, number of non-frail / robust male participants, prevalence of frailty in male participants, prevalence of pre-frailty in male participants, prevalence of non-frailty / robustness in male participants, number of female participants, number of frail female participants, number of pre-frail female participants, number of non-frail / robust female participants, prevalence of frailty in female participants, prevalence of pre-frailty in female participants, prevalence of non-frailty / robustness in female participants, and finally authors' comments and reviewers' comments.

External to the studies, data will also be extracted with regard to the 5-year average gross domestic product (GDP) per capita purchasing power parity (PPP) (current international $) of the country in which each study takes place, incorporating the five years directly preceding

the commencement of recruitment to the study (18). External data will also be extracted with regard to the 5-year average health care expenditure per capita PPP (current international $) of the country in which each study takes place, incorporating the five years directly preceding the commencement of recruitment to the study (19). Each calendar year of the study will also be included provided recruitment continues through to > 6 months in the preceding year.

Data synthesis

Quantitative synthesis (meta-analysis): If a sufficient quantity of identified studies are comparable, a meta-analysis, pooling the aggregated data from each study, will be performed. Clinical heterogeneity will be assessed by two reviewers based on their judgement of the available data and any disagreements will be discussed thoroughly with the aim of reaching a unanimous consensus. If a unanimous consensus cannot be reached, the opinion of a third reviewer will be sought, and the proceeding majority consensus will be taken. Statistical heterogeneity will be assessed through the utilisation of a Cochran Q test and considered present at $p < .05$. An I^2 test will be performed in order to assess the magnitude of this heterogeneity, with I^2 values of 25%, 50%, and 75% being considered low, moderate, and high respectively. If the Cochrane Q statistic test detected statistically significant heterogeneity, combined with the researcher's assessment, a randomised-effects model will be utilised. Given the nature of this review and in particular its overall aim, combined with the eligible studies identified in preliminary searches, it is likely the initial quantitative synthesis will utilise a random-effects model.

Stratified analysis will also be conducted according to age (65-74 years, 75-84 years, and 85+ years), sex, operational frailty definition, ward type, prevalent morbidity and geographic location (country and continent) where possible. These variables have been specifically chosen for stratified analysis predominantly due to an enhanced knowledge of these areas

being of practical utility to researchers and clinicians; stemming from empirical evidence persistently showing alterations in these factors to impact upon the prevalence of frailty (2,4,20-22). As such stratified analysis pertaining to these variables will facilitate this review to provide a more in-depth and thorough insight into the prevalence of frailty amongst geriatric hospital inpatients.

Clinical heterogeneity for stratified analysis will be assessed by two reviewers based on their judgement of the available data. Any disagreements will be discussed thoroughly with the aim of reaching a unanimous consensus. If a unanimous consensus cannot be reached, the opinion of a third reviewer will be sought. Statistical heterogeneity for sub-analysis will similarly be assessed through the utilisation of a Cochran Q test and considered present at $p < .05$. An I^2 test will be performed in order to assess the magnitude of this heterogeneity, with I^2 values of 25%, 50%, and 75% being considered low, moderate, and high respectively.

Similarly, it is likely a random-effects model will be utilised to synthesise pooled estimates of the prevalence of frailty stratified by these criteria (although there is more of a likelihood that a fixed effects model could potentially be utilised within these analyses, in comparison to the initial analysis, given the nature of stratified analysis).

Correlation analysis will also be employed to examine the relationship between the prevalence of frailty of geriatric inpatients and economic prosperity (GDP per capita PPP) (current international $), and health care expenditure (per capita PPP) (current international $). Additionally, multi-linear regression analysis will examine the predictive value between economic prosperity and health care expenditure, and the prevalence of frailty of geriatric inpatients. Preliminary research into these areas have shown frailty in the community to be correlated with economic indicators (GDP per capita PPP, and healthcare expenditure as a percentage of GDP) (23), however, note that more research is needed in this regard to better

understand this relationship; which this review will facilitate through examination of the relationship of GDP per capita PPP and health care expenditure per capita PPP, and the prevalence of frailty amongst geriatric hospital inpatients.

Qualitative synthesis: if a meta-analysis is not possible based on the nature of the studies and the data available, a more thorough systematic narrative analysis will be conducted, with findings presented in both textual and tabular formats.

Patient and public involvement

All authors are strong proponents of patient and public involvement and engagement with research and believe the finding of this review will be important to aid the facilitation of improvements in the planning and orientation of organisation structures and resources within this setting to meet the needs of service users; specifically relating to the enhanced care of older adults in inpatient hospital settings. However, given the nature of this study (systematic review), it was not possible to involve the public. However, the findings will be disseminated to our patient and public involvement groups.

Ethics and dissemination

Formal ethical approval was not required for this review as primary data will not be collected. The findings of this study will be disseminated through publication in the form of scientific papers in peer reviewed open access scientific journals, public engagement events within the United Kingdom and Europe, online via social media (Twitter, Instagram) and the PANINI project website (24,25), and presentation at conferences within the UK and internationally. This review is scheduled for completion during the second half of 2019.

2.4 Acknowledgements

The authors of this review would like to thank and acknowledge Ms. Lynne Harris (Subject advisor of the Main Library at the University of Birmingham, United Kingdom) for her assistance during the formulation of the search strategy utilised within this systematic review.

Footnotes

Contributors: PD is guarantor and lead reviewer. PD designed the systematic review protocol, conducted the literature searches and prepared this manuscript for publication, with supervision, input and feedback from AW, CG and JL. EA and JA are independent reviewers for title and abstract and full text screenings. JA will also act as independent data extractor for included studies. All authors have read and approved the final manuscript.

Funding: This review has been funded by the European Commission's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement (675003); of which PD, EA, and JA are Marie Sklodowska-Curie Doctoral Research Fellows, AW, JL, and CG doctoral supervisors, and AW the grants Principal Investigator.

References

(1) Rodriguez-Mañas L, Fried LP. Frailty in the clinical scenario. The Lancet 2015 /02/14;385(9968):e9.

(2) Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al. Frailty in older adults evidence for a phenotype. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences 2001;56(3):M157.

(3) Gill TM, Gahbauer EA, Allore HG, Han L. Transitions between frailty states among community-living older persons. Arch Intern Med 2006;166(4):418-423.

(4) Sternberg SA, Schwartz AW, Karunananthan S, Bergman H, Mark Clarfield A. The identification of frailty: a systematic literature review. J Am Geriatr Soc 2011;59(11):2129-2138.

(5) Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly people. The Lancet 2013 March 8,;381(9868):752-762.

(6) Sourial N, Bergman H, Karunananthan S, Wolfson C, Payette H, Gutierrez-Robledo LM, et al. Implementing Frailty Into Clinical Practice: A Cautionary Tale. J Gerontol A Biol Sci Med Sci 2013 -05-02:glt053.

(7) Collard RM, Boter H, Schoevers RA, Oude Voshaar RC. Prevalence of frailty in community-dwelling older persons: a systematic review. J Am Geriatr Soc 2012 Aug;60(8):1487-1492.

(8) Siriwardhana DD, Hardoon S, Rait G, Weerasinghe MC, Walters KR. Prevalence of frailty and prefrailty among community-dwelling older adults in low-income and middle-income countries: a systematic review and meta-analysis. BMJ open 2018;8(3):e018195.

(9) Kojima G, Iliffe S, Taniguchi Y, Shimada H, Rakugi H, Walters K. Prevalence of frailty in Japan: A systematic review and meta-analysis. Journal of epidemiology 2017;27(8):347-353.

(10) Verlaan S, Ligthart-Melis GC, Wijers SL, Cederholm T, Maier AB, de van der Schueren, Marian AE. High prevalence of physical frailty among community-dwelling malnourished older adults–a systematic review and meta-analysis. Journal of the American Medical Directors Association 2017;18(5):374-382.

(11) Kojima G. Prevalence of frailty in nursing homes: A systematic review and meta-analysis. Journal of the American Medical Directors Association 2015;16(11):940-945.

(12) Handforth C, Clegg A, Young C, Simpkins S, Seymour MT, Selby PJ, et al. The prevalence and outcomes of frailty in older cancer patients: a systematic review. Annals of Oncology 2015 June;26(6):1091-1101.

(13) Hewitt J, Long S, Carter B, Bach S, McCarthy K, Clegg A. The prevalence of frailty and its association with clinical outcomes in general surgery: a systematic review and meta-analysis. Age Ageing 2018;47(6):793-800.

(14) Theou O, Stathokostas L, Roland KP, Jakobi JM, Patterson C, Vandervoort AA, et al. The effectiveness of exercise interventions for the management of frailty: a systematic review. Journal of aging research 2011;2011.

(15) Fiatarone MA, O'Neill EF, Ryan ND, Clements KM, Solares GR, Nelson ME, et al. Exercise training and nutritional supplementation for physical frailty in very elderly people. N Engl J Med 1994;330(25):1769-1775.

(16) Tarazona-Santabalbina FJ, Gmez-Cabrera MC, Prez-Ros P, Martnez-Arnau FM, Cabo H, Tsaparas K, et al. A multicomponent exercise intervention that reverses frailty and improves cognition, emotion, and social networking in the community-dwelling frail elderly:

a randomized clinical trial. Journal of the American Medical Directors Association 2016;17(5):426-433.

(17) Munn Z, Moola S, Riitano D, Lisy K. The development of a critical appraisal tool for use in systematic reviews addressing questions of prevalence. International journal of health policy and management 2014;3(3):123.

(18) International Monetary Fund (. World Economic Outlook (April 2019). 2019; Available at: https://www.imf.org/external/datamapper/PPPPC@WEO/ADVEC/WEOWORLD. Accessed 02/05/, 2019.

(19) World Health Organisation (. Global Health Expenditure Database (GHED). 2019; Available at: http://apps.who.int/nha/database/Home/Index/en. Accessed 02/05/, 2019.

(20) Purser JL, Kuchibhatla MN, Fillenbaum GG, Harding T, Peterson ED, Alexander KP. Identifying frailty in hospitalized older adults with significant coronary artery disease. J Am Geriatr Soc 2006;54(11):1674-1681.

(21) Santos-Eggimann B, Cuénoud P, Spagnoli J, Junod J. Prevalence of frailty in middle-aged and older community-dwelling Europeans living in 10 countries. The Journals of Gerontology: Series A 2009;64(6):675-681.

(22) Andela RM, Dijkstra A, Slaets JPJ, Sanderman R. Prevalence of frailty on clinical wards: Description and implications; 20158543. Int J Nurs Pract 2010;16(1):14-19.

(23) Theou O, Brothers TD, Rockwood MR, Haardt D, Mitnitski A, Rockwood K. Exploring the relationship between national economic indicators and relative fitness and frailty in middle-aged and older Europeans. Age Ageing 2013;42(5):614-619.

(24) Whittaker AC, Delledonne M, Finni T, Garagnani P, Greig C, Kallen V, et al. Physical Activity and Nutrition INfluences In ageing (PANINI): consortium mission statement. Aging clinical and experimental research 2018:1-8.

(25) University of Birmingham. Physical Activity and Nutritional INfluences In ageing (PANINI) Available at: http://www.birmingham.ac.uk/generic/panini/index.aspx. Accessed 6th February, 2019.

Appendix 2.1.1. Systematic review search strategy

Systematic search strategy

Ovid search strategy

1. Frail$.ti.ab.
2. Prevalence.ti,ab.
3. Percent$.ti,ab.
4. “were frail”.ti,ab.
5. “considered frail”.ti,ab.
6. Hospital$.ti,ab.
7. Ward.ti,ab.
8. Department.ti,ab.
9. Surg*.ti,ab.
10. Unit.ti,ab.
11. Geriatr*.tx.
12. “older adult*”.tx.
13. Elder$.tx.
14. Retire*.tx.
15. Old$.tx.
16. Patient$.tx.
17. “community-dwelling”.ti,ab.
18. 2 OR 3 OR 4 OR 5
19. 6 OR 7 OR 8 OR 9 OR 10
20. 11 OR 12 OR 13 OR 14 OR 15 OR 16
21. 1 AND 18 AND 19 AND 20
22. 21 NOT 17

Scopus search strategy

((((TITLE-ABS-KEY(frail*)) AND (TITLE-ABS-KEY(Prevalence)) OR (TITLE-ABS-KEY(Percent*)) OR (TITLE-ABS-KEY ("were frail")) OR (TITLE-ABS-KEY ("considered frail"))) AND (((TITLE-ABS-KEY(Hospital*)) OR (TITLE-ABS-KEY(Ward)) OR (TITLE-ABS-KEY(Department)) OR (TITLE-ABS-KEY(surg*)) OR (TITLE-ABS-KEY(unit))))) AND ((ALL(Geriatr*)) OR (ALL("older adult*")) OR (ALL(Elder*)) OR (ALL(retire*)) OR (ALL(old)) OR (ALL(older)) OR (ALL(Patient*)))) AND NOT (TITLE-ABS-KEY("community-dwelling"))

Web of Science search strategy

1. TS = Frail*
2. TS = Prevalence
3. TS = Percent*
4. TS = “were frail”
5. TS = “considered frail”
6. TS = Hospital*
7. TS = Ward
8. TS = Department
9. TS = Surg*
10. TS = Unit
11. TS = Geriatr*
12. TS = “older adult”
13. TS = Elder*
14. TS = Retir*
15. TS = Old*
16. TS = Patient*
17. TS = “community-dwelling”
18. #2 OR #3 OR #4 OR #5
19. #6 OR #7 OR #8 OR #9 OR #10
20. #11 OR #12 OR #13 OR #14 OR #15 OR #16
21. #1 AND #18 AND #19 AND #20
22. #21 NOT #17

CINAHL Plus search strategy

1. AB frail*
2. AB prevalence OR AB Percent* OR AB “were frail” OR AB “considered frail”
3. AB Hospital* OR AB Ward OR AB Department OR AB Surg* OR AB Unit
4. AB Geriatr* OR AB “older adult” OR AB Elder* OR AB Retir* OR AB OLD* OR AB Patient*
5. S1 AND S2 AND S3 AND S4

Cochrane Library search strategy

1. frail*:ti,ab,kw (Word variations have been searched)
2. prevalence:ti,ab,kw OR percent*:ti,ab,kw OR “were frail”:ti,ab,kw OR “considered frail”:ti.ab.kw (Word variations have been searched)
3. hospital*:ti,ab,kw OR ward:ti,ab,kw or department:ti,ab,kw OR surg*:ti,ab,kw OR unit:ti,ab,kw (Word variations have been searched)
4. Geriatr*:ti,ab,kw OR “older adult”:ti,ab,kw OR Elder*:ti,ab,kw OR Retir*:ti,ab,kw OR Old*:ti,ab,kw (Word variations have been searched)
5. Patient*:ti,ab,kw (Word variations have been searched)
6. #4 OR #5
7. #1 AND #2 AND #3 AND #6

Appendix 2.1.2. Systematic review screening form

The prevalence of frailty amongst geriatric populations within inpatient hospital settings: A systematic review

Inclusion criteria - All studies must:

- have a minimum age of ≥ 65 years
- use a clearly defined and validated operational definition for the classification of frailty
- either assess (or attempt to assess) the whole ward, department, unit, hospital, or clinical population, or employ some form of randomised selection of participants
- occur within a hospital setting, in, or including hospital in-patients*
- report the prevalence of frailty or provide sufficient data to allow the calculation of the prevalence of frailty.

*=If a study examines a mixed cohort, only data pertaining to hospital inpatients will be

included.

Exclusion criteria:

- studies not available in the English language
- studies where the sample are non-hospital inpatients (i.e., outpatients, day patients, or community-dwelling individuals).

Systematic Review - Screening procedure

1). Import attached RIS file into your reference manager software (preferably EndNote X8.2)

2). Once imported, screen all title and abstracts for eligibility against the inclusion / exclusion criteria above.

3). Move all studies identified as potentially eligible based on title and abstract into a separate group (EndNote), Or folder (RefWorks, Mendeley).

4). Screen full text of identified studies to determine eligibility.

5). Move all eligible studies into separate group / folder.

6). Make note of excluded studies and reasons for their exclusion based on eligibility criteria, in the attached excel file.

5). Compare identified studies.

6). If all reviewers identify the exact same studies, with no discrepancies, this is the end of the initial screening process for the systematic review.

7). If there are differences in the study's identified by different reviewers - discuss until resolution is determined. In the event a unanimous consensus cannot be met by the three reviewers, the majority consensus will be taken, and a note made of this.

Appendix 2.1.3. Full text screening master file template

Initial studies included from full text screening (prior to reviewer discussion)										Key	
Author(s) / Year	Title	Reviewer 1 (PD)	Reviewer 2 (JA)	Reviewer 3 (EA)	Conclusion of discussion	Decision	Response received from authors	Outcome			
										Unanimous consensus inclusion	
										Majority consensus inclusion	
										Initial majority / non-minority consensus contact author*	*In event where there is neither, majority or unanimous consensus on inclusion or exclusion i.e. at least one reviewer (max 2) wishes to seek further information and at least one reviewer wishes to exclude / include initially
										Majority consensus exclusion**	** = Reasons for all excluded studies given in exclusion form
										Unanimous consensus exclusion**	** = Reasons for all excluded studies given in exclusion form
										Unanimous consensus contact author	
										? = Contact author***	** = Reasons for all instances of contacting author to assess eligibility outlined in contact author form
										✓= Included	
										x = Excluded	

Appendix 2.1.4. Joanna Briggs Institute critical appraisal checklist for studies reporting prevalence data

Reviewer: _____ Date: _____

Author(s): _____ Record Number:

	Yes	No	Unclear	Not applicable
1. Was the sample frame appropriate to address the target population?	☐	☐	☐	☐
2. Were study participants sampled in an appropriate way?	☐	☐	☐	☐
3. Was the sample size adequate?	☐	☐	☐	☐
4. Were the study subjects and the setting described in detail?	☐	☐	☐	☐
5. Was the data analysis conducted with sufficient coverage of the identified sample?	☐	☐	☐	☐
6. Were valid methods used for the identification of the condition?	☐	☐	☐	☐
7. Was the condition measured in a standard, reliable way for all participants?	☐	☐	☐	☐
8. Was there appropriate statistical analysis?	☐	☐	☐	☐
9. Was the response rate adequate, and if not, was the low response rate managed appropriately?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

_____

_____

_____

Critical appraisal tool guidelines

Answer: Yes, No, Unclear or Not/Applicable.

1. Was the sample frame appropriate to address the target population?

This question relies upon knowledge of the broader characteristics of the population of interest and the geographical area. If the study is of women with breast cancer, knowledge of at least the characteristics, demographics and medical history is needed. The term "target population" should not be taken to infer every individual from everywhere or with similar disease or exposure characteristics. Instead, give consideration to specific population characteristics in the study, including age range, gender, morbidities, medications, and other potentially influential factors. For example, a sample frame may not be appropriate to address the target population if a certain group has been used (such as those working for one organisation, or one profession) and the results then inferred to the target population (i.e., working adults). A sample frame may be appropriate when it includes almost all the members of the target population (i.e., a census, or a complete list of participants or complete registry data).

2. Were study participants recruited in an appropriate way?

Studies may report random sampling from a population, and the methods section should report how sampling was performed. Random probabilistic sampling from a defined subset of the population (sample frame) should be employed in most cases, however, random probabilistic sampling is not needed when everyone in the sampling frame will be included/ analysed. For example, reporting on all the data from a good census is appropriate as a good census will identify everybody. When using cluster sampling, such as a random sample of villages within a region, the methods need to be clearly stated as the precision of the final prevalence estimate incorporates the clustering effect. Convenience samples, such as a street survey or interviewing lots of people at a public gatherings are not considered to provide a representative sample of the base population.

3. Was the sample size adequate?

The larger the sample, the narrower will be the confidence interval around the prevalence estimate, making the results more precise. An adequate sample size is important to ensure good precision of the final estimate. Ideally, we are looking for evidence that the authors conducted a sample size calculation to determine an adequate sample size. This will estimate how many subjects are needed to produce a reliable estimate of the measure(s) of interest. For conditions with a low prevalence, a larger sample size is needed. Also consider sample sizes for subgroup (or characteristics) analyses, and whether these are appropriate. Sometimes, the study will be large enough (as in large national surveys) whereby a sample size calculation is not required. In these cases, sample size can be considered adequate.

When there is no sample size calculation and it is not a large national survey, the reviewers may consider conducting their own sample size analysis using the following formula: (Naing et al., 2006, Daniel 1999)

$$n = \frac{Z^2 P(1-P)}{d^2}$$

Where:

n= sample size

Z = Z statistic for a level of confidence

P = Expected prevalence or proportion (in proportion of one; if 20%, P = 0.2)

d = precision (in proportion of one; if 5%, d=0.05)

4. Were the study subjects and setting described in detail?

Certain diseases or conditions vary in prevalence across different geographic regions and populations (e.g. Women vs. Men, sociodemographic variables between countries). The study sample should be described in sufficient detail so that other researchers can determine if it is comparable to the population of interest to them.

5. Was data analysis conducted with sufficient coverage of the identified sample?

Coverage bias can occur when not all subgroups of the identified sample respond at the same rate. For instance, you may have a very high response rate overall for your study, but the response rate for a certain subgroup (i.e., older adults) may be quite low.

6. Were valid methods used for the identification of the condition?

Here we are looking for measurement or classification bias. Many health problems are not easily diagnosed or defined and some measures may not be capable of including or excluding appropriate levels or stages of the health problem. If the outcomes were assessed based on existing definitions or diagnostic criteria, then the answer to this question is likely to be yes. If the outcomes were assessed using observer reported, or self-reported scales, the risk of over- or under-reporting is increased, and objectivity is compromised. Importantly, determine if the measurement tools used were validated instruments as this has a significant impact on outcome assessment validity.

7. Was the condition measured in a standard, reliable way for all participants?

Considerable judgment is required to determine the presence of some health outcomes. Having established the validity of the outcome measurement instrument (see item 6 of this scale), it is important to establish how the measurement was conducted. Were those involved in collecting data trained or educated in the use of the instrument/s? If there was more than

one data collector, were they similar in terms of level of education, clinical or research experience, or level of responsibility in the piece of research being appraised? When there was more than one observer or collector, was there comparison of results from across the observers? Was the condition measured in the same way for all participants?

8. Was there appropriate statistical analysis?

Importantly, the numerator and denominator should be clearly reported, and percentages should be given with confidence intervals. The methods section should be detailed enough for reviewers to identify the analytical technique used and how specific variables were measured. Additionally, it is also important to assess the appropriateness of the analytical strategy in terms of the assumptions associated with the approach as differing methods of analysis are based on differing assumptions about the data and how it will respond.

9. Was the response rate adequate, and if not, was the low response rate managed appropriately?

A large number of dropouts, refusals or "not founds" amongst selected subjects may diminish a study's validity, as can a low response rates for survey studies. The authors should clearly discuss the response rate and any reasons for non-response and compare persons in the study to those not in the study, particularly with regards to their socio-demographic characteristics. If reasons for non-response appear to be unrelated to the outcome measured and the characteristics of non-responders are comparable to those who do respond in the study (addressed in question 5, coverage bias), the researchers may be able to justify a more modest response rate.

Appendix 2.1.5. Data extraction form template

Data extraction form part 1:

Study details					Study Methods and participant characteristics													
Author	Year of Publication	Study title	Journal of publication	Aim	Setting	Ward / Department / Unit / Hospital / Clinical population type	Study design	Recruitment duration	Age of participants (mean +/- SD)	Age of participants (range)	Country	Continent	5-year average GDP per capita PPP (current international $) (years preceding the study) (International Monetary Fund data)	5-year average healthcare expenditure per capita PPP (current international $) (years preceding the study) (World Health Organisation data)	Sample size (n)	Diagnosis / Prevalent morbidity (if applicable)	Any other relevant characteristic	Criteria utilised for the operational definition of frailty

Data extraction form part 2:

Results																						
Number of frail participants	Number of "pre-frail" participants	Number of robust / non-frail	Prevalence of frailty	Prevalence of frailty	Prevalence of frailty	Prevalence of frailty	Number of frail Male participants	Number of pre-frail Male participants	Number of non-frail / robust Male participants	Prevalence of frailty in Male participants	Prevalence of pre-frailty in Male participants	Prevalence of robust / non-frailty Male participants	Number of Female participants	Number of frail Female participants	Number of pre-frail Female participants	Number of non-frail / robust Female participants	Prevalence of frailty in Female participants	Prevalence of pre-frailty in Female participants	Prevalence of robust / non-frailty Female participants	Relevant authors comments	Relevant reviewers' comments

Data extraction form part 3:

	Study details					5-year average GDP per capita PPP (current international $) (years preceding the study*) (International Monetary Fund data)																				*Five years prior to commencement of data collection for the study. Each calendar year of the study will also be included provided recruitment continues through to > 6 months in the preceding year.
Study	Author	Year of Publication	Country / location	Recruitment start date	Recruitment end date	Year 5	Year 4	Year 3	Year 2	Year 1	Additional Year 1	Additional Year 2	Additional Year 3	Additional Year 4	Additional Year 5	Additional Year 6	Additional Year 7	Additional Year 8	Additional Year 9	Additional Year 10	Additional Year 11	Additional Year 12	Years	5-year average GDP per capita PPP (current international $) (years preceding the study*) (International Monetary Fund data)		

Data extraction form part 4:

	Study details					5-year average healthcare expenditure per capita PPP (current international $) (years preceding the study*) (World Health Organisation data)																				*Five years prior to commencement of data collection for the study. Each calendar year of the study will also be included provided recruitment continues through to > 6 months in the preceding year.
Study	Author	Year of Publication	Country / location	Recruitment start date	Recruitment end date	Year 5	Year 4	Year 3	Year 2	Year 1	Additional Year 1	Additional Year 2	Additional Year 3	Additional Year 4	Additional Year 5	Additional Year 6	Additional Year 7	Additional Year 8	Additional Year 9	Additional Year 10	Additional Year 11	Additional Year 12	Years	5-year average healthcare expenditure per capita PPP (current international $) (years preceding the study*) (World Health Organisation data)		

Appendix 2.2. Systematic review search strategy results

Systematic search strategy

Ovid search strategy (925 results)

23. Frail$.ti.ab.
24. Prevalence.ti,ab.
25. Percent$.ti,ab.
26. “were frail”.ti,ab.
27. “considered frail”.ti,ab.
28. Hospital$.ti,ab.
29. Ward.ti,ab.
30. Department.ti,ab.
31. Surg*.ti,ab.
32. Unit.ti,ab.
33. Geriatr*.tx.
34. “older adult*”.tx.
35. Elder$.tx.
36. Retire*.tx.
37. Old$.tx.
38. Patient$.tx.
39. “community-dwelling”.ti,ab.
40. 2 OR 3 OR 4 OR 5
41. 6 OR 7 OR 8 OR 9 OR 10
42. 11 OR 12 OR 13 OR 14 OR 15 OR 16
43. 1 AND 18 AND 19 AND 20
44. 21 NOT 17

Scopus search strategy (1,314 results)

((((TITLE-ABS-KEY(frail*)) AND (TITLE-ABS-KEY(Prevalence)) OR (TITLE-ABS-KEY(Percent*)) OR (TITLE-ABS-KEY ("were frail")) OR (TITLE-ABS-KEY ("considered frail"))) AND (((TITLE-ABS-KEY(Hospital*)) OR (TITLE-ABS-KEY(Ward)) OR (TITLE-ABS-KEY(Department)) OR (TITLE-ABS-KEY(surg*)) OR (TITLE-ABS-KEY(unit))))) AND ((ALL(Geriatr*)) OR (ALL("older adult*")) OR (ALL(Elder*)) OR (ALL(retire*)) OR (ALL(old)) OR (ALL(older)) OR (ALL(Patient*)))) AND NOT (TITLE-ABS-KEY("community-dwelling"))

Web of Science search strategy (1,007 results)

23. TS = Frail*
24. TS = Prevalence
25. TS = Percent*
26. TS = “were frail”
27. TS = “considered frail”
28. TS = Hospital*
29. TS = Ward
30. TS = Department
31. TS = Surg*
32. TS = Unit
33. TS = Geriatr*
34. TS = “older adult”
35. TS = Elder*
36. TS = Retir*
37. TS = Old*
38. TS = Patient*
39. TS = “community-dwelling”
40. #2 OR #3 OR #4 OR #5
41. #6 OR #7 OR #8 OR #9 OR #10
42. #11 OR #12 OR #13 OR #14 OR #15 OR #16
43. #1 AND #18 AND #19 AND #20
44. #21 NOT #17

CINAHL Plus search strategy (1,375 results)

6. AB frail*
7. AB prevalence OR AB Percent* OR AB “were frail” OR AB “considered frail”
8. AB Hospital* OR AB Ward OR AB Department OR AB Surg* OR AB Unit
9. AB Geriatr* OR AB “older adult” OR AB Elder* OR AB Retir* OR AB OLD* OR AB Patient*
10. S1 AND S2 AND S3 AND S4

Cochrane Library search strategy (136 results)

8. frail*:ti,ab,kw (Word variations have been searched)
9. prevalence:ti,ab,kw OR percent*:ti,ab,kw OR “were frail”:ti,ab,kw OR “considered frail”:ti.ab.kw (Word variations have been searched)
10. hospital*:ti,ab,kw OR ward:ti,ab,kw or department:ti,ab,kw OR surg*:ti,ab,kw OR unit:ti,ab,kw (Word variations have been searched)
11. Geriatr*:ti,ab,kw OR “older adult”:ti,ab,kw OR Elder*:ti,ab,kw OR Retir*:ti,ab,kw OR Old*:ti,ab,kw (Word variations have been searched)
12. Patient*:ti,ab,kw (Word variations have been searched)
13. #4 OR #5
14. #1 AND #2 AND #3 AND #6

UNIVERSITY OF BIRMINGHAM

Appendix 2.3. Systematic review screening form

The prevalence of frailty amongst geriatric populations within inpatient hospital settings: A systematic review

Inclusion criteria - All studies must:

- have a minimum age of ≥ 65 years
- use a clearly defined and validated operational definition for the classification of frailty
- either assess (or attempt to assess) the whole ward, department, unit, hospital, or clinical population, or employ some form of randomised selection of participants
- occur within a hospital setting, in, or including hospital in-patients*
- report the prevalence of frailty or provide sufficient data to allow the calculation of the prevalence of frailty.

*=If a study examines a mixed cohort, only data pertaining to hospital inpatients will be included.

Exclusion criteria:

- studies not available in the English language
- studies where the sample are non-hospital inpatients (i.e., outpatients, day patients, or community-dwelling individuals).

Systematic Review - Screening procedure

1). Import attached RIS file into your reference manager software (preferably EndNote X8.2)

2). Once imported, screen all title and abstracts for eligibility against the inclusion / exclusion criteria above.

3). Move all studies identified as potentially eligible based on title and abstract into a separate group (EndNote), Or folder (RefWorks, Mendeley).

4). Screen full text of identified studies to determine eligibility.

5). Move all eligible studies into separate group / folder.

6). Make note of excluded studies and reasons for their exclusion based on eligibility criteria, in the attached excel file.

5). Compare identified studies.

6). If all reviewers identify the exact same studies, with no discrepancies, this is the end of the initial screening process for the systematic review.

7). If there are differences in the study's identified by different reviewers - discuss until resolution is determined. In the event a unanimous consensus cannot be met by the three reviewers, the majority consensus will be taken, and a note made of this.

Appendix 2.4. Full text screening master file

Initial studies included from full text screening prior to reviewer discussion										Key	
Author(s) / Year	Title	Reviewer 1 (PD)	Reviewer 2 (JA)	Reviewer 3 (EA)	Conclusion of discussion	Decision	Response received from authors	Outcome			
A et al., 2018	Correlation of pre-surgery frailty related measurements with post transplant outcomes in patients after lung transplantation	x	x	x	N/A	Excluded	N/A	Excluded		**Unanimous consensus inclusion**	
Abdel-Kader et al., 2018	Acute Kidney Injury and Subsequent Frailty Status in Survivors of Critical Illness: A Secondary Analysis	x	x	✓	Reviewer 3 now agrees this study is not eligible due to a minimum age below 65	Excluded	N/A	Excluded		**Majority consensus inclusion**	
Abel et al., 2015	Feasibility of routine frailty screening assessment for patients in a hematologic oncology clinic: results from a pilot study	?	x	x	All reviewers have agreed to contact authors as per contact author form	Contact authors	Yes - All reviewers agree to exclude as the author has confirmed that the sample consists entirely of outpatients	Excluded		**Initial majority / non-minority consensus contact author***	*In event where there is neither, majority or unanimous consensus on inclusion or exclusion i.e., at least one reviewer (max 2) wishes to seek further information and at least one reviewer wishes to exclude / include initially
Abramowitz et al., 2016	Impact of Body Mass Index on the Outcomes Following Transcatheter Aortic Valve Implantation	?	x	✓	Reviewer 2 initially could not agree if an attempt was made to assess the whole ward, or an equivalent functional unit in the form of a ward sub-unit. Reviewer 2 now agrees on inclusion based on this criteria. However, all reviewers have agreed to contact authors to confirm the minimum age of participants, and also if the operational definition of frailty utilised has been validated. The fact that this is not explicitly stated was initially missed by reviewer 2 and reviewer 3	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that several participants were < 65 years of age. The operational definition utilised for the classification of frailty has also not been validated	Excluded		**Majority consensus exclusion****	** = Reasons for all excluded studies given in exclusion form
Abramowitz et al., 2015	Comparison of Outcomes of Transcatheter Aortic Valve Implantation in Patients >= 90 Years Versus < 90 Years	?	x	✓	Reviewer 2 initially could not agree if an attempt was made to assess the whole ward, or an equivalent functional unit in the form of a ward sub-unit. Reviewer 2 now agrees on inclusion based on this criteria. However, all reviewers have agreed to contact authors to confirm the minimum age of participants, and also if the operational definition of frailty utilised has been validated. The fact that this is not explicitly stated was initially missed by reviewer 2 and reviewer 3	Contact authors	Yes - All reviewers have agreed to exclude as the operational definition utilised for the classification of frailty has not been validated	Excluded		**Unanimous consensus exclusion****	** = Reasons for all excluded studies given in exclusion form
Abt et al., 2016	Assessment of the Predictive Value of the Modified Frailty Index for Clavien-Dindo Grade IV Critical Care Complications in Major Head and Neck Cancer Operations	x	x	x	N/A	Excluded	N/A	Excluded		Unanimous consensus contact author	
Ad et al., 2016	The Effects of Frailty in Patients Undergoing Elective Cardiac Surgery	x	?	?	Reviewer 3 was initially unsure if all patients were inpatients, while reviewer 2 was uncertain that an attempt had been made to recruit all patients over the time period. All Reviewers now agree that an attempt was made to recruit consecutive patients over the time period of the study. However, all Reviewers now agree to exclude as participants were not inpatients during the conduction of frailty assessments, which were conducted on an outpatient basis, prior to inpatient admission.	Excluded	N/A	Excluded		? = Contact author***	** = Reasons for all instances of contacting author to assess eligibility outlined in contact author form
Adedayo et al., 2018	Preoperative frailty is a risk factor for non-home discharge in patients undergoing surgery for endometrial cancer	x	x	x	N/A	Excluded	N/A	Excluded		✓= Included	
Afilalo et al., 2014	Frailty assessment in the cardiovascular care of older adults	x	x	x	N/A	Excluded	N/A	Excluded		x = Excluded	
Afilalo et al., 2017	Frailty in Older Adults Undergoing Aortic Valve Replacement The FRAILTY-AVR Study	?	x	?	All reviewers agree on the need to contact the study authors to determine if all participants were inpatients, and if not, if there is separate data related to participants who were inpatients	Contact authors	No - All reviewers have agreed to exclude as the authors were unable to provide an answer to the inquiry	Excluded			
Afilalo et al., 2012	Addition of Frailty and Disability to Cardiac Surgery Risk Scores Identifies Elderly Patients at High Risk of Mortality or Major Morbidity	x	x	✓	All reviewers agree on the need to contact the study authors to clarify if all assessments were performed while participants were inpatients, and if not, if separate data exists relating solely to those that were inpatients	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Ahc., 2016	Research Suggests Importance of Assessing Patients' Frailty, Pre-Surgery: Frailty is under-recognized	x	?	?	All reviewers have agreed to exclude as this is a commentary of a paper. The paper for which this paper provides commentary is also ineligible. Initially reviewer 2 and reviewer 3 could not locate the full text	Excluded	N/A	Excluded			
Ahlund et al., 2018	Physical Performance Impairments and Limitations Among Hospitalized Frail Older Adults	?	✓	✓	All reviewers agree to contact authors as per contact author form	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirm that information does not exist related to all of those initially screened	Excluded			
Ahmed et al., 2012	The Role of an Acute Care for the Elderly Unit in Achieving Hospital Quality Indicators While Caring for Frail Hospitalized Elders	x	x	x	N/A	Excluded	N/A	Excluded			
Al Zuhir et al., 2015	Survival, Readmission and Healthcare Costs of Frail Vascular Surgical Patients: Vascular and Transplant 0579	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Alabaf et al., 2018	Allocating patients to geriatric medicine wards in a tertiary university hospital in England: A service evaluation of the Specialist Advice for the Frail Elderly (SAFE) team	x	✓	✓	All reviewers agree to exclude as study reports on a partial cohort of the sample reported by Keevil et al. 2018 - "*Care home residents admitted to hospital through the emergency pathway: characteristics and associations with inpatient mortality*", which reports data for all participants included in this present study, as well as additional participants relevant to this review, not reported within this study	Excluded	Yes	Excluded			
Alegre et al., 2018	An Easy Assessment of Frailty at Baseline Independently Predicts Prognosis in Very Elderly Patients With Acute Coronary Syndromes	x	✓	✓	All reviewers agree to contact author to see if the scale utilised for the assessment of frailty is a reflection of frailty level at admission, or if not, when.	Contact authors	Yes - All reviewers have agreed to exclude as the frailty score is reflective of a period prior to patients having inpatient status	Excluded			
Alfredsson et al., 2016	Gait speed predicts 30-day mortality after transcatheter aortic valve replacement: results from the Society of Thoracic Surgeons/American College of Cardiology Transcatheter Valve Therapy Registry	x	x	x	N/A	Excluded	N/A	Excluded			
Ali et al., 2014	Mid-term survival outcomes for frail vascular surgical patients: O84	?	?	✓	All reviewers agree to contact author as per contact author form	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Aliberti et al., 2018	Targeted Geriatric Assessment for Fast-Paced Healthcare Settings: Development, Validity, and Reliability	x	x	x	N/A	Excluded	N/A	Excluded			

Allen et al., 2005	Gathering facts to drive change: services for acutely ill elderly people presenting to a general hospital	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as a validated operation definition of frailty was not utilised.	Excluded			
Al-Nammari et al., 2014	Fragility fractures of the ankle in the frail elderly patient: TREATMENT WITH A LONG CALCANEOTALOTIBIAL NAIL	x	x	x	N/A	Excluded	N/A	Excluded			
Alonso Salinas et al., 2016	Frailty is a short-term prognostic marker in acute coronary syndrome of elderly patients	?	x	✓	All reviewers have agreed to contact the authors as per the contact author form, to inquire if this study utilised a sub-sample of the sample utilised in Alonso-Salinas et al. 2018 - "*The Role of Frailty in Acute Coronary Syndromes in the Elderly*". The fact that this may be the case was initially missed by reviewer 2 and reviewer 3. Reviewer 2 initially wished to exclude the study, however, now agrees with the inclusion of patients with specific morbidities as a functional unit in the form of a clinical population, serving as a parameter through which frailty can be assessed in that specific group of hospital inpatients, as per the screening form	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that this paper reports on a sub-sample of the same participants reported on in Alonso-Salinas et al. 2018 - "The Role of Frailty in Acute Coronary Syndromes in the Elderly", which has been included	Excluded			
Alonso Salinas et al., 2017	Frailty is an independent prognostic marker in elderly patients with myocardial infarction	?	x	✓	All reviewers have agreed to contact the authors as per the contact author form, to inquire if this study utilised a sub-sample of the sample utilised in Alonso-Salinas et al. 2018 - "*The Role of Frailty in Acute Coronary Syndromes in the Elderly*". The fact that this may be the case was initially missed by reviewer 2 and reviewer 3. Reviewer 2 initially wished to exclude the study, however, now agrees with the inclusion of patients with specific morbidities as a functional unit in the form of a clinical population, serving as a parameter through which frailty can be assessed in that specific group of hospital inpatients, as per the screening form	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that this paper reports on a sub-sample of the same participants reported on in Alonso-Salinas et al. 2018 - "The Role of Frailty in Acute Coronary Syndromes in the Elderly", which has been included	Excluded			
Alonso Salinas et al., 2018	The Role of Frailty in Acute Coronary Syndromes in the Elderly	✓	✓	✓	N/A	Included	N/A	Included			
Alotaibi et al., 2018	Breast cancer mortality in Saudi Arabia: Modelling observed and unobserved factors	x	x	x	N/A	Excluded	N/A	Excluded			
Andela et al., 2010	Prevalence of frailty on clinical wards: Description and implications	✓	✓	✓	N/A	Included	N/A	Included			
Andrew et al., 2017	The Importance of Frailty in the Assessment of Influenza Vaccine Effectiveness Against Influenza-Related Hospitalization in Elderly People	✓	✓	✓	N/A	Included	N/A	Included			
Annoni, Mazzola, 2016	Real-world characteristics of hospitalized frail elderly patients with atrial fibrillation: can we improve the current prescription of anticoagulants?	x	x	✓	Reviewer 2 now agrees with the inclusion of patients with specific morbidities as representing a specific clinical population (as per screening form). Which was the initial reason for their wish to exclude. However, all authors now agree to exclude as a validated operational definition was not used for the classification of frailty. This was initially missed by Reviewer 2 and Reviewer 3	Excluded	N/A	Excluded			
Ansryan et al., 2018	Systems Addressing Frail Elder Care: Description of a Successful Model	?	✓	x	All reviewers agree to contact authors as per contact author form	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Anzaldi et al., 2017	Comparing clinician descriptions of frailty and geriatric syndromes using electronic health records: a retrospective cohort study	x	x	x	N/A	Excluded	N/A	Excluded			
Artaza-Artabe et al., 2016	The relationship between nutrition and frailty: Effects of protein intake, nutritional supplementation, vitamin D and exercise on muscle metabolism in the elderly. A systematic review	x	x	x	N/A	Excluded	N/A	Excluded			
Arya et al., 2015	Frailty increases the risk of 30-day mortality, morbidity, and failure to rescue after elective abdominal aortic aneurysm repair independent of age and comorbidities	x	x	?	All reviewers have agreed to exclude as the minimum age of participants is < 65	Excluded	N/A	Excluded			
Astiz et al., 2015	Prevalence of frailty and impact on survival in elderly patients hospitalized for heart failure	✓	?	✓	All reviewers have agreed to exclude as this is a duplicate of Vidan et al. 2016	Excluded	N/A	Excluded			
Atas et al., 2018	Short- and long-term mortality predictors in octogenarians with acute coronary syndromes	?	?	?	N/A	Contact authors	Full text located prior to contacting authors. After review by all reviewers, the study is excluded as it did not utilise a clearly defined and validated operational definition for the classification of frailty or report the prevalence of frailty.	Excluded			
Attisano et al., 2017	Sici-gise community campania survey donna TAVI (incanta). Acute, short-and long-term outcome in women after TAVI	?	?	?	N/A	Contact authors	Yes - Upon review all reviewers agreed to further contact the author to confirm the minimum age of participants and the assessment tool utilised for the operational definition of frailty. The authors have confirmed this information and all reviewers now agree on inclusion	Included			
Augustin et al., 2016	Frailty predicts risk of life-threatening complications and mortality after pancreatic resections	x	x	x	N/A	Excluded	N/A	Excluded			
Aydin et al., 2015	Improving hospital patient falls: Leveraging staffing characteristics and processes of care	x	x	x	N/A	Excluded	N/A	Excluded			
Ayesta et al., 2018	Rationale and design of the FELICITAR registry (Frailty Evaluation After List Inclusion, Characteristics and Influence on Transplantation and Results)	x	x	x	N/A	Excluded	N/A	Excluded			
Bachrach-Lindström et al., 2000	Nutritional state and functional capacity among elderly Swedish people with acute hip fracture	x	x	x	N/A	Excluded	N/A	Excluded			
Bagshaw et al., 2014	Association between frailty and short- and long-term outcomes among critically ill patients: A multicentre prospective cohort study	x	?	x	All reviewers have agreed to exclude as the minimum age of participants is < 65	Excluded	N/A	Excluded			
Bagshaw et al., 2015	Long-term association between frailty and health-related quality of life among survivors of critical illness: a prospective multicenter cohort study	x	x	x	N/A	Excluded	N/A	Excluded			

Bakker et al., 2014	The carewell in hospital questionnaire: A measure of frail elderly inpatient experiences with individualized and integrated hospital care	x	x	x	N/A	Excluded	N/A	Excluded			
Baldwin et al., 2014	The feasibility of measuring frailty to predict disability and mortality in older medical intensive care unit survivors	✓	x	x	Reviewer 2 and reviewer 3 now agree on inclusion of this study. Initially reviewer 2 excluded the study as it consists of patients with specific morbidities. Reviewer 3 initially misinterpreted the minimum age of participants. Upon discussion both reviewers now agree on inclusion	Included	N/A	Included			
Baldwin et al., 2017	Refining Low Physical Activity Measurement Improves Frailty Assessment in Advanced Lung Disease and Survivors of Critical Illness	x	✓	x	All reviewers agree to exclude as the minimum age of participants is < 65 years. Reviewers agreed to remain consistent in their interpretation of studies having a minimum age of < 65 years, even if sub analysis is available for those > 65, as to do the opposite and apply the latter criteria consistently would be impractical due to having to contact the authors of every study for sub-analysis of those > 65, in addition to having to screen the full text of over 4,000 studies in order to see if there was a sub sample analysis in studies with a minimum age < 65, or if there were patients over the age of 65. While creating an issue of deviating from the actual eligibility criteria, this approach poses an issue, which contributed to the formulation of this specific eligibility criteria, which is to apply such a criteria consistently would pose a impractical logistical issues due to the need to contact the authors of every study with a minimum age of < 65 during full text screening to see if information exists relating to a sub analysis of those over 65, in addition to initially not excluding any studies within the title and abstract screening on the basis of minimum age. As such all reviewers agree to remain consistent in their application of the stated eligibility criteria by excluding any studies with a minimum age < 65 year	Excluded	N/A	Excluded			
Ballham et al., 2017	36 Frailty flying squad: an emergency department focussed acute care of the elderly service DR genevieve robson, royal united hospital NHS foundation trust	?	✓	x	All reviewers agree to contact author as per contact author form	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a full text does not exist relating to this poster presentation	Excluded			
Bancu et al., 2017	Frail Patient in Haemodialysis: A New Challenge in Nephrology - Incidence in Our Area, Barcelonès Nord and Maresme	x	x	x	N/A	Excluded	N/A	Excluded			
Basic et al., 2017	The Impact of Being a Migrant from a Non-English-Speaking Country on Healthcare Outcomes in Frail Older Inpatients: an Australian Study	?	✓	✓	All reviewers agree to contact author as per contact author form	Contact authors	Yes - All reviewers have agreed to excluded as the authors have confirmed that the minimum age was < 65 years	Excluded			
Baylis et al., 2015	Cachexia, sarcopenia, inflammaging and outcomes in hospitalised older people (the CaSIO study): Study protocol and preliminary results	x	x	x	N/A	Excluded	N/A	Excluded			
Belga et al., 2016	Comparing three different measures of frailty in medical inpatients: Multicenter prospective cohort study examining 30-day risk of readmission or death	x	x	x	N/A	Excluded	N/A	Excluded			
Bernal et al., 2018	Interatrial block, frailty, and prognosis in elderly patients with myocardial infarction	?	✓	✓	All reviewers agree to contact author as per contact author form	Contact authors	Yes - All reviewers have agreed to exclude as the frailty score is reflective of a period prior to patients having inpatient status	Excluded			
Bernaud et al., 2016	Descriptive study of elderly HIV-infected patients in Loire Valley area in France	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as participants were not inpatients at the time of frailty assessment	Excluded			
Bertoli et al., 2017	Low FT3: A possible marker of frailty in the elderly	?	x	✓	All reviewers agree to contact authors as per contact authors form to request information regarding the prevalence of frailty. Reviewer initially excluded due to specific morbidity but now agrees with the inclusion of patients with specific morbidities as a subgroup / clinical population. Reviewer 2 initially missed the fact that the prevalence of frailty is not expressly stated.	Contact authors	Yes - All reviewers agree that the study is eligible for inclusion based on the inquiry as the authors were able to provide information regarding the prevalence of frailty However, this study consists of the same sample as Valentini et al. 2018 (the latter which contains more information about this sample relevant to this review). As such, all reviewers agree to exclude this study, as it consists of the same sample as Valentini et al. 2018, which has been included in the review, and contains more information relevant to this review, that this present study	Excluded			
Bertone et al., 2012	New technologies applied to rehabilitation in elderly patients: A pilot study on the step training system	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the study was in outpatients.	Excluded			
Bethune et al., 2016	What happens when we do not operate? Survival following conservative bowel cancer management	x	x	x	N/A	Excluded	N/A	Excluded			
Biagi et al., 2011	Clinical profile and predictors of in-hospital outcome in patients with heart failure: The FADOI "cONFINE" Study	x	x	x	N/A	Excluded	N/A	Excluded			
Bieniek et al., 2016	Fried frailty phenotype assessment components as applied to geriatric inpatients	x	✓	x	Reviewer 2 agrees to exclude due to minimum age being below 65	Excluded	N/A	Excluded			
Birch, Stokoe, 2014	12 INTRODUCING COMPREHENSIVE GERIATRIC ASSESSMENT TO THE MEDICAL EMERGENCY ASSESSMENT UNIT	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors were unable to provide a published full text related to this data	Excluded			
Blanco et al., 2017	Prognosis Impact of Frailty Assessed by the Edmonton Frail Scale in the Setting of Acute Coronary Syndrome in the Elderly	✓	✓	✓	N/A	Included	N/A	Included			
Blandfort, Damsgaard, Gregersen, 2015	Blood transfusion strategy and risk of postoperative delirium in nursing homes residents with hip fracture	?	?	x	All authors have agreed to contact authors as per the contact author form. Reviewer 2 initially excluded after only screening the abstract. All reviewers have reaffirmed the agreement to attempt to attempt to obtain the full text, by contacting the study authors, as per the requirements of full text screening	Contact authors	Full text located prior to contacting authors. After review by all reviewers, the study is excluded as it did not utilise a clearly defined and validated operational definition for the classification of frailty or report the prevalence of frailty.	Excluded			
Bo et al., 2015	Health status, geriatric syndromes, and prescription of oral anticoagulant therapy in elderly medical in-patients with atrial fibrillation: A prospective observational study	✓	✓	✓	N/A	Included	N/A	Included			
Bo et al., 2016	Prevalence of and factors associated with prolonged length of stay in older hospitalized medical patients	✓	✓	✓	N/A	Included	N/A	Included			

Bo et al., 2017	Effects of oral anticoagulant therapy in older medical in-patients with atrial fibrillation: a prospective cohort observational study	x	✓	✓	All authors have agreed to exclude as this study consists of the same cohort as Bo et al. 2015 - "Health status, geriatric syndromes and prescription of oral anticoagulant therapy in elderly medical in-patients with atrial fibrillation: A prospective observational study", which reports all data within this present study, and additional data relevant to this review. This was initially missed by Reviewer 2 and Reviewer 3. However, upon discussion all Reviewers have agreed to exclude	Excluded	N/A	Excluded			
Bonaga et al., 2018	Frailty, Polypharmacy, and Health Outcomes in Older Adults: The Frailty and Dependence in Albacete Study	x	x	x	N/A	Excluded	N/A	Excluded			
Bonaventura et al., 2018	Levels of serum uric acid at admission for hypoglycaemia predict 1-year mortality	x	x	x	N/A	Excluded	N/A	Excluded			
Bone et al., 2016	Factors Associated with Transition from Community Settings to Hospital as Place of Death for Adults Aged 75 and Older: A Population-Based Mortality Follow-Back Survey	x	x	x	N/A	Excluded	N/A	Excluded			
Bottignole et al., 2013	Falls in the frail elderly as a cause of admission to the emergency department: Phenomenon analysis and follow-up study	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Boxer et al., 2008	The association between vitamin D and inflammation with the 6-minute walk and frailty in patients with heart failure	x	x	x	N/A	Excluded	N/A	Excluded			
Bras et al., 2015	Predictive value of the Groningen Frailty Indicator for treatment outcomes in elderly patients after head and neck, or skin cancer surgery in a retrospective cohort	x	x	✓	Reviewer 3 has agreed to exclude due to participants being outpatients	Excluded	N/A	Excluded			
Briggs et al., 2017	Dementia in the acute hospital: the prevalence and clinical outcomes of acutely unwell patients with dementia	?	x	x	All reviewers have agreed to contact study authors as per the contact author form. Reviewer 2 and 3 initially believed that participants were not inpatients, however, have now agreed to contact study authors for clarification	Contact authors	Yes - All reviewers have agreed to exclude as the entire sample did not comprise of inpatients. The two cohorts were not differentiated at any stage in the assessment of frailty, and the author confirms that raw data is no longer available to facilitate this analysis.	Excluded			
Brouns et al., 2014	Hyponatraemia in elderly emergency department patients: A marker of frailty	x	x	x	N/A	Excluded	N/A	Excluded			
Brousseau et al., 2018	Identification of older adults with frailty in the Emergency Department using a frailty index: Results from a multinational study	?	x	x	All reviewers have agreed to exclude as the participants within this study were not hospital inpatients. Reviewer 1 initially wished to contact the authors for clarification, however, now agrees on exclusion	Excluded	N/A	Excluded			
Brown et al., 2016	The Association between Preoperative Frailty and Postoperative Delirium after Cardiac Surgery	x	x	x	N/A	Excluded	N/A	Excluded			
Brown et al., 2000	Low-intensity exercise as a modifier of physical frailty in older adults	x	x	x	N/A	Excluded	N/A	Excluded			
Brummel et al., 2017	Frailty and subsequent disability and mortality among patients with critical illness	x	x	x	N/A	Excluded	N/A	Excluded			
Bucholz et al., 2016	Underweight, Markers of Cachexia, and Mortality in Acute Myocardial Infarction: A Prospective Cohort Study of Elderly Medicare Beneficiaries	x	✓	x	Review 2 agrees to exclude as study does not use a validated operational definition for the classification of frailty	Excluded	N/A	Excluded			
Buck et al., 2011	The impact of frailty on health-related quality of life in heart failure	x	x	x	N/A	Excluded	N/A	Excluded			
Bustamante-Chavez, Pena-Sanchez, Leguia-Cerna, 2016	Fragility and factors associated with older adults of geriatry offices of two hospitals level III of Lambayeque	?	?	x	All reviewers have agreed to contact authors as per contact author form. Reviewer 2 initially excluded after only screening the abstract. All reviewers have agreed to obtain full text as per the requirements of full text screening	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Buttery, Martin, 2099	Knowledge, attitudes, and intentions about participation in physical activity of older post-acute hospital inpatients	x	✓	✓	Reviewer 1 initially excluded as handgrip strength was used to classify frailty, while an indicator of frailty, handgrip strength is not a validated operational definition of frailty. This was initially missed by reviewer 2 and 3. Upon review all reviewers agree to exclude	Excluded	N/A	Excluded			
Bylow, K. A. et al., 2009	Abnormal physical performance and frailty in older men with biochemical recurrence of prostate cancer (PCa) on androgen deprivation therapy (ADT)	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Cabre et al., 2010	Prevalence and prognostic implications of dysphagia in elderly patients with pneumonia	x	x	x	N/A	Excluded	N/A	Excluded			
Cacciatore et al., 2013	Clinical frailty and long-term mortality in elderly subjects with diabetes	x	x	x	N/A	Excluded	N/A	Excluded			
Cahir, C. et al., 2017	Adverse Drug reactions in an Ageing PopulaTion (ADAPT) study protocol: a cross-sectional and prospective cohort study of hospital admissions related to adverse drug reactions in older patients	?	x	x	All reviewers have agreed to contact authors as per contact author form. Reviewer 2 and reviewer 3 initially excluded due to the study being a protocol. All reviewers agree that while the protocol is excluded it is worthwhile contact authors to see if this study has progressed adequately and a full text exists which can be screened for inclusion	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a full text or preliminary results do not presently exists related to this protocol. If preliminary results had of existed, the authors may have waited for a full text to become available to screen.	Excluded			
Calle et al., 2018	Frailty Related Factors as Predictors of Functional Recovery in Geriatric Rehabilitation: The Sarcopenia and Function in Aging Rehabilitation (SAFARI) Multi-Centric Study	x	x	x	N/A	Excluded	N/A	Excluded			
Callen et al., 2004	Admission and Discharge Mobility of Frail Hospitalized Older Adults	x	x	x	N/A	Excluded	N/A	Excluded			
Calvo et al., 2018	Frailty in elderly patients undergoing primary percutaneous coronary intervention	✓	?	?	All reviewers agree to contact author to see if scale is a reflection of frailty level at admission, or if not, when.	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that frailty assessments are reflective of pre-admission frailty status	Excluded			
Cameron et al., 2000	Impact of a nurse-led multidisciplinary team on an acute medical admissions unit	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there	Excluded			

							remains insufficient data in this regard to facilitate inclusion				
Cares Lay et al., 2013	Evolution of functional capacity of older people during hospital stay	x	?	?	Initially reviewer 2 and reviewer 3 could not locate the full text in English, upon review all reviewers agree to exclude due to a lack of a validated operational definition for the classification of frailty	Excluded	N/A	Excluded			
Carmeli, 2017	Frailty and primary sarcopenia: A review	x	x	x	N/A	Excluded	N/A	Excluded			
Carneiro et al., 2017	Frailty in the elderly: prevalence and associated factors	✓	?	x	Reviewer 1 agrees to exclude as sample was not inpatients (community-dwelling)	Excluded	N/A	Excluded			
Carpenter, Rothenberger, Stark, 2010	Grip Strength Testing to Identify a Frail Subset of Geriatric Adults In the Emergency Department: 270	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors were unable to provide a full English test relating to the conference abstract	Excluded			
Casals et al., 2016	Changes in emergency services to adapt to the complexity pathway within the health system	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Cecile et al., 2009	Adverse drug events in hospitalized elderly in a Geriatric medicine unit: Study of prevalence and risk factors	x	?	?	Initially reviewer 2 and reviewer 3 could not locate the full text in English, upon review of the full text all reviewers agree to exclude as frailty was not measured	Excluded	N/A	Excluded			
Cezar et al., 2017	Frailty in older adults with amnestic mild cognitive impairment as a result of Alzheimer's disease: A comparison of two models of frailty characterization	x	x	x	N/A	Excluded	N/A	Excluded			
Chapman et al., 2014	Development of a comprehensive multidisciplinary geriatric oncology center, the Thomas Jefferson university experience	x	✓	x	Reviewer 2 agrees to exclude as sample is outpatients	Excluded	N/A	Excluded			
Chappidi et al., 2016	Frailty as a marker of adverse outcomes in patients with bladder cancer undergoing radical cystectomy	x	x	x	N/A	Excluded	N/A	Excluded			
Charest-Morin et al., 2018	Frailty and sarcopenia do not predict adverse events in an elderly population undergoing non-complex primary elective surgery for degenerative conditions of the lumbar spine	?	✓	✓	All reviewers have agreed to contact the authors as per the contact author form to clarify if frailty assessment were conducted while patients were inpatients or during outpatient appointments	Contact authors	Yes - All reviewers have agreed to exclude as the author confirms that frailty status was calculated retrospectively from pre-operative consultations	Excluded			
Chen et al., 2015	Pre-surgical Geriatric Syndromes, Frailty, and Risks for Postoperative Delirium in Older Patients Undergoing Gastrointestinal Surgery: Prevalence and Red Flags	?	✓	✓	All reviewers agree to contact authors as per contact author form to clarify if the modified version of the Fried frailty phenotype criteria utilised has been validated	Contact authors	Yes - All reviewers have agreed to exclude as the modified version of the Fried frailty phenotype utilised has not been validated	Excluded			
Chen et al., 2014	Effects of a Modified Hospital Elder Life Program on Frailty in Individuals Undergoing Major Elective Abdominal Surgery	?	✓	✓	All reviewers have agreed to contact authors as per the contact author form. The fact that only participants with a score or 4 or above were classified as frail, while the Fried frailty phenotype actually classified a score of 3 greater as frail was initially missed by reviewer 2 and 3. Additionally reviewer 2 and 3 missed that this is additionally a modified version of the Fried frailty phenotype criteria, and clarification is needed as to whether this modified version has been validated.	Contact authors	Yes - Although study authors provided raw data to facilitate the former aspect of the inquiry, all reviewers have agreed to exclude as the modified version of the Fried frailty phenotype utilised has not been validated	Excluded			
Cheung et al., 2016	A prospective cohort study of older surgical inpatients examining the prevalence and implications of frailty: FP05	✓	✓	✓	N/A	Included	N/A	Included			
Chew et al., 2017	Impact of frailty and residual subsyndromal delirium on 1-year functional recovery: A prospective cohort study	✓	✓	✓	N/A	Included	N/A	Included			
Chia et al., 2016	'Start to finish trans-institutional transdisciplinary care': a novel approach improves colorectal surgical results in frail elderly patients	✓	x	x	Reviewer 2 and 3 have agreed to include study. Reviewer 2 initially excluded due to reporting specific morbidities. Reviewer 3 initially excluded as he missed the frailty tool used and prevalence reported	Included	N/A	Included			
Chong et al., 2010	Troponin I and NT-proBNP (N-terminal pro-Brain Natriuretic Peptide) Do Not Predict 6-Month Mortality in Frail Older Patients Undergoing Orthopedic Surgery	x	x	x	N/A	Excluded	N/A	Excluded			
Chong et al., 2017	Frailty and Risk of Adverse Outcomes in Hospitalized Older Adults: A Comparison of Different Frailty Measures	✓	✓	✓	N/A	Included	N/A	Included			
Chong et al., 2018	Frailty Predicts Incident Urinary Incontinence Among Hospitalized Older Adults—A 1-Year Prospective Cohort Study	x	✓	✓	All authors agree to exclude as this study consists of the same sample as Chong et al. 2017 - "*Frailty and Risk of Adverse Outcomes in Hospitalized Older Adults: A Comparison of Different Frailty Measures*", which reports all data within this present study, and additional data relevant to this review. This was initially missed by Reviewer 2 and Reviewer 3	Excluded	N/A	Excluded			
Chong et al., 2018	Frailty in Hospitalized Older Adults: Comparing Different Frailty Measures in Predicting Short- and Long-term Patient Outcomes	x	✓	✓	All authors have agreed to exclude as this study consists of the same sample as Chong et al. 2017 - "*Frailty and Risk of Adverse Outcomes in Hospitalized Older Adults: A Comparison of Different Frailty Measures*", which reports all data within this present study relevant to this review. As no difference exists in terms of the quantity of data relevant to the review, as Chong et al. 2017 was published first, this is the study included in the review. This was initially missed by Reviewer 2 and Reviewer 3	Excluded	N/A	Excluded			
Clegg et al., 2016	Development and validation of an electronic frailty index using routine primary care electronic health record data	x	x	x	N/A	Excluded	N/A	Excluded			

Clols et al., 2016	Care route of attention to chronicity in the high field and basin of Barbera. Results of the deployment of alternatives to conventional hospitalization in a regional hospital	?	x	x	All reviewers have agreed to contact authors as per contact author form. Reviewer 2 and 3 initially excluded having only read the abstract. All reviewers have agreed to attempt to obtain full text for screening as per the requirements of full text screening	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Cohen et al., 2002	Frailty as Determined by a Comprehensive Geriatric Assessment-Derived Deficit-Accumulation Index in Older Patients With Cancer Who Receive Chemotherapy	x	x	x	N/A	Excluded	N/A	Excluded			
Cohen et al., 2016	A controlled trial of inpatient and outpatient geriatric evaluation and management	x	x	x	N/A	Excluded	N/A	Excluded			
Coleman et al., 2012	Factors associated with 'caregiver burden' for atrial fibrillation patients	x	x	x	N/A	Excluded	N/A	Excluded			
Coleman et al., 2012	Outcomes among older people in a post-acute inpatient rehabilitation unit	?	x	x	All reviewers have agreed to contact authors as per contact author form. Reviewer 2 and 3 initially excluded due to the absence of information relating to the prevalence of frailty, however, now agree to contact authors to see if information exists in this regard	Contact authors	Yes - All reviewers have agreed to include as the authors were able to provide information regarding the prevalence of frailty	Included			
Colombo et al., 2010	Depressive symptoms: Prevalence and meaning in geriatric rehabilitation	?	?	x	All authors have agreed to contact authors as per contact author form. Reviewer 3 initially excluded after only screening abstract. All reviewers have agreed to attempt to obtain full text for screening as per the requirements of full text screening	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a full English text does not exist (full text only available in Italian)	Excluded			
Comin-Colet et al., 2016	Impact on clinical events and healthcare costs of adding telemedicine to multidisciplinary disease management programmes for heart failure: results of a randomized controlled trial	x	x	x	N/A	Excluded	N/A	Excluded			
Congiusta, Palvannan, Merchant, 2017	The Impact of Frailty on Morbidity and Mortality following Open Emergent Colectomies	x	x	x	N/A	Excluded	N/A	Excluded			
Connelly, Ullah, Moug, 2016	The prevalence of frailty, cognitive impairment, and delirium in an older acute surgical population	?	?	x	All reviewers have agreed to contact authors as per contact author form. Reviewer 3 initially excluded after only screening the abstract. All reviewers have agreed to attempt to obtain full text as per the requirements of full text screening	Contact authors	Yes - All reviewers have agreed to exclude as this meeting abstract relates to a subsequently published full text that is already included within the screening - Moug et al. 2016	Excluded			
Conroy et al., 2013	Understanding readmissions: An in-depth review of 50 patients readmitted back to an acute hospital within 30 days	?	x	✓	All reviewers agree to contact author as per contact author form	Contact authors	Yes - All reviewers have agreed to exclude as authors unable to provide information regarding the prevalence of frailty	Excluded			
Cooper et al., 2016	Comparison of Frailty Measures as Predictors of Outcomes After Orthopedic Surgery	✓	✓	x	Reviewer 1 and reviewer 2 have agreed with reviewer 3 to exclude the study due to the frailty assessment taking place during an outpatient appointment prior to admission. This was initially missed by reviewer 1 and 2	Excluded	N/A	Excluded			
Corcoran et al., 2017	Timely identification of frailty & comprehensive multidisciplinary assessment on a newly established specialist geriatric ward	?	?	x	All reviewers have agreed to contact authors as per the contact author form. Reviewer 3 initially excluded after only screening abstract. All reviewers have agreed to attempt to obtain the full text as per the requirements of full text screening	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Cornali et al., 2007	Lack of implementation of clinical Guidelines in a geriatric rehabilitation ward	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Cornali et al., 2009	Implementation of guidelines for type 2 diabetes mellitus in a post-acute geriatric setting	x	x	x	N/A	Excluded	N/A	Excluded			
Courtney-Brooks et al., 2012	Frailty: An outcome predictor for elderly gynecologic oncology patients	✓	x	✓	Included as reviewer 2 now agrees with the inclusion of patients with specific morbidities	Included	N/A	Included			
Crehan et al., 2013	A profile of elderly fallers referred for physiotherapy in the emergency department of a Dublin teaching hospital	?	?	✓	All three reviewers have agreed to contact authors to see if information exists related to the prevalence of frailty in the inpatient cohort of the sample	Contact authors	Yes - All reviewers have agreed to exclude as the study was not in hospital inpatients (emergency department patients)	Excluded			
Cron, D. C. et al., 2016	Depression and Frailty in Patients With End-Stage Liver Disease Referred for Transplant Evaluation	x	x	x	N/A	Excluded	N/A	Excluded			
Crotty et al., 2005	Transitional care facility for elderly people in hospital awaiting a long-term care bed: randomised controlled trial	x	?	x	All reviewers have agreed to exclude as a clearly defined and validated operational definition of frailty was not utilised. Reviewer 2 initially could not locate full text. Upon review all reviewers agree on exclusion	Excluded	N/A	Excluded			
Crozier-Shaw, Joyce, 2018	Too frail for surgery? A frailty index in major colorectal surgery	✓	?	✓	Reviewer 2 agrees to include. Initially could not find full text	Included	N/A	Included			
Cuijpers, Nelissen, Lenssen, 2004	Intra- and inter-rater reliability of the Dutch version of the Elderly Mobility Scale in the frail elderly	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that an English version of the full text does not exist	Excluded			
Curtin, O'Mahony, Gallagher, 2018	Drug consumption and futile medication prescribing in the last year of life: an observational study	?	✓	✓	All reviewers have agreed to contact the authors to enquire if information exists regarding the breakdown of the prevalence of frailty by the original Clinical Frailty Scale (CFS) category i.e., 1 - 3 Non-frail, 4 vulnerable, 5 + Frail. The fact that a non-validated adapted scoring criteria is reported within the study was initially missed by Reviewer 2 and 3	Contact authors	Yes - All reviewers have agreed to exclude as the authors were unable to provide information regarding the prevalence of frailty as per the original validated Clinical Frailty Scale scoring criteria	Excluded			
da Graça Oliveira Crossetti et al., 2018	Factors that contribute to a NANDA nursing diagnosis of risk for frail elderly syndrome	x	x	x	N/A	Excluded	N/A	Excluded			
Dahya et al., 2016	Computed tomography-derived skeletal muscle index: A novel predictor of frailty and hospital length of stay after transcatheter aortic valve replacement	?	x	x	All reviewers agree to contact the authors as per the contact author form. Initially reviewer 2 and 3 wished to exclude as the prevalence of frailty was not reported. All reviewers now agree to contact the authors to attempt to obtain information in this regard. Reviewer 3 also initially believed that an attempt was not made to recruit the entire clinical population, however upon review now agrees on inclusion based on this criteria as consecutive patients were recruited.	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Dal Moro et al., 2017	Frailty and elderly in urology: Is there an impact on post-operative complications?	✓	✓	✓	N/A	Included	N/A	Included			
Dalleur et al., 2014	Reduction of Potentially Inappropriate Medications Using the STOPP Criteria in Frail Older Inpatients: A Randomised Controlled Study	?	x	x	All reviewers agree to contact authors to see if information exists relating to the prevalence of frailty. Reviewer 2 and 3 initially wished to exclude due to the lack of information relating to the prevalence of frailty, however, now agree to contact authors as per contact author form	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that information is not available regarding the prevalence of frailty derived from the CGA	Excluded			
Dalleur et al., 2012	Inappropriate Prescribing and Related Hospital Admissions in Frail Older Persons According to the STOPP and START Criteria	?	x	x	All reviewers agree to contact authors to see if information exists relating to the prevalence of frailty. Reviewer 2 and reviewer 3 initially wished to exclude due to the lack of	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that information is not	Excluded			

					information relating to the prevalence of frailty, however, now agree to contact authors as per contact author form		available regarding the prevalence of frailty derived from the CGA				
Dana et al., 2017	Physical activity and frailty as indicators of cardiorespiratory reserve and predictors of surgical prognosis: General and digestive surgery population characterization	x	x	x	N/A	Excluded	N/A	Excluded			
Dawson et al., 2017	Is there a need for 'specialists' to become 'generalists'? a survey comparing hospital outcomes in older patients aged over 75 years who are managed by general physicians versus those aged over 80 years managed by older people's medicine physicians (OPM)	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a full text is not available related to this title, which was solely a poster presentation	Excluded			
De Alfieri et al., 2013	Thyroid Hormones as Predictors of Short- and Long-term Mortality in Very Old Hospitalized Patients	x	x	x	N/A	Excluded	N/A	Excluded			
de Asteasu et al., 2018	Multicomponent Exercise Program Effects On Functional Capacity And Cognition In Frail Hospitalized Patients: 1008 Board #269 May 30 3: 30 PM - 5: 00 PM	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a full text does not exists (solely poster presentation)	Excluded			
de Gelder et al., 2017	Optimising the ISAR-HP to screen efficiently for functional decline in older patients	x	x	x	N/A	Excluded	N/A	Excluded			
De Jonge et al., 2014	Effects of Home-Based Primary Care on Medicare Costs in High-Risk Elders	x	x	x	N/A	Excluded	N/A	Excluded			
De Saint-Hubert et al., 2009	Risk factors predicting later functional decline in older hospitalized patients	x	x	x	N/A	Excluded	N/A	Excluded			
de Souza, Fabiana, Dutra, 2014	Assessment of the frailty level of elderly people with chronic kidney disease undergoing hemodialysis	x	x	x	N/A	Excluded	N/A	Excluded			
Delgado et al., 2015	Association of Self-Reported Frailty with Falls and Fractures among Patients New to Dialysis	x	x	x	N/A	Excluded	N/A	Excluded			
Della Pepa et al., 2017	Predictive Comprehensive Geriatric Assessment in elderly prostate cancer patients: the prospective observational scoop trial results	x	x	✓	All reviewers have agreed to exclude as participants are outpatients. Reviewer 3 initially missed this	Excluded	N/A	Excluded			
Demircioglu, 2018	The Association of Vitamin D Levels and the Frailty Phenotype Among Non-geriatric Dialysis Patients: A Cross-sectional Study	x	x	x	N/A	Excluded	N/A	Excluded			
Denewet et al., 2016	Comprehensive geriatric assessment and comorbidities predict survival in geriatric oncology	x	x	x	N/A	Excluded	N/A	Excluded			
Denoël et al., 2014	Could some geriatric characteristics hinder the prescription of anticoagulants in atrial fibrillation in the elderly?	x	x	x	N/A	Excluded	N/A	Excluded			
Dent et al., 2017	Frailty and usage of health care systems: Results from the South Australian Monitoring and Surveillance System (SAMSS)	x	x	x	N/A	Excluded	N/A	Excluded			
Dent, Hoogendijk, 2014	Psychosocial factors modify the association of frailty with adverse outcomes: a prospective study of hospitalised older people	x	✓	✓	All reviewers have agreed to exclude as this study consists of the same sample as *Dent et al. 2015 - Frailty and functional decline indices predict poor outcomes in hospitalised older patients*, which provides more information on this sample relevant to this review. The fact that these two studies consist of the same sample was initially missed by Reviewer 2 and Reviewer 3	Excluded	N/A	Excluded			
Dent et al., 2012	Use of the mini nutritional assessment to detect frailty in hospitalised older people	x	✓	✓	All reviewers have agreed to exclude as this study consists of the same sample as *Dent et al. 2015 - Frailty and functional decline indices predict poor outcomes in hospitalised older patients*, (albeit a reduced cohort as data collection was still on-going at the time of publication) which provides more information on this sample relevant to this review. The fact that these two studies consist of the same sample was initially missed by Reviewer 2 and Reviewer 3	Excluded	N/A	Excluded			
Dent et al., 2014	Frailty and functional decline indices predict poor outcomes in hospitalised older people	✓	✓	✓	N/A	Included	N/A	Included			
Dent et al., 2018	Nutritional screening and dietitian consultation rates in a geriatric evaluation and management unit	x	✓	✓	All reviewers have agreed to exclude as this study consists of the same sample as *Dent et al. 2015 - Frailty and functional decline indices predict poor outcomes in hospitalised older patients*, which provides more information on this sample relevant to this review. The fact that these two studies consist of the same sample was initially missed by Reviewer 2 and Reviewer 3	Excluded	N/A	Excluded			
Des Guetz et al., 2010	Cohort study of elderly patients with surgically removed colorectal cancers	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Dhaussy et al., 2012	Is Health-Related Quality of Life an Independent Prognostic Factor for 12-Month Mortality and Nursing Home Placement Among Elderly Patients Hospitalized via the Emergency Department?	x	x	x	N/A	Excluded	N/A	Excluded			
Diaz, Nazzal, Verdejo, 2016	Frailty in heart failure: prevalence and factors associated in elderly patients hospitalized in Santiago, Chile	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Diaz-Toro et al., 2017	Frailty in patients admitted to hospital with acute decompensated heart failure	x	x	?	Reviewer 3 initially could not locate full text in English, upon review all reviewers agreed to exclude due to the minimum age of participants being < 65	Excluded	N/A	Excluded			
Dinescu, Korc-Grodzicki, Ross, 2010	Discharge Location Disagreements and Re-hospitalization Risk among Frail, Elderly Adults.: B114	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as upon review of the full text a clearly defined and validated operational definition was not utilised for the classification of frailty, the prevalence of frailty was not reported, and it was not clear if the minimum age of participants was ≥ 65 years	Excluded			

Dodson et al., 2016	Slow Gait Speed and Risk of Mortality or Hospital Readmission after Myocardial Infarction in the Translational Research Investigating Underlying Disparities in Recovery from Acute Myocardial Infarction: Patients' Health Status Registry	x	x	x	N/A	Excluded	N/A	Excluded			
Dodson et al., 2017	Abstract 15096: The Association of Frailty With In-Hospital Bleeding Among Older Adults With Acute Myocardial Infarction: Insights From the Action Registry-GWTG	?	✓	?	Reviewer 2 initially included after only screening abstract. All reviewers have agreed to obtain full text as per the requirements of full text screening. Reviewer 3 initially wished to contact authors to request full text. Reviewer 1 was able to locate full text. Upon review all reviewers have agreed to contact the authors to confirm if the operational definition utilised for the classification of frailty has been validated	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that the operational definition of frailty utilised has not been validated	Excluded			
Donini et al., 2005	Comorbidity, frailty, and evolution of pressure ulcers in geriatrics	x	x	x	N/A	Excluded	N/A	Excluded			
Donini et al., 2009	Predicting the outcome of artificial nutrition by clinical and functional indices	x	x	x	N/A	Excluded	N/A	Excluded			
Dorner et al., 2013	Nutritional intervention and physical training in malnourished frail community-dwelling elderly persons carried out by trained lay "buddies": study protocol of a randomized controlled trial	✓	x	?	Excluded as a protocol. Reviewer 1 initially included as conflated this with the pre-study of this protocol within the protocol incorrectly. All reviewers have agreed to contact authors to see if the study has since been published or if preliminary data exists in the form of a full text which can be screened for eligibility	Contact authors	Unfortunately, a response to inquiry was not received from either of the contacted authors. However, the reviewers were subsequently successful in locating the full results manuscript for this protocol manuscript. Upon title and abstract, and subsequent full text screening all reviewers agree that the results manuscript of this study is eligible for inclusion within the review	Included			
dos Santos Tavares et al., 2015	Association of socioeconomic and clinical variables with the state of frailty among older inpatients	x	x	x	N/A	Excluded	N/A	Excluded			
Drks, 2017	Patient safety, cost-effectiveness, and quality of life: reduction of delirium risk and post-operative cognitive dysfunction (POCD) after elective procedures in the elderly	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a full text does not presently exist related to this title	Excluded			
Drudi et al., 2018	Association of Depression With Mortality in Older Adults Undergoing Transcatheter or Surgical Aortic Valve Replacement	?	✓	✓	All reviewers have agreed to contact authors to confirm patients were inpatients during the assessments as per author contact form	Contact authors	yes - All reviewers have agreed to include as the authors have confirmed that all participants were inpatients at the time of frailty assessment	Included			
Drudi et al., 2016	Effect of Comorbid Peripheral Arterial Disease on the Prevalence and Prognostic Impact of Physical Frailty in Transcatheter and Surgical Aortic Valve Replacement: IP163	?	?	?	N/A	Contact authors	Yes - The authors have confirmed that published full text related to this data does not presently exists	Excluded			
Drudi et al., 2017	Depression in older adults undergoing interventions for peripheral arterial disease	?	?	?	N/A	Contact authors	Yes - The authors have confirmed that a published full text related to this data does not presently exist	Excluded			
Drumm et al., 2017	Integrated Healthcare for the Frail Older Adult	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a full text is not available (only poster for oral presentation)	Excluded			
Du et al., 2014	Sarcopenia is a predictor of outcomes in very elderly patients undergoing emergency surgery	x	x	x	N/A	Excluded	N/A	Excluded			
Dunphy et al., 2017	Designing an integrated care pathway for falls prevention in University Hospital Waterford	?	?	?	N/A	Contact authors	yes - All reviewers have agreed to exclude as the authors have confirmed that a published full text related to this title does not exist, and furthermore that the sample comprised entirely of hospital outpatients	Excluded			
Dutta et al., 2015	32EVALUATION OF AN IN-REACH SINGLE COMPREHENSIVE GERIATRIC ENCOUNTER IN FRAIL OLDER PEOPLE ADMITTED TO AN ACUTE ADMISSIONS UNIT	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a full text does not exist (solely poster presentation)	Excluded			
Dutzi et al., 2017	Cognitive Change in Rehabilitation Patients with Dementia: Prevalence and Association with Rehabilitation Success	?	✓	✓	All reviewers have agreed to contact authors related to the prevalence of frailty (study only reports median)	Contact authors	Yes - All reviewers have agreed to include as the author was able to provide data relating to the prevalence of frailty within the sample	Included			
Dziewierz et al., 2018	Impact of chronic obstructive pulmonary disease and frailty on long-term outcomes and quality of life after transcatheter aortic valve implantation	?	✓	✓	All reviewers have agreed to contact authors to confirm the minimum age of participant and that frailty assessments were performed while patients were inpatients, as per author contact form	Contact authors	Yes - All reviewers have agreed to exclude as although the authors have confirmed that patients were inpatients at the time of frailty assessments, authors have also confirmed that the minimum age of participants was < 65 years	Excluded			
Eagles et al., 2017	Timed Up and Go predicts functional decline in older patients presenting to the emergency department following minor trauma	x	x	x	N/A	Excluded	N/A	Excluded			
Eamer et al., 2018	Analysis of post discharge costs following emergent general surgery in elderly patients	✓	✓	x	Reviewer 3 has agreed to include. Initially excluded as he believed frailty assessment was conducted as outpatients prior to admission based on misinterpretation of phrase.	Included	N/A	Included			
Ebrahimi et al., 2017	Effects of a continuum of care intervention on frail elders' self-rated health, experiences of security/safety and symptoms: A randomised controlled trial	✓	x	x	Reviewer has agreed to excluded as sample is not reflective of the entire ward or random. This was initially missed by reviewer 1.	Excluded	N/A	Excluded			
Eeles et al., 2012	The impact of frailty and delirium on mortality in older inpatients	✓	✓	✓	N/A	Included	N/A	Included			
Ekerstad et al., 2017	Early rehospitalizations of frail elderly patients - the role of medications: a clinical, prospective, observational trial	?	✓	x	Reviewers have agreed to contact authors as per contact author form	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Ekerstad et al., 2017	Acute care of severely frail elderly patients in a CGA-unit is associated with less functional decline than conventional acute care	?	✓	✓	Reviewers have agreed to contact authors to see if data exists relating to the prevalence of frailty of all those initially screened as per contact author form	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Ekerstad et al., 2018	Hospitalized frail elderly patients - atrial fibrillation, anticoagulation, and 12 months' outcomes	?	✓	✓	Reviewers agree to contact authors as per author contact form	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the	Excluded			

							contacted authors. As such there remains insufficient data in this regard to facilitate inclusion				
Ekerstad et al., 2018	Frailty as an instrument for evaluation of elderly patients with non-ST-segment elevation myocardial infarction: A follow-up after more than 5 years	x	✓	✓	All authors have agreed to exclude as this study consists of the same data as Ekerstad et al. 2018 - Frailty as an instrument for evaluation of elderly patients with non-ST-segment elevation myocardial infarction: A follow-up after more than 5 years. Both studies report the exact same data related to this sample relevant to this review, however as Ekerstad et al. 2011 was published first this is the study included in the review. This was initially missed by Reviewer 2 and Reviewer 3	Excluded	N/A	Excluded			
Ekerstad et al., 2011	Frailty Is Independently Associated With Short-Term Outcomes for Elderly Patients With Non-ST-Segment Elevation Myocardial Infarction	✓	✓	✓	N/A	Included	N/A	Included			
Eklund et al., 2013	One-year outcome of frailty indicators and activities of daily living following the randomised controlled trial: "Continuum of care for frail older people"	?	x	x	All reviewers have agreed to exclude as participants were not inpatients. This was initially missed by reviewer 1	Excluded	N/A	Excluded			
El-Hayeck et al., 2015	Geriatric profile according to the Identification of Seniors At Risk (ISAR) tool in the emergency department in a teaching hospital	?	?	x	Reviewer 3 initially excluded as he could not locate the full English text. All reviewers have now agreed to contact study authors to attempt to obtain full text	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a full English text is not available (article only available in French)	Excluded			
Elias, 2018	The Relationship between Sleep Quality and Motor Function in Hospitalized Older Adult Survivors of Critical Illness	?	x	?	All reviewers have agreed to contact authors as per contact author form. Reviewer 2 initially excluded as the full text was not available. All authors have now agreed to contact the authors to attempt to locate full text	Contact authors	Yes - All reviewers have agreed to exclude. The authors have confirmed that a published full text is not presently available regarding this data (in press awaiting publication), however were able to provide the PhD thesis containing these data, which allowed the reviewers to confirm that a validated operational definition for the classification of frailty was not utilised	Excluded			
El-Sharkawy et al., 2015	Hydration and outcome in older patients admitted to hospital (The HOOP prospective cohort study)	?	x	x	All reviewers have agreed to contact authors as per the contact author form. Reviewer 2 initially excluded as he believed there was bias in the recruitment of participants, however upon review all reviewers agree this is not the case. Reviewer 3 initially excluded due to the lack of information relating to the prevalence of frailty. All reviewers now agree to contact authors to see if information exists relating to the prevalence of frailty	Contact authors	Yes - All reviewers have agreed to exclude as unfortunately, despite an initial response, the authors were unable to provide these data	Excluded			
Engelhardt et al., 2018	Frailty screening and a frailty pathway decrease length of stay, loss of independence, and 30-day readmission rates in frail geriatric trauma and emergency general surgery patients	✓	✓	✓	N/A	Included	N/A	Included			
Enguidanos, Gibbs, 2008	Improving Hospital Transition to Home among Frail Older Adults: Results of a Pilot Project: B100	?	?	x	Reviewer 3 initially excluded due to reading the wrong study. All reviewers now agree to contact study authors to attempt to obtain the full text	Contact authors	Yes - All reviewers have agreed to exclude as upon review of the full text provided by the authors, as the minimum age of participants was < 65 years, the study did not utilise a clearly defined and validation operational definition for the classification of frailty, did not report the prevalence of frailty	Excluded			
Enrique et al., 2015	Cost of patients care with fragility syndrome vs. Pre-frailty patients	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a full English text does not exist	Excluded			
Erekson et al., 2015	Frailty, cognitive impairment, and functional disability in older women with female pelvic floor dysfunction	x	x	x	N/A	Excluded	N/A	Excluded			
Esbrí-Víctor et al., 2017	Frailty and Fear of Falling: The FISTAC Study	?	✓	x	Contact authors as per author contact form	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that the sample consisted entirely of outpatients	Excluded			
Espaulella et al., 2007	Time-dependent prognostic factors of 6-month mortality in frail elderly patients admitted to post-acute care	x	x	x	N/A	Excluded	N/A	Excluded			
Ettinger et al., 1993	Management of elderly patients in the private practice system	x	?	x	Reviewer 2 initially could not locate the full text. Upon review all reviewers have agreed to exclude on the basis that the paper is a review article	Excluded	N/A	Excluded			
Evans et al., 2014	The risk of adverse outcomes in hospitalized older patients in relation to a frailty index based on a comprehensive geriatric assessment	?	✓	✓	All reviewers agree to contact authors as per contact author form to request information regarding the prevalence of frailty. The fact that it is not stated within the paper was initially missed by reviewer 2 and 3	Contact authors	Yes - All reviewers have agreed to exclude as the authors were unable to provide information relating to the prevalence of frailty	Excluded			
Experton et al., 1997	The impact of payor/provider type on health care use and expenditures among the frail elderly	x	x	x	N/A	Excluded	N/A	Excluded			
Eyigor et al., 2015	Frailty prevalence and related factors in the older adult—FrailTURK Project	x	x	x	N/A	Excluded	N/A	Excluded			
Fallon et al., 2015	Characteristics and Outcomes of Older Patients Attending an Acute Medical Assessment Unit	x	x	x	N/A	Excluded	N/A	Excluded			
Fallon et al., 2018	Screening for frailty in older emergency department patients: The utility of the Survey of Health, Ageing and Retirement in Europe Frailty Instrument	x	x	✓	All authors have agreed to excluded as frailty assessments were conducted while participants were not hospital in-patients. This was initially missed by reviewer 3, who initially classified the patients in the emergency departments inpatients	Excluded	N/A	Excluded			
Fattori et al., 2014	Cluster analysis to identify elderly people's profiles: A healthcare strategy based on frailty characteristics	x	x	x	N/A	Excluded	N/A	Excluded			

Fattori et al., 2014	Cluster analysis to identify elderly people's profiles: A healthcare strategy based on frailty characteristics	x	x	x	N/A	Excluded	N/A	Excluded			
Ferguson et al., 2017	Multi-morbidity, frailty, and self-care: important considerations in treatment with anticoagulation drugs. Outcomes of the AFASTER study	x	x	x	N/A	Excluded	N/A	Excluded			

Ferrat et al., 2017	Performance of Four Frailty Classifications in Older Patients With Cancer: Prospective Elderly Cancer Patients Cohort Study	✓	x	x	All reviewers have agreed to contacts to confirm if participants were inpatients or if a sub-group of participants were inpatients. Reviewer 2 and 3 initially excluded as they believed all participants were outpatients	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Ferrero et al., 2017	Ovarian Cancer in Elderly Patients Patterns of Care and Treatment Outcomes According to Age and Modified Frailty Index	✓	✓	✓	N/A	Included	N/A	Included			
Fisher et al., 2015	Predicting intensive care and hospital outcome with the Dalhousie clinical frailty scale: A pilot assessment	?	?	✓	All reviewers have agreed to exclude as minimum age is < 65. This was initially overlooked by reviewer 3. Reviewer 1 (PD) and reviewer 2 (JA) initially could not find full text, however upon review of full text have both agreed to exclude due to minimum age being < 65	Excluded	N/A	Excluded			
Flexman et al., 2016	Frailty and postoperative outcomes in patients undergoing surgery for degenerative spine disease	x	?	x	Reviewer 2 initially wished to confirm if all participants were inpatients. Upon review all reviewers have agreed to exclude due to the minimum age being < 65	Excluded	N/A	Excluded			
Flood et al., 2006	Geriatric syndromes in elderly patients admitted to an oncology-acute care for elders unit	x	?	x	Initially reviewer 2 could not find the full text. Upon review all reviewers have agreed to exclude as a validated operational definition for the classification of frailty was not used	Excluded	N/A	Excluded			
Folbert et al., 2017	Improved 1-year mortality in elderly patients with a hip fracture following integrated orthogeriatric treatment	?	✓	x	All reviewers agree to contact the author to determine if the frailty tool utilised has been validated. If validated study is included	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that the frailty tool utilised is not validated.	Excluded			
Fougère et al., 2017	Association Between Frailty and Cognitive Impairment: Cross-Sectional Data From Toulouse Frailty Day Hospital	x	x	x	N/A	Excluded	N/A	Excluded			
Franchini et al., 2016	Integrated information for integrated care in the general practice setting in Italy: using social network analysis to go beyond the diagnosis of frailty in the elderly	x	x	x	N/A	Excluded	N/A	Excluded			
Frew, Sequeira, Cant, 2010	Nutrition screening process for patients in an acute public hospital servicing an elderly, culturally diverse population	x	✓	x	Reviewer 2 has agreed to excluded due to minimum age being < 65	Excluded	N/A	Excluded			
Frisoli et al., 2015	Frailty predictors and outcomes among older patients with cardiovascular disease: Data from Fragicor	x	x	x	N/A	Excluded	N/A	Excluded			
Fukui et al., 2016	Physical frailty in older people with severe aortic stenosis	x	✓	x	All reviewers have agreed to contact authors to confirm the patient (in-patient or outpatient) status of participants	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that frailty assessments were conducted during preoperative outpatient appointments	Excluded			
Fumagalli et al., 2010	Atrial fibrillation is a possible marker of frailty in hospitalized patients: Results of the GIFA Study	x	x	x	N/A	Excluded	N/A	Excluded			
Fumagalli et al., 2010	Atrial fibrillation: Still a benign condition in the elderly?	x	x	x	N/A	Excluded	N/A	Excluded			
Furukawa et al., 2018	Initial clinical evaluation of preoperative frailty in surgical patients with Stanford type A acute aortic dissection	x	x	x	N/A	Excluded	N/A	Excluded			
Ga, Won, Jung, 2018	Use of the Frailty Index and FRAIL-NH Scale for the Assessment of the Frailty Status of Elderly Individuals Admitted in a Long-term Care Hospital in Korea	✓	✓	✓	N/A	Included	N/A	Included			
Gaertner et al., 2012	Recommending early integration of palliative care - Does it work?	x	x	x	N/A	Excluded	N/A	Excluded			
Gaffney et al., 2018	246Use of The 'Surprise Question' in Predicting Adverse Outcomes Among Frail Older Patients after Hospital Admission	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that participants were not hospital inpatients at the time of frailty assessment.	Excluded			
Galizia et al., 2011	Role of clinical frailty on long-term mortality of elderly subjects with and without chronic obstructive pulmonary disease	x	x	x	N/A	Excluded	N/A	Excluded			
Gambassi et al., 2000	Management of heart failure among very old persons living in long-term care: Has the voice of trials spread?	x	x	x	N/A	Excluded	N/A	Excluded			
Ganapathi et al., 2014	Frailty and risk in proximal aortic surgery	x	x	x	N/A	Excluded	N/A	Excluded			
Garcia-Molina et al., 2018	Benefits of a multicomponent Falls Unit-based exercise program in older adults with falls in real life	x	x	x	N/A	Excluded	N/A	Excluded			
García-Nogueras et al., 2017	Use of health resources and healthcare costs associated with frailty: The FRADEA study	x	x	x	N/A	Excluded	N/A	Excluded			
Gardiner et al., 2013	Palliative care for frail older people: A crosssectional survey of patients at two hospitals in England	?	x	x	All reviewers have agreed to contact the study authors as per the contact author form to clarify if the operation definition of frailty used has been validated. Reviewer 2 and reviewer 3 initially excluded as they believed that the operational definition was not validated, however have now agreed to contact authors for clarification	Contact authors	Yes - All reviewers have agreed to exclude as the operational definition of frailty utilised has not been validated within this population	Excluded			
Garrido et al., 2012	Differences in the expression of the frailty syndrome in institutionalized elderly men and women with no severe cognitive decline	?	x	x	All reviewers have agreed to exclude upon review of the full text. Reviewer 1 initially could not locate the full text. The reasons for exclusion were a minimum age < 65, and not occurring in a hospital setting in hospital inpatients	Excluded	N/A	Excluded			
Gellis et al., 2014	Integrated Telehealth Care for Chronic Illness and Depression in Geriatric Home Care Patients: The Integrated Telehealth Education and Activation of Mood (I-TEAM) Study	x	x	x	N/A	Excluded	N/A	Excluded			
Gerrior, Pickles, Florent, 2015	Optimizing Renal Care of the Frail Elderly in a Satellite Dialysis Unit	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to fa	Excluded			

Gharacholou et al., 2015	Echocardiographic Indices Associated With Frailty in Adults >= 65 Years	?	x	x	All reviewers have agreed to contact authors as per contact author form. Reviewer 2 and 3 initially excluded as they believed that participants were outpatients. Reviewer 1 also believes that this is likely but wanted to contact authors for confirmation.	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to fa	Excluded			
Giantin et al., 2018	Performance of the Multidimensional Geriatric Assessment and Multidimensional Prognostic Index in predicting negative outcomes in older adults with cancer	?	✓	✓	All reviewers have agreed this is likely excluded due to participant being outpatients, however reviewer 1 would like to email authors first to be fully certain.	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to fa	Excluded			
Gilden et al., 2015	Diagnostic Pathways to Alzheimer Disease Costs Incurred in a Medicare Population	x	x	x	N/A	Excluded	N/A	Excluded			
Gill et al., 2004	Hospitalization, restricted activity, and the development of disability among older persons	x	x	x	N/A	Excluded	N/A	Excluded			
Gill et al., 2015	The role of intervening hospital admissions on trajectories of disability in the last year of life: prospective cohort study of older people	x	x	x	N/A	Excluded	N/A	Excluded			
Girones, Torregrosa, Diaz-Beveridge, 2010	Comorbidity, disability and geriatric syndromes in elderly breast cancer survivors. Results of a single-center experience	x	x	x	N/A	Excluded	N/A	Excluded			
Girones et al., 2012	Comprehensive Geriatric Assessment (CGA) of elderly lung cancer patients: A single-center experience	x	x	x	N/A	Excluded	N/A	Excluded			
Giroux et al., 2018	FRAILTY ASSESSMENT TO HELP PREDICT PATIENTS AT RISK OF DELIRIUMWHEN CONSULTING THE EMERGENCY DEPARTMENT	✓	x	✓	Reviewer 2 initially excluded as participants were assessed for frailty before they were technically inpatients in the emergency department. This was initially missed by Reviewer 1 and 2. All reviewers have now agreed to exclude the study as frailty assessments were conducted prior to the participants being inpatients	Excluded	N/A	Excluded			
Gladman, Forster, Young, 1995	Hospital- and home-based rehabilitation after discharge from hospital for stroke patients: analysis of two trials	x	x	x	N/A	Excluded	N/A	Excluded			
Glajchen et al., 2011	A rapid two-stage screening protocol for palliative care in the emergency department: a quality improvement initiative	x	x	x	N/A	Excluded	N/A	Excluded			
Gleason et al., 2017	FRAIL Questionnaire Screening Tool and Short-Term Outcomes in Geriatric Fracture Patients	✓	✓	✓	N/A	Included	N/A	Included			
Glover et al., 2014	Diagnoses, problems and healthcare interventions amongst older people with an unscheduled hospital admission who have concurrent mental health problems: A prevalence study	x	x	x	N/A	Excluded	N/A	Excluded			
Goeteyn et al., 2017	Frailty as a predictor of mortality in the elderly emergency general surgery patient	?	✓	✓	All reviewers have agreed to contact the study authors as per the contact author form, to clarify conflicting information reported within the paper regarding the prevalence of frailty. This conflict was initially missed by Reviewer 2 and Reviewer 3	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to fa	Excluded			
Goldfarb et al., 2016	Abstract 17008: Increased Cost of Cardiac Surgery in Frail Compared to Non-frail Older Adults	x	x	?	All reviewers have agreed to exclude as the minimum age is < 65. Reviewer 3 initially could not find the full text	Excluded	N/A	Excluded			
Goldfarb et al., 2018	Malnutrition and Mortality in Frail and Non-Frail Older Adults Undergoing Aortic Valve Replacement	✓	✓	✓	N/A	Included	N/A	Included			
Gonzalez-Moneo et al., 2016	Ischemic aetiology, self-reported frailty, and gender with respect to cognitive impairment in chronic heart failure patients	x	x	x	N/A	Excluded	N/A	Excluded			
Gonzalez-Vaca et al., 2014	Frailty in INstitutionalized older adults from ALbacete. The FINAL Study: Rationale, design, methodology, prevalence and attributes	x	x	x	N/A	Excluded	N/A	Excluded			
Gorelik et al., 2014	Frailty syndrome and main geriatric syndromes in surgical clinical picture	x	x	x	N/A	Excluded	N/A	Excluded			
Gormley, Moore, 2018	154Pilot of a Frail Intervention Therapy Team (FITT) in Emergency Department at Cavan General Hospital	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to fa	Excluded			
Graverholt et al., 2013	Acute hospital admissions from nursing homes: Predictors of unwarranted variation?	x	x	x	N/A	Excluded	N/A	Excluded			
Gray et al., 2007	THE INTERRAI ACUTE CARE: A NEW STRUCTURED ASSESSMENT METHODOLOGY FOR THE FRAIL ELDERLY IN HOSPITAL: P01	?	x	x	All reviewers have agreed to contact the study authors as per the contact author form to attempt to obtain the full text. Review 2 and 3 initially excluded before review of the full text. All reviewers now agree to review full text as per the requirements of full text screening	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a clearly defined and validated operational definition for the classification of frailty was not utilised	Excluded			
Gray, 2007	Context for WOC Practice: Ostomy Research, Incontinence in Frail Elders, Surgical and Traumatic Wounds	x	x	x	N/A	Excluded	N/A	Excluded			
Green, Teale, 2017	A cluster, randomised feasibility study of the prevention of delirium (POD) programme for elderly patients admitted to hospital	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a full text does not exist related to this abstract	Excluded			
Green et al., 2016	Frailty in intermediate risk patients undergoing transcatheter or surgical aortic valve replacement, cut points and relationship with outcomes: an analysis of the placement of aortic transcatheter valves (PARTNER) 2 cohort a randomized trial	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Green et al., 2015	Relation of frailty to outcomes after transcatheter aortic valve replacement (from the PARTNER trial)	✓	x	✓	Author have agreed this study is likely excluded due to the lack of a validated frailty assessment tool. However, all reviewers have also agreed to contact the author to see if the tool has been validated since this publication.	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			

Gregersen, Borris, Damsgaard, 2015	Blood Transfusion and Overall Quality of Life After Hip Fracture in Frail Elderly Patients--The Transfusion Requirements in Frail Elderly Randomized Controlled Trial	?	x	x	All reviewers have agreed to contact authors as per contact author form to see if information exists relating to the prevalence of frailty. Reviewer 3 initially excluded due to the belief that participants were outpatients, however upon review this was not the case, and all reviewers now agree to contact authors as per contact author form.	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that the operational definition utilised for the classification of frailty is not validated	Excluded			
Gregorevic et al., 2018	Do health assets have a protective effect for hospitalized frail older adults?	?	✓	✓	All reviewers have agreed to contact author to see if information exists relating to the prevalence of frailty. Initially included by Reviewer 2 and 3. Reports mean but not prevalence	Contact authors	Yes - All authors have agreed to exclude as the authors were unable to provide data regarding the prevalence of frailty of the sample. The authors however did provide another paper to the reviewers which used the same dataset and focused on frailty; however, this study also did not report the prevalence of frailty. The corresponding author for this paper was also contacted by the reviewers, however, no reply was received	Excluded			
Gregorevic et al., 2016	The clinical frailty scale predicts functional decline and mortality when used by junior medical staff: a prospective cohort study	?	✓	✓	All reviewers agree to contact authors to see if information exists regarding the number of participants with a CFS score of 4 (vulnerable). The fact that this was not expressly stated was initially missed by Reviewer 2 and Reviewer 3	Contact authors	Yes - All reviewers have agreed to exclude as the authors were unable to provide information regarding the specific number of participants with a CFS score of 4 (vulnerable), as such it was not possible to determine the prevalence of frailty due to the inability to differentiate between those who were classified as vulnerable and those who were classified as frail	Excluded			
Gregson et al., 1997	Issues of recruitment and maintaining high response rates in a longitudinal study of older hospital patients in England - pathways through care study	x	x	x	N/A	Excluded	N/A	Excluded			
Griebling, 2014	Re: Too Frail for Surgery? Initial Results of a Large Multidisciplinary Prospective Study Examining Preoperative Variables Predictive of Poor Surgical Outcomes	x	x	x	N/A	Excluded	N/A	Excluded			
Griffin, Yared, Ray, 2000	Nonsteroidal antiinflammatory drugs and acute renal failure in elderly persons	x	x	x	N/A	Excluded	N/A	Excluded			
Grivaux et al., 2016	Early mortality in lung cancer: French prospective multicentre observational study	x	x	x	N/A	Excluded	N/A	Excluded			
Grube et al., 2017	Clinical Outcomes With a Repositionable Self-Expanding Transcatheter Aortic Valve Prosthesis: The International FORWARD Study	?	x	x	Reviewer 2 and reviewer 3 initially excluded study due to the fact that it was group of patient with a specific morbidity across multiple wards. All reviewers have agreed that specific morbidity can also be used as the functional unit through which to assess the frailty of inpatients in addition to traditional wards, provided all patients with that condition are assessed, attempted to be assessed or some form of randomised selection is employed. Patients with specific morbidities represent a sub section of the ward. Review 1 however was unsure if that operational definition utilised for the classification of frailty within the study had been validated and wished to contact the study authors for clarification. Upon review all reviewers agree that this operational definition of frailty has not been validated. All reviewers agree on exclusion	Excluded	N/A	Excluded			
Gruenewald et al., 2009	Allostatic load and frailty in older adults	x	x	x	N/A	Excluded	N/A	Excluded			
Guerrero-García et al., 2016	Frailty in the elderly and nutritional status according to the Mini Nutritional Assessment	?	?	x	All reviewers have agreed to contact the study authors as per the contact author form to attempt to obtain the full text in English. Initially reviewer 3 excluded after only screening the abstract. All reviewers have now agreed to contact authors for full text to attempt to screen full text as per the requirements of full text screening	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Guidet et al., 2018	Withholding or withdrawing of life-sustaining therapy in older adults (≥ 80 years) admitted to the intensive care unit	?	✓	✓	All authors have agreed to contact authors as per author contact form. Initially included by reviewer 2 and 3, but only reported median frailty, not prevalence.	Contact authors	Yes - All reviewers have agreed to include as the authors were able to provide information regarding the prevalence of frailty	Included			
Gullon et al., 2018	Baseline functional status as the strongest predictor of in-hospital mortality in elderly patients with non-valvular atrial fibrillation: Results of the NONAVASC registry	✓	✓	✓	N/A	Included	N/A	Included			
Gunaratna, Limaye, 2014	51 RECOGNITION OF HOSPITALISED PATIENTS LIKELY TO DIE WITHIN 30 DAYS OF HOSPITAL DISCHARGE - ARE WE MISSING OPPORTUNITIES TO COMMUNICATE END OF LIFE AND ADVANCE CARE PLANNING DECISIONS TO PRIMARY CARE?	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Haley, Wells, Holland, 2014	Relationship between frailty and discharge outcomes in subacute care	x	x	x	N/A	Excluded	N/A	Excluded			
Hall et al., 2017	Development and Initial Validation of the Risk Analysis Index for Measuring Frailty in Surgical Populations	x	x	x	N/A	Excluded	N/A	Excluded			
Hall et al., 2017	Association of a Frailty Screening Initiative With Postoperative Survival at 30, 180, and 365 Days	x	x	x	N/A	Excluded	N/A	Excluded			
Halpert, Pearson, Reina, 1999	Direct admission to an extended-care facility from the emergency department	?	x	x	All reviewers have agreed to contact authors to attempt to obtain the full text. Reviewer 2 and reviewer 3 excluded after only screening the abstract. All reviewers have agreed to attempt to obtain the full text from the study authors as per the pre-defined requirements of full text screening	Contact authors	Yes - All reviewers have agreed to exclude as the authors were unable to provide a full text related to this abstract	Excluded			
Hamano, Oishi, Kizawa, 2018	Identified palliative care approach needs with SPICT in family practice: A preliminary observational study	x	x	x	N/A	Excluded	N/A	Excluded			
Han Ting et al., 2018	Frailty as a predictor of hospital length of stay after elective total joint replacements in elderly patients	x	x	x	N/A	Excluded	N/A	Excluded			
Handforth et al., 2015	The prevalence and outcomes of frailty in older cancer patients: a systematic review	x	x	x	N/A	Excluded	N/A	Excluded			
Hanlon et al., 2004	Inappropriate Medication Use among Frail Elderly Inpatients	?	x	x	All reviewers have agreed to contact authors as per the contact author form. Reviewer 2 and reviewer 3 initially excluded due to the lack of information provided regarding the prevalence of frailty. All reviewers now agree to contact	Contact authors	Yes -- All reviewers have agreed to exclude as the authors have confirmed that this study is a sub-study already excluded during the full text screening as a clearly defined and validated	Excluded			

					the authors to see if information relating to the prevalence of frailty exists		operational definition for the classification of frailty was not utilised (Cohen et al. 2002)				
Hansen et al., 2012	Ingestive Skill Difficulties are Frequent Among Acutely-Hospitalized Frail Elderly Patients, and Predict Hospital Outcomes	?	x	x	All reviewers have agreed to contact the study authors to enquire if the adapted version of the Fried frailty phenotype utilised has been validated. Reviewer 2 initially excluded due to belief that study did not report the prevalence of frailty. Reviewer 3 initially excluded as the study was within patients with a specific morbidity. Both Reviewer 2 and Reviewer 3 have now agreed to contact study authors to enquire if the adapted version of the Fried frailty phenotype utilised has been validated	Contact authors	Yes - All reviewers have agreed to exclude as the authors were unable to confirm if the adapted version of the Fried frailty phenotype utilised has been validated	Excluded			
Harmsen et al., 2016	Fall-related injuries in Amsterdam: Frail older women at risk	x	x	x	N/A	Excluded	N/A	Excluded			
Hartley et al., 2019	Earlier Physical Therapy Input Is Associated With a Reduced Length of Hospital Stay and Reduced Care Needs on Discharge in Frail Older Inpatients: An Observational Study	?	x	✓	All reviewers have agreed to contact authors as per contact author form. Reviewer 2 initially excluded because no prevalence was reported. All reviewers have now agreed to contact authors to see if information exists relating on the prevalence of frailty and to confirm the minimum age of participants	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that the minimum age of participants was <65 years	Excluded			
Hartley et al., 2017	Clinical frailty and functional trajectories in hospitalized older adults: A retrospective observational study	✓	✓	✓	N/A	Included	N/A	Included			
Hastings et al., 2008	Frailty predicts some but not all adverse outcomes in older adults discharged from the emergency department	?	x	x	All reviewers have agreed to contact the authors as per the contact author form. Reviewer 2 and reviewer 3 initially excluded as they believed that frailty assessments were not conducted while participants were hospital inpatients. Upon review all reviewers agree to contact authors as per contact author form.	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that information does not exist relating to the prevalence of frailty	Excluded			
Hauer et al., 2001	Exercise training for rehabilitation and secondary prevention of falls in geriatric patients with a history of injurious falls	x	x	x	N/A	Excluded	N/A	Excluded			
Hawkins et al., 2018	Psoas Muscle Size Predicts Risk-Adjusted Outcomes After Surgical Aortic Valve Replacement	x	x	✓	All reviewers have agreed to exclude as this study did not use a validated operational definition for the classification of frailty or report the prevalence of frailty. Reviewer 3 initially missed this	Excluded	N/A	Excluded			
Hegener, Krause, Von Renteln-Kruse, 2007	Patient characteristics and factors associated with unfavourable in-hospital rehabilitation therapy outcome in very old geriatric patients with first-ever ischemic stroke - A retrospective case-control study	?	x	x	Reviewer 3 initially excluded as he could not locate the full text. Reviewer 3 initially excluded based on abstract. All reviewers now agree to contact thew study authors to attempt to obtain the full text for screening as per the requirements of full text screening	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Heim et al., 2015	The development, implementation and evaluation of a transitional care programme to improve outcomes of frail older patients after hospitalisation	?	✓	✓	All reviewers have agreed to contact authors to confirm that the frailty assessment tool is validated	Contact authors	Yes - Although the authors of this paper were unable to provide information regarding the validity of the tool utilised, the authors of another paper (Folbert et al. 2017) which utilised the same tool were able to confirm that the tool has not be validated for the classification of frailty, as such all reviewers have agreed to exclude	Excluded			
Heim et al., 2016	Optimal screening for increased risk for adverse outcomes in hospitalised older adults	?	✓	✓	All reviewers have agreed to contact authors to confirm that the frailty assessment tool is validated	Contact authors	Yes - Although the authors of this paper were unable to provide information regarding the validity of the tool utilised, the authors of another paper (Folbert et al. 2017) which utilised the same tool were able to confirm that the tool has not be validated for the classification of frailty, as such all reviewers have agreed to exclude	Excluded			
Heppenstall et al., 2018	Telephone discharge support for frail, vulnerable older people discharged from hospital: Impact on readmission rates - Participant and general practitioner feedback	?	✓	✓	All reviewers have agreed to contact authors as per author contact form	Contact authors	Yes - All reviewers have agreed to exclude, as although the authors were able to provide raw data regarding that allowed calculation of the prevalence of frailty, due to discrepancies in the data provided and that reported within the published paper, and an inability of the authors to clarify these discrepancies, all authors agreed to exclude.	Excluded			
Heppenstall et al., 2011	Factors related to care home admission in the year following hospitalisation in frail older adults	?	✓	x	Reviewer 3 initially excluded as he believed that discharged patients were included in the frailty assessment, however upon analysis of the paper this was not the case. All reviewers have agreed to contact authors as per author contact form	Contact authors	Yes - All reviewers have agreed to include as the authors were able to provide information regarding the prevalence of frailty	Included			
Hermans et al., 2005	Prevalence and determinants of impaired glucose metabolism in frail elderly patients: The Belgian elderly diabetes survey (BEDS)	x	x	x	N/A	Excluded	N/A	Excluded			
Hernandez et al., 2018	Assessment of health status and program performance in patients on long-term oxygen therapy	x	x	x	N/A	Excluded	N/A	Excluded			
Hewitt et al., 2016	Prevalence of multimorbidity and its association with outcomes in older emergency general surgical patients: an observational study	✓	?	✓	Reviewer 2 initially could not locate the full text. Upon review all reviewers agree to include.	Included		Included			
Hewitt et al., 2015	Prevalence of frailty and its association with mortality in general surgery	✓	✓	✓	N/A	Included	N/A	Included			
Hii, Lainchbury, Bridgman, 2015	Frailty in acute cardiology: comparison of a quick clinical assessment against a validated frailty assessment tool	✓	✓	✓	N/A	Included	N/A	Included			
Hilmer et al., 2009	The assessment of frailty in older people in acute care	?	✓	✓	All reviewers agree to contact study authors as per the contact author form to confirm authors definition of a "convenience sample" in this instance - did they attempt to assess all patients admitted to all involved medical wards over this period or alternatively employ some form of randomised selection of participants	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that an attempt was not made to assess the whole ward, nor was some form of randomised selection of participants implemented	Excluded			
Hilmer et al., 2011	Gentamicin pharmacokinetics in old age and frailty	?	x	✓	All authors have agreed to contact authors as per the contact author form to confirm if an attempt was made to recruit potentially eligible patients over this period or that some form of randomised selection of participants was employed. Reviewer 2 initially wished to exclude as only patients taking a specific medication were assessed. However, after a lengthy discussion it was decided that	Contact authors	Yes - All reviewers have agreed to include as the authors have confirmed that an attempt was made to assess all potentially eligible participants over the duration of the studies recruitment period	Included			

					those taking a specific medication would be classified as a specific clinical population and if the authors of this study attempted to recruit all of those within this population or employ some form of randomised selection of participants within this population, the study is eligible.						
Hippisley-Cox et al., 2017	Development and validation of QMortality risk prediction algorithm to estimate short term risk of death and assess frailty: cohort study	x	x	x	N/A	Excluded	N/A	Excluded			
Hiraoka et al., 2018	Modified predictive score based on frailty for mid-term outcomes in open total aortic arch surgery	x	x	?	All reviewers have agreed to exclude as the minimum age of participants was > 65. Initially reviewer 3 wished to contact authors to clarify the validity of the operational definition of frailty utilised. Upon review all reviewers have agreed to exclude due the minimum age of participants being < 65	Excluded	N/A	Excluded			
Ho, Lewis, Paz, 2017	Laparoscopy can safely be performed in frail patients undergoing colon resection for cancer	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors were unable to provide a full text related to this abstract	Excluded			
Hobert et al., 2018	Validation of the Geriatric Check in a cohort of hospitalized neurological patients	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Hogan et al., 2012	Comparing frailty measures in their ability to predict adverse outcome among older residents of assisted living	x	x	x	N/A	Excluded	N/A	Excluded			
Hogan et al., 2012	Preventable deaths due to problems in care in English acute hospitals: a retrospective case record review study	x	x	x	N/A	Excluded	N/A	Excluded			
Holtta et al., 2012	Apathy: Prevalence, Associated Factors, and Prognostic Value Among Frail, Older Inpatients	x	x	x	N/A	Excluded	N/A	Excluded			
Hoogendijk et al., 2015	Components of the Frailty Phenotype in Relation to the Frailty Index: Results From the Toulouse Frailty Platform	x	✓	✓	Excluded. Reviewer 2 and Reviewer 3 initially missed the fact that patients were day cases	Excluded	N/A	Excluded			
Hope et al., 2015	Frailty before critical illness and mortality for elderly medicare beneficiaries	x	x	✓	All reviewers have agreed to exclude as this study did not use a validated operational definition for the classification of frailty. Reviewer 3 initially missed this.	Excluded	N/A	Excluded			
Hope et al., 2017	Assessing the Usefulness and Validity of Frailty Markers in Critically Ill Adults	x	x	x	N/A	Excluded	N/A	Excluded			
Host et al., 2007	Training-induced strength and functional adaptations after hip fracture	x	x	x	N/A	Excluded	N/A	Excluded			
Hshieh et al., 2018	Prevalence of Cognitive Impairment and Association With Survival Among Older Patients With Hematologic Cancers	x	x	x	N/A	Excluded	N/A	Excluded			
Hubbard et al., 2011	Assessing balance and mobility to track illness and recovery in older inpatients	?	✓	✓	All reviewers have agreed to contact the authors as per author contact form	Contact authors	Yes - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Hubbard et al., 2008	Plasma esterases and inflammation in ageing and frailty	?	x	x	All reviewers have agreed to contact authors as per contact author form. Initially reviewer 2 excluded as only frail patients were enrolled, but now agrees to contact the author to see if information exists regarding all of those initially screened. Reviewer 3 initially excluded as no information exists relating to the prevalence of frailty. Reviewer 3 now agrees to contact the authors to see if information exists in this regard	Contact authors	Yes - All reviewers have agreed to exclude as the author has confirmed that an attempt was not made to recruit all patients within this population / setting, nor was some form of randomised selection of participants employed	Excluded			
Hubbard et al., 2008	Nutrition, inflammation, and leptin levels in aging and frailty	x	x	x	N/A	Excluded	N/A	Excluded			
Huded et al., 2016	Frailty Status and Outcomes after Transcatheter Aortic Valve Implantation	?	✓	x	All reviewers have agreed to contact the study authors as per author contact form	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Huded et al., 2015	Abstract 10342: Frailty Status and Outcomes Following Trans-catheter Aortic Valve Replacement	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Huijberts, Buurman, de Rooij, 2016	End-of-life care during and after an acute hospitalization in older patients with cancer, end-stage organ failure, or frailty: A sub-analysis of a prospective cohort study	x	x	✓	All reviewers have agreed to exclude as study did not use a clearly defined and validated operational definition for the classification of frailty. Reviewer 3 initially missed this.	Excluded	N/A	Excluded			
Huo et al., 2015	Phenotype of Osteosarcopenia in Older Individuals With a History of Falling	x	x	x	N/A	Excluded	N/A	Excluded			
Huyen et al., 2017	Prevalence of frailty and its associated factors in older hospitalised patients in Vietnam	x	x	✓	All reviewers have agreed to exclude study based on minimum age being <65. Reviewer 3 initially missed this	Excluded	N/A	Excluded			
Hyatt et al., 2016	The frailest of the frail? Identifying the unmet palliative care needs of frail older hospital inpatients: Poster No. 219 [Abstract]	x	?	?	All reviewers have agreed to exclude study as a validated operational definition was not utilised for the classification of frailty. Initially Reviewer 2 and Reviewer 3 were unable to locate the full text this abstract related to, however upon review all reviewers agree to exclude	Excluded	N/A	Excluded			

Ilango et al., 2017	Prescribing in the oldest old inpatients: a retrospective analysis of patients referred for specialist geriatric consultation	?	✓	✓	All authors have agreed to contact authors to see if information exists relating to the prevalence of frailty (only reports mean).	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that information does not exists regarding the prevalence of frailty	Excluded			
Induruwa et al., 2017	Clinical frailty is independently associated with non-prescription of anticoagulants in older patients with atrial fibrillation	✓	✓	✓	N/A	Included	N/A	Included			
Jacobs et al., 2017	Clinical Relevance of Differences in Glomerular Filtration Rate Estimations in Frail Older People by Creatinine- vs. Cystatin C-Based Formulae	✓	✓	✓	N/A	Included	N/A	Included			
Jankowski, Bryden, 2018	Using a modified cristal scoring system identifies factors associated with a poor outcome after admission to critical care	?	?	x	Initially reviewer 3 excluded as he could not locate the full text. All reviewers now agree on contacting the study authors as per the contact author form	Contact authors	Yes - Authors were able to provide reviewers with the full text, which was then screened by the three reviewers for eligibility. Upon screening all reviewers agreed to contact the authors again to enquire if information exists which distinguished between those classified as vulnerable (CFS score of 4), and those classified as frail (CFS score of 5 or above). The authors were unable to provide these data and as such all reviewers have agreed to exclude	Excluded			
Jansen et al., 2017	Challenges in integration of primary care for older adults addressed by introducing a geriatric care model: results of a RCT	?	?	x	Initially reviewer 3 excluded as the full text was not available. Upon review all reviewers agree to contact the authors to attempt to obtain the full text	Contact authors	Yes - All reviewers have agreed to exclude as upon review of the full text provided by the author, the study did not occur in a hospital setting, in, or including, hospital inpatients (community-dwelling)	Excluded			
Jha et al., 2016	The Prevalence and Prognostic Significance of Frailty in Patients with Advanced Heart Failure Referred for Heart Transplantation	x	x	x	N/A	Excluded	N/A	Excluded			
Jha et al., 2016	Cognitive impairment improves the predictive validity of physical frailty for mortality in patients with advanced heart failure referred for heart transplantation	x	x	x	N/A	Excluded	N/A	Excluded			
Jha et al., 2017	Reversibility of Frailty After Bridge-to-Transplant Ventricular Assist Device Implantation or Heart Transplantation	x	x	x	N/A	Excluded	N/A	Excluded			
Jimenez et al., 2017	Impact on clinical events and healthcare costs of adding telemedicine to multidisciplinary care of patients with heart failure and mid-range or preserved LVEF: a randomised controlled trial	?	?	x	Initially reviewer 3 excluded as the full text was not available. Upon review all reviewers agree to contact the authors to attempt to obtain the full text	Contact authors	N/A - Prior to contacting authors it was determined that this conference abstract related to a sub-sample of the same cohort utilised in Comin-Colet et al. 2016 . After review by all reviewers, the study is excluded on these ground	Excluded			
Jimenez-Corona et al., 2015	Prevalence of pre-frailty and frailty in older patients with cataract from a specialized hospital in Mexico City	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a full text is not available regarding this title	Excluded			
Jokar et al., 2016	Emergency general surgery specific frailty index: A validation study	✓	✓	✓	N/A	Included	N/A	Included			
Jones et al., 2017	Physical activity interventions are delivered consistently across hospitalized older adults but multimorbidity is associated with poorer rehabilitation outcomes: A population-based cohort study	x	✓	✓	Reviewer 1 initially excluded as a validated operational definition for the classification of frailty was not utilised. This was initially missed by reviewer 2 and 3. Upon review all reviewers agree that while handgrip strength is an indicator of frailty, it is not by itself a validated operational definition for the classification of frailty, and agree to exclude	Excluded	N/A	Excluded			
Joosten et al., 2014	Prevalence of frailty and its ability to predict in hospital delirium, falls, and 6-month mortality in hospitalized older patients	✓	✓	✓	N/A	Included	N/A	Included			
Joseph et al., 2017	Redefining the association between old age and poor outcomes after trauma: The impact of frailty syndrome	?	?	✓	All Reviewers agree to contact authors to confirm if there is overlap in the participants within this present study and that of *Joseph et al. 2016 - "The impact of frailty on failure-to-rescue in geriatric trauma patients: a prospective study"*. The fact that this may be the case was initially missed by Reviewer 2, and Reviewer 3. Additionally, Reviewer 2 initially could not locate full text. Upon review all Reviewers now agree to contact the authors in the above regard.	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Joseph et al., 2015	Managing older adults with ground-level falls admitted to a trauma service: The effect of frailty	?	✓	✓	All Reviewers have agreed to contact authors to inquire if there is overlap in the participants within this present study and that of *Joseph et al. 2014 - "Superiority of frailty over age in predicting outcomes among geriatric trauma patients: A prospective analysis"*. The fact that this may be the case was initially missed by Reviewer 2 and Reviewer 3, however upon discussion and examination of the study, all Reviewers agree to contact the authors in the above regard	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Joseph et al., 2014	Superiority of frailty over age in predicting outcomes among geriatric trauma patients: A prospective analysis	✓	?	✓	Reviewer 2 initially could not locate full text. Upon review now agrees to include	Included	N/A	Included			
Joseph et al., 2016	The impact of frailty on failure-to-rescue in geriatric trauma patients: a prospective study	✓	✓	✓	N/A	Included	N/A	Included			
Joseph et al., 2017	Upper-Extremity Function Predicts Adverse Health Outcomes among Older Adults Hospitalized for Ground-Level Falls	x	x	✓	Reviewer 2 initially excluded this study as he believed it was too specific of a population (fall victims), but now agrees could be included in this regard as it is a specific clinical population, and for sub analysis. However, as a valid operational definition of frailty was not employed, all three reviewers now agree to exclude. The fact that a validated operational definition of frailty was not employed, was initially missed by Reviewer 2 and Reviewer 3	Excluded	N/A	Excluded			
Joseph et al., 2016	Emergency General Surgery in the Elderly: Too Old or Too Frail? Presented orally at the Surgical Forum of the American College of Surgeons 100th Annual Clinical Congress, San Francisco, CA, October 2014	?	?	✓	All Reviewers have agreed to contact authors to inquire if there is overlap in the participants within this present study and that of *Joseph et al. 2014 - "Superiority of frailty over age in predicting outcomes among geriatric trauma patients: A prospective analysis*". The fact that this may be the case was initially missed by Reviewer 2 and Reviewer 3, however upon discussion and examination of the study, all Reviewers agree to contact the authors in the above regard. Additionally, Reviewer 2 initially could not find full text, but upon review, agrees to contact the authors in the above regard	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Joyce et al., 2016	Abstract 17795: Prospective Assessment of Mini-Cog and Grip Strength Identifies Hospitalized Heart Failure Patients at	x	?	?	All reviewers have agreed to exclude due to the lack of a validated operational definition for the classification of frailty. Initially reviewer 2 and reviewer 3 could not locate	Excluded	N/A	Excluded			

	Increased Risk of Worse Post-Discharge Outcomes				the full text that this abstract related to. Upon review all authors agreed to exclude						
Jr. Holmes et al., 2015	Annual Outcomes With Transcatheter Valve Therapy: From the STS/ACC TVT Registry	x	x	x	N/A	Excluded	N/A	Excluded			
Juma, Salina et al., 2016	Clinical Frailty Scale in an Acute Medicine Unit: a Simple Tool That Predicts Length of Stay	✓	✓	✓	N/A	Included	N/A	Included			
Jung et al., 2015	The impact of frailty on postoperative delirium in cardiac surgery patients	x	x	x	N/A	Excluded	N/A	Excluded			
Kaehr et al., 2016	FRAIL-NH predicts outcomes in long term care	x	x	x	N/A	Excluded	N/A	Excluded			
Kahlon et al., 2015	Association between frailty and 30-day outcomes after discharge from hospital	x	x	x	N/A	Excluded	N/A	Excluded			
Kajsa et al., 2016	Screening for frailty among older emergency department visitors: Validation of the new FRESH-screening instrument	x	x	x	N/A	Excluded	N/A	Excluded			
Kang et al., 2015	Is frailty associated with short-term outcomes for elderly patients with acute coronary syndrome?	✓	?	✓	All reviewers agree study is likely eligible, however wish to contact authors to confirm that sample was comprised entirely of inpatients.	Contact authors	Yes - All reviewers have agreed to include as the authors have confirmed that the sample consisted entirely of inpatients	Included			
Kang et al., 2017	Association between frailty and hypertension prevalence, treatment, and control in the elderly Korean population	x	x	x	N/A	Excluded	N/A	Excluded			
Kaplan et al., 2017	Association of Radiologic Indicators of Frailty With 1-Year Mortality in Older Trauma Patients Opportunistic Screening for Sarcopenia and Osteopenia	x	✓	x	All reviewers have agreed to exclude as a validated measurement of frailty was not utilised	Excluded	N/A	Excluded			
Karlekar et al., 2017	Creating New Opportunities to Educate Families on the Impact of Frailty and Cognitive Impairment in a Trauma Intensive Care Unit: Results of a Quality Improvement Project	✓	✓	✓	N/A	Included	N/A	Included			
Kavanagh et al., 2017	101Early MDT Intervention and Improved Care Pathways for the Frail Older Person in a Rehabilitation Hospital	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Keevil et al., 2018	Care home residents admitted to hospital through the emergency pathway: characteristics and associations with inpatient mortality	✓	?	✓	All reviewers have now agreed to include. Initially Reviewer 2 was uncertain that there was enough information to be sure all patients were inpatients. After discussion this has been rectified	Included	N/A	Included			
Kelaiditi et al., 2016	Frailty Index and Incident Mortality, Hospitalization, and Institutionalization in Alzheimer's Disease: Data From the ICTUS Study	x	x	x	N/A	Excluded	N/A	Excluded			
Kelaiditi et al., 2016	Frailty Index and Cognitive Decline in Alzheimer's Disease: Data from the Impact of Cholinergic Treatment USe Study	x	x	x	N/A	Excluded	N/A	Excluded			
Kenig et al., 2018	The Surgical Apgar score combined with Comprehensive Geriatric Assessment improves short- but not long-term outcome prediction in older patients undergoing abdominal cancer surgery	x	✓	✓	All reviewers have agreed to exclude as frailty was assessed prior to admission. This was initially missed by reviewer 2 and 3	Excluded	N/A	Excluded			
Kenig et al., 2015	Cumulative deficit model of geriatric assessment to predict the postoperative outcomes of older patients with solid abdominal cancer	x	✓	✓	All reviewers have agreed to exclude as frailty was assessed prior to admission. This was initially missed by reviewer 2 and 3	Excluded	N/A	Excluded			
Kenig et al., 2014	Vulnerable elderly survey 13 as a screening method for frailty in polish elderly surgical patient -prospective study	x	✓	x	All Reviewers have agreed to exclude as a validated operational definition for the classification of frailty was not utilised. This was initially missed by Reviewer 2 and Reviewer 3. Reviewer 3 initially wished to exclude due to a typo within the text	Excluded	N/A	Excluded			
Kenig et al., 2016	Geriatric Assessment as a qualification element for elective and emergency cholecystectomy in older patients	x	✓	✓	All authors have agreed to exclude as a validated operational definition of frailty was not utilised. This was initially missed by Reviewer 2 and Reviewer 3	Excluded	N/A	Excluded			
Kenig et al., 2015	Six screening instruments for frailty in older patients qualified for emergency abdominal surgery	✓	✓	✓	N/A	Included	N/A	Included			
Kenig et al., 2015	Screening for frailty among older patients with cancer that qualify for abdominal surgery	?	✓	✓	All Reviewers have agreed to contact the authors to confirm if there is overlap in the sample within this present study, and that of Kenig et al. 2015 - "Six screening instruments for frailty in older patients qualified for emergency abdominal surgery". The fact that this may be the case was initially missed by Reviewer 2 and Reviewer 3	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Kenig et al., 2018	The Surgical Apgar Score predicts outcomes of emergency abdominal surgeries both in fit and frail older patients	x	✓	✓	All authors have agreed to exclude as a validated operational definition for the classification of frailty was not utilised. This was initially missed by Reviewer 2 and Reviewer 3	Excluded	N/A	Excluded			
Kennelly et al., 2016	177PRELIMINARY RESULTS OF THE FRAIL ELDERLY PILOT PROGRAMME IN CONNOLLY HOSPITAL BLANCHARDSTOWN 2016	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Kersten et al., 2015	Clinical impact of potentially inappropriate medications during hospitalization of acutely ill older patients with multimorbidity	x	x	x	N/A	Excluded	N/A	Excluded			
Kessler et al., 2018	Impact of frailty on complications in patients with thoracic and thoracolumbar spinal fracture	x	x	x	N/A	Excluded	N/A	Excluded			
Khan et al., 2019	Failure to rescue after emergency general surgery in geriatric patients: does frailty matter?	✓	✓	✓	N/A	Included	N/A	Included			
Khandelwal et al., 2012	Frailty is associated with longer hospital stay and increased mortality in hospitalized older patients	x	x	x	N/A	Excluded	N/A	Excluded			
Kim et al., 2018	Measuring Frailty in Medicare Data: Development and Validation of a Claims-Based Frailty Index	x	x	?	Reviewer 3 initially could not locate the full text. Upon review all reviewers agree on exclusion based on the lack of a validated operational definition for the classification of frailty.	Excluded	N/A	Excluded			

Kircher et al., 2007	A randomised trial of a geriatric evaluation and management consultation services in frail hospitalised patients	x	x	x	N/A	Excluded	N/A	Excluded			
Kistler, 2015	Frailty and Short-Term Outcomes in Patients With Hip Fracture	?	✓	✓	All reviewers agree that the modified version of the operational definition of frailty utilised is likely non-validated (though original operational definition is validated), but to contact authors to clarify on the validation of this specific modified version of the operational definition of frailty utilised	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that the modified version of the Fried frailty phenotype utilised has not been validated	Excluded			
Kizilarslanoglu et al., 2017	Is frailty a prognostic factor for critically ill elderly patients?	x	x	x	N/A	Excluded	N/A	Excluded			
Kleczynski et al., 2017	Impact of frailty on mortality after transcatheter aortic valve implantation	?	x	✓	All reviewers have agreed to contact authors as per contact author form	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Kodama et al., 2018	Association between preoperative frailty and mortality in patients with critical limb ischemia following infrainguinal bypass surgery — Usefulness of the Barthel index	x	x	x	N/A	Excluded	N/A	Excluded			
Kominski, 2002	Inpatient geriatric units and outpatient geriatric clinics improve quality of life, but not survival for frail older adults	x	?	?	All reviewers have agreed to exclude as this is a commentary of a paper. The paper for which this paper provides commentary is also ineligible. Initially reviewer 2 and reviewer 3 could not locate the full text	Excluded	N/A	Excluded			
Kono et al.,2017	Abstract 12128: Frailty in Patients With Heart Failure May be Caused by Catabolic Anabolic Imbalance and Ventricular Vascular Stiffening	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Kopczynska et al., 2018	Sepsis-related deaths in the at-risk population on the wards: Attributable fraction of mortality in a large point-prevalence study	x	x	✓	All reviewers have agreed to exclude as minimum age is > 65. This was initially overlooked by reviewer 3	Excluded	N/A	Excluded			
Kotajarvi et al., 2017	The Impact of Frailty on Patient-Centered Outcomes Following Aortic Valve Replacement	✓	x	x	All reviewers have agreed to contact authors to confirm if all participants were inpatients when frailty assessments were conducted. Reviewer 2 initially excluded as sample was a specific clinical population. Reviewer 2 now agrees this can be included in sub-analysis. Reviewer 3 initially excluded as he believed patients were outpatients during the frailty assessment	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that all frailty assessments were conducted as outpatients	Excluded			
Koyama et al., 2018	Preadmission frailty status as a powerful predictor of dependency after discharge among hospitalized older patients: A clinical-based prospective study	✓	✓	✓	N/A	Included	N/A	Included			
Kristjansson et al., 2012	A comparison of two pre-operative frailty measures in older surgical cancer patients	?	x	✓	All reviewers have agreed to contact author as per contact author form. Reviewer 2 initially excluded as it was a specific type of clinical population, but now agrees can be included in sub analysis	Contact authors	Yes - All reviewers have agreed to exclude as while the authors have confirmed that all participants were inpatients, it was also confirmed that the modified operational definition utilised has not been validated	Excluded			
Kua et al., 2016	Which frailty measure is a good predictor of early post-operative complications in elderly hip fracture patients?	x	x	x	N/A	Excluded	N/A	Excluded			
Kubala et al., 2017	Utility of Frailty Assessment for Elderly Patients Undergoing Cardiac Resynchronization Therapy	x	x	✓	All authors have agreed to exclude as a validated operational definition for the classification of frailty was not utilised. Reviewer 2 initially excluded as the sample consisted of a specific clinical population and was also multi-centered. Reviewer 2 now agrees that the study would not be excluded based on these criteria, as it can be included in the above regard and during sub-analysis, and additionally that multi-centre can be included provided the study attempted to recruit all of those with that condition within the multiple centres. The fact that a validated operational definition for the classification of frailty was not utilised was initially missed by Reviewer 2 and 3	Excluded	N/A	Excluded			
Kuroda et al., 1992	A comparative study of the characteristics and social backgrounds of frail and elderly persons at home, long-stay elderly hospital patients, and residents of welfare homes for the frail elderly	?	?	x	Reviewer 3 initially excluded as he could not locate the full text. All reviewers have now agreed to contact study authors to attempt to obtain full text	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Kusunose et al., 2018	Prognostic Value of Frailty and Diastolic Dysfunction in Elderly Patients	?	x	✓	All reviewers agree to contact authors as per contact author form	Contact authors	Yes - All reviewers have agreed to include as the authors have confirmed that all participants within the study were inpatients	Included			
Lai et al., 2017	Development of a novel frailty index to predict mortality in patients with end-stage liver disease	x	x	x	N/A	Excluded	N/A	Excluded			
Landi et al., 2002	Predictors of rehabilitation outcomes in frail patients treated in a geriatric hospital	x	x	x	N/A	Excluded	N/A	Excluded			
Langer et al., 2019	Intraoperative hypotension is not associated with postoperative cognitive dysfunction in elderly patients undergoing general anaesthesia for surgery: results of a randomized controlled pilot trial	x	✓	x	All reviewers agree to exclude. Reviewer 2 initially missed that all frailty assessments were conducted at an outpatient clinic	Excluded	N/A	Excluded			
Launay et al., 2018	Prediction of in-hospital mortality with the 6-item Brief Geriatric Assessment tool: An observational prospective cohort study	x	✓	x	All reviewers have agreed to exclude as the study does not utilise a validated operational definition for the classification of frailty, and also does not report the prevalence of frailty. This was initially missed by reviewer 2	Excluded	N/A	Excluded			
Le Maguet et al., 2014	Prevalence and impact of frailty on mortality in elderly ICU patients: A prospective, multicenter, observational study	✓	✓	✓	N/A	Included	N/A	Included			
Lee et al., 2018	Toward Using a Smartwatch to Monitor Frailty in a Hospital Setting: Using a Single Wrist-Wearable Sensor to Assess Frailty in Bedbound Inpatients	?	✓	✓	All reviewers have agreed to contact authors to confirm that an attempt was made to recruit the entire ward/clinical population during the recruitment period or that some form of randomised selection of participants was employed. The fact that this not expressed stated or clear within the manuscript was initially missed by Reviewer 2 and Reviewer 3	Contact authors	Yes - All reviewers have agreed to include as the authors have confirmed that an attempt was made to recruit the entire clinical population during their recruitment period and that there was no form of selection bias with regard to the participant recruitment process.	Included			
Lee et al., 2016	Exploration of the importance of geriatric frailty on health-related quality of life	x	x	x	N/A	Excluded	N/A	Excluded			

Lee et al., 2015	Predictors of successful completion of diagnostic home sleep testing in patients with chronic kidney disease	x	x	x	N/A	Excluded	N/A	Excluded			
Lee, Son, Shin, 2015	Influence of frailty on health-related quality of life in pre-dialysis patients with chronic kidney disease in Korea: A cross-sectional study	x	x	x	N/A	Excluded	N/A	Excluded			
Lee et al., 2017	Is Frailty a Modifiable Risk Factor of Future Adverse Outcomes in Elderly Patients with Incident End-Stage Renal Disease?	x	x	x	N/A	Excluded	N/A	Excluded			
Lee et al., 2011	Effectiveness of short-term interdisciplinary intervention on postacute patients in Taiwan	x	x	x	N/A	Excluded	N/A	Excluded			
Lee et al., 2014	The Impact of Influenza Vaccination on Hospitalizations and Mortality Among Frail Older People	?	x	x	Initially reviewer 2 and 3 excluded as patients were outpatients. Upon review all reviewers agree to contact the study authors to confirm the minimum age of participants and to see if information exists relating to the prevalence of frailty as per the contact author form	Contact authors	Yes - All reviewers have agreed to exclude as while the authors have confirmed that the minimum age of participants was 65 years, unfortunately, the authors were unable to provide information regarding the prevalence of frailty of patients while hospitalised	Excluded			
Lee et al., 2016	Plasma zinc alpha2-glycoprotein levels correlate positively with frailty severity in female elders	x	x	✓	All reviewers have agreed to exclude as the sample are not hospital inpatients. This was initially missed by reviewer 3.	Excluded	N/A	Excluded			
Lefebvre et al., 2015	Reliability of a Method to Evaluate Frailty Using Medical Records of Hospitalized Octogenarians	?	x	x	Reviewer 2 initially excluded as he believed the study was an editorial not containing any primary data. Reviewer 3 initially excluded as he believed that the participants were not inpatients. Upon review all reviewers agree to contact the study authors to see if information exists relating to the prevalence of frailty as per the contact author form	Contact authors	Yes - All reviewers have agreed to exclude as the author has outlined that this study consists of a sub-sample of patients already included in Lefebrve et al. 2016.	Excluded			
Lefebvre et al., 2016	The Effect of Bleeding Risk and Frailty Status on Anticoagulation Patterns in Octogenarians With Atrial Fibrillation: The FRAIL-AF Study	?	?	✓	All reviewers have agreed to contact author as per contact author form	Contact authors	Yes - The authors were able to provide information regarding to the prevalence of frailty within the sample, and to confirm that assessments were reflective of the time when participants were inpatients. However, a follow-up inquiry was sent to the authors to confirm that the 67% prevalence reported in the initial response was based on a CFS score of > 4. The authors response was that it was not. Given this a follow-up email was sent to inquire if information was available regarding the number of participants with a CFS score > 4. Unfortunately, the authors have not responded this inquiry email and subsequent follow-ups. As such all reviews have agreed to exclude due to insufficient data regarding the prevalence of frailty	Excluded			
Lekan, McCoy, 2018	Frailty risk in hospitalised older adults with and without diabetes mellitus	x	x	x	N/A	Excluded	N/A	Excluded			
Lekan, 2013	Frailty in hospitalized adults	x	x	x	N/A	Excluded	N/A	Excluded			
Leung, Tsai, Sands, 2011	Preoperative frailty in older surgical patients is associated with early postoperative delirium	?	?	✓	All reviewers have agreed to contact authors as per contact author form	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that participants were assessed for frailty preoperatively as outpatients	Excluded			
Li et al.,2015	A Pilot Study of the FRAIL Scale on Predicting Outcomes in Chinese Elderly People With Type 2 Diabetes	x	x	x	N/A	Excluded	N/A	Excluded			
Li et al., 2018	Impact of frailty on outcomes after discharge in older surgical patients: a prospective cohort study	x	✓	✓	All reviewers have agreed to exclude as frailty was reflective of a period prior to admission, this was initially missed by reviewer 2 and 3	Excluded	N/A	Excluded			
Lightbody, Baldwin, 2002	Inpatient geriatric evaluation and management did not reduce mortality but reduced functional decline	x	?	x	Reviewer 2 initially recommended to contact the author as he was not acutely aware that the study referenced within this commentary paper was already in the screening. Upon review all reviewers agree to exclude due to the paper being a commentary paper	Excluded	N/A	Excluded			
Liguori et al., 2018	Orthostatic Hypotension in the Elderly: A Marker of Clinical Frailty?	?	x	x	Initially reviewer 2 and 3 excluded due to the belief that the participants were outpatients. Upon review all reviewers agree to contact the study authors to confirm if participants were inpatients, and if so, also to see if information exists regarding the prevalence of frailty within the sample?	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that the sample consists of outpatients	Excluded			
Lilamand et al., 2015	Validation of the Mini Nutritional Assessment-Short Form in a population of frail elders without disability. Analysis of the Toulouse Frailty Platform population in 2013	x	x	x	N/A	Excluded	N/A	Excluded			
Lin et al., 2017	Perioperative assessment of older surgical patients using a frailty index-feasibility and association with adverse postoperative outcomes	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to include as a full text was located by the lead reviewer prior to contacting authors, and upon review all three reviewers have agreed on inclusion	Included			
Lin et al., 2018	Comparison of 3 Frailty Instruments in a Geriatric Acute Care Setting in a Low-Middle Income Country	x	x	?	Reviewer 3 initially wanted to contact the study authors as he could not locate the full text. Upon review all reviewers agree on exclusion as the participants were not hospital inpatients	Excluded	N/A	Excluded			
Livbjerg, Dorflinger, 2017	The prevalence and outcomes of frailty in elderly patients undergoing curative surgery for urologic malignancy - a pilot study	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Llao et al., 2018	Invasive strategy and frailty in very elderly patients with acute coronary syndromes	✓	?	?	All reviewers have agreed to include. Initially reviewers 2 and 3 were unable to locate the full text. Upon review they agree to include	Included	N/A	Included			

Lohman et al., 2017	Incorporating Persistent Pain in Phenotypic Frailty Measurement and Prediction of Adverse Health Outcomes	x	x	x	N/A	Excluded	N/A	Excluded			
Lokman et al., 2015	6IMPACT OF THE ACUTE GERIATRICS SERVICE ON THE FRAIL POPULATION ADMITTED TO THE ACUTE MEDICAL UNIT AT UNIVERSITY COLLEGE LONDON HOSPITAL - AN AUDIT LOOKING AT DIFFERENCES IN OUTCOMES BETWEEN ACUTE GERIATRICS AND ACUTE MEDICINE LED CARE FOR THE OLDER PATIENT POPULATION	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Lu et al., 2017	The Preoperative Frailty Versus Inflammation-Based Prognostic Score: Which is Better as an Objective Predictor for Gastric Cancer Patients 80 Years and Older?	?	x	x	All reviewers agree to contact the author to determine if the frailty assessment was conducted while patients were inpatients. Reviewer 2 initially excluded as it was a specific clinical population, but now agrees can be used in sub analysis. Reviewer 3 initially excluded as believed that frailty assessments were conducted prior to hospitalisation	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Lund et al., 2017	The effect of geriatric intervention in frail elderly patients receiving chemotherapy for colorectal cancer: a randomized trial (GERICO)	x	x	x	N/A	Excluded	N/A	Excluded			
Lupon et al., 2008	Prognostic implication of frailty and depressive symptoms in an outpatient population with heart failure	x	x	x	N/A	Excluded	N/A	Excluded			
Lytwyn et al., 2017	The impact of frailty on functional survival in patients 1 year after cardiac surgery	x	✓	✓	All authors have agreed to exclude as the minimum ages is less than 65. This was initially missed by reviewer 2 and 3	Excluded	N/A	Excluded			
Ma, Yu, Woo, 2013	Recurrent hospitalisation with pneumonia is associated with higher 1-year mortality in frail older people	✓	✓	✓	N/A	Included	N/A	Included			
Madan et al., 2016	Frailty Assessment in Advanced Heart Failure	✓	✓	x	All reviewers have agreed to contact authors to confirm if participants were inpatients or outpatients	Contact authors	Yes - All reviewers have agreed to exclude at the authors have confirmed that the study sample were not inpatients (outpatients)	Excluded			
Maddocks et al., 2016	Physical frailty and pulmonary rehabilitation in COPD: a prospective cohort study	x	x	x	N/A	Excluded	N/A	Excluded			
Madni et al., 2017	The Relationship Between Frailty and the Subjective Decision to Conduct a Goals of Care Discussion With Burned Elders	✓	✓	✓	N/A	Included	N/A	Included			
Main et al., 2002	WHERE ARE FRAIL OLDER PATIENTS IN OUR ACUTE HOSPITALS?	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a full text does not exist relating to this poster presentation	Excluded			
Makary et al., 2010	Frailty as a predictor of surgical outcomes in older patients	?	✓	x	All reviewers have agreed to contact authors as per author contact form	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Maloney et al., 2017	Frailty Intervention Therapy Team (FITT): A Step in the Right Direction - Integration of Early Interdisciplinary Assessment in the Emergency Department	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that published full text is not available related to this conference abstract	Excluded			
Maloney et al., 2017	294Working Differently to Greatly Improve Care for Frail Patients Attending the Emergency Department	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a published full text is not available related to this abstract	Excluded			
Mansur et al., 2012	[Prevalence of frailty in patients in chronic kidney disease on conservative treatment and on dialysis]	x	?	x	All reviewers have agreed to exclude as the minimum age of participants was < 65, and participants were not hospital inpatients. Reviewer 2 initially wished to contact the authors as he was unable to locate the full English text. Reviewer 3 initially excluded as he was unable to locate the full text in English. Upon review all reviewers now agree to exclude as the minimum age of participants was < 65, and participants were not hospital inpatients. Going forward agree to contact the study authors to attempt to obtain a full English text for screening of any study where it is not readily available, as per the requirements of full text screening	Excluded	N/A	Excluded			
Marchiori et al., 2017	Changes in frailty conditions and phenotype components in elderly after hospitalization	x	✓	x	All authors have agreed to exclude due to minimum age being < 65. Reviewer 2 initially missed this	Excluded	N/A	Excluded			
Martín et al., 2018	Effect of a Minimal-Massive Intervention in Hospitalized Older Patients with Oropharyngeal Dysphagia: A Proof of Concept Study	✓	✓	✓	N/A	Included	N/A	Included			
Martinchek et al., 2016	Resident Presentation Barriers to Enrollment in an Exercise Intervention for Pre-Frail and Frail Thoracic Surgery Patients: D173	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a published full text is not available related to this poster abstract				
Martinez-Arroyo et al., 2014	Polypharmacy prevalence and potentially inappropriate drug prescription in the elderly hospitalized for cardiovascular disease	?	?	x	Reviewer 3 initially excluded as the full text was not available in English. All reviewers now agree to contact the study authors to attempt to obtain a full English text for screening as per the requirements of full text screening	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion				
Martín-Sánchez et al., 2018	Identification of Senior At Risk scale predicts 30-day mortality among older patients with acute heart failure	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion				
Martin-Sanchez et al., 2018	Impact of geriatric assessment variables on 30-day mortality among older patients with acute heart failure	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the				

							contacted authors. As such there remains insufficient data in this regard to facilitate inclusion				
Mason et al., 2018	Establishing a proactive geriatrician led comprehensive geriatric assessment in older emergency surgery patients: Outcomes of a pilot study	✓	✓	✓	N/A	Included	N/A	Included			
Mastalerz et al., 2018	The Surgical Apgar Score and frailty as outcome predictors in short- and long-term evaluation of fit and frail older patients undergoing elective laparoscopic cholecystectomy - a prospective cohort study	x	✓	✓	All reviewers have agreed to exclude as a validated operational definition for the classification of frailty was not utilised. This was initially missed by reviewer 2 and Reviewer 3	Excluded	N/A	Excluded			
Masud et al., 2013	The use of a frailty scoring system for burns in the elderly	?	X	✓	All reviewers agree to contact authors as per contact author form. Reviewer 2 initially excluded as sample only related to a specific population, but now agrees can be used in sub analysis	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Maxwell et al., 2018	Feasibility of screening for preinjury frailty in hospitalized injured older adults	x	✓	✓	All authors have agreed to exclude as the frailty assessment was assessed retrospectively prior to admission	Excluded	N/A	Excluded			
Maxwell et al., 2018	The FRAIL Questionnaire: A Useful Tool for Bedside Screening of Geriatric Trauma Patients	✓	x	?	All reviewers have agreed to include. Reviewer 2 initially excluded due to the belief the paper was solely a description a proposed test as opposed to a full paper on a validated frailty tool. Reviewer 3 initially could not find the full text. Upon review all reviewers have agreed to include	Included	N/A	Included			
McAdams-DeMarco et al., 2015	Frailty and Mortality in Kidney Transplant Recipients	x	?	x	Reviewer 2 initially wished to contact the study authors for the full text. Reviewer 3 initially excluded due to believing that the sample was non representative of the ward, however, now agrees can be utilised as an assessment of prevalence of the clinical population. However, upon review all reviewers agree to exclude as the minimum age is < 65.	Excluded	N/A	Excluded			
McAdams-DeMarco et al., 2017	Frailty, Length of Stay, and Mortality in Kidney Transplant Recipients: A National Registry and Prospective Cohort Study	x	?	✓	All authors have agreed to exclude as the minimum ages is < 65. This was initially missed by reviewer 3. Reviewer 2 initially could not find the full text. Upon review all reviewers have agreed to exclude	Excluded	N/A	Excluded			
McAlister, van Walraven, 2019	External validation of the Hospital Frailty Risk Score and comparison with the Hospital-patient One-year Mortality Risk Score to predict outcomes in elderly hospitalised patients: a retrospective cohort study	x	x	✓	All authors have agreed to exclude as a validated operational definition of frailty was not utilised	Excluded	N/A	Excluded			
McCarthy et al., 2014	52 THE PREVALENCE OF FRAILTY IN THE ACUTE GENERAL SURGICAL SETTING	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that this abstract consists of a sub-set of the sample published in Hewitt et al. 2015 - "*Prevalence of frailty and its association with mortality in general surgery*", which has been included in this review	Excluded			
McCullagh et al., 2017	Step-Count Accuracy of 3 Motion Sensors for Older and Frail Medical Inpatients	x	x	x	N/A	Excluded	N/A	Excluded			
McGuckin et al., 2018	The association of peri-operative scores, including frailty, with outcomes after unscheduled surgery	?	✓	✓	All reviewers have agreed to include. Reviewer 1 initially wished to contact the authors for a breakdown of frailty score, however this exists in a table which the reviewer initially overlooked.	Included	N/A	Included			
McIsaac et al., 2018	Derivation and Validation of a Generalizable Preoperative Frailty Index Using Population-based Health Administrative Data	✓	✓	✓	N/A	Included	N/A	Included			
McLeod, Hominick, Rockwood, 2016	Characteristics of Older Adults Admitted to Hospital versus Those Discharged Home, in Emergency Department Patients Referred to Internal Medicine	?	x	x	All reviewers agree to exclude as frailty assessments were conducted in the ED prior to inpatient admission, this was initially missed by reviewer 1 who initially wished to contact the study authors to see if information exists relating to the prevalence of frailty	Excluded	N/A	Excluded			
McNallan et al., 2013	Measuring frailty in heart failure: A community perspective	x	x	x	N/A	Excluded	N/A	Excluded			
McRae et al., 2016	Frailty and Geriatric Syndromes in Vascular Surgical Ward Patients	?	✓	✓	All reviewers have agreed to contact author as per contact author form	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that the operational definition utilised for the classification of frailty has not been validated	Excluded			
Melgaard et al., 2017	The Prevalence of Oropharyngeal Dysphagia in Danish Patients Hospitalised with Community-Acquired Pneumonia	x	✓	x	All authors have agreed to exclude as the minimum age is < 65. Also did not use a validated operational definition for the classification of frailty. Also did not assess frailty as in-patients (assessed retrospectively for pre-hospitalisation frailty status)	Excluded	N/A	Excluded			
Meulendijks et al., 2015	Groningen frailty indicator in older patients with end-stage renal disease	x	✓	x	All authors have agreed to exclude as participants are outpatients. Reviewer 2 initially missed this	Excluded	N/A	Excluded			
Miller et al., 2018	External Validation of the Adult Spinal Deformity (ASD) Frailty Index (ASD-FI) in the Scoli-RISK-1 Patient Database	x	x	x	N/A	Excluded	N/A	Excluded			
Mitchell et al., 2011	Hepatotoxicity of therapeutic short-course paracetamol in hospital inpatients: impact of ageing and frailty	x	x	✓	All authors have agreed to exclude as minimum age is < 65. This was initially missed by reviewer 3	Excluded	N/A	Excluded			
Miura et al.,	Early Safety and Efficacy of Transcatheter Aortic Valve Implantation for Asian Nonagenarians (from KMH Registry)	?	✓	✓	All reviewers have agreed to contact authors as per contact author form	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that the minimum age of participants was <65 years	Excluded			
Mizutani et al., 2017	Safety and efficacy of simultaneous biplane mode of 3-dimensional transesophageal echocardiography-guided antegrade multiple-inflation balloon aortic valvuloplasty in patients with severe aortic stenosis	?	x	x	Initially reviewer 3 excluded due to the absence in reporting of the prevalence of frailty. Initially reviewer 2 excluded due to believing that the participants were not representative of the whole ward. Upon review all reviewers agree to contact the study authors as per the contact author form to attempt to obtain information relating to the prevalence of frailty	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Mlynarska, Golba, Mlynarski, 2018	Capability for self-care of patients with heart failure	x	x	✓	All authors have agreed to exclude as minimum age <65	Excluded	N/A	Excluded			
Mlynarska, Mlynarski, Golba, 2017	Frailty syndrome in patients with heart rhythm disorders	?	x	✓	All reviewers have agreed to contact authors as per author contact form. Reviewer 2 initially excluded based on belief that the minimum age was < 65, however upon review this is not the case	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Mlynarska, Mlynarski, Golba, 2018	Anxiety, age, education and activities of daily living as predictive factors of the occurrence of frailty syndrome in patients with heart rhythm disorders	✓	✓	x	All authors have agreed to exclude as minimum age is 60. This is presented as being > 64 in the abstract, but within the main text this is > 60, and within the inclusion criteria for the study	Excluded	N/A	Excluded			

Mlynarska, Mlynarski, Golba, 2018	Frailty as a predictor of negative outcomes after cardiac resynchronization therapy	x	✓	✓	All reviewers have agreed to exclude as the minimum age is < 60. This was initially missed by reviewer 2 and 3	Excluded	N/A	Excluded			
Molina-Garrido, Guillén-Ponce, 2012	Ability of the comprehensive geriatric assessment to predict frailty in older people diagnosed with cancer in a general hospital	x	✓	✓	All reviewers have agreed to exclude due to the lack of a validated operational definition for the classification of frailty. This was initially missed by reviewer 2 and reviewer 3	Excluded	N/A	Excluded			
Monacelli et al., 2017	Validation of the photography method for nutritional intake assessment in hospitalized elderly subjects	x	x	x	N/A	Excluded	N/A	Excluded			
Monacelli et al., 2018	Delirium, Frailty, and Fast-Track Surgery in Oncogeriatrics: Is There a Link?	?	✓	✓	All reviewers have agreed to contact author as per contact author form. Reviewer 2 and Reviewer 3 initially included but have agreed now to contact author to see if information exists relating to the prevalence of frailty	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Monacelli et al., 2017	Evaluation of prognostic indices in elderly hospitalized patients	x	x	x	N/A	Excluded	N/A	Excluded			
Moorhouse, Mallery, 2012	Palliative and therapeutic harmonization: A model for appropriate decision-making in frail older adults	x	x	x	N/A	Excluded	N/A	Excluded			
Mor, Papandonatos, Miller, 2005	End-of-life hospitalization for African American and non-latino white nursing home residents: Variation by race and a facility's racial composition	x	x	x	N/A	Excluded	N/A	Excluded			
Morin et al., 2012	Evaluation of adherence to recommendations within 3 months after comprehensive geriatric assessment by an inpatient geriatric consultation team	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Morisaki et al., 2017	Influence of frailty on treatment outcomes after revascularization in patients with critical limb ischemia	?	x	?	All reviewers agree to contact the study authors to confirm the minimum age of participants. Initially reviewer 2 wished to exclude as minimum age was not stated, while reviewer 1 and 3 wished to seek additional information to clarify.	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Morton et al.,2018	Is Frailty a Predictor of Outcomes in Elderly inpatients with Acute Kidney Injury? A Prospective Cohort Study	✓	✓	✓	N/A	Included	N/A	Included			
Mosquera et al., 2016	Impact of frailty on surgical outcomes: The right patient for the right procedure	x	?	x	All reviewers have agreed to exclude due to the minimum age of participants being < 65 years, and not utilising a validated operational definition for the classification of frailty. Reviewer 2 initially wished to contact authors to confirm when frailty was assessed however now agrees to exclude on the above basis.	Excluded	N/A	Excluded			
Mottershead et al., 2017	Under-diagnosed cognitive impairment in renal inpatients - A single centre qip experience	?	✓	?	Reviewer 2 included after only screening abstract. All reviewers have agreed to obtain full text as per the requirements of full text screening	Contact authors	Yes - All reviewers agree to exclude as the authors have confirmed that a full published text is not available in this regard	Excluded			
Mottillo et al., 2015	Frailty as a predictor of repeat emergency department visits and disability in the elderly: a pilot study	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Moug et al., 2016	Frailty and cognitive impairment: Unique challenges in the older emergency surgical patient	x	x	x	N/A	Excluded	N/A	Excluded			
Moulis et al., 2015	Exposure to Atropinic Drugs and Frailty Status	x	x	x	N/A	Excluded	N/A	Excluded			
Muessig et al., 2018#	Clinical Frailty Scale (CFS) reliably stratifies octogenarians in German ICUs: a multicentre prospective cohort study	✓	✓	✓	N/A	Included	N/A	Included			
Muldoon et al., 2017	Frail Elderly Pilot Programme Connolly Hospital Blanchardstown 2016	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Muller et al.,2017	Impaired nutritional status in geriatric trauma patients	✓	✓	✓	N/A	Included	N/A	Included			
Mullie et al., 2018	Phase Angle as a Biomarker for Frailty and Postoperative Mortality: The BICS Study	x	x	✓	All reviewers have agreed to contact authors to ascertain if information exists relating to the minimum age of participants. Reviewer 1 and reviewer 2 initially excluded they believed minimum age was < 65.	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Myers et al.,2013	Exposure to particulate air pollution and long-term incidence of frailty after myocardial infarction	x	x	x	N/A	Excluded	N/A	Excluded			
Myint et al., 2018	Is anemia associated with cognitive impairment and delirium among older acute surgical patients?	✓	✓	✓	N/A	Included	N/A	Included			
Myint et al., 2016	The prevalence of hyperglycaemia and its relationship with mortality, readmissions and length of stay in an older acute surgical population: a multicentre study	?	✓	✓	All reviewers have agreed to contact the authors as per the contact author form to inquire if this study utilised a sub-sample of the sample utilised in Myint et al. 2018 - "Is anemia associated with cognitive impairment and delirium among older acute surgical patients?". The fact that this may be the case was initially missed by reviewer 2 and reviewer 3	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that there is overlap in the sample reported on within this paper and that of Myint et al. 2018 - "Is anaemia associated with cognitive impairment and delirium among older acute surgical patients"	Excluded			
Mzoughi et al., 2018	Early outcomes of cardiac surgery in elderly patients	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as upon review of the full text provided by the author, a clearly defined and validated operational definition for the classification of frailty was not utilised. The prevalence of frailty was also not reported.	Excluded			
Nct, 2018	PRehabilitiation in Elective Frail and Elderly Cardiac Surgery PaTients	?	x	?	All reviewers have agreed to exclude due to a minimum age < 65. This is a protocol paper, which reviewer 1 and reviewer 3 initially wished to contact the authors regarding whether a full text or preliminary data exists. Reviewer 2 initially wished to exclude due to this paper being a protocol paper	Excluded	N/A	Excluded			
Nemoto et al., 2012	Assessment of vulnerable older adults' physical function according to the Japanese Long-Term Care Insurance	x	x	✓	All reviewers have agreed to exclude due to the study not occurring in a hospital setting in hospital inpatients. Reviewer 3 initially missed this but now agrees to exclude	Excluded	N/A	Excluded			

	(LTCI) system and Fried's criteria for frailty syndrome										
Neuman et al., 2013	Surgical treatment of colon cancer in patients aged 80 years and older: Analysis of 31,574 patients in the SEER-Medicare database	?	x	x	All reviewers have agreed to contact the authors as per the contact author form	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Neuman et al., 2013	Predictors of Short-Term Postoperative Survival after Elective Colectomy in Colon Cancer Patients ≥80 Years of Age	?	x	x	All reviewers have agreed to contact authors as per contact author form. Initially reviewer 2 excluded as he believed patients were all outpatients, and reviewer 3 initially excluded due to patients being a specific clinical population. All reviewers agree to include based on these criteria as inpatients are included within the sample and specific clinical populations can be included.	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Newcomer, Steiner, Bayliss, 2011	Identifying Subgroups of Complex Patients With Cluster Analysis	x	x	x	N/A	Excluded	N/A	Excluded			
Newton et al., 2016	Acute heart failure admissions in New South Wales and the Australian Capital Territory: the NSW HF Snapshot Study	x	x	x	N/A	Excluded	N/A	Excluded			
Ng et al., 2016	Colorectal cancer outcomes in patients aged over 85 years	x	x	x	N/A	Excluded	N/A	Excluded			
Nguyen et al., 2018	Postprandial hypotension in older survivors of critical illness	x	✓	x	All reviewers have agreed to exclude as assessments were not conducted in a hospital setting in hospital inpatients. This was initially missed by reviewer 2	Excluded	N/A	Excluded			
Nguyen, Cumming, Hilmer, 2016	Atrial fibrillation in older inpatients: are there any differences in clinical characteristics and pharmacological treatment between the frail and the non-frail?	✓	✓	✓	N/A	Included	N/A	Included			
Nguyen, Cumming, Hilmer, 2017	The Impact of Frailty on Mortality, Length of Stay and Re-hospitalisation in Older Patients with Atrial Fibrillation	x	✓	✓	All reviewers have agreed to exclude as this study consists of the same sample as Nguyen et al. 2016 - *Atrial fibrillation in older inpatients: are there any differences in clinical characteristics and pharmacological treatment between the frail and the non-frail?* which provides more information on this sample relevant to this review. The fact that these two studies consist of the same sample was initially missed by Reviewer 2 and Reviewer 3	Excluded	N/A	Excluded			
Nguyen et al., 2017	The impact of frailty on coagulation and responses to warfarin in acute older hospitalised patients with atrial fibrillation: a pilot study	x	✓	✓	All reviewers have agreed to exclude as this study consists of the same sample as Nguyen et al. 2016 - *Atrial fibrillation in older inpatients: are there any differences in clinical characteristics and pharmacological treatment between the frail and the non-frail?* which provides more information on this sample relevant to this review. The fact that these two studies consist of the same sample was initially missed by Reviewer 2 and Reviewer 3	Excluded	N/A	Excluded			
Nieman et al., 2018	Frailty, hospital volume, and failure to rescue after head and neck cancer surgery	x	x	?	All reviewers have agreed to exclude as the minimum age is < 65. This was initially missed by reviewer 3 who initially wished to contact authors to confirm minimum age	Excluded		Excluded			
Nightingale, Skonecki, Boparai, 2017	The impact of polypharmacy on patient outcomes in older adults with cancer	x	x	x	N/A	Excluded	N/A	Excluded			
Nipp et al., 2012	Role of Pain Medications, Consultants, and Other Services in Improved Pain Control of Elderly Adults with Cancer in Geriatric Evaluation and Management Units	x	x	x	N/A	Excluded	N/A	Excluded			
Nolan et al., 2016	Frailty and its association with rehabilitation outcomes in a post-acute older setting	✓	✓	x	All reviewers have agreed to include. Reviewer 3 initially excluded due to the phrasing convenience sample, but upon review of the full text with the other reviewers agrees that there was no bias in recruitment as patients were consecutively recruited over this timeframe	Included	N/A	Included			
Nouvenne et al., 2016	The prognostic value of high-sensitivity C-reactive protein and prealbumin for short-term mortality in acutely hospitalized multimorbid elderly patients: A prospective cohort study	?	x	x	Initially reviewer 3 excluded due to the lack of reporting as to the prevalence of frailty. Reviewer 2 initially excluded as he believed a validated tool was not utilised. All reviewers now agree to contact the authors as per contact author form	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that information is not available regarding the prevalence of frailty of all of those initially screened	Excluded			
Ntlholang et al., 2014	124 THE ROLE FRAILTY SYNDROME CAN PLAY IN SUPPORTING AND TARGETING RESOURCES IN OUR AGEING POPULATION - HIGH PREVALENCE OF FRAILTY SYNDROME IN A POPULATION ATTENDING THE DAY HOSPITAL	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
O'Shea et al., 2017	Malnutrition in hospitalised older adults: A multicentre observational study of prevalence, associations and outcomes	x	✓	✓	All reviewers have agreed to exclude as this present study consists of the same sample as Timmons et al. 2015 - "Dementia in older people admitted to hospital: a regional multi-hospital observational study of prevalence, associations and case recognition", which reports all data within this present study relevant to this review. As no difference existed in terms of the quantity of data relevant to the review, as Timmons et al. 2015 was published first, this is the study included in the review. The fact that these two papers report on the same sample was initially missed by Reviewer 2 and Reviewer 3.	Excluded	N/A	Excluded			
O'Caoimh et al., 2017	Integrating Care and Improving Flow for Frail Older Adults through the Development of an Acute Inpatient Frailty Service	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Ogawa et al., 2017	Impact of delirium on postoperative frailty and long term cardiovascular events after cardiac surgery	x	x	?	All reviewers have agreed to exclude due to the lack of a validated operational definition for the classification of frailty. Initially reviewer 2 wished to exclude due to minimum age < 65, while reviewer 3 wished to seek clarification on minimum age. However already excluded on the basis of the utilisation of a non-validated operational definition	Excluded	N/A	Excluded			
Oliphant et al., 2015	Colorectal Enhanced Recovery for Frail Elderly Patients With Cancer: Cancer/Surgical Oncology (GI) 0847	?	?	x	Reviewer 3 initially excluded due to the lack of a full text. All reviewers now agree to contact study authors to attempt to obtain the full text as per the requirements of full text screening	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Oliveira et al., 2013	Prevalence of frailty syndrome in old people in a hospital institution	✓	✓	✓	N/A	Included	N/A	Included			

Ommundsen et al., 2018	Preoperative geriatric assessment and tailored interventions in frail older patients with colorectal cancer: a randomized controlled trial	x	✓	x	All reviewers have agreed to exclude as participants were not hospital inpatients at the time of frailty assessment. Reviewer 2 initially missed this and believed participants were inpatients.	Excluded	N/A	Excluded			
Ommundsen et al., 2014	Frailty Is an Independent Predictor of Survival in Older Patients With Colorectal Cancer	?	✓	✓	All reviewers have agreed to contact authors as per contact author form	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
O'Neill et al., 2016	Do first impressions count? Frailty judged by initial clinical impression predicts medium-term mortality in vascular surgical patients*	?	?	✓	All reviewers have agreed to contact authors to confirm minimum age of participants. Reviewer 3 initially included based on mean age and standard deviation, but agrees it is not clear if minimum age is < 65, so has agreed to contact authors	Contact authors	Yes - All reviewers have agreed to excluded as the authors have confirmed that the minimum age was < 65 years	Excluded			
Onorati et al., 2014	Different impact of sex on baseline characteristics and major periprocedural outcomes of transcatheter and surgical aortic valve interventions: Results of the multicenter Italian OBSERVANT Registry	?	?	x	Reviewer 3 initially wished to exclude due to the lack of validated operational definition for the classification of frailty. Reviewer 1 and reviewer 2 wished to contact authors for clarification as to the frailty tool utilised as well as the minimum age of participants. All reviewers have agreed to contact the study authors as per the contact author form.	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Oo et al., 2013	Assessing frailty in the acute medical admission of elderly patients	x	✓	✓	All reviewers have agreed to contact authors to ascertain if the frailty tool utilised has been validated.	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Orford et al., 2016	Prevalence, goals of care and long-term outcomes of patients with life-limiting illness referred to a tertiary ICU	x	x	x	N/A	Excluded	N/A	Excluded			
Orford et al., 2017	Effect of communication skills training on outcomes in critically ill patients with life-limiting illness referred for intensive care management: A before-and-after study	x	x	x	N/A	Excluded	N/A	Excluded			
O'Riordan et al., 2017	Safer Transitions: Optimising Care and Function from Hospital to Home	?	?	?	N/A	Contact authors	N/A - A full text was located by the lead reviewer prior to contacting authors, and upon review all three reviewers have agreed on exclusion as this is a review article	Excluded			
Orvin et al., 2015	Efficacy and Safety of Transcatheter Aortic Valve Implantation in Aortic Stenosis Patients with Extreme Age	?	x	x	Initially reviewer 2 and reviewer 3 wished to exclude as a database was utilised and were unsure if these patients were inpatients. Upon review all reviewers agree to contact authors as per the contact author form to clarify if the modified frailty assessment tool utilised is validated.	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Öztürk et al., 2017	Quality of life and fall risk in frail hospitalized elderly patients	✓	✓	✓	N/A	Included	N/A	Included			
Pangilinan et al., 2017	The Timed Up and Go Test as a Measure of Frailty in Urologic Practice	x	x	x	N/A	Excluded	N/A	Excluded			
Papageorgiou et al., 2018	Frailty in elderly ICU patients in Greece: a prospective, observational study	✓	✓	✓	N/A	Included	N/A	Included			
Papakonstantinou et al., 2018	Frailty Status Affects the Decision for Long-Term Anticoagulation Therapy in Elderly Patients with Atrial Fibrillation	?	✓	✓	All reviewers have agreed to contact the author as per contact author form	Contact authors	Yes - All reviewers have agreed to include as the authors were able to provide information regarding the prevalence of frailty for those with a CFS score of 5 and above	Included			
Pareja, 2008	Do geriatric interventions in the Emergency Department reduce the need of Hospital admission of frail older adults? C45	?	?	?	N/A	Contact authors	No -All reviewers have agreed to exclude as a response to inquiry was not received from the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion *As there was only one author on this paper, the second email inquiry was resent to the author	Excluded			
Park et al., 2016	Prolonged Length of Stay after Esophageal Resection: Identifying Drivers of Increased Length of Stay Using the NSQIP Database	?	x	✓	All reviewers have agreed to contact the authors as per contact author form	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Parmar et al., 2017	Influence of frailty in older patients undergoing emergency laparotomy: a UK-based observational study	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to include as the authors confirmed that a full results manuscript for this protocol was presently in press in the annals of surgery (available imminently), and that all participants were inpatients at the time of frailty assessment	Included			
Partridge, Harari, Dhesi, 2012	Frailty in the older surgical patient: A review	x	x	x	N/A	Excluded	N/A	Excluded			
Pasqualetti et al., 2018	Degree of Peripheral Thyroxin Deiodination, Frailty, and Long-Term Survival in Hospitalized Older Patients	✓	✓	x	All reviewers have agreed to contact the authors to clarify if the operational definition of frailty utilised has been validated for the assessment of frailty specifically	Contact authors	Yes - All reviewers have agreed to include as the authors have confirmed that the operational definition of frailty utilised has been validated regarding predictive value regarding negative health outcomes aligned with frailty	Included			
Patel et al., 2018	Frailty and outcomes after myocardial infarction: Insights from the CONCORDANCE registry	✓	?	✓	All reviewers have agreed to contact authors to clarify if the operational definition of frailty utilised within the study is validated	Contact authors	Yes - All reviewers have agreed to include as the authors have confirmed that the operational definition of frailty utilised has been validated regarding predictive value related to negative health outcomes aligned with frailty	Included			
Paulson, Lichtenberg, 2013	Vascular depression: An early warning sign of frailty	x	x	x	N/A	Excluded	N/A	Excluded			

Pearl et al., 2017	Patient Frailty and Discharge Disposition Following Radical Cystectomy	x	x	x	N/A	Excluded	N/A	Excluded			
Peel et al., 2017	Frailty and adverse outcomes: impact of multiple bed moves for older inpatients	✓	✓	✓	N/A	Included	N/A	Included			
Peeters et al., 2018	Associations of Guideline Recommended Medications for Acute Coronary Syndromes With Fall-Related Hospitalizations and Cardiovascular Events in Older Women With Ischemic Heart Disease	✓	x	x	All authors have agreed to contact authors as per contact author form	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that participants were not inpatients	Excluded			
Pereira et al., 2010	How can we improve targeting of frail elderly patients to a geriatric day-hospital rehabilitation program?	x	x	x	N/A	Excluded	N/A	Excluded			
Perera et al., 2009	The impact of frailty on the utilisation of antithrombotic therapy in older patients with atrial fibrillation	✓	✓	✓	N/A	Included	N/A	Included			
Perna et al., 2017	Sarcopenia and sarcopenic obesity in comparison: prevalence, metabolic profile, and key differences. A cross-sectional study in Italian hospitalized elderly	?	?	✓	All reviewers agree to contact the study authors as per the contact author form. Initially reviewer 3 missed that the prevalence of frailty was not stated and that it is not explicitly stated when the frailty assessment was conducted	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that information does not exist relating to the prevalence of frailty defined by the validated original Edmonton Frailty scale classification.	Excluded			
Perna et al., 2017	Performance of Edmonton Frail Scale on frailty assessment: its association with multi-dimensional geriatric conditions assessed with specific screening tools	?	✓	✓	All reviewers have agreed to contact authors as per contact author form	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that information does not exist relating to the prevalence of frailty defined by the validated original Edmonton Frailty scale classification.	Excluded			
Pitkala et al., 2005	Prognostic significance of delirium in frail older people	x	x	x	N/A	Excluded	N/A	Excluded			
Pokharel, Stefan, Lindenauer, 2015	The Baystate Frailty Study - Prevalence of Frailty in a Cohort of Hospitalized Elderly Patients	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a full text does not presently exist relating to the data present within this meeting abstract	Excluded			
Polidoro et al.,2011	Frailty and disability in the elderly: A diagnostic dilemma	x	x	x	N/A	Excluded	N/A	Excluded			
Polidoro et al., 2013	Frailty in patients affected by atrial fibrillation	x	x	x	N/A	Excluded	N/A	Excluded			
Pollack et al., 2017	The Frailty Phenotype and Palliative Care Needs of Older Survivors of Critical Illness	✓	x	x	All authors have agreed to include. Initially Reviewer 2 excluded due to exclusion criteria utilised however now agrees on inclusion as agrees no bias exists in this context. Reviewer 3 initially excluded as he believed a convenience sample was utilised however upon review this was not the case.	Included	N/A	Included			
Ponzetti et al., 2014	Role of multidimensional assessment of frailty in predicting short-term outcomes in hospitalized cancer patients: results of a prospective cohort study	x	?	✓	All reviewers have agreed to exclude as the minimum age was > 65. This was initially missed by Reviewer 2 and Reviewer 3	Excluded	N/A	Excluded			
Poudel et al., 2016	Adverse Outcomes in Relation to Polypharmacy in Robust and Frail Older Hospital Patients	?	?	✓	All reviewers have agreed to contact authors as per contact author form	Contact authors	Yes - All reviewers have agreed to include as the authors were able to provide information regarding the prevalence of frailty	Included			
Poudel et al., 2014	Potentially Inappropriate Prescribing in Older Patients Discharged From Acute Care Hospitals to Residential Aged Care Facilities	?	?	✓	All reviewers have agreed to contact authors as per contact author form	Contact authors	Yes - All reviewers have agreed to exclude, as although the authors were able to provide information regarding the prevalence of frailty, the authors have confirmed that this study reports on a sub-sample of the sample reported on in Poudel et al. 2016 - "Adverse Outcomes in Relation to Polypharmacy in Robust and Frail Older Hospital Patients", which has been included in the review and contains more information relevant to the review than this present study	Excluded			
Provencher et al., 2016	Frail older adults with minor fractures show lower health-related quality of life (SF-12) scores up to six months following emergency department discharge	x	x	x	N/A	Excluded	N/A	Excluded			
Provencher et al., 2015	Decline in activities of daily living after a visit to a Canadian emergency department for minor injuries in independent older adults: Are frail older adults with cognitive impairment at greater risk?	x	x	x	N/A	Excluded	N/A	Excluded			
Prudon et al., 2016	Is gait speed improving performance of the EuroSCORE II for prediction of early mortality and major morbidity in the elderly?	?	x	?	Initially reviewer 2 excluded after only screening the abstract. All reviewers now agree to contact the authors to obtain the full text for screening as per the requirements of full text screening	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Pulignano et al., 2010	Usefulness of frailty profile for targeting older heart failure patients in disease management programs: a cost-effectiveness, pilot study	x	x	✓	All reviewers have agreed to exclude as participants were outpatients. This was initially missed by reviewer 3	Excluded	N/A	Excluded			
Purser et al., 2006	Identifying frailty in hospitalized older adults with significant coronary artery disease	✓	✓	✓	N/A	Included	N/A	Included			
Puts et al., 2011	Changes in functional status in older newly-diagnosed cancer patients during cancer treatment: A six-month follow-up period. Results of a prospective pilot study	x	x	x	N/A	Excluded	N/A	Excluded			
Raivio et al., 2006	Use of Inappropriate Medications and Their Prognostic Significance Among In-Hospital and Nursing Home Patients with and without Dementia in Finland	x	x	x	N/A	Excluded	N/A	Excluded			
Raveau et al., 2013	Comprehensive geriatric assessment in intensive care unit: A pilot study (pre-Seniorea)	?	?	x	Initially reviewer 3 excluded as the full text was not available. All reviewers agree to contact the study authors to attempt to obtain the full English text as per the requirements of full text screening	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Recoche et al., 2017	Potentially inappropriate prescribing in a population of frail elderly people	x	x	x	N/A	Excluded	N/A	Excluded			

Reeves et al., 2014	A novel rehabilitation intervention for older patients with acute decompensated heart failure: the rehab-HF pilot study	x	x	x	N/A	Excluded	N/A	Excluded			
Ridda et al., 2008	The challenges of clinical trials in the exclusion zone: The case of the frail elderly	x	x	x	N/A	Excluded	N/A	Excluded			
Ritchie et al., 1997	Nutritional status of urban homebound older adults	x	x	x	N/A	Excluded	N/A	Excluded			
Ritt et al., 2016	Prediction of one-year mortality by five different frailty instruments: A comparative study in hospitalized geriatric patients	?	✓	✓	All reviewers have agreed to contact authors as per contact author form as frailty does not report the prevalence of frailty. This was initially missed by reviewers 2 and 3	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Ritt et al., 2016	A comparison of frailty indexes based on a comprehensive geriatric assessment for the prediction of adverse outcomes	?	✓	✓	All reviewers have agreed to contact authors as per contact author form as study does not report the prevalence of frailty. This was initially missed by reviewers 2 and 3	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Ritt et al., 2015	Analysis of Rockwood et al's Clinical Frailty Scale and Fried et al's frailty phenotype as predictors of mortality and other clinical outcomes in older patients who were admitted to a geriatric ward	✓	✓	✓	N/A	Included	N/A	Included			
Ritt et al., 2017	High-technology based gait assessment in frail people: Associations between spatio-temporal and three-dimensional gait characteristics with frailty status across four different frailty measures	x	✓	✓	All authors have agreed to exclude as the authors did assess (or attempt to assess) the whole ward / clinical population or employ some form of randomised selection of participants. This was initially missed by reviewer 2 and 3. Upon review all reviewers agree to exclude	Excluded	N/A	Excluded			
Robinson et al., 2011	Frailty predicts increased hospital and six-month healthcare cost following colorectal surgery in older adults	?	✓	✓	All reviewers have agreed to contact authors as per contact author form	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Robinson et al., 2013	Simple frailty score predicts postoperative complications across surgical specialties	?	✓	✓	All reviewers have agreed to contact authors as per contact author form	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Rockwood et al., 2008	Reliability of the hierarchical assessment of balance and mobility in frail older adults	?	✓	x	All reviewers have agreed to contact author as per contact author form.	Contact authors	Yes - All reviewers have agreed to exclude as unfortunately the authors were unable to provide information regarding the prevalence of frailty within the inpatient cohort of the sample	Excluded			
Rodriguez-Pascual et al., 2016	The frailty syndrome and mortality among very old patients with symptomatic severe aortic stenosis under different treatments	✓	x	x	All reviewers have agreed to contact authors to confirm when frailty assessments were conducted in regard to inpatient status.	Contact authors	No - All reviewers have agreed to exclude as the authors have confirmed that participants were not hospital inpatients	Excluded			
Rodriguez-Pascual et al., 2017	The frailty syndrome is associated with adverse health outcomes in very old patients with stable heart failure: A prospective study in six Spanish hospitals	x	x	x	N/A	Excluded	N/A	Excluded			
Rogers et al., 2018	Clinical Frailty as an Outcome Predictor After Transcatheter Aortic Valve Implantation	?	?	✓	All reviewers have agreed to contact authors as per contact author form	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Romanowski et al., 2015	Frailty Score on Admission Predicts Outcomes in Elderly Burn Injury	?	x	✓	All reviewers have agreed to contact authors as per contact author form	Contact authors	Yes - All reviewers have agreed to exclude, as although the authors were able to provide information regarding the prevalence of frailty, these data were related to participants pre-admission frailty status, rather than their frailty status as inpatients. As such all reviewers have agreed to exclude.	Excluded			
Ronayne et al., 2016	250ADDRESSING THE ACUTE NEEDS OF THE OLDEST OLD IN A RURAL HOSPITAL: THE FRAIL ELDERLY ASSESSMENT TEAM (FEAT) PILOT PROJECT	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a full a full English text is not available (poster presentation)	Excluded			
Rose et al., 2014	Can frailty predict complicated care needs and length of stay?	✓	✓	x	All reviewers have agreed to include. Reviewer 3 initially excluded as he believed frailty prevalence was not reported. Upon review it is agreed that this is not the case	Included	N/A	Included			
Rossiter et al., 2016	52 THE ASSESSMENT OF FRAILTY IN ACUTE HOSPITALS: A COMPARISON OF THE FRIED FRAILTY SCORE, THE FRAIL SCALE AND GRIP STRENGTH MEASUREMENT	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to include as the authors were able to provide a published full text related to this data, which upon review, all reviewers agree is eligible for inclusion - Ibrahim et al. 2019 "The feasibility of assessing frailty and sarcopenia in hospitalised older people: a comparison of commonly used tools".	Included			
Rosted, Schultz, Sanders, 2016	Frailty and polypharmacy in elderly patients are associated with a high readmission risk	x	x	✓	All reviewers have agreed to exclude as a validated operational definition of frailty was not utilised. This was initially missed by reviewer 3.	Excluded	N/A	Excluded			
Rouge-Bugat et al., 2013	Impact of an oncogeriatric consulting team on therapeutic decision-making	✓	x	x	All reviewers have agreed to contact authors to confirm if the operational definition of frailty utilised has been validated	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that the operational definition of frailty utilised has not been validated	Excluded			
Roy, O'Sullivan, 2017	122Defining Stressors Leading to Acute Hospitalisation in Frail Older Adults	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Rozenberg et al., 2018	Frailty and clinical benefits with lung transplantation	x	x	x	N/A	Excluded	N/A	Excluded			
Runganga, Peel, Hubbard, 2014	Multiple medication use in older patients in post-acute transitional care: A prospective cohort study	x	x	x	N/A	Excluded	N/A	Excluded			
Ryan et al., 2013	Symptom burden, palliative care need and predictors of physical and	x	x	x	N/A	Excluded	N/A	Excluded			

	psychological discomfort in two UK hospitals										
Saarelainen et al., 2014	Potentially inappropriate medication use in older people with cancer: Prevalence and correlates	x	x	x	N/A	Excluded	N/A	Excluded			
Sabartés et al., 2003	Functional deterioration of the fragile elderly person with chronic respiratory pathology. A multidisciplinary evaluation	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Saber et al., 2016	Improving the diagnosis and recording of clinical frailty in the acute hospital setting. The introduction of "frailty tab" on the electronic discharge letter (EDL) template at MEHT	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a full text does not exist relating to this poster presentation	Excluded			
Sacco et al., 2018	A new frailty index as a risk predictor of morbidity and mortality: Its application in a surgery unit	x	?	✓	All authors have agreed to exclude as the minimum age was > 65. This was initially missed by reviewer 2 and 3. Reviewer 2 initially wanted to contact authors to determine when frailty assessments were conducted but now agrees to exclude as minimum age is < 65	Excluded	N/A	Excluded			
Sadarangani, Squires, 2014	Frailty as a predictive factor in geriatric trauma patient outcomes	x	x	?	All reviewers have agreed to exclude as the paper is a commentary paper. This was initially missed by reviewer 2 and 3. Reviewer 2 initially excluded after screening the paper for which the commentary relates to while reviewer 3 initially wished to contact study authors for full text. All reviewers now agree on exclusion as this is commentary paper of a study already within the full text screening	Excluded	N/A	Excluded			
Sadiq et al., 2018	Frailty Phenotypes and Relations With Surgical Outcomes: A Latent Class Analysis	x	?	x	All reviewers have agreed to exclude due to minimum age being < 65. This was initially missed by reviewer 2, who wished to contact the authors to clarify when frailty assessments were conducted	Excluded	N/A	Excluded			
Sahota et al., 2017	The Community In-reach Rehabilitation and Care Transition (CIRACT) clinical and cost-effectiveness randomisation controlled trial in older people admitted to hospital as an acute medical emergency	x	x	x	N/A	Excluded	N/A	Excluded			
Saia et al., 2016	Balloon aortic valvuloplasty as a bridge-to-decision in high risk patients with aortic stenosis: A new paradigm for the heart team decision making	?	?	x	All reviewers agree to contact authors as per contact author form. Initially reviewer 3 wished to exclude due to believing that the minimum age was < 65, however now agrees on contacting authors for clarification.	Contact authors	Yes - All reviewers have agreed to exclude as although the authors have confirmed that patients were inpatients at the time of frailty assessments, authors have also confirmed that the minimum age of participants was <65	Excluded			
Salter et al., 2015	Perceived frailty and measured frailty among adults undergoing hemodialysis: a cross-sectional analysis	x	x	x	N/A	Excluded	N/A	Excluded			
Saltvedt et al., 2002	Reduced mortality in treating acutely sick, frail older patients in a geriatric evaluation and management unit. A prospective randomized trial	?	x	x	Initially reviewer 2 wished to exclude as frailty was used as a screening tool and the tool used not validated. Now agrees that this distinction with regard to the former is not important or reason for exclusion. Reviewer 3 also initially excluded due to the belief that the operational definition of frailty was not validated. Upon review all reviewers agree to contact authors to clarify that the operational definition of frailty utilised is validated and see if information exists relating to the prevalence of frailty	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that the operational definition of frailty utilised has not been validated	Excluded			
Salvi, Morichi, Dessi-Fulgheri, 2010	The "Silver Code" and the Frail Elder in the Emergency Department	x	x	x	N/A	Excluded	N/A	Excluded			
Sanchez et al., 2011	Prevalence of geriatric syndromes and impact on clinical and functional outcomes in older patients with acute cardiac diseases	✓	✓	✓	N/A	Included	N/A	Included			
Sanchis et al., 2015	Usefulness of Clinical Data and Biomarkers for the Identification of Frailty After Acute Coronary Syndromes	✓	✓	✓	N/A	Included	N/A	Included			
Schaefer, 2006	An operational definition of frailty predicted death and other adverse outcomes in older women	x	?	x	Initially reviewer 2 could not locate the full text, while reviewer 3 wished to exclude due to the participants being outpatients. All reviewers now agree to exclude as this is a commentary paper. The paper for which this paper is commentary for is also conducted in outpatients.	Excluded	N/A	Excluded			
Schulkes et al., 2018	Multidisciplinary decision-making regarding chemotherapy for lung cancer patients-An age-based comparison	x	x	x	N/A	Excluded	N/A	Excluded			
Schulkes et al., 2017	Prognostic Value of Geriatric 8 and Identification of Seniors at Risk for Hospitalized Patients Screening Tools for Patients With Lung Cancer	x	x	✓	All reviewers have agreed to exclude as a validated operational definition for the classification of frailty was not utilised. This was initially missed by reviewer 3. Reviewer 2 also missed this but excluded due to the belief that patients were not inpatients. However, all reviewers now agree to additional clarification would be needed in this regard however already excluded on the basis of as lack of a validated operational definition for frailty	Excluded	N/A	Excluded			
Schultz, Rosted, Sanders, 2015	Frailty is associated with a history with more falls in elderly hospitalised patients	x	x	x	N/A	Excluded	N/A	Excluded			
Segal et al., 2017	Development of a Claims-based Frailty Indicator Anchored to a Well-established Frailty Phenotype	x	x	x	N/A	Excluded	N/A	Excluded			
Segal et al., 2009	Staphylococcus aureus colonization in the nasopharynx of nasogastric tube-fed patients in a long-term care facility	x	x	x	N/A	Excluded	N/A	Excluded			
Segal et al., 2000	Barium enema in frail elderly patients	x	x	x	N/A	Excluded	N/A	Excluded			
Sepehripour et al., 2018	Life expectancy in elderly patients following burns injury	?	?	✓	All reviewers have agreed to contact authors as per contact author form. Reviewer 2 initially could not find full text and wished to contact authors for full text, however upon discussion and review of full text agrees to contact authors in the above regard	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that the operational definition of frailty utilised has not been validated	Excluded			
Sevilla-Sanchez et al., 2018	Potentially inappropriate medication in palliative care patients according to STOPP-Frail criteria	x	?	✓	All reviewers have agreed to exclude due to the lack of a validated operational definition for the classification of frailty. This was initially missed by reviewer 2 (JA) and reviewer 3 (EA)	Excluded	N/A	Excluded			
Shah et al., 2017	Comparison of bedside screening methods for frailty in older adult trauma patients	x	✓	✓	All Reviewers have agreed to excluded as participants were not hospital inpatients at the time of frailty assessments. This was initially missed by Reviewer 2 and 3	Excluded	N/A	Excluded			
Shahar et al., 2001	High prevalence and impact of subnormal serum vitamin B 12 levels in Israeli elders admitted to a Geriatric Hospital	?	?	?	N/A	Contact authors	No -All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there	Excluded			

							remains insufficient data in this regard to facilitate inclusion				
Shiraishi, 2015	Relationships between frailty and outcomes following to emergency transportation in elderly patients in Rural Area	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as unfortunately no response was received from the author. *As there was only one author on this conference paper, a follow-up email was resent to the corresponding author as the second email inquiry	Excluded			
Sikder et al., 2018	Postoperative Recovery in Frail, Pre-frail, and Non-frail Elderly Patients Following Abdominal Surgery	✓	✓	✓	N/A	Included	N/A	Included			
Simms, Irani, Schiff, 2014	38 HEART FAILURE IN THE OLDER PERSON: IS THERE STILL A PLACE FOR THE GERIATRICIAN?	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response was not received from either author to the email inquiry. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Singh et al., 2012	Predictors of adverse outcomes on an acute geriatric rehabilitation ward	?	x	✓	All reviewers have agreed to contact authors as per contact author form	Contact authors	No - All reviewers have agreed to exclude as a response was not received from either author to the email inquiry. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Sirois et al., 2017	Measuring Frailty Can Help Emergency Departments Identify Independent Seniors at Risk of Functional Decline After Minor Injuries	x	x	x	N/A	Excluded	N/A	Excluded			
Sirven, Rapp, 2017	The Dynamics of Hospital Use among Older People Evidence for Europe Using SHARE Data	x	x	x	N/A	Excluded	N/A	Excluded			
Siu et al., 1996	Postdischarge Geriatric Assessment of Hospitalized Frail Elderly Patients	x	x	x	N/A	Excluded	N/A	Excluded			
Slee, Birch, Stokoe, 2015	A comparison of the malnutrition screening tools, MUST, MNA and bioelectrical impedance assessment in frail older hospital patients	x	x	x	N/A	Excluded	N/A	Excluded			
Slee, Birch, Stokoe, 2015	Bioelectrical impedance vector analysis, phase-angle assessment and relationship with malnutrition risk in a cohort of frail older hospital patients in the United Kingdom	x	x	x	N/A	Excluded	N/A	Excluded			
Small et al., 2016	147FRAILTY IN AN EMERGENCY DEPARTMENT: PREDICTORS AND POINT PREVALENCE OF FRAILTY AND PRE-FRAILTY IN AN IRISH COHORT	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response was not received from either author to the email inquiry. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Smets et al., 2014	Four screening instruments for frailty in older patients with and without cancer: a diagnostic study	x	?	✓	All reviewers have agreed to contact authors to clarify if frailty assessments in the cancer cohort of the sample were conducted while they were inpatients.	Contact authors	Yes - All reviewers have agreed to exclude, as while the authors have confirmed that frailty assessments were conducted, mostly during hospitalisation (though not always), the authors were unable to provide information regarding the prevalence of frailty solely within these participants assessed during inpatient hospitalisation, or clarification as to the reasons why all participants were not assessed during hospitalisation	Excluded			
Soler et al., 2016	Visual impairment screening at the Geriatric Frailty Clinic for Assessment of Frailty and Prevention of Disability at the Gérontopôle	x	✓	x	All reviewers have agreed to exclude as the participants were not hospital inpatients. Reviewer 2 initially missed this	Excluded	N/A	Excluded			
Soong et al., 2015	Quantifying the prevalence of frailty in English hospitals	x	x	x	N/A	Excluded	N/A	Excluded			
Souwer et al., 2018	Risk stratification for surgical outcomes in older colorectal cancer patients using ISAR-HP and G8 screening tools	x	✓	✓	All reviewers have agreed to exclude as a validated operational definition for the classification of frailty was not utilised. This was initially missed by Reviewer 2 and Reviewer 3	Excluded	N/A	Excluded			
Stapleton, 2017	Role of the Dietitian within the Frail Elderly Pilot in Connolly Hospital Blanchardstown from February to June 2016	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as unfortunately no response was received from the author. *As there was only one author on this conference paper, a follow-up email was resent to the corresponding author as the second email inquiry	Excluded			
Stiffler et al., 2013	Frailty assessment in the emergency department	x	x	x	N/A	Excluded	N/A	Excluded			
Storti et al., 2013	Frailty of elderly patients admitted to the medical clinic of an emergency unit at a general tertiary hospital	x	?	x	Initially reviewer 2 could not locate the full text in English. Upon review all authors agree to exclude as the minimum age is < 65	Excluded	N/A	Excluded			
Subbe et al., 2015	Relationship between input and output in acute medicine - secondary analysis of the Society for Acute Medicine's benchmarking audit 2013 (SAMBA '13)	x	x	x	N/A	Excluded	N/A	Excluded			
Suemoto, 2016	Towards a unified and standardized definition of the frailty phenotype	x	x	?	Initially reviewer 3 could not locate the full text. Upon review all reviewers agree to exclude as the paper is an editorial	Excluded	N/A	Excluded			
Sullivan et al., 2001	Progressive resistance muscle strength training of hospitalized frail elderly	?	x	x	Reviewer 1 initially could not locate full text. Initially reviewer 2 and reviewer 3 wished to exclude based on the minimum age being < 65. Upon review this is not the case. All reviewers now agree to exclude as a clearly defined and validated operational definition of frailty was not utilised, and the prevalence of frailty was not reported	Excluded	N/A	Excluded			
Sundermann et al., 2011	One-year follow-up of patients undergoing elective cardiac surgery assessed with the Comprehensive Assessment of Frailty test and its simplified form	?	✓	✓	All reviewers have agreed to contact authors as per contact author form	Contact authors	Yes - All reviewers have agreed to include as the authors have confirmed that all participants were inpatients	Included			

Suskind et al., 2016	Preoperative Frailty Is Associated With Discharge to Skilled or Assisted Living Facilities After Urologic Procedures of Varying Complexity	x	x	✓	All reviewers have agreed to exclude as an attempt was not made to screen the whole ward / clinical population. This was initially missed by Reviewer 3 who wished to include the study, and Reviewer 2 initially excluded due to the belief that participants were not hospital inpatients. Upon Reviewer all reviewers agree that the participants were hospital inpatients, however the study is still excluded as an attempt was not made to screen the whole ward / clinical population	Excluded	N/A	Excluded			
Suskind et al., 2017	Frailty and the Role of Obliterative versus Reconstructive Surgery for Pelvic Organ Prolapse: A National Study	x	x	x	N/A	Excluded	N/A	Excluded			
Sze et al., 2017	Prognostic value of simple frailty and malnutrition screening tools in patients with acute heart failure due to left ventricular systolic dysfunction	?	✓	✓	All reviewers have agreed to contact authors as per author contact form	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that the minimum age of participants was <65 years	Excluded			
Tanaka et al., 2017	Effects of Acute Phase Intensive Electrical Muscle Stimulation in Frail Elderly Patients With Acute Heart Failure (ACTIVE-EMS): rationale and protocol for a multicenter randomized controlled trial	x	?	?	All reviewers have agreed to exclude as this is a protocol paper of a paper which does not utilise a validated operational definition for the classification of frailty	Excluded	N/A	Excluded			
Tavares et al., 2016	Cardiovascular risk factors associated with frailty syndrome among hospitalized elderly people: a cross-sectional study	x	x	x	N/A	Excluded	N/A	Excluded			
Tavassoli et al., 2014	Description of 1, 108 older patients referred by their physician to the "Geriatric Frailty clinic (G.F.C) for assessment of frailty and prevention of disability" at the gerontopole	x	x	x	N/A	Excluded	N/A	Excluded			
Tay et al., 2017	Prevalence of frailty and its association with the composite outcome of mortality at 90-day and readmission at 30-day in older surgical patients	?	?	x	Initially reviewer 3 excluded as the full text was not available. All reviewers now agree to contact the study authors to attempt to obtain the full text as per the requirements of full text screening	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a full text does not exist relating to this poster abstract	Excluded			
Thai et al., 2015	Prevalence of Potential and Clinically Relevant Statin–Drug Interactions in Frail and Robust Older Inpatients	✓	✓	✓	N/A	Included	N/A	Included			
Thourani et al., 2016	Impact of Preoperative Chronic Kidney Disease in 2,531 High-Risk and Inoperable Patients Undergoing Transcatheter Aortic Valve Replacement in the PARTNER Trial	?	?	x	Initially reviewer 3 excluded based on not stating the prevalence of frailty. All reviewers now wish to contact the study authors as per the contact author form.	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Ticinesi et al., 2016	Lung ultrasound and chest x-ray for detecting pneumonia in an acute geriatric ward	?	x	✓	All authors have agreed to contact the authors as per the contact author form to inquire if information is available regarding the prevalence of frailty of the entire sample. Reviewer 2 initially excluded as he believed the sample was not of the whole ward, however, now agrees can be used for stratified analysis based on specific population	Contact authors	Yes - All reviewers have agreed to include as the authors were able to provide information regarding the prevalence of frailty for the entire sample	Included			
Ticinesi et al., 2016	An investigation of multimorbidity measures as risk factors for pneumonia in elderly frail patients admitted to hospital	?	?	✓	All reviewers have agreed to contact authors as per contact author form	Contact authors	No - All reviewers have agreed to exclude as the authors have confirmed that information is not available regarding the prevalence if frailty for the entire sample of all patients admitted patients over the duration of the study	Excluded			
Timmons et al., 2015	Dementia in older people admitted to hospital: a regional multi-hospital observational study of prevalence, associations and case recognition	✓	✓	✓	N/A	Included	N/A	Included			
Tran et al., 2018	Association of frailty and long-term survival in patients undergoing coronary artery bypass grafting	x	x	✓	All authors have agreed to excluded as minimum age is < 65 and the sample consisted of community-dwelling participants.	Excluded	N/A	Excluded			
Tsai et al., 2014	Fall injuries and related factors of elderly patients at a medical center in Taiwan	?	x	x	All reviewers have agreed to contact authors as per contact author form. Initially reviewer 2 excluded as he believed the participants were not hospital inpatients, while reviewer 3 excluded as he believed a clearly defined and validated operational definition for the classification of frailty was not utilised.	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Uchmanowicz, Gobbens, 2015	The relationship between frailty, anxiety and depression, and health-related quality of life in elderly patients with heart failure	x	x	x	N/A	Excluded	N/A	Excluded			
Valentini et al., 2018	Frailty and nutritional status in older people: the Mini Nutritional Assessment as a screening tool for the identification of frail subjects	✓	✓	✓	N/A	Included	N/A	Included			
Valenza et al., 2016	Results of an exercise intervention in frail older patients with acute exacerbation of COPD	?	?	?	N/A	Contact authors	No - Although a response was not received from the study authors to either of the initial email inquiries regarding the procurement of a potential full text from this conference abstract, the authors were ultimately successful in locating a full text online. Upon screening of the full text, all reviewers have agreed to exclude as a validated operational definition for the classification of frailty was not utilised.	Excluded			
Van Der Ven et al., 2015	Unplanned readmissions of frail elderly patients: A retrospective analysis of admissions in a teaching hospital Objective: To assess the prevalence and predictors of readmission in patients of 65 years or older	?	?	x	Initially reviewer 3 excluded as he could not obtain the full text in English. All reviewers now agree to contact the study authors to attempt to obtain the full English text for screening as per the requirements of full text screening	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that an English full text does not exist related to this study	Excluded			
Van Kempen et al., 2014	Construct validity and reliability of a two-step tool for the identification of frail older people in primary care	x	x	x	N/A	Excluded	N/A	Excluded			
van Kempen et al., 2015	Diagnosis of Frailty after a Comprehensive Geriatric Assessment: Differences between Family Phyisicans and Geriatricians	x	x	x	N/A	Excluded	N/A	Excluded			
van Loon et al., 2017	Frailty screening tools for elderly patients incident to dialysis	x	✓	x	All reviewers have agreed to exclude as frailty assessments were not conducted during an inpatient stay	Excluded	N/A	Excluded			
Van Munster et al., 2016	Discriminative value of frailty screening instruments in end-stage renal disease	x	✓	x	All reviewers have agreed to exclude as minimum age is < 65. Initially reviewer 2 included as he was unsure if stratified analysis of age groups could be employed. There is now unanimous consensus to exclude.	Excluded	N/A	Excluded			

Vandewoude et al., 2006	A screening tool to identify older people at risk of adverse health outcomes at the time of hospital admission	x	x	✓	All reviewers have agreed to exclude as a validated operational definition was not utilised. This was initially missed by reviewer 3	Excluded	N/A	Excluded			
Venkat et al., 2018	Frailty Predicts Morbidity and Mortality after Colectomy for Clostridium difficile Colitis	x	?	x	Initially reviewer 2 could not locate the full text. Upon review all reviewers agree to excluded on the basis of minimum age being < 65.	Excluded	N/A	Excluded			
Vergara et al., 2016	Wrist fractures and their impact in daily living functionality on elderly people: a prospective cohort study	x	x	x	N/A	Excluded	N/A	Excluded			
Verloo et al., 2016	Association between frailty and delirium in older adult patients discharged from hospital	?	x	x	Initially reviewer 2 wished to exclude as he believed a representative sample of the ward was not recruited. Upon review he agrees this is not the case. Reviewer 1 initially wished to contact study authors to clarify when frailty assessments were conducted. Upon review all reviewers agree to exclude on the basis that frailty assessments were conducted while participants were no longer inpatients	Excluded	N/A	Excluded			
Vidán et al., 2014	FRAIL-HF, a study to evaluate the clinical complexity of heart failure in nondependent older patients: Rationale, methods and baseline characteristics	✓	✓	✓	N/A	Included	N/A	Included			
Vidan et al., 2013	Prevalence of frailty in elderly non-dependent patients hospitalized for heart failure, and characteristics of frail patients	?	?	✓	All reviewers have agreed to contact authors as per contact author form to obtain full text. Reviewer 3 included after only screening abstract. All reviewers have agreed to obtain full text as per the requirements of full text screening	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed the full text that this abstract relates to is already included within the review (Vidan et al. 2014)	Excluded			
Vidan et al., 2016	Prevalence and prognostic impact of frailty and its components in non-dependent elderly patients with heart failure	x	✓	✓	All authors have agreed to exclude as consists of the same sample as Vidan et al. 2014 - "FRAIL-HF, a study to evaluate the clinical complexity of heart failure in nondependent older patients: Rationale, methods and baseline characteristics" which contains more information relevant to the review. This was initially missed by Reviewer 2 and Reviewer 3.	Excluded	N/A	Excluded			
Wahl et al., 2017	Association of the Modified Frailty Index With 30-Day Surgical Readmission	x	✓	x	All reviewers have agreed to exclude as minimum age is < 65. Initially reviewer 2 included as he was unsure if stratified analysis of age groups could be employed. There is now unanimous consensus to exclude.	Excluded	N/A	Excluded			
Wakefield, 1996	Prevalence, incidence, risk factors and short-term outcomes for hospitalized elderly patients experiencing acute confusion	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that this title relates to the title of a dissertation. The authors have provided all the published papers originating from this dissertation as well as the means to locate the original, none of which contains data, which is eligible for inclusion in the review, due to the lack of a clearly defined and validated operational definition for the classification of frailty, and lack of reporting regarding the prevalence of frailty.	Excluded			
Wall, Wallis, 2014	109 CAN A FRAILTY SCALE BE USED TO TRIAGE ELDERLY PATIENTS FROM EMERGENCY DEPARTMENT TO GERIATRIC WARDS?	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Wall, Wallis, 2014	41 FRAILTY IN THE EMERGENCY DEPARTMENT: ARE BED ALLOCATION PRESSURES PRIORITISED OVER PATIENT FRAILTY IN THE ALLOCATION OF GERIATRIC BEDS?	?	?	?	N/A	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Wang et al., 2015	Incidence and effects of polypharmacy on clinical outcome among patients aged 80+: A five-year follow-up study	x	x	x	N/A	Excluded	N/A	Excluded			
Warnier et al., 2016	Validity, reliability and feasibility of tools to identify frail older patients in inpatient hospital care: A systematic review	x	x	x	N/A	Excluded	N/A	Excluded			
Warnier et al., 2017	The Maastricht Frailty Screening Tool for Hospitalised Patients (MFST-HP) to Identify Non-Frail Patients	x	✓	✓	All Reviewers have agreed to exclude as a validated operational definition for the classification of frailty was not utilised (Maastricht Frailty Screening Tool for Hospitalised Patients (MFST-HP) is a frailty indicator, but not itself an operational definition. This was initially missed by Reviewer 2 and Reviewer 3. Upon Review all reviewers have agreed to exclude	Excluded	N/A	Excluded			
Westgård et al., 2018	Comprehensive geriatric assessment pilot of a randomized control study in a Swedish acute hospital: A feasibility study	?	✓	✓	All reviewers have agreed to contact authors enquire if some form of randomised selection pf participants was employed with regard to the initial approach to participate	Contact authors	No - All reviewers have agreed to exclude as the authors have confirmed that a randomised selection of participants was not employed with regard to the initial approach of participants	Excluded			
Williams et al., 2017	Frailty and skeletal muscle in older adults with cancer	x	x	x	N/A	Excluded	N/A	Excluded			
Winograd et al., 1998	Targeting the hospitalized elderly for geriatric consultation	x	x	✓	All reviewers have agreed to contact authors to confirm if the operational definition of frailty utilised has been validated and if information exists relating to the prevalence of frailty	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion	Excluded			
Wong et al., 2010	Outcomes of Geriatric Evaluation and Management Unit on functional improvement, mortality, and readmission among frail older patients at the Modbury Hospital: O43	?	?	?	N/A	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a full text does not exist related to this abstract	Excluded			
Woodard et al., 2014	39 FRAILTY IDENTIFICATION IN ACUTE MEDICAL ADMISSIONS	?	?	✓	All reviewers have agreed to contact authors to obtain full text. Reviewer 3 included after only screening abstract. All reviewers have agreed to obtain full text as per the requirements of full text screening	Contact authors	Yes - All reviewers have agreed to exclude as the authors have confirmed that a full text does not exist related to this abstract	Excluded			
Wou et al., 2013	The predictive properties of frailty-rating scales in the acute medical unit	✓	?	✓	Reviewer 2 initially could not find locate full text. Upon review all reviewers have agreed to include	Included	N/A	Included			
Yagi et al., 2018	Impact of Frailty and Comorbidities on Surgical Outcomes and Complications in Adult Spinal Disorders	x	x	x	N/A	Excluded	N/A	Excluded			
Yamada et al., 2016	The frailty-based prognostic criteria in heart failure patients. A multicenter prospective cohort study (FLAGSHIP study): design and preliminary data	?	?	x	Reviewer 3 initially excluded as this is a conference abstract. Upon review all reviewers agree to contact study authors as per the contact author form to see if a full text exists relating to this data or if preliminary data exists	Contact authors	No - All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there	Excluded			

							remains insufficient data in this regard to facilitate inclusion				
Yang et al., 218	Comparison of procalcitonin, a potentially new inflammatory biomarker of frailty, to interleukin-6 and C-reactive protein among older Chinese hospitalized patients	x	x	?	All reviewers have agreed to exclude due to the minimum age being < 65. This was initially missed by reviewer 3 who wished to contact the study authors to confirm minimum age	Excluded	N/A	Excluded			
Young et al., 2005	A prospective baseline study of frail older people before the introduction of an intermediate care service	x	x	✓	All reviews have agreed to exclude as a validated operational definition of frailty was not utilised. This was initially missed by reviewer 3.	Excluded	N/A	Excluded			
Zhang et al., 2018	Risk factors for falls in older patients with cancer	x	x	x	N/A	Excluded	N/A	Excluded			
Zulfiqar, 2018	Identification of frailty by the use of the SEGAm scale (part A) in geriatrical consultation	?	?	x	Reviewer 3 initially excluded due to not being able to locate full text. All authors have now agreed to contact study authors to attempt to obtain the full text in English for screening as per the requirements of full text screening	Contact authors	All reviewers have agreed to exclude as the authors have confirmed that a full English text is not available (article only available in French)	Excluded			
Zulfiqar et al., 2017	Anemia in the elderly: study of links with geriatric criteria	?	?	?	N/A	Contact authors	All reviewers have agreed to exclude as the authors have confirmed that a full English text is not available (article only available in French)	Excluded			

Appendix 2.5. Full text screening excluded studies, with reasons

Full text screening excluded studies with reasons			
Author(s) / Year	**Title**	**Reason for exclusion**	**Additional information**
A et al., 2018	Correlation of pre-surgery frailty related measurements with post transplant outcomes in patients after lung transplantation	Minimum age < 65	N/A
Abdel-Kader et al., 2018	Acute Kidney Injury and Subsequent Frailty Status in Survivors of Critical Illness: A Secondary Analysis	Minimum age < 65	N/A
Abt et al., 2016	Assessment of the Predictive Value of the Modified Frailty Index for Clavien-Dindo Grade IV Critical Care Complications in Major Head and Neck Cancer Operations	Minimum age < 65	N/A
Ad et al., 2016	The Effects of Frailty in Patients Undergoing Elective Cardiac Surgery	Did not occur within a hospital setting, in, or including hospital inpatients	Participants were not inpatients at the time of frailty assessments. Frailty assessments were conducted during outpatient visits prior to hospital admission
Adedayo et al., 2018	Preoperative frailty is a risk factor for non-home discharge in patients undergoing surgery for endometrial cancer	Minimum age < 65	N/A
Afilalo et al., 2014	Frailty assessment in the cardiovascular care of older adults	Other (Please elaborate in Column C to the right)	Review article
Ahc., 2016	Research Suggests Importance of Assessing Patients' Frailty, Pre-Surgery: Frailty is under-recognized	Other (Please elaborate in Column C to the right)	Not a research paper (Commentary)
Ahmed et al., 2012	The Role of an Acute Care for the Elderly Unit in Achieving Hospital Quality Indicators While Caring for Frail Hospitalized Elders	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Alabaf et al., 2018	Allocating patients to geriatric medicine wards in a tertiary university hospital in England: A service evaluation of the Specialist Advice for the Frail Elderly (SAFE) team	Other (Please elaborate in Column C to the right)	Excluded as study reports on a partial cohort of the sample reported by Keevil et al., 2018 - "*Care home residents admitted to hospital through the emergency pathway: characteristics and associations with inpatient mortality*", which reports data for all participants included in this present study, as well as additional participants relevant to this review, not reported within this study
Alfredsson et al., 2016	Gait speed predicts 30-day mortality after transcatheter aortic valve replacement: results from the Society of Thoracic Surgeons/American College of Cardiology Transcatheter Valve Therapy Registry	Did not use clearly defined and validated operation definition for the classification of frailty	Used gait speed alone which is not a validated operational definition for frailty, rather an indicator of frailty and forms part of several operational definitions but is not itself an operational definition. Also did not report the prevalence of frailty
Aliberti et al., 2018	Targeted Geriatric Assessment for Fast-Paced Healthcare Settings: Development, Validity, and Reliability	Minimum age < 65	Also did not occur in hospital inpatients (geriatric day hospital - outpatient clinic)
Al-Nammari et al., 2014	Fragility fractures of the ankle in the frail elderly patient: TREATMENT WITH A LONG CALCANEOTALOTIBIAL NAIL	Minimum age < 65	N/A
Alotaibi et al., 2018	Breast cancer mortality in Saudi Arabia: Modelling observed and unobserved factors	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not state minimum age, whether patients were inpatient, and did not report the prevalence of frailty.
Annoni, Mazzola, 2016	Real-world characteristics of hospitalized frail elderly patients with atrial fibrillation: can we improve the current prescription of anticoagulants?	Did not use clearly defined and validated operation definition for the classification of frailty	Did not use validated operational definition for the classification of frailty
Anzaldi et al., 2017	Comparing clinician descriptions of frailty and geriatric syndromes using electronic health records: a retrospective cohort study	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not occur solely in hospital inpatients and did not differentiate between the frailty status of different types of participants. However, did not use a clearly defined and validated operational definition for the classification of frailty and as such no need to contact authors to see if this information exists
Artaza-Artabe et al., 2016	The relationship between nutrition and frailty: Effects of protein intake, nutritional supplementation, vitamin D and exercise on muscle metabolism in the elderly. A systematic review	Other (Please elaborate in Column C to the right)	Review
Arya et al., 2015	Frailty increases the risk of 30-day mortality, morbidity, and failure to rescue after elective abdominal aortic aneurysm repair independent of age and comorbidities	Minimum age < 65	N/A
Astiz et al., 2015	Prevalence of frailty and impact on survival in elderly patients hospitalized for heart failure	Other (Please elaborate in Column C to the right)	Duplicate of Vidan et al., 2016 - "*Prevalence and prognostic impact of frailty and its components in non-dependent elderly patients with heart failure*"
Augustin et al., 2016	Frailty predicts risk of life-threatening complications and mortality after pancreatic resections	Minimum age < 65	N/A
Aydin et al., 2015	Improving hospital patient falls: Leveraging staffing characteristics and processes of care	Minimum age < 65	N/A
Ayesta et al., 2018	Rationale and design of the FELICITAR registry (Frailty Evaluation After List Inclusion, Characteristics and Influence on Transplantation and Results)	Minimum age < 65	Also outpatients
Bachrach-Lindström et al., 2000	Nutritional state and functional capacity among elderly Swedish people with acute hip fracture	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Bagshaw et al., 2014	Association between frailty and short- and long-term outcomes among critically ill patients: A multicentre prospective cohort study	minimum age < 65	N/A
Bagshaw et al., 2015	Long-term association between frailty and health-related quality of life among survivors of critical illness: a prospective multicenter cohort study	Minimum age < 65	N/A
Bakker et al., 2014	The carewell in hospital questionnaire: A measure of frail elderly inpatient experiences with individualized and integrated hospital care	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report frailty
Baldwin et al., 2017	Refining Low Physical Activity Measurement Improves Frailty Assessment in Advanced Lung Disease and Survivors of Critical Illness	Minimum age < 65	N/A
Bancu et al., 2017	Frail Patient in Hemodialysis: A New Challenge in Nephrology - Incidence in Our Area, Barcelonès Nord and Maresme	Minimum age < 65	Also outpatients
Baylis et al., 2015	Cachexia, sarcopenia, inflammaging and outcomes in hospitalised older people (the CaSIO study): Study protocol and preliminary results	Other (Please elaborate in Column C to the right)	Did not measure frailty until 6 month follow-up post discharge
Belga et al., 2016	Comparing three different measures of frailty in medical inpatients: Multicenter prospective cohort study examining 30-day risk of readmission or death	Minimum age < 65	N/A

Bethune et al., 2016	What happens when we do not operate? Survival following conservative bowel cancer management	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty (frailty was not measured)
Biagi et al., 2011	Clinical profile and predictors of in-hospital outcome in patients with heart failure: The FADOI "cONFINE" Study	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty (frailty was not measured)
Bieniek et al., 2016	Fried frailty phenotype assessment components as applied to geriatric inpatients	Minimum age < 65	N/A
Bo et al., 2017	Effects of oral anticoagulant therapy in older medical in-patients with atrial fibrillation: a prospective cohort observational study	Other (Please elaborate in Column C to the right)	Excluded as consists of the same cohort as Bo et al. 2015 - "*Health status, geriatric syndromes and prescription of oral anticoagulant therapy in elderly medical in-patients with atrial fibrillation: A prospective observational study*", which reports all data within this present study, and additional data relevant to this review
Bonaga et al., 2018	Frailty, Polypharmacy, and Health Outcomes in Older Adults: The Frailty and Dependence in Albacete Study	Did not occur within a hospital setting, in, or including hospital inpatients	Community-dwelling participants
Bonaventura et al., 2018	Levels of serum uric acid at admission for hypoglycaemia predict 1-year mortality	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty. It is also unclear if patients are inpatients, this would take further follow-up with authors to fully determine, however already excluded based on lack of a clearly defined and validated operational definition for the classification of frailty
Bone et al., 2016	Factors Associated with Transition from Community Settings to Hospital as Place of Death for Adults Aged 75 and Older: A Population-Based Mortality Follow-Back Survey	Did not occur within a hospital setting, in, or including hospital inpatients	N/A
Boxer et al., 2008	The association between vitamin D and inflammation with the 6-minute walk and frailty in patients with heart failure	Minimum age < 65	Also outpatients
Bras et al., 2015	Predictive value of the Groningen Frailty Indicator for treatment outcomes in elderly patients after head and neck, or skin cancer surgery in a retrospective cohort	Did not occur within a hospital setting, in, or including hospital inpatients	Assessments were conducted on outpatients
Brouns et al., 2014	Hyponatraemia in elderly emergency department patients: A marker of frailty	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty (frailty was not measured)
Brousseau et al., 2018	Identification of older adults with frailty in the Emergency Department using a frailty index: Results from a multinational study	Did not occur within a hospital setting, in, or including hospital inpatients	N/A
Brown et al., 2016	The Association between Preoperative Frailty and Postoperative Delirium after Cardiac Surgery	Minimum age < 65	Also frailty was measured pre-operatively as outpatients prior to surgery
Brown et al., 2000	Low-intensity exercise as a modifier of physical frailty in older adults	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients. Also did not use validated operational definition of frailty or report the prevalence of frailty
Brummel et al., 2017	Frailty and subsequent disability and mortality among patients with critical illness	Minimum age < 65	N/A
Bucholz et al., 2016	Underweight, Markers of Cachexia, and Mortality in Acute Myocardial Infarction: A Prospective Cohort Study of Elderly Medicare Beneficiaries	Did not use clearly defined and validated operation definition for the classification of frailty	N/A
Buck et al., 2011	The impact of frailty on health related quality of life in heart failure	Minimum age < 65	N/A
Buttery, Martin, 2009	Knowledge, attitudes and intentions about participation in physical activity of older post-acute hospital inpatients	Did not use clearly defined and validated operation definition for the classification of frailty	Did not utilise a validated operational definition for the classification of frailty
Cabre et al., 2010	Prevalence and prognostic implications of dysphagia in elderly patients with pneumonia	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Cacciatore et al., 2013	Clinical frailty and long-term mortality in elderly subjects with diabetes	Did not occur within a hospital setting, in, or including hospital inpatients	Community-dwelling participants
Calle et al., 2018	Frailty Related Factors as Predictors of Functional Recovery in Geriatric Rehabilitation: The Sarcopenia and Function in Aging Rehabilitation (SAFARI) Multi-Centric Study	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Callen et al., 2004	Admission and Discharge Mobility of Frail Hospitalized Older Adults	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Cares Lay et al., 2013	Evolution of functional capacity of older people during hospital stay	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Carmeli, 2017	Frailty and primary sarcopenia: A review	Other (Please elaborate in Column C to the right)	Review article
Carneiro et al., 2017	Frailty in the elderly: prevalence and associated factors	Did not occur within a hospital setting, in, or including hospital inpatients	Community-dwelling participants
Cecile et al., 2009	Adverse drug events in hospitalized elderly in a Geriatric medicine unit: Study of prevalence and risk factors	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Cezar et al., 2017	Frailty in older adults with amnestic mild cognitive impairment as a result of Alzheimer's disease: A comparison of two models of frailty characterization	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients
Chapman et al., 2014	Development of a comprehensive multidisciplinary geriatric oncology center, the Thomas Jefferson university experience	Minimum age < 65	Also not in hospitalised inpatients (outpatients)
Chappidi et al., 2016	Frailty as a marker of adverse outcomes in patients with bladder cancer undergoing radical cystectomy	Minimum age < 65	N/A
Chong et al., 2010	Troponin I and NT-proBNP (N-terminal pro-Brain Natriuretic Peptide) Do Not Predict 6-Month Mortality in Frail Older Patients Undergoing Orthopedic Surgery	Did not use clearly defined and validated operation definition for the classification of frailty	N/A
Chong et al., 2018	Frailty in Hospitalized Older Adults: Comparing Different Frailty Measures in Predicting Short- and Long-term Patient Outcomes	Other (Please elaborate in Column C to the right)	Excluded as consists of the same sample as Chong et al. 2017 - "*Frailty and Risk of Adverse Outcomes in Hospitalized Older Adults: A Comparison of Different Frailty Measures*", which reports all data within this present study relevant to this review. As no difference existed in terms of the quantity of data relevant to the review, as Chong et al. 2017 was published first, this is the study included in the review
Chong et al., 2018	Frailty Predicts Incident Urinary Incontinence Among Hospitalized Older Adults—A 1-Year Prospective Cohort Study	Other (Please elaborate in Column C to the right)	Excluded as consists of the same sample as Chong et al. 2017 - "*Frailty and Risk of Adverse Outcomes in Hospitalized Older Adults: A Comparison of Different Frailty Measures*", which reports all data within this present study, and additional data relevant to this review
Clegg et al., 2016	Development and validation of an electronic frailty index using routine primary care electronic health record data	Did not occur within a hospital setting, in, or including hospital inpatients	N/A

Cohen et al., 2002	Frailty as Determined by a Comprehensive Geriatric Assessment-Derived Deficit-Accumulation Index in Older Patients With Cancer Who Receive Chemotherapy	Did not use clearly defined and validated operation definition for the classification of frailty	N/A
Cohen et al., 2016	A controlled trial of inpatient and outpatient geriatric evaluation and management	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients
Coleman et al., 2012	Factors associated with 'caregiver burden' for atrial fibrillation patients	Minimum age < 65	Did not use a clearly defined operational definition for the classification of frailty. Also not in inpatients
Comin-Colet et al., 2016	Impact on clinical events and healthcare costs of adding telemedicine to multidisciplinary disease management programmes for heart failure: results of a randomized controlled trial	Minimum age < 65	N/A
Congiusta, Palvannan, Merchant, 2017	The Impact of Frailty on Morbidity and Mortality following Open Emergent Colectomies	Minimum age < 65	N/A
Cooper et al., 2016	Comparison of Frailty Measures as Predictors of Outcomes After Orthopedic Surgery	Did not occur within a hospital setting, in, or including hospital inpatients	Frailty assessment conducted during outpatient appointment prior to admission
Cornali et al., 2009	Implementation of guidelines for type 2 diabetes mellitus in a post-acute geriatric setting	Minimum age < 65	N/A
Cron, D. C. et al., 2016	Depression and Frailty in Patients With End-Stage Liver Disease Referred for Transplant Evaluation	Minimum age < 65	N/A
Crotty et al., 2005	Transitional care facility for elderly people in hospital awaiting a long term care bed: randomised controlled trial	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
da Graça Oliveira Crossetti et al., 2018	Factors that contribute to a NANDA nursing diagnosis of risk for frail elderly syndrome	Minimum age < 65	N/A
Dana et al., 2017	Physical activity and frailty as indicators of cardiorespiratory reserve and predictors of surgical prognosis: General and digestive surgery population characterization	Minimum age < 65	Also patients were not inpatients (community-dwelling),
De Alfieri et al., 2013	Thyroid Hormones as Predictors of Short- and Long-term Mortality in Very Old Hospitalized Patients	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
de Gelder et al., 2017	Optimising the ISAR-HP to screen efficiently for functional decline in older patients	Did not use clearly defined and validated operation definition for the classification of frailty	Used ISAR as a frailty indicator. Also did not report the prevalence of frailty
De Jonge et al., 2014	Effects of Home-Based Primary Care on Medicare Costs in High-Risk Elders	Did not occur within a hospital setting, in, or including hospital inpatients	N/A
De Saint-Hubert et al., 2009	Risk factors predicting later functional decline in older hospitalized patients	Other (Please elaborate in Column C to the right)	Review
de Souza, Fabiana, Dutra, 2014	Assessment of the frailty level of elderly people with chronic kidney disease undergoing hemodialysis	Minimum age < 65	N/A
Delgado et al., 2015	Association of Self-Reported Frailty with Falls and Fractures among Patients New to Dialysis	Minimum age < 65	Also did not use a validated operational definition for the classification of frailty or occur in hospital inpatients
Della Pepa et al., 2017	Predictive Comprehensive Geriatric Assessment in elderly prostate cancer patients: the prospective observational scoop trial results	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients
Demircioglu, 2018	The Association of Vitamin D Levels and the Frailty Phenotype Among Non-geriatric Dialysis Patients: A Cross-sectional Study	Minimum age < 65	Also not in hospital in-patients (outpatients)
Denewet et al., 2016	Comprehensive geriatric assessment and comorbidities predict survival in geriatric oncology	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients
Denoël et al., 2014	Could some geriatric characteristics hinder the prescription of anticoagulants in atrial fibrillation in the elderly?	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Dent et al., 2012	Use of the mini nutritional assessment to detect frailty in hospitalised older people	Other (Please elaborate in Column C to the right)	Exclude as consists of the same sample as Dent et al. 2015 - "*Frailty and functional decline indices predict poor outcomes in hospitalised older patients*", which provides more information on this sample relevant to this review
Dent, Hoogendijk, 2014	Psychosocial factors modify the association of frailty with adverse outcomes: a prospective study of hospitalised older people	Other (Please elaborate in Column C to the right)	Exclude as consists of the same sample as Dent et al. 2015 - "*Frailty and functional decline indices predict poor outcomes in hospitalised older patients*", which provides more information on this sample relevant to this review
Dent et al., 2017	Frailty and usage of health care systems: Results from the South Australian Monitoring and Surveillance System (SAMSS)	Did not occur within a hospital setting, in, or including hospital inpatients	Community-dwelling participants
Dent et al., 2018	Nutritional screening and dietitian consultation rates in a geriatric evaluation and management unit	Other (Please elaborate in Column C to the right)	Exclude as consists of the same sample as Dent et al. 2015 - "*Frailty and functional decline indices predict poor outcomes in hospitalised older patients*", which provides more information on this sample relevant to this review
Dhaussy et al., 2012	Is Health-Related Quality of Life an Independent Prognostic Factor for 12-Month Mortality and Nursing Home Placement Among Elderly Patients Hospitalized via the Emergency Department?	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Diaz-Toro et al., 2017	Frailty in patients admitted to hospital with acute decompensated heart failure	Minimum age < 65	N/A
Dodson et al., 2016	Slow Gait Speed and Risk of Mortality or Hospital Readmission after Myocardial Infarction in the Translational Research Investigating Underlying Disparities in Recovery from Acute Myocardial Infarction: Patients' Health Status Registry	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty and did not occur in hospital inpatients
Donini et al., 2005	Comorbidity, frailty, and evolution of pressure ulcers in geriatrics	Minimum age < 65	N/A
Donini et al., 2009	Predicting the outcome of artificial nutrition by clinical and functional indices	Minimum age < 65	N/A
dos Santos Tavares et al., 2015	Association of socioeconomic and clinical variables with the state of frailty among older inpatients	Minimum age < 65	N/A
Du et al., 2014	Sarcopenia is a predictor of outcomes in very elderly patients undergoing emergency surgery	Did not use clearly defined and validated operation definition for the classification of frailty	Used sarcopenia rather than frailty as operational definition
Eagles et al., 2017	Timed Up and Go predicts functional decline in older patients presenting to the emergency department following minor trauma	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Ebrahimi et al., 2017	Effects of a continuum of care intervention on frail elders' self-rated health, experiences of security/safety and symptoms: A randomised controlled trial	Did not assess (or attempt to assess) the whole ward or employ some form of randomised selection of participants	N/A

Ekerstad et al., 2018	Frailty as an instrument for evaluation of elderly patients with non-ST-segment elevation myocardial infarction: A follow-up after more than 5 years	Other (Please elaborate in Column C to the right)	Exclude as consists of the same data as Ekerstad et al. 2018 - "*Frailty as an instrument for evaluation of elderly patients with non-ST-segment elevation myocardial infarction: A follow-up after more than 5 years*", Both studies report the exact same data related to this sample relevant to this review, however as Ekerstad et al. 2011 was published first this is the study included in the review
Eklund et al., 2013	One-year outcome of frailty indicators and activities of daily living following the randomised controlled trial: "Continuum of care for frail older people"	Did not occur within a hospital setting, in, or including hospital inpatients	N/A
Erekson et al., 2015	Frailty, cognitive impairment, and functional disability in older women with female pelvic floor dysfunction	Did not occur within a hospital setting, in, or including hospital inpatients	Community-dwelling participants
Espaulella et al., 2007	Time-dependent prognostic factors of 6-month mortality in frail elderly patients admitted to post-acute care	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Ettinger et al., 1993	Management of elderly patients in the private practice system	Other (Please elaborate in Column C to the right)	Review article
Experton et al., 1997	The impact of payor/provider type on health care use and expenditures among the frail elderly	Did not occur within a hospital setting, in, or including hospital inpatients	Community-dwelling participants
Eyigor et al., 2015	Frailty prevalence and related factors in the older adult—FrailTURK Project	Did not occur within a hospital setting, in, or including hospital inpatients	Occurred in outpatients
Fallon et al., 2015	Characteristics and Outcomes of Older Patients Attending an Acute Medical Assessment Unit	Did not use clearly defined and validated operation definition for the classification of frailty	Did not measure frailty, also did not report the prevalence of frailty
Fallon et al., 2018	Screening for frailty in older emergency department patients: The utility of the Survey of Health, Ageing and Retirement in Europe Frailty Instrument	Did not occur within a hospital setting, in, or including hospital inpatients	Frailty assessments conducted prior to inpatient admission
Fattori et al., 2014	Cluster analysis to identify elderly people's profiles: A healthcare strategy based on frailty characteristics	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Ferguson et al., 2017	Multi-morbidity, frailty and self-care: important considerations in treatment with anticoagulation drugs. Outcomes of the AFASTER study	Minimum age < 65	N/A
Fisher et al., 2015	Predicting intensive care and hospital outcome with the Dalhousie clinical frailty scale: A pilot assessment	Minimum age < 65	
Flexman et al., 2016	Frailty and postoperative outcomes in patients undergoing surgery for degenerative spine disease	Minimum age < 65	N/A
Flood et al., 2006	Geriatric syndromes in elderly patients admitted to an oncology-acute care for elders unit	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence
Fougère et al., 2017	Association Between Frailty and Cognitive Impairment: Cross-Sectional Data From Toulouse Frailty Day Hospital	Did not occur within a hospital setting, in, or including hospital inpatients	Day patients
Franchini et al., 2016	Integrated information for integrated care in the general practice setting in Italy: using social network analysis to go beyond the diagnosis of frailty in the elderly	Did not occur within a hospital setting, in, or including hospital inpatients	Community-dwelling participants, also did not use a validated operational definition for the classification of frailty
Frew, Sequeira, Cant, 2010	Nutrition screening process for patients in an acute public hospital servicing an elderly, culturally diverse population	Minimum age < 65	Also did not use a validated operational definition for the classification of frailty (observation). Also did not report the prevalence of frailty
Frisoli et al., 2015	Frailty predictors and outcomes among older patients with cardiovascular disease: Data from Fragicor	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients
Fumagalli et al., 2010	Atrial fibrillation is a possible marker of frailty in hospitalized patients: Results of the GIFA Study	Minimum age < 65	N/A
Fumagalli et al., 2010	Atrial fibrillation: Still a benign condition in the elderly?	Did not use clearly defined and validated operation definition for the classification of frailty	N/A
Furukawa et al., 2018	Initial clinical evaluation of preoperative frailty in surgical patients with Stanford type A acute aortic dissection	Minimum age < 65	Also did not use a validated operational definition for the classification of frailty
Gaertner et al., 2012	Recommending early integration of palliative care - Does it work?	Minimum age < 65	N/A
Galizia et al., 2011	Role of clinical frailty on long-term mortality of elderly subjects with and without chronic obstructive pulmonary disease	Did not occur within a hospital setting, in, or including hospital inpatients	Community-Dwelling participants
Gambassi et al., 2000	Management of heart failure among very old persons living in long-term care: Has the voice of trials spread?	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Ganapathi et al., 2014	Frailty and risk in proximal aortic surgery	Minimum age < 65	Not fully clear as to whether baseline assessment took place while patients were inpatients, but already excluded based on age criteria. Operational definition for the classification of frailty also not fully clear whether validated but already excluded based on age criteria
Garcia-Molina et al., 2018	Benefits of a multicomponent Falls Unit-based exercise program in older adults with falls in real life	Did not occur within a hospital setting, in, or including hospital inpatients	Community-dwelling participants. Also did not report the prevalence of frailty, however already excluded due to age
García-Nogueras et al., 2017	Use of health resources and healthcare costs associated with frailty: The FRADEA study	Did not occur within a hospital setting, in, or including hospital inpatients	Population based study
Garrido et al., 2012	Differences in the expression of the frailty syndrome in institutionalized elderly men and women with no severe cognitive decline	Minimum age < 65	Also did not occur in a hospital setting among hospital inpatients
Gellis et al., 2014	Integrated Telehealth Care for Chronic Illness and Depression in Geriatric Home Care Patients: The Integrated Telehealth Education and Activation of Mood (I-TEAM) Study	Did not use clearly defined and validated operation definition for the classification of frailty	Also does not report the prevalence of frailty. Also outpatients
Gilden et al., 2015	Diagnostic Pathways to Alzheimer Disease Costs Incurred in a Medicare Population	Did not occur within a hospital setting, in, or including hospital inpatients	Community-dwelling participants
Gill et al., 2004	Hospitalization, restricted activity, and the development of disability among older persons	Did not occur within a hospital setting, in, or including hospital inpatients	Community-dwelling participants
Gill et al., 2015	The role of intervening hospital admissions on trajectories of disability in the last year of life: prospective cohort study of older people	Did not occur within a hospital setting, in, or including hospital inpatients	Community-dwelling participants
Girones, Torregrosa, Diaz-Beveridge, 2010	Comorbidity, disability and geriatric syndromes in elderly breast cancer survivors. Results of a single-center experience	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients
Girones et al., 2012	Comprehensive Geriatric Assessment (CGA) of elderly lung cancer patients: A single-center experience	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients
Giroux et al., 2018	FRAILTY ASSESSMENT TO HELP PREDICT PATIENTS AT RISK OF DELIRIUMWHEN CONSULTING THE EMERGENCY DEPARTMENT	Did not occur within a hospital setting, in, or including hospital inpatients	Participants were not technically inpatients at the time of frailty assessment
Gladman, Forster, Young, 1995	Hospital- and home-based rehabilitation after discharge from hospital for stroke patients: analysis of two trials	Minimum age < 65	N/A

Glajchen et al., 2011	A rapid two-stage screening protocol for palliative care in the emergency department: a quality improvement initiative	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Glover et al., 2014	Diagnoses, problems and healthcare interventions amongst older people with an unscheduled hospital admission who have concurrent mental health problems: A prevalence study	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Goldfarb et al., 2016	Abstract 17008: Increased Cost of Cardiac Surgery in Frail Compared to Non-frail Older Adults	Minimum age < 65	N/A
Gonzalez-Moneo et al., 2016	Ischemic aetiology, self-reported frailty, and gender with respect to cognitive impairment in chronic heart failure patients	Minimum age < 65	Patients also appear to be community-dwelling. Further clarification would be needed to be certain, but study already excluded based on minimum age
Gonzalez-Vaca et al., 2014	Frailty in INstitutionalized older adults from ALbacete. The FINAL Study: Rationale, design, methodology, prevalence and attributes	Did not occur within a hospital setting, in, or including hospital inpatients	nursing home residents
Gorelik et al., 2014	Frailty syndrome and main geriatric syndromes in surgical clinical picture	Minimum age < 65	N/A
Graverholt et al., 2013	Acute hospital admissions from nursing homes: Predictors of unwarranted variation?	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Gray, 2007	Context for WOC Practice: Ostomy Research, Incontinence in Frail Elders, Surgical and Traumatic Wounds	Other (Please elaborate in Column C to the right)	Editorial
Gregson et al., 1997	Issues of recruitment and maintaining high response rates in a longitudinal study of older hospital patients in England - pathways through care study	Did not use clearly defined and validated operation definition for the classification of frailty	N/A
Griebling, 2014	Re: Too Frail for Surgery? Initial Results of a Large Multidisciplinary Prospective Study Examining Preoperative Variables Predictive of Poor Surgical Outcomes	Minimum age < 65	N/A
Griffin, Yared, Ray, 2000	Nonsteroidal antiinflammatory drugs and acute renal failure in elderly persons	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Grivaux et al., 2016	Early mortality in lung cancer: French prospective multicentre observational study	Minimum age < 65	N/A
Grube et al., 2017	Clinical Outcomes With a Repositionable Self-Expanding Transcatheter Aortic Valve Prosthesis: The International FORWARD Study	Did not use clearly defined and validated operation definition for the classification of frailty	N/A
Gruenewald et al., 2009	Allostatic load and frailty in older adults	Did not occur within a hospital setting, in, or including hospital inpatients	Community-dwelling participants
Haley, Wells, Holland, 2014	Relationship between frailty and discharge outcomes in subacute care	Minimum age < 65	N/A
Hall et al., 2017	Development and Initial Validation of the Risk Analysis Index for Measuring Frailty in Surgical Populations	Minimum age < 65	N/A
Hall et al., 2017	Association of a Frailty Screening Initiative With Postoperative Survival at 30, 180, and 365 Days	Minimum age < 65	N/A
Hamano, Oishi, Kizawa, 2018	Identified palliative care approach needs with SPICT in family practice: A preliminary observational study	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients
Han Ting et al., 2018	Frailty as a predictor of hospital length of stay after elective total joint replacements in elderly patients	Did not occur within a hospital setting, in, or including hospital inpatients	Assessed patients during out-patient appointments
Handforth et al., 2015	The prevalence and outcomes of frailty in older cancer patients: a systematic review	Other (Please elaborate in Column C to the right)	Review
Harmsen et al., 2016	Fall-related injuries in Amsterdam: Frail older women at risk	Minimum age < 65	Also did not use clearly defined and validated operational definition of the classification of frailty. Also did not report the prevalence of frailty
Hauer et al., 2001	Exercise training for rehabilitation and secondary prevention of falls in geriatric patients with a history of injurious falls	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Hawkins et al., 2018	Psoas Muscle Size Predicts Risk-Adjusted Outcomes After Surgical Aortic Valve Replacement	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty. Minimum age is also unclear, but no need follow-up as excluded already
Hermans et al., 2005	Prevalence and determinants of impaired glucose metabolism in frail elderly patients: The Belgian elderly diabetes survey (BEDS)	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Hernandez et al., 2018	Assessment of health status and program performance in patients on long-term oxygen therapy	Minimum age < 65	N/A
Hippisley-Cox et al., 2017	Development and validation of Mortality risk prediction algorithm to estimate short term risk of death and assess frailty: cohort study	Did not occur within a hospital setting, in, or including hospital inpatients	Community-dwelling participants (primary care patient data)
Hiraoka et al., 2018	Modified predictive score based on frailty for mid-term outcomes in open total aortic arch surgery	Minimum age < 65	Also did not report the prevalence of frailty
Hogan et al., 2012	Comparing frailty measures in their ability to predict adverse outcome among older residents of assisted living	Did not occur within a hospital setting, in, or including hospital inpatients	Nursing home residents
Hogan et al., 2012	Preventable deaths due to problems in care in English acute hospitals: a retrospective case record review study	Did not use clearly defined and validated operation definition for the classification of frailty	N/A
Holtta et al., 2012	Apathy: Prevalence, Associated Factors, and Prognostic Value Among Frail, Older Inpatients	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Hoogendijk et al., 2015	Components of the Frailty Phenotype in Relation to the Frailty Index: Results From the Toulouse Frailty Platform	Did not occur within a hospital setting, in, or including hospital inpatients	Day patients
Hope et al., 2015	Frailty before critical illness and mortality for elderly medicare beneficiaries	Did not use clearly defined and validated operation definition for the classification of frailty	N/A
Hope et al., 2017	Assessing the Usefulness and Validity of Frailty Markers in Critically Ill Adults	Minimum age < 65	Also not clear if assessed (or attempted to assess) the whole ward or employed some form of randomised selection of participants, but already excluded based on age
Host et al., 2007	Training-induced strength and functional adaptations after hip fracture	Did not use clearly defined and validated operation definition for the classification of frailty	N/A
Hshieh et al., 2018	Prevalence of Cognitive Impairment and Association With Survival Among Older Patients With Hematologic Cancers	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients
Hubbard et al., 2008	Nutrition, inflammation, and leptin levels in aging and frailty	Did not occur within a hospital setting, in, or including hospital inpatients	N/A
Huijberts, Buurman, de Rooij, 2016	End-of-life care during and after an acute hospitalization in older patients with cancer, end-stage organ failure, or frailty: A sub-analysis of a prospective cohort study	Did not use clearly defined and validated operation definition for the classification of frailty	N/A
Huo et al., 2015	Phenotype of Osteosarcopenia in Older Individuals With a History of Falling	Did not use clearly defined and validated operation definition for the classification of frailty	N/A

Huyen et al., 2017	Prevalence of frailty and its associated factors in older hospitalised patients in Vietnam	Minimum age < 65	Also not clear if assessed (or attempted to assess) the whole ward or employed some form of randomised selection of participants, but already excluded based on age
Hyatt et al., 2016	The frailest of the frail? Identifying the unmet palliative care needs of frail older hospital inpatients: Poster No. 219 [Abstract]	Did not use clearly defined and validated operation definition for the classification of frailty	Conference abstract. Full text it relates to not eligible as a validated operational definition for the classification of frailty was not utilised
Jha et al., 2016	The Prevalence and Prognostic Significance of Frailty in Patients with Advanced Heart Failure Referred for Heart Transplantation	Minimum age < 65	N/A
Jha et al., 2016	Cognitive impairment improves the predictive validity of physical frailty for mortality in patients with advanced heart failure referred for heart transplantation	Minimum age < 65	N/A
Jha et al., 2017	Reversibility of Frailty After Bridge-to-Transplant Ventricular Assist Device Implantation or Heart Transplantation	Minimum age < 65	N/A
Jones et al., 2017	Physical activity interventions are delivered consistently across hospitalized older adults but multimorbidity is associated with poorer rehabilitation outcomes: A population-based cohort study	Did not use clearly defined and validated operation definition for the classification of frailty	Did not utilise a validated operational definition for the classification of frailty
Joseph et al., 2017	Upper-Extremity Function Predicts Adverse Health Outcomes among Older Adults Hospitalized for Ground-Level Falls	Did not use clearly defined and validated operation definition for the classification of frailty	Did not use a validated operational definition for the classification of frailty
Joyce et al., 2016	Abstract 17795: Prospective Assessment of Mini-Cog and Grip Strength Identifies Hospitalized Heart Failure Patients at Increased Risk of Worse Post-Discharge Outcomes	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Jr. Holmes et al., 2015	Annual Outcomes With Transcatheter Valve Therapy: From the STS/ACC TVT Registry	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the minimum age but already excluded due to lack of an clearly defined and validated operation for the classification of frailty
Jung et al., 2015	The impact of frailty on postoperative delirium in cardiac surgery patients	Minimum age < 65	Also not clear if operational definition of frailty is validated, could be derived from contacting authors but already excluded based on minimum age being < 65
Kaehr et al., 2016	FRAIL-NH predicts outcomes in long term care	Did not occur within a hospital setting, in, or including hospital inpatients	Participants were recruited from nursing homes and long term care facilities
Kahlon et al., 2015	Association between frailty and 30-day outcomes after discharge from hospital	Minimum age < 65	N/A
Kajsa et al., 2016	Screening for frailty among older emergency department visitors: Validation of the new FRESH-screening instrument	Did not occur within a hospital setting, in, or including hospital inpatients	Community-dwelling participants
Kang et al., 2017	Association between frailty and hypertension prevalence, treatment, and control in the elderly Korean population	Did not occur within a hospital setting, in, or including hospital inpatients	Community-dwelling participants
Kaplan et al., 2017	Association of Radiologic Indicators of Frailty With 1-Year Mortality in Older Trauma Patients Opportunistic Screening for Sarcopenia and Osteopenia	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Kelaiditi et al., 2016	Frailty Index and Incident Mortality, Hospitalization, and Institutionalization in Alzheimer's Disease: Data From the ICTUS Study	Did not occur within a hospital setting, in, or including hospital inpatients	Also did not report minimum age. Could be derived from contacting authors, however already excluded on the basis that the sample were not hospital inpatients
Kelaiditi et al., 2016	Frailty Index and Cognitive Decline in Alzheimer's Disease: Data from the Impact of Cholinergic Treatment USe Study	Did not occur within a hospital setting, in, or including hospital inpatients	Also did not report minimum age. Could be derived from contacting authors, however already excluded on the basis that the sample were not hospital inpatients
Kenig et al., 2014	Vulnerable elderly survey 13 as a screening method for frailty in polish elderly surgical patient -prospective study	Did not use clearly defined and validated operation definition for the classification of frailty	Did not use a validated operational definition for the classification of frailty
Kenig et al., 2015	Cumulative deficit model of geriatric assessment to predict the postoperative outcomes of older patients with solid abdominal cancer	Did not occur within a hospital setting, in, or including hospital inpatients	Frailty assessments were conducted prior to admission while patients were technically not inpatients (up to 7 days prior)
Kenig et al., 2016	Geriatric Assessment as a qualification element for elective and emergency cholecystectomy in older patients	Did not use clearly defined and validated operation definition for the classification of frailty	Did not use a validated operational definition for the classification of frailty
Kenig et al., 2018	The Surgical Apgar score combined with Comprehensive Geriatric Assessment improves short- but not long-term outcome prediction in older patients undergoing abdominal cancer surgery	Did not occur within a hospital setting, in, or including hospital inpatients	Frailty assessment for some patients was conducted up to a week prior to admission
Kenig et al., 2018	The Surgical Apgar Score predicts outcomes of emergency abdominal surgeries both in fit and frail older patients	Did not use clearly defined and validated operation definition for the classification of frailty	Did not use a validated operational definition for the classification of frailty
Kersten et al., 2015	Clinical impact of potentially inappropriate medications during hospitalization of acutely ill older patients with multimorbidity	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Kessler et al., 2018	Impact of frailty on complications in patients with thoracic and thoracolumbar spinal fracture	Minimum age < 65	N/A
Khandelwal et al., 2012	Frailty is associated with longer hospital stay and increased mortality in hospitalized older patients	Minimum age < 65	N/A
Kim et al., 2018	Measuring Frailty in Medicare Data: Development and Validation of a Claims-Based Frailty Index	Did not use clearly defined and validated operation definition for the classification of frailty	N/A
Kircher et al., 2007	A randomised trial of a geriatric evaluation and management consultation services in frail hospitalised patients	Did not use clearly defined and validated operation definition for the classification of frailty	N/A
Kizilarslanoglu et al., 2017	Is frailty a prognostic factor for critically ill elderly patients?	Minimum age < 65	N/A
Kodama et al., 2018	Association between preoperative frailty and mortality in patients with critical limb ischemia following infrainguinal bypass surgery — Usefulness of the Barthel index	Minimum age < 65	Also did not use a clearly defined and validated operational definition for the classification of frailty. Also did not report the prevalence if frailty
Kominski, 2002	Inpatient geriatric units and outpatient geriatric clinics improve quality of life, but not survival for frail older adults	Other (Please elaborate in Column C to the right)	Commentary of paper also within full text screening (Cohen et al. 2002)
Kopczynska et al., 2018	Sepsis-related deaths in the at-risk population on the wards: Attributable fraction of mortality in a large point-prevalence study	Minimum age < 65	N/A
Kua et al., 2016	Which frailty measure is a good predictor of early post-operative complications in elderly hip fracture patients?	Minimum age < 65	N/A
Kubala et al., 2017	Utility of Frailty Assessment for Elderly Patients Undergoing Cardiac Resynchronization Therapy	Did not use clearly defined and validated operation definition for the classification of frailty	Did not use a validated operational definition for the classification of frailty
Lai et al., 2017	Development of a novel frailty index to predict mortality in patients with end-stage liver disease	Minimum age < 65	Also not in hospital in-patients (outpatients)

Landi et al., 2002	Predictors of rehabilitation outcomes in frail patients treated in a geriatric hospital	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Langer et al., 2019	Intraoperative hypotension is not associated with postoperative cognitive dysfunction in elderly patients undergoing general anesthesia for surgery: results of a randomized controlled pilot trial	Did not occur within a hospital setting, in, or including hospital inpatients	Frailty assessments conducted in outpatient clinic
Launay et al., 2018	Prediction of in-hospital mortality with the 6-item Brief Geriatric Assessment tool: An observational prospective cohort study	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Lee et al., 2016	Plasma zinc alpha2-glycoprotein levels correlate positively with frailty severity in female elders	Did not assess (or attempt to assess) the whole ward or employ some form of randomised selection of participants	Also did not state minimum age. Could potentially be obtained from contacting authors but study already excluded
Lee et al., 2011	Effectiveness of short-term interdisciplinary intervention on postacute patients in Taiwan	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Lee, Son, Shin, 2015	Influence of frailty on health-related quality of life in pre-dialysis patients with chronic kidney disease in Korea: A cross-sectional study	Minimum age < 65	Also did not use a validated operational definition for the classification of frailty. Also outpatients
Lee et al., 2015	Predictors of successful completion of diagnostic home sleep testing in patients with chronic kidney disease	Minimum age < 65	Also outpatients. Also did not use a clearly defined and validated operational definition for the classification of frailty. Also did not report the prevalence of frailty
Lee et al., 2016	Exploration of the importance of geriatric frailty on health-related quality of life	Did not occur within a hospital setting, in, or including hospital inpatients	Community-dwelling participants
Lee et al., 2017	Is Frailty a Modifiable Risk Factor of Future Adverse Outcomes in Elderly Patients with Incident End-Stage Renal Disease?	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients
Lekan, 2013	Frailty in hospitalized adults	Minimum age < 65	N/A
Lekan, McCoy, 2018	Frailty risk in hospitalised older adults with and without diabetes mellitus	Minimum age < 65	N/A
Li et al.,2015	A Pilot Study of the FRAIL Scale on Predicting Outcomes in Chinese Elderly People With Type 2 Diabetes	Minimum age < 65	N/A
Li et al., 2018	Impact of frailty on outcomes after discharge in older surgical patients: a prospective cohort study	Did not occur within a hospital setting, in, or including hospital inpatients	Frailty assessment was a retrospective assessment of the two weeks prior to admission
Lightbody, Baldwin, 2002	Inpatient geriatric evaluation and management did not reduce mortality but reduced functional decline	Other (Please elaborate in Column C to the right)	Commentary of paper also within full text screening (Cohen et al. 2002)
Lilamand et al., 2015	Validation of the Mini Nutritional Assessment-Short Form in a population of frail elders without disability. Analysis of the Toulouse Frailty Platform population in 2013	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients
Lin et al., 2018	Comparison of 3 Frailty Instruments in a Geriatric Acute Care Setting in a Low-Middle Income Country	Minimum age < 65	Also day cases
Lohman et al., 2017	Incorporating Persistent Pain in Phenotypic Frailty Measurement and Prediction of Adverse Health Outcomes	Did not occur within a hospital setting, in, or including hospital inpatients	N/A
Lund et al., 2017	The effect of geriatric intervention in frail elderly patients receiving chemotherapy for colorectal cancer: a randomized trial (GERICO)	Other (Please elaborate in Column C to the right)	Study protocol. Study to be conducted in outpatients as such will not contact authors to see if preliminary data exists. Study also does not use a validated operational definition for the classification of frailty (G8)
Lupon et al., 2008	Prognostic implication of frailty and depressive symptoms in an outpatient population with heart failure	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients. Minimum age also less than 65
Lytwyn et al., 2017	The impact of frailty on functional survival in patients 1 year after cardiac surgery	Minimum age < 65	N/A
Maddocks et al., 2016	Physical frailty and pulmonary rehabilitation in COPD: a prospective cohort study	Minimum age < 65	Also outpatients
Mansur et al., 2012	[Prevalence of frailty in patients in chronic kidney disease on conservative treatment and on dialysis]	Minimum age < 65	Also did not occur in hospital inpatients
Marchiori et al., 2017	Changes in frailty conditions and phenotype components in elderly after hospitalization	Minimum age < 65	N/A
Mastalerz et al., 2018	The Surgical Apgar Score and frailty as outcome predictors in short- and long-term evaluation of fit and frail older patients undergoing elective laparoscopic cholecystectomy - a prospective cohort study	Did not use clearly defined and validated operation definition for the classification of frailty	Did not utilise a validated operational definition for the classification of frailty
Maxwell et al., 2018	Feasibility of screening for preinjury frailty in hospitalized injured older adults	Did not occur within a hospital setting, in, or including hospital inpatients	Frailty was assessed retrospectively prior to admission
McAdams-DeMarco et al., 2015	Frailty and Mortality in Kidney Transplant Recipients	Minimum age < 65	N/A
McAdams-DeMarco et al., 2017	Frailty, Length of Stay, and Mortality in Kidney Transplant Recipients: A National Registry and Prospective Cohort Study	Minimum age < 65	Also did not report the prevalence of frailty. This could be derived from contacting authors but already excluded on the basis on minimum age < 65
McAlister, van Walraven, 2019	External validation of the Hospital Frailty Risk Score and comparison with the Hospital-patient One-year Mortality Risk Score to predict outcomes in elderly hospitalised patients: a retrospective cohort study	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
McCullagh et al., 2017	Step-Count Accuracy of 3 Motion Sensors for Older and Frail Medical Inpatients	Did not assess (or attempt to assess) the whole ward or employ some form of randomised selection of participants	N/A
McLeod, Hominick, Rockwood, 2016	Characteristics of Older Adults Admitted to Hospital versus Those Discharged Home, in Emergency Department Patients Referred to Internal Medicine	Did not occur within a hospital setting, in, or including hospital inpatients	Participants were not inpatients at the time of frailty assessment
McNallan et al., 2013	Measuring frailty in heart failure: A community perspective	Minimum age < 65	Also a mixed sample included outpatients. Could email authors to differentiate between inpatients and outpatients, however already excluded based on minimum age < 65
Melgaard et al., 2017	The Prevalence of Oropharyngeal Dysphagia in Danish Patients Hospitalised with Community-Acquired Pneumonia	Minimum age < 65	Also did not use a validated operational definition of frailty or report the prevalence of frailty
Meulendijks et al., 2015	Groningen frailty indicator in older patients with end-stage renal disease	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients
Miller et al., 2018	External Validation of the Adult Spinal Deformity (ASD) Frailty Index (ASD-FI) in the Scoli-RISK-1 Patient Database	Minimum age < 65	Also did not report the prevalence of frailty (mean and standard deviation)
Mitchell et al., 2011	Hepatotoxicity of therapeutic short-course paracetamol in hospital inpatients: impact of ageing and frailty	Minimum age < 65	Also did not report the prevalence of frailty (mean and standard deviation). Also not clear if attempted to assess the whole ward or employ some form of randomised selection of participants. Could contact authors to determine the latter but already excluded based on previously stated criteria
Mlynarska, Golba, Mlynarski, 2018	Capability for self-care of patients with heart failure	Minimum age < 65	Also did not report the prevalence of frailty. This could be derived from contacting the author, but study

			already excluded on the basis of minimum age being less than 65
Mlynarska, Mlynarski, Golba, 2018	Anxiety, age, education and activities of daily living as predictive factors of the occurrence of frailty syndrome in patients with heart rhythm disorders	Minimum age < 65	N/A
Mlynarska, Mlynarski, Golba, 2018	Frailty as a predictor of negative outcomes after cardiac resynchronization therapy	Minimum age < 65	N/A
Molina-Garrido, Guillén-Ponce, 2012	Ability of the comprehensive geriatric assessment to predict frailty in older people diagnosed with cancer in a general hospital	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty. Also not clear if participants were inpatients, could be derived from contacting authors but already excluded based on the previously listed criteria
Monacelli et al., 2017	Evaluation of prognostic indices in elderly hospitalized patients	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Monacelli et al., 2017	Validation of the photography method for nutritional intake assessment in hospitalized elderly subjects	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Moorhouse, Mallery, 2012	Palliative and therapeutic harmonization: A model for appropriate decision-making in frail older adults	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients
Mor, Papandonatos, Miller, 2005	End-of-life hospitalization for African American and non-Latino white nursing home residents: Variation by race and a facility's racial composition	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Mosquera et al., 2016	Impact of frailty on surgical outcomes: The right patient for the right procedure	Minimum age < 65	Also did not use a validated operational definition of frailty or report the prevalence of frailty
Moug et al., 2016	Frailty and cognitive impairment: Unique challenges in the older emergency surgical patient	Other (Please elaborate in Column C to the right)	Review article
Moulis et al., 2015	Exposure to Atropinic Drugs and Frailty Status	Did not occur within a hospital setting, in, or including hospital inpatients	N/A
Myers et al., 2013	Exposure to particulate air pollution and long-term incidence of frailty after myocardial infarction	Did not occur within a hospital setting, in, or including hospital inpatients	Frailty assessment conducted during follow-up after hospitalization while participants were not inpatients
Nct, 2018	PRehabilitiation in Elective Frail and Elderly Cardiac Surgery PaTients	Minimum age < 65	Protocol paper
Nemoto et al., 2012	Assessment of vulnerable older adults' physical function according to the Japanese Long-Term Care Insurance (LTCI) system and Fried's criteria for frailty syndrome	Did not occur within a hospital setting, in, or including hospital inpatients	Community-dwelling participants
Newcomer, Steiner, Bayliss, 2011	Identifying Subgroups of Complex Patients With Cluster Analysis	Minimum age < 65	Also did not occur in hospital inpatients (geriatric day hospital - outpatient clinic). Also did not occur in inpatients. Also did not use a clearly defined or validated operational definition for the classification of frailty. Also did not report the prevalence of frailty
Newton et al., 2016	Acute heart failure admissions in New South Wales and the Australian Capital Territory: the NSW HF Snapshot Study	Minimum age < 65	N/A
Ng et al., 2016	Colorectal cancer outcomes in patients aged over 85 years	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Nguyen et al., 2018	Postprandial hypotension in older survivors of critical illness	Did not occur within a hospital setting, in, or including hospital inpatients	Assessments were conducted on patients post discharge (90 days). Also did not report the prevalence of frailty, could be derived from contacting authors but already excluded as participants were not inpatients at the time of the assessment of frailty.
Nieman et al., 2018	Frailty, hospital volume, and failure to rescue after head and neck cancer surgery	Minimum age < 65	N/A
Nightingale, Skonecki, Boparai, 2017	The impact of polypharmacy on patient outcomes in older adults with cancer	Other (Please elaborate in Column C to the right)	Review article
Nipp et al., 2012	Role of Pain Medications, Consultants, and Other Services in Improved Pain Control of Elderly Adults with Cancer in Geriatric Evaluation and Management Units	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Nguyen, Cumming, Hilmer, 2017	The Impact of Frailty on Mortality, Length of Stay and Re-hospitalisation in Older Patients with Atrial Fibrillation	Other (Please elaborate in Column C to the right)	Exclude as consists of the same sample as Nguyen et al. 2016 - Atrial fibrillation in older inpatients: are there any differences in clinical characteristics and pharmacological treatment between the frail and the non-frail? which provides more information on this sample relevant to this review
Nguyen et al., 2017	The impact of frailty on coagulation and responses to warfarin in acute older hospitalised patients with atrial fibrillation: a pilot study	Other (Please elaborate in Column C to the right)	Exclude as consists of the same sample as Nguyen et al. 2016 - Atrial fibrillation in older inpatients: are there any differences in clinical characteristics and pharmacological treatment between the frail and the non-frail? which provides more information on this sample relevant to this review
Ogawa et al., 2017	Impact of delirium on postoperative frailty and long term cardiovascular events after cardiac surgery	Did not use clearly defined and validated operation definition for the classification of frailty	Minimum age also unclear, but already excluded due to the lack of a validated operational definition for the classification of frailty
Ommundsen et al., 2018	Preoperative geriatric assessment and tailored interventions in frail older patients with colorectal cancer: a randomized controlled trial	Did not occur within a hospital setting, in, or including hospital inpatients	Patients were assessed for frailty prior to admission at an outpatient clinic
Orford et al., 2016	Prevalence, goals of care and long-term outcomes of patients with life-limiting illness referred to a tertiary ICU	Minimum age < 65	Did not use a clearly defined operational definition for the classification of frailty
Orford et al., 2017	Effect of communication skills training on outcomes in critically ill patients with life-limiting illness referred for intensive care management: A before-and-after study	Minimum age < 65	Also did not use a validated operational definition for the classification of frailty
O'Shea et al., 2017	Malnutrition in hospitalised older adults: A multicentre observational study of prevalence, associations and outcomes	Other (Please elaborate in Column C to the right)	Excluded as consists of the same sample as Timmons et al. 2015 - "*Dementia in older people admitted to hospital: a regional multi-hospital observational study of prevalence, associations and case recognition*", which reports all data within this present study relevant to this review. As no difference existed in terms of the quantity of data relevant to the review, as Timmons et al. 2015 was published first, this is the study included in the review
Pangilinan et al., 2017	The Timed Up and Go Test as a Measure of Frailty in Urologic Practice	Did not use clearly defined and validated operation definition for the classification of frailty	Not validated as an operational definition for the classification of frailty. Also outpatients
Partridge, Harari, Dhesi, 2012	Frailty in the older surgical patient: A review	Other (Please elaborate in Column C to the right)	Review article
Paulson, Lichtenberg, 2013	Vascular depression: An early warning sign of frailty	Did not occur within a hospital setting, in, or including hospital inpatients	Also did not use a validated operational definition for the classification of frailty
Pearl et al., 2017	Patient Frailty and Discharge Disposition Following Radical Cystectomy	Minimum age < 65	Sample also consisted of a mixture of inpatients and outpatients. Could email authors to see if information

			exists solely relating to inpatients, however already excluded on the basis of minimum age being < 65
Pereira et al., 2010	How can we improve targeting of frail elderly patients to a geriatric day-hospital rehabilitation program?	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients. Also did not use a clearly defined and validated operational definition for the classification of frailty. Also did not report the prevalence of frailty
Pitkala et al., 2005	Prognostic significance of delirium in frail older people	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Polidoro et al.,2011	Frailty and disability in the elderly: A diagnostic dilemma	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty. Minimum age also appears to be less than 65, could email to confirm for certainty but already excluded on the basis of lack of clearly defined and validated operational definition for the classification of frailty.
Polidoro et al., 2013	Frailty in patients affected by atrial fibrillation	Minimum age < 65	Also does not use a validated operational definition for the classification of frailty (34 items of a 40 item validated scale. Could email authors to see if the 34 items have been validated by themselves since but already excluded on the basis of minimum age being < 65.
Ponzetti et al., 2014	Role of multidimensional assessment of frailty in predicting short-term outcomes in hospitalized cancer patients: results of a prospective cohort study	Minimum age < 65	Also did not use a validated operational definition for the classification of frailty
Provencher et al., 2015	Decline in activities of daily living after a visit to a Canadian emergency department for minor injuries in independent older adults: Are frail older adults with cognitive impairment at greater risk?	Did not occur within a hospital setting, in, or including hospital inpatients	N/A
Provencher et al., 2016	Frail older adults with minor fractures show lower health-related quality of life (SF-12) scores up to six months following emergency department discharge	Did not occur within a hospital setting, in, or including hospital inpatients	N/A
Pulignano et al., 2010	Usefulness of frailty profile for targeting older heart failure patients in disease management programs: a cost-effectiveness, pilot study	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatient
Puts et al., 2011	Changes in functional status in older newly-diagnosed cancer patients during cancer treatment: A six-month follow-up period. Results of a prospective pilot study	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients. Also did not use a validated operational definition for the classification of frailty. Also did not report the prevalence of frailty
Raivio et al., 2006	Use of Inappropriate Medications and Their Prognostic Significance Among In-Hospital and Nursing Home Patients with and without Dementia in Finland	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Recoche et al., 2017	Potentially inappropriate prescribing in a population of frail elderly people	Did not occur within a hospital setting, in, or including hospital inpatients	Day patients
Reeves et al., 2014	A novel rehabilitation intervention for older patients with acute decompensated heart failure: the rehab-HF pilot study	Other (Please elaborate in Column C to the right)	Conference abstract. Full text it relates to not eligible as minimum age is > 65,
Ridda et al., 2008	The challenges of clinical trials in the exclusion zone: The case of the frail elderly	Minimum age < 65	Also did not report the prevalence of frailty. Could potentially be obtained from contacting author however already excluded on the basis of minimum age <65
Ritchie et al., 1997	Nutritional status of urban homebound older adults	Did not occur within a hospital setting, in, or including hospital inpatients	Community-dwelling (homebound) participants. Also did not utilise a clearly defined and validated operational definition for the classification of frailty and attempt to assess the prevalence of frailty.
Ritt et al., 2017	High-technology based gait assessment in frail people: Associations between spatio-temporal and three-dimensional gait characteristics with frailty status across four different frailty measures	Did not assess (or attempt to assess) the whole ward or employ some form of randomised selection of participants	N/A
Rodriguez-Pascual et al., 2017	The frailty syndrome is associated with adverse health outcomes in very old patients with stable heart failure: A prospective study in six Spanish hospitals	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients (post inpatient discharge - frailty assessments conducted a month after discharge)
Rosted, Schultz, Sanders, 2016	Frailty and polypharmacy in elderly patients are associated with a high readmission risk	Did not use clearly defined and validated operation definition for the classification of frailty	N/A
Rozenberg et al., 2018	Frailty and clinical benefits with lung transplantation	Minimum age < 65	Also not clear if participants were inpatients at the time of frailty assessment, however already excluded on the basis of age.
Runganga, Peel, Hubbard, 2014	Multiple medication use in older patients in post-acute transitional care: A prospective cohort study	Minimum age < 65	Also did not report the prevalence of frailty (mean and standard deviation). Could be derived by contacting authors but already excluded on the basis of the minimum age being < 65.
Ryan et al., 2013	Symptom burden, palliative care need and predictors of physical and psychological discomfort in two UK hospitals	Minimum age < 65	N/A
Saarelainen et al., 2014	Potentially inappropriate medication use in older people with cancer: Prevalence and correlates	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients. Also did not use a validated operational definition for the classification of frailty.
Sacco et al., 2018	A new frailty index as a risk predictor of morbidity and mortality: Its application in a surgery unit	Minimum age < 65	N/A
Sadarangani, Squires, 2014	Frailty as a predictive factor in geriatric trauma patient outcomes	Other (Please elaborate in Column C to the right)	Commentary of paper also within full text screening (Joseph et al. 2014)
Sadiq et al., 2018	Frailty Phenotypes and Relations With Surgical Outcomes: A Latent Class Analysis	Minimum age < 65	N/A
Sahota et al., 2017	The Community In-reach Rehabilitation and Care Transition (CIRACT) clinical and cost-effectiveness randomisation controlled trial in older people admitted to hospital as an acute medical emergency	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty.
Salter et al., 2015	Perceived frailty and measured frailty among adults undergoing hemodialysis: a cross-sectional analysis	Minimum age < 65	Also did not occur in hospital inpatients
Salvi, Morichi, Dessi-Fulgheri, 2010	The "Silver Code" and the Frail Elder in the Emergency Department	Other (Please elaborate in Column C to the right)	Letter to editor
Schaefer, 2006	An operational definition of frailty predicted death and other adverse outcomes in older women	Other (Please elaborate in Column C to the right)	Commentary. Paper to which this commentary relates occurs in outpatients
Schulkes et al., 2018	Multidisciplinary decision-making regarding chemotherapy for lung cancer patients-An age-based comparison	Minimum age < 65	Also did not occur in hospital inpatients or utilises a clearly defined and validated operational definition for the classification of frailty, or report the prevalence of frailty
Schulkes et al., 2017	Prognostic Value of Geriatric 8 and Identification of Seniors at Risk for Hospitalized Patients Screening Tools for Patients With Lung Cancer	Did not use clearly defined and validated operation definition for the classification of frailty	Neither the Geriatric 8 (G8) or Identification of Seniors at Risk for Hospitalized Patients (ISAR-HP) are operation definitions for the classification of frailty, rather both are tools used to identify potential frailty.
Schultz, Rosted, Sanders, 2015	Frailty is associated with a history with more falls in elderly hospitalised patients	Did not occur within a hospital setting, in, or including hospital inpatients	

Segal et al., 2000	Barium enema in frail elderly patients	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty. The minimum age of participants within the study is also unclear. Could be derived from contact authors however already excluded based on not utilising a clearly defined and validated operational definition for the classification of frailty
Segal et al., 2009	Staphylococcus aureus colonization in the nasopharynx of nasogastric tube-fed patients in a long-term care facility	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty. Minimum age of participants is also unclear. Could be derived from contacting authors however already excluded on the basis of not utilising a clearly defined and validated operational definition for the classification of frailty
Segal et al., 2017	Development of a Claims-based Frailty Indicator Anchored to a Well-established Frailty Phenotype	Did not occur within a hospital setting, in, or including hospital inpatients	Also did not report the prevalence of frailty. Could be derived from contacting authors however study already excluded on the basis of not occurring in hospital inpatients.
Sevilla-Sanchez et al., 2018	Potentially inappropriate medication in palliative care patients according to STOPP-Frail criteria	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Shah et al., 2017	Comparison of bedside screening methods for frailty in older adult trauma patients	Did not occur within a hospital setting, in, or including hospital inpatients	Participants were not inpatients at the time of frailty assessment
Sirois et al., 2017	Measuring Frailty Can Help Emergency Departments Identify Independent Seniors at Risk of Functional Decline After Minor Injuries	Did not occur within a hospital setting, in, or including hospital inpatients	N/A
Sirven, Rapp, 2017	The Dynamics of Hospital Use among Older People Evidence for Europe Using SHARE Data	Minimum age < 65	N/A
Siu et al., 1996	Postdischarge Geriatric Assessment of Hospitalized Frail Elderly Patients	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Slee, Birch, Stokoe, 2015	A comparison of the malnutrition screening tools, MUST, MNA and bioelectrical impedance assessment in frail older hospital patients	Minimum age < 65	Also did not use an operational definition for the classification of frailty or report the prevalence of frailty
Slee, Birch, Stokoe, 2015	Bioelectrical impedance vector analysis, phase-angle assessment and relationship with malnutrition risk in a cohort of frail older hospital patients in the United Kingdom	Minimum age < 65	Also did not use an operational definition for the classification of frailty or report the prevalence of frailty
Soler et al., 2016	Visual impairment screening at the Geriatric Frailty Clinic for Assessment of Frailty and Prevention of Disability at the Gérontopôle	Did not occur within a hospital setting, in, or including hospital inpatients	N/A
Soong et al., 2015	Quantifying the prevalence of frailty in English hospitals	Did not use clearly defined and validated operation definition for the classification of frailty	N/A
Souwer et al., 2018	Risk stratification for surgical outcomes in older colorectal cancer patients using ISAR-HP and G8 screening tools	Did not use clearly defined and validated operation definition for the classification of frailty	Did not utilise a validated operational definition for the classification of frailty
Stiffler et al., 2013	Frailty assessment in the emergency department	Did not occur within a hospital setting, in, or including hospital inpatients	N/A
Storti et al., 2013	Frailty of elderly patients admitted to the medical clinic of an emergency unit at a general tertiary hospital	Minimum age < 65	N/A
Subbe et al., 2015	Relationship between input and output in acute medicine - secondary analysis of the Society for Acute Medicine's benchmarking audit 2013 (SAMBA '13)	Minimum age < 65	N/A
Suemoto, 2016	Towards a unified and standardized definition of the frailty phenotype	Other (Please elaborate in Column C to the right)	Editorial
Sullivan et al., 2001	Progressive resistance muscle strength training of hospitalized frail elderly	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Suskind et al., 2016	Preoperative Frailty Is Associated With Discharge to Skilled or Assisted Living Facilities After Urologic Procedures of Varying Complexity	Did not assess (or attempt to assess) the whole ward or employ some form of randomised selection of participants	Did not assess the whole ward / clinical population
Suskind et al., 2017	Frailty and the Role of Obliterative versus Reconstructive Surgery for Pelvic Organ Prolapse: A National Study	Minimum age < 65	Also not clear if the frailty assessment was conducted while patients were inpatients. Could contact the authors to clarify, however already excluded on the basis of minimum age being < 65
Tanaka et al., 2017	Effects of Acute Phase Intensive Electrical Muscle Stimulation in Frail Elderly Patients With Acute Heart Failure (ACTIVE-EMS): rationale and protocol for a multicenter randomized controlled trial	Other (Please elaborate in Column C to the right)	Study protocol. Study to be conducted utilising a non-validated operational definition for the classification of frailty
Tavares et al., 2016	Cardiovascular risk factors associated with frailty syndrome among hospitalized elderly people: a cross-sectional study	Minimum age < 65	N/A
Tavassoli et al., 2014	Description of 1, 108 older patients referred by their physician to the "Geriatric Frailty clinic (G.F.C) for assessment of frailty and prevention of disability" at the gerontopole	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients
Tran et al., 2018	Association of frailty and long-term survival in patients undergoing coronary artery bypass grafting	Minimum age < 65	Also non-hospital inpatients (community-dwelling)
Uchmanowicz, Gobbens, 2015	The relationship between frailty, anxiety and depression, and health-related quality of life in elderly patients with heart failure	Minimum age < 65	Also explicitly stated that patients were inpatients. Could contact authors to confirm this, however study already on the basis of minimum age being < 65
Van Kempen et al., 2014	Construct validity and reliability of a two-step tool for the identification of frail older people in primary care	Did not occur within a hospital setting, in, or including hospital inpatients	N/A
van Kempen et al., 2015	Diagnosis of Frailty after a Comprehensive Geriatric Assessment: Differences between Family Phyisicans and Geriatricians	Did not occur within a hospital setting, in, or including hospital inpatients	N/A
van Loon et al., 2017	Frailty screening tools for elderly patients incident to dialysis	Did not occur within a hospital setting, in, or including hospital inpatients	N/A
Van Munster et al., 2016	Discriminative value of frailty screening instruments in end-stage renal disease	Minimum age < 65	N/A
Vandewoude et al., 2006	A screening tool to identify older people at risk of adverse health outcomes at the time of hospital admission	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty
Venkat et al., 2018	Frailty Predicts Morbidity and Mortality after Colectomy for Clostridium difficile Colitis	Minimum age < 65	Also did not report the prevalence of frailty. Could potentially be derived from contacting authors however already excluded on the basis of age.
Vergara et al., 2016	Wrist fractures and their impact in daily living functionality on elderly people: a prospective cohort study	Did not occur within a hospital setting, in, or including hospital inpatients	Emergency department patients. Also did not use a clearly defined and validated operational definition for the classification of frailty. Also did not report the prevalence of frailty
Verloo et al., 2016	Association between frailty and delirium in older adult patients discharged from hospital	Did not occur within a hospital setting, in, or including hospital inpatients	Participants were no longer hospital inpatients at the time of frailty assessment

Prevalence and prognostic impact of frailty and its components in non-dependent elderly patients with heart failure	Prevalence and prognostic impact of frailty and its components in non-dependent elderly patients with heart failure	Other (Please elaborate in Column C to the right)	Excluded as consists of the same sample as Vidan et al. 2014 - "*FRAIL-HF, a study to evaluate the clinical complexity of heart failure in nondependent older patients: Rationale, methods and baseline characteristics*" which contains more information relevant to the review
Association of the Modified Frailty Index With 30-Day Surgical Readmission	Association of the Modified Frailty Index With 30-Day Surgical Readmission	Minimum age < 65	N/A
Wang et al., 2015	Incidence and effects of polypharmacy on clinical outcome among patients aged 80+: A five-year follow-up study	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients
Warnier et al., 2016	Validity, reliability and feasibility of tools to identify frail older patients in inpatient hospital care: A systematic review	Other (Please elaborate in Column C to the right)	Review
Warnier et al., 2017	The Maastricht Frailty Screening Tool for Hospitalised Patients (MFST-HP) to Identify Non-Frail Patients	Did not use clearly defined and validated operation definition for the classification of frailty	Did not utilise a validated operational definition for the classification of frailty (MFST-HP is a frailty indicator but not itself an operational definition for the classification of frailty)
Williams et al., 2017	Frailty and skeletal muscle in older adults with cancer	Did not occur within a hospital setting, in, or including hospital inpatients	Outpatients
Yagi et al., 2018	Impact of Frailty and Comorbidities on Surgical Outcomes and Complications in Adult Spinal Disorders	Minimum age < 65	Also did not report the prevalence of frailty. Could potentially be derived from contacting authors however already excluded on the basis of age.
Yang et al., 2018	Comparison of procalcitonin, a potentially new inflammatory biomarker of frailty, to interleukin-6 and C-reactive protein among older Chinese hospitalized patients	Minimum age < 65	N/A
Young et al., 2005	A prospective baseline study of frail older people before the introduction of an intermediate care service	Did not use clearly defined and validated operation definition for the classification of frailty	Also did not report the prevalence of frailty. Also does not report the minimum age of participants. Could be derived from contacting authors, however already excluded on the basis of not using a clearly defined and validated operational definition for the classification of frailty.
Zhang et al., 2018	Risk factors for falls in older patients with cancer	Did not occur within a hospital setting, in, or including hospital inpatients	N/A

Appendix 2.6. Master contact author file

Author, Year	Inquiry (via email to corresponding author(s))	Email 1	Response received	Email 2	Response received	Outcome	Additional information
Abel et al. 2015	Email to request full text and clarify if all baseline assessments were conducted on outpatients	Sent	No	Sent	Yes	Excluded	All reviewers agree to exclude as the author has confirmed that the sample consists of outpatients
Abramowitz et al., 2015	Email to confirm minimum age of patients within the cohort (not evident from paper), and also to confirm if the operational definition utilised for the classification of frailty has been validated	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that several participants were < 65 years of age. The operational definition utilised for the classification of frailty has also not been validated
Abramowitz et al., 2016	Email to confirm minimum age of patients within the cohort (not evident from paper), and also to confirm if the operational definition utilised for the classification of frailty has been validated	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the operational definition utilised for the classification of frailty has not been validated
Afilalo et al., 2012	Email authors to clarify if all assessments were performed while participants were inpatients, and if not, if separate data exists relating solely to those that were inpatients	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors were unable to provide an answer to the inquiry
Afilalo et al., 2017	Email to enquire if all patients were assessed as inpatients or during outpatient appointments	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Ahlund et al., 2017	Email authors to see if information exists relating to the prevalence of frailty in all of those screened for the study (study only included those who were frail).	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirm that information does not exist related to all of those initially screened
Al Zuhir et al., 2015	Email to see if full text linked to this exists related to this data	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Alegre et al., 2018	Email authors to confirm if the scale utilised for the assessment of frailty is a reflection of frailty level at admission, or if not, when.	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the frailty score is reflective of a period prior to patients having inpatient status
Ali et al., 2014	Email to see if full text linked to this exists related to this data	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Allen et al., 2005	Email author to obtain full text	Sent	Yes	N/A	NA	Excluded	All reviewers have agreed to exclude as a validated operation definition of frailty was not utilised.
Alonso Salinas et al., 2016	Email authors to enquire if this study examines a sub-sample of the sample examined in Alonso-Salinas et al., 2018 - "The Role of Frailty in Acute Coronary Syndromes in the Elderly"	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors have confirmed that this paper reports on a sub-sample of the same participants reported on in Alonso-Salinas et al., 2018 - "The Role of Frailty in Acute Coronary Syndromes in the Elderly", which has been included
Alonso Salinas et al., 2017	Email authors to enquire if this study examines a sub-sample of the sample examined in Alonso-Salinas et al., 2018 - "The Role of Frailty in Acute Coronary Syndromes in the Elderly"	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that this paper reports on a sub-sample of the same participants reported on in Alonso-Salinas et al., 2018 - "The Role of Frailty in Acute Coronary Syndromes in the Elderly", which has been included
Ansryan et al., 2018	Email authors to find out if information exists relating to the prevalence of frailty within the sample	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Atas et al., 2018	Email authors to obtain full text	N/A	N/A	N/A	N/A	Excluded	Full text located prior to contacting authors. After review by all reviewers, the study is excluded as it did not utilise a clearly defined and validated operational definition for the classification of frailty or report the prevalence of frailty.
Attisano et al., 2017	Emailed to request English version of full text	Sent	Yes	N/A	N/A	Included	Upon review all reviewers agreed to further contact the author to confirm the minimum age of participants and the assessment tool utilised for the operational definition of frailty. The authors have confirmed this information and all reviewers now agree on inclusion
Ballham et al., 2017	Email authors to obtain full text	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a full text does not exist relating to this poster presentation
Basic et al., 2017	Email authors to confirm minimum age was ≥ 65	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to excluded as the authors have confirmed that the minimum age was < 65 years
Bernal et al., 2018	Email to confirm sample consisted of hospital in-patients based on the reviewers operational definition of inpatient	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the frailty score is reflective of a period prior to patients having inpatient status
Bernaud et al., 2016	Email authors to see if full text exists related to this data	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as participants were not inpatients at the time of frailty assessment
Bertoli et al., 2017	Emailed to confirm the prevalence of frailty within the hospitalised in-patients component of the cohort	Sent	Yes	N/A	N/A	Excluded	All reviewers agree that the study is eligible for inclusion based on the inquiry as the authors were able to provide information regarding the prevalence of frailty. However, this study consists of the same sample as Valentini et al., 2018 (the latter which contains more information about this sample relevant to this review). As such all reviewers agree to exclude this study as it consists of the same sample as Valentini et al., 2018, which has been included in the review, and contains more information relevant to this review, than this present study
Bertone et al., 2012	Email authors to obtain full text	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the study was in outpatients.
Birch et al., 2014	Email authors to see if full published text related to this data exists	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors were unable to provide a published full text related to this data

Blandfort et al., 2015	Email author to see if full published text related to this data exists	N/A	N/A	N/A	N/A	Excluded	Full text located prior to contacting authors. After review by all reviewers, the study is excluded as it did not utilise a clearly defined and validated operational definition for the classification of frailty or report the prevalence of frailty.
Bottignole et al., 2013	Email authors to request English version of full text	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Briggs et al., 2017	Emailed to clarify whether the entire sample comprised of inpatients, or a combination of inpatients and day cases. (If the latter follow-up to see if these two sub-samples were differentiated at any stage in the assessment and recording of frailty, or if not, if raw data is available to facilitate this analysis)	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the entire sample did not comprise of inpatients. The two cohorts were not differentiated at any stage in the assessment of frailty, and the author confirms that raw data is no longer available to facilitate this analysis.
Bustamante-Chavez, Pene-Sanchez and Leguia-Cerna 2016	Email authors to request English version of full text	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Bylow et al., 2009	Email author to request full text	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Cahir et al., 2017	Protocol - Email to see if a subsequent full text or preliminary results related to the prevalence of frailty exist	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a full text or preliminary results do not presently exists related to this protocol. If preliminary results had of existed, the authors may have waited for a full text to become available to screen.
Calvo et al., 2018	Email authors to confirm if the scale utilised for the assessment of frailty is a reflection of frailty level at admission, or if not, when.	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that frailty assessments are reflective of pre-admission frailty status
Cameron et al., 2000	Email author to request full text	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Carpenter, Rothenberger, Stark 2010	Conference abstract - email to request the full text of study this abstract relates to	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors were unable to provide a full English test relating to the conference abstract
Casals et al., 2016	Email author to see if full published text related to this data exists	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Charest-Morin et al., 2018	Email to see if frailty assessment was conducted while patients were in-patients or during outpatient appointments	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the author confirms that frailty status was calculated retrospectively from pre-operative consultations
Chen et al., 2015	Email authors to confirm if the modified version of the Fried frailty phenotype criteria utilised has been validated	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the modified version of the Fried frailty phenotype utilised has not been validated
Chen et al., 2014	Email to see if raw data available to calculate the prevalence of frailty for those ≥ 3 on the Fried frailty phenotype assessment. Also confirm with authors if the modified version of the Fried frailty phenotype criteria utilised has been validated	Sent	Yes	N/A	N/A	Excluded	Although study authors provided raw data to facilitate the former aspect of the inquiry, all reviewers have agreed to exclude as the modified version of the Fried frailty phenotype utilised has not been validated
Clols et al., 2016	Email author to see if full published text related to this data exists	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Coleman et al 2012	Email to see if information is available relating to the prevalence of frailty	Sent	Yes	N/A	N/A	Included	All reviewers have agreed to include as the authors were able to provide information regarding the prevalence of frailty
Colombo et al., 2010	Email authors to obtain full text	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a full English text does not exist (full text only available in Italian)
Connelly et al., 2016	Email authors about the status of the study	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as this meeting abstract relates to a subsequently published full text that is already included within the screening - Moug et al., 2016
Conroy et al., 2013	Email author to see if information exists relating to the prevalence of frailty	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as authors unable to provide information regarding the prevalence of frailty
Corcoran et al., 2018	Email authors to see if there is full published text related to this data	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Cornali et al., 2007	Email authors to obtain full text	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Crehan et al., 2013	Email to obtain full text	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the study was not in hospital inpatients (emergency department patients)
Cuijpers et al., 2004	Email to request English version of full text	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors have confirmed that an English version of the full text does not exist
Curtin et al., 2018	Email authors to enquire if information exists regarding the breakdown of the prevalence of frailty by the original Clinical Frailty Scale (CFS) category i.e. 1 - 3 Non-frail, 4 vulnerable, 5 + Frail	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors were unable to provide information regarding the prevalence of frailty as per the original validated Clinical Frailty Scale scoring criteria

Dahya et al., 2016	To email to ascertain if information exists relating to the prevalence of frailty and to confirm minimum age ≥ 65	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Dalleur et al., 2012	Email author to see if information exists relating to the prevalence of frailty	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors have confirmed that information is not available regarding the prevalence of frailty derived from the CGA
Dalleur et al., 2014	Email to see if information available relating to the prevalence of frailty	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors have confirmed that information is not available regarding the prevalence of frailty derived from the CGA
Dawson et al., 2017	Email to obtain full text	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a full text is not available related to this title, which was solely a poster presentation
De Asteasu et al., 2018	Email authors to request full text	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a full text does not exists (solely poster presentation)
Des Guetz et al., 2010	Email author to request full text	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Diaz et al., 2016	Email author to see if full published text related to this data exists	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Dinescu et al., 2010	Email author to see if full published text related to this data exists	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as upon review of the full text a clearly defined and validated operational definition was not utilised for the classification of frailty, the prevalence of frailty was not reported, and it was not clear if the minimum age of participants was ≥ 65 years
Dodson et al., 2017	Email authors to enquire if the operational definition utilised for the classification of frailty has been validated	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that the operational definition of frailty utilised has not been validated
Dorner et al., 2013	Email authors to see if the study has since been published or if preliminary data exists in the form of a full text which can be screened for eligibility	Sent	No	Sent	No	Included	Unfortunately, a response to inquiry was not received from either of the contacted authors. However, the reviewers were subsequently successful in locating the full results manuscript for this protocol manuscript. Upon title and abstract, and subsequent full text screening all reviewers agree that the results manuscript of this study is eligible for inclusion within the review
Drks 2017	Email to request full text	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a full text does not presently exist related to this title
Drudi et al., 2017	Email to confirm patients were inpatients at baseline or during of the assessments	Sent	No	Sent	Yes	Included	All reviewers have agreed to include as the authors have confirmed that all participants were inpatients at the time of frailty assessment
Drudi et al., 2017	Email authors to see if a published full text related to this data exists	Sent	No	Sent	Yes	Excluded	The authors have confirmed that published full text related to this data does not presently exists
Drudi et al., 2016	Email authors to see if a published full text related to this data exists	Sent	No	Sent	Yes	Excluded	The authors have confirmed that a published full text related to this data does not presently exist
Drumm et al., 2017	Email to request full text	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a full text is not available (only poster for oral presentation)
Dunphy et al., 2017	Email to request full text	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a published full text related to this title does not exist, and furthermore that the sample comprised entirely of hospital outpatients
Dutta et al., 2015	Email authors to see if full published text related to this data exists	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a full text does not exist (solely poster presentation)
Dutzi et al., 2017	Email to see if information exists relating to the prevalence of frailty	Sent	Yes	N/A	N/A	Included	All reviewers have agreed to include as the author was able to provide data relating to the prevalence of frailty within the sample
Dziewierz et al 2018	Email to confirm the minimum age of participants and that frailty assessment were performed while participants were inpatients	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as although the authors have confirmed that patients were inpatients at the time of frailty assessments, authors have also confirmed that the minimum age of participants was < 65 years
Ekerstad et al., 2017	Email to see if information available relating to the prevalence of frailty	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Ekerstad et al., 2017	Email to see if information available relating to the prevalence of frailty of the entire sample	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Ekerstad et al., 2018	Email to see if information exists relating to the prevalence of frailty	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
El-Hayeck et al., 2015	Email author to request English full text	Sent	Yes	N/A	NA	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a full English text is not available (article only available in French)

Elias et al., 2018	Email author for full text	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude. The authors have confirmed that a published full text is not presently available regarding this data (in press awaiting publication), however were able to provide the PhD thesis containing these data, which allowed the reviewers to confirm that a validated operational definition for the classification of frailty was not utilised
El-Sharkawy et al., 2015	Email to find out if any information exists relating to the prevalence of frailty, also confirm all participants were in patients based on the studies operational definition	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as unfortunately, despite an initial response, the authors were unable to provide these data
Enguidos et al., 2008	Email to see if full text linked to this exists related to this data	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as upon review of the full text provided by the authors, as the minimum age of participants was < 65 years, the study didn't utilise a clearly defined and validation operational definition for the classification of frailty, did not report the prevalence of frailty
Enrique et al., 2015	Email author to request full text	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a full English text does not exist
Esbri-Victor et al., 2017	Email authors to confirm whether sample consisted of inpatients or outpatients in the geriatric falls unit	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that the sample consisted entirely of outpatients
Evans et al., 2014	Email to see if information exists relating to the prevalence of frailty	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors were unable to provide information relating to the prevalence of frailty
Ferrat et al., 2017	Email authors to confirm if participants were inpatients or if a sub-group of participants were inpatients.	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Folbert et al., 2017	Email to see if operational definition of frailty is validated	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that the frailty tool utilised is not validated.
Fukui et al., 2016	Email authors to confirm the patient (in-patient or outpatient) status of participants	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors have confirmed that frailty assessments were conducted during preoperative outpatient appointments
Gaffney et al., 2018	Email author to see if there is any provisional data or full text	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors have confirmed that participants were not hospital inpatients at the time of frailty assessment.
Gardiner et al., 2013	Email to confirm the operational definition used with the GSF assessment was the fried criteria (or some other validated operational definition for the classification of frailty	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the operational definition of frailty utilised has not been validated within this population
Gerrior et al., 2015	Email author to see if there is a full published text related to this data	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Gharacholou et al., 2015	Email to confirm participants were outpatients (exclusion). If inpatients, follow-up and ask if the replacement for the Minnesota leisure time questionnaire has been validated within the Fried Frailty phenotype before	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Giantin et al., 2018	Email to confirm participants were outpatients (exclusion).	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Goeteyn et al., 2017	Email authors to clarify conflicting information provided within the paper regarding the prevalence of frailty	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Gormley, Moore 2018	Email authors to see if full text is available or provisional data	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Gray et al., 2007 (The interrai acute care)	Email authors to see if there is full published text related to this data	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a clearly defined and validated operational definition for the classification of frailty was not utilised
Green et al., 2017	Email authors to see if data is awaiting publication or if preliminary data relating to the prevalence of frailty exists	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a full text does not exist related to this abstract
Green et al., 2016	Email authors to see if there is full published text related to this data	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Green et al., 2015	Email authors to confirm if the tool has been validated since this publication.	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Gregersen et al., 2015	Email authors to see if information exists relating to the prevalence of frailty	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as there authors have confirmed that the operational definition utilised for the classification of frailty is not validated
Gregorevic et al., 2018	Email author to see if information exists relating to the prevalence of frailty	Sent	Yes	N/A	N/A	Excluded	All authors have agreed to exclude as the authors were unable to provide data regarding the prevalence of frailty of the sample. The authors however did provide another paper to the reviewers which used the same dataset and focused on frailty; however this study also did not report the prevalence of frailty. The corresponding author for this paper was also contacted by the reviewers, however, no reply was received

Gregorevic et al., 2016	Email authors to see if information exists regarding the number of participants with a CFS score of 4 (vulnerable)	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors were unable to provide information regarding the specific number of participants with a CFS score of 4 (vulnerable), as such it was not possible to determine the prevalence of frailty due to the inability to differentiate between those who were classified as vulnerable and those who were classified as frail
Guerrero-Garcia 2016	Email authors for full English text	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Guidet et al., 2018	Email authors to see if information exists relating to the prevalence of frailty	Sent	Yes	N/A	N/A	Included	All reviewers have agreed to include as the authors were able to provide information regarding the prevalence of frailty
Gunaratna et al., 2014	Email authors to see if there is a full published text related to this data	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Halpert et al., 1999	Email authors to obtain full text	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors were unable to provide a full text related to this abstract
Hanlon et al., 2004	Email authors to verify the operational definition of frailty within the study and if data exists relating to the prevalence of frailty of all those screened	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that this study is a sub-study already excluded during the full text screening as a clearly defined and validated operational definition for the classification of frailty was not utilised (Cohen et al., 2002)
Hansen et al., 2012	Email authors to enquire if the adapted version of the Fried frailty phenotype utilised has been validated	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors were unable to confirm if the adapted version of the Fried frailty phenotype utilised has been validated
Hartley et al., 2017	Email to confirm minimum age of participants and to see if information exists relating to the prevalence of frailty	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that the minimum age of participants was <65 years
Hastings et al., 2008	Email to see if baseline assessments were conducted when patients were inpatients, also enquire if information exists relating to the prevalence of frailty	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that information does not exist relating to the prevalence of frailty
Hegener, Krause, Von Renteln-Kruse 2007	Email authors to see if an English version of the full text is available	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Heim et al., 2015	Email authors to confirm that the frailty assessment tool is validated	Sent	Yes	N/A	N/A	Excluded	Although the authors of this paper were unable to provide information regarding the validity of the tool utilised, the authors of another paper (Folbert et al., 2017) which utilised the same tool were able to confirm that the tool has not be validated for the classification of frailty, as such all reviewers have agreed to exclude
Heim et al., 2016	Email authors to confirm that the frailty assessment tool is validated	Sent	Yes	N/A	N/A	Excluded	Although the authors of this paper were unable to provide information regarding the validity of the tool utilised, the authors of another paper (Folbert et al., 2017) which utilised the same tool were able to confirm that the tool has not be validated for the classification of frailty, as such all reviewers have agreed to exclude
Heppenstall et al., 2018	Email to see if information exists relating to the prevalence of frailty	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude, as although the authors were able to provide raw data regarding that allowed calculation of the prevalence of frailty, due to discrepancies in the data provided and that reported within the published paper, and an inability of the authors to clarify these discrepancies, all authors agreed to exclude.
Heppenstall et al., 2011	Email to see if information exists relating to the prevalence of frailty (only reports mean)	Sent	Yes	N/A	N/A	Included	All reviewers have agreed to include as the authors were able to provide information regarding the prevalence of frailty
Hilmer et al., 2009	Email to confirm what authors definition of a convenience sample in this instance - did they assess or attempt to assess all patients admitted to all medical surgical wards during this period or alternatively employ some randomised selection of participants	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that an attempt was not made to assess the whole ward, nor was some form of randomised selection of participants implemented
Hilmer et al., 2011	Email to confirm that an attempt was made to recruit all potentially eligible patients over this period of that some form of randomised selection of participants was used	Sent	Yes	N/A	N/A	Included	All reviewers have agreed to include as the authors have confirmed that an attempt was made to assess all potentially eligible participants over the duration of the studies recruitment period
Ho et al., 2017	Email to obtain full text	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors were unable to provide a full text related to this abstract
Hobert et al., 2018	Email to see if information exists in relation to the prevalence of frailty	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Hubbard et al., 2011	Email to see if any information exists relating to the prevalence of frailty	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Hubbard et al., 2008 (Plasma esterases)	Email to see if information exists relating to the prevalence of frailty in the hospital cohort of the sample (.i.e. all those approached verses all those with frailty), and if so were all patients assessed or attempted to be assessed or was some form of randomised selection employed.	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the author has confirmed that an attempt was not made to recruit all patients within this population / setting, nor was some form of randomised selection of participants employed

Huded et al., 2016	Email to confirm minimum age of participants	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Huded et al., 2015	Email authors to see if full published text related to this data exists	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Ilango et al., 2017	Email authors to see if information exists relating to the prevalence of frailty (only reports mean)	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that information does not exists regarding the prevalence of frailty
Jankowski et al., 2018	Conference abstract - email authors to obtain full text of study this abstract relates to or to see if applicable preliminary data exits	Sent	Yes	N/A	N/A	Excluded	Authors were able to provide reviewers with the full text, which was then screened by the three reviewers for eligibility. Upon screening all reviewers agreed to contact the authors again to enquire if information exists which distinguished between those classified as vulnerable (CFS score of 4), and those classified as frail (CFS score of 5 or above). The authors were unable to provide this data and as such all reviewers have agreed to exclude
Jansen et al., 2017	Email authors to see if full text is available	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as upon review of the full text provided by the author, the study did not occur in a hospital setting, in, or including, hospital inpatients (community-dwelling)
Jimenez et al., 2017	Email authors to see if full text is available	N/A	N/A	N/A	N/A	Excluded	Prior to contacting authors it was determined that this conference abstract related to a sub-sample of the same cohort utilised in Comin-Colet et al., 2016 . After review by all reviewers, the study is excluded on these ground
Jimenez et al., 2015	Email author to see if full published text related to this data exists	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a full text is not available regarding this title
Joseph et al., 2015	Email authors to see if there is overlap in the participants within this present study and that of Joseph et al., 2014 - "Superiority of frailty over age in predicting outcomes among geriatric trauma patients: A prospective analysis"	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Joseph et al., 2016	Email authors to see if there is overlap in the participants within this present study and that of Joseph et al. 2014 - "Superiority of frailty over age in predicting outcomes among geriatric trauma patients: A prospective analysis"	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Joseph et al. 2017	Email authors to confirm if there is overlap in the participants within this present study and that of Joseph et al. 2016 - "The impact of frailty on failure-to-rescue in geriatric trauma patients: a prospective study".	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Kang et al. 2015	Email authors to confirm that sample was comprised entirely of inpatients.	Sent	Yes	N/A	N/A	Included	All reviewers have agreed to include as the authors have confirmed that the sample consisted entirely of inpatients
Kavanagh et al., 2017	Abstract - email authors to obtain full text or to see if applicable preliminary data exists	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Kenig et al., 2015	Email authors to confirm if there is overlap in the sample within this present study, and that of Kenig et al., 2015 - "Six screening instruments for frailty in older patients qualified for emergency abdominal surgery"	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Kennelly et al., 2016	Email author to see if full published text related to this data exists or if applicable preliminary data exists	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Kistler et al., 2015	Email authors to confirm operational definition of frailty utilised is not validated	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that the modified version of the Fried frailty phenotype utilised has not been validated
Kleczynski et al., 2017	Email authors to confirm minimum age was ≥ 65 and also to confirm all baseline frailty assessments were conducted while participants were inpatients	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Kono et al., 2018	Email authors to see when full text will be published or obtain a copy of the full text if possible	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Kotajarvi et al., 2017	Email authors to confirm if all participants were inpatients when frailty assessments were conducted	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors have confirmed that all frailty assessments were conducted as outpatients
Kristjansson et al., 2012	Email authors to query if participants were inpatients at the time of assessment, also to query if modified operational definitions of frailty that were utilised have been validated	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as while the authors have confirmed that all participants were inpatients, it was also confirmed that the modified operational definition utilised has not been validated
Kuroda et al., 1992	Email authors to obtain full text (likely ineligible)	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Kusunose et al., 2018	Email to confirm patients were inpatients	Sent	Yes	N/A	N/A	Included	All reviewers have agreed to include as the authors have confirmed that all participants within the study were inpatients

Lee et al., 2018	Email authors to confirm that an attempt was made to recruit the entire ward / clinical population during the recruitment period or that some form of randomised selection of participants was employed	Sent	Yes	N/A	N/A	Included	All reviewers have agreed to include as the authors have confirmed that an attempt was made to recruit the entire clinical population during their recruitment period and that there was no form of selection bias with regard to the participant recruitment process.
Lee et al., 2014	Email authors to confirm minimum age of participants, and to enquire if information exists relating to the prevalence of frailty amongst patients while hospitalised, and if additional information exists relating to the specific hospitals or hospital units these individuals were recruited from.	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as while the authors have confirmed that the minimum age of participants was 65 years, unfortunately, the authors were unable to provide information regarding the prevalence of frailty of patients while hospitalised
Lefebrve et al., 2015	Email author to see if information exists relating to the prevalence of frailty	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the author has outlined that this study consists of a sub-sample of patients already included in Lefebrve et al., 2016.
Lefebvre et al., 2016	Email authors to see if information exists relating to the prevalence of frailty, and to confirm if frailty assessments were conducted while participants were inpatients	Sent	Yes	N/A	N/A	Excluded	The authors were able to provide information regarding to the prevalence of frailty within the sample, and to confirm that assessments were reflective of the time when participants were inpatients. However, a follow-up inquiry was sent to the authors to confirm that the 67% prevalence reported in the initial response was based on a CFS score of > 4. The authors response was that it was not. Given this a follow-up email was sent to inquire if information was available regarding the number of participants with a CFS score > 4. Unfortunately, the authors have not responded this inquiry email and subsequent follow-ups. As such all reviews have agreed to exclude due to insufficient data regarding the prevalence of frailty
Leung et al., 2011	Email to confirm frailty assessment was performed while participants were inpatients and see if information exists relating to the exact prevalence of frailty (states 1/3 of patients, but exact percentage or number of patients is not stated). As such confirm that it is indeed 33.3% or 21/63 of the participants that had frailty and if so if information exists relating to those who were robust and pre-frail.	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that participants were assessed for frailty preoperatively as outpatients
Liguori et al., 2018	Email authors to confirm if participants were inpatients, and if so to see if information exists relating to the prevalence of frailty within the sample	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that the sample consists of outpatients
Lin et al., 2017	Email authors to request full text	N/A	N/A	N/A	N/A	Included	All reviewers have agreed to include as a full text was located by the lead reviewer prior to contacting authors, and upon review all three reviewers have agreed on inclusion
Livbjerg et al., 2017	Email authors to obtain full text	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Lokman et al., 2015	Abstract - Email authors to see if full text exists	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Lu et al., 2017	Email to confirm patients were inpatients	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Madan et al., 2016	Email authors to confirm if participants were inpatients or outpatients	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude at the authors have confirmed that the study sample were not inpatients (outpatients)
Main et al., 2002	Email authors to request full text	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a full text does not exist relating to this poster presentation
Makary et al., 2010	Email authors to see if information exists relating to the prevalence of frailty of all those with a Fried frailty phenotype score of 3 or higher (only presents 4 or 5 on the Fried scale as frail, however the scale considers all those 3 and above on the criteria scale to be frail). Also clarify if participants meet operational definition of inpatient within this review.	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Maloney et al., 2017	Conference abstract - email authors to obtain full text of study this abstract relates to or to see if applicable preliminary data exits	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors have confirmed that published full text is not available related to this conference abstract
Maloney et al., 2017	Email author request full text of study this abstract relates to or see if preliminary data is available	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a published full text is not available related to this abstract
Martinchek et al., 2016	Poster abstract - email authors to see if full text exists	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a published full text is not available related to this poster abstract
Martinez-Arroyo et al., 2014	Email authors to obtain English full text (Spanish)	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Martin-Sanchez et al., 2018 - Identification of	Email authors to request full text in English (Spanish)	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Martin-Sanchez et al., 2018 - Impact of	Email authors to request full text in English (Spanish)	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Masud et al., 2013	Email authors to see if information exists relating to the prevalence of frailty (reports mean and standard deviation)	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion

McCarthy et al., 2014	Email authors to see if full text exists relating to the abstract	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that this abstract consists of a sub-set of the sample published in Hewitt et al., 2015 - "*Prevalence of frailty and its association with mortality in general surgery*", which has been included in this review
McRae et al., 2015	Email author to confirm that operational definition of frailty is not validated	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that the operational definition utilised for the classification of frailty has not been validated
Miura et al., 2017	Email authors to find out minimum age of the entire sample, also see if information exists relating to the prevalence of frailty i.e. those with a CFS score of 5 and above (presently only reports 4 and above, with no breakdown to determine the number of participants in each category	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors have confirmed that the minimum age of participants was <65 years
Mizutani et al., 2017	Email authors to see if information exists relating to the prevalence of frailty	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Mlynarska et al., 2017	Email authors to confirm participants were assessed for frailty while inpatients	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Monacelli et al., 2018	Email authors to see if information exists relating to the prevalence of frailty	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Morin et al., 2012	Email authors to obtain English full text (French)	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Morisaki et al., 2017	Contact authors to confirm minimum age of participants	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Mottershead et al., 2017	Email author to see if full published text related to this data exists	Sent	No	Sent	Yes	Excluded	All reviewers agree to exclude as the authors have confirmed that a full published text is not available in this regard
Mottillo et al., 2015	Poster abstract - email authors to see if full text exists or if applicable preliminary data is available	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Muldoon et al., 2016	Conference abstract - email authors to obtain full text of study this abstract relates to or to see if applicable preliminary data exits	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Mullie et al., 2018	Email authors to ascertain if information exists relating to the minimum age of participants.	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Myint et al., 2016	Email authors to inquire if this study utilised a sub-sample of the sample utilised in Myint et al., 2018 - "Is anaemia associated with cognitive impairment and delirium among older acute surgical patients?"	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that there is overlap in the sample reported on within this paper and that of Myint et al., 2018 - "Is anaemia associated with cognitive impairment and delirium among older acute surgical patients"
Mzoughi et al., 2018	Email authors to request full text	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as upon review of the full text provided by the author, a clearly defined and validated operational definition for the classification of frailty was not utilised. The prevalence of frailty was also not reported.
Neuman et al., 2013 - Surgical treatment	Email authors to see if information exists solely relating to the prevalence of frailty of inpatients within the sample and to clarify if frailty assessment criteria relates solely to thar specific inpatient episode	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Neuman et al., 2013 - Predictors of	Email authors to see if information exists solely relating to the prevalence of frailty of inpatients within the sample and to clarify if frailty assessment criteria relates solely to thar specific inpatient episode	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Nouvenne et al., 2016	Email authors to see if information exists relating to the prevalence of frailty of all those initially screened	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors have confirmed that information is not available regarding the prevalence of frailty of all of those initially screened
Ntlholang et al., 2014	Abstract - contact authors to see if full text exists relating to this data	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
O'Caoimh et al., 2017	Conference abstract - email authors to obtain full text of study this abstract relates to or to see if applicable preliminary data exits	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Oliphant et al., 2015	Poster abstract - contact authors to see if full text exists relating to this data	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion

Ommundsen et al., 2014	Email author to confirm if modified version of operational definition of frailty utilised is validated	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
O'Neill et al., 2016	Email authors to confirm minimum age	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to excluded as the authors have confirmed that the minimum age was < 65 years
Onorati et al., 2014	Email authors to clarify what assessment tool was utilised for the assessment of frailty and the minimum age of participants	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Oo et al. 2013	Email authors to ascertain if the frailty tool utilised has been validated.	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
O'Riordan et al. 2017	Poster abstract - email authors to see if full text exists or if applicable preliminary data is available	N/A	N/A	N/A	N/A	Excluded	A full text was located by the lead reviewer prior to contacting authors, and upon review all three reviewers have agreed on exclusion as this is a review article
Orvin et al. 2015	Email authors to clarify if modified assessment tool utilised is validated	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Papakonstantinou et al. 2018	Email authors to see if information exists relating to the prevalence of frailty i.e. those with a CFS score of 5 and above (study only reports mean)	Sent	Yes	N/A	N/A	Included	All reviewers have agreed to include as the authors were able to provide information regarding the prevalence of frailty for these with a CFS score of 5 and above
Pareja et al. 2008	Poster abstract - Email authors to see if full text exists or if applicable preliminary data is available	Sent	No	Sent*	No	Excluded	*As there was only one author on this paper, the second email inquiry was resent to the author
Park et al. 2016	Email authors to request information regarding the minimum age of participants. Also request information regarding the validity of the frailty assessment utilised and if information exists relating to the prevalence of frailty	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Parmar et al. 2017	Protocol - Emailed to see if presently any preliminary results for the study, specifically relating to the assessment of frailty and if so, clarify that frailty assessments occurred while participants were inpatients	Sent	Yes	N/A	N/A	Included	All reviewers have agreed to include as the authors confirmed that a full results manuscript for this protocol was presently in press in the annals of surgery (available imminently), and that all participants were inpatients at the time of frailty assessment
Pasqualetti et al. 2018	Email authors to clarify if the operational definition of frailty utilised has been validated for the assessment of frailty specifically	Sent	Yes	N/A	N/A	Included	All reviewers have agreed to include as the authors have confirmed that the operational definition of frailty utilised has been validated regarding predictive value regarding negative health outcomes aligned with frailty
Patel et al. 2018	Email authors to clarify if the operational definition of frailty utilised within the study is validated	Sent	Yes	N/A	N/A	Included	All reviewers have agreed to include as the authors have confirmed that the operational definition of frailty utilised has been validated regarding predictive value related to negative health outcomes aligned with frailty
Peeters et al. 2018	Email authors to confirm the patient (in-patient or outpatient) status of participants	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors have confirmed that participants were not inpatients
Perna et al. 2017	Email author to see if information exists relating to the prevalence of frailty as defined by the actual Edmonton frailty scale scoring criteria	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that information does not exist relating to the prevalence of frailty defined by the validated original Edmonton Frailty scale classification.
Perna et al. 2017 - Sarcopenia and sarcopenic obesity	Contact authors to confirm that a sub-sample of the cohort consisted of participant who would have been considered hospital inpatients at the time of frailty assessment, and if so, to see if information exists relating to the prevalence of frailty of these inpatients as defined by the actual Edmonton frailty scoring criteria	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that information does not exist relating to the prevalence of frailty defined by the validated original Edmonton Frailty scale classification.
Pokharel et al. 2015	Meeting abstract - contact authors to see if full text exists relating to this data	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a full text does not presently exist relating to the data present within this meeting abstract
Poudel et al. 2014	Email authors to see if information exists relating to the prevalence of frailty, and also to enquire if this study reports on a sub-sample of the sample reported on in Poudel et al. 2016 - "*Adverse Outcomes in Relation to Polypharmacy in Robust and Frail Older Hospital Patients*"	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude, as although the authors were able to provide information regarding the prevalence of frailty, the authors have confirmed that this study reports on a sub-sample of the sample reported on in Poudel et al. 2016 - "Adverse Outcomes in Relation to Polypharmacy in Robust and Frail Older Hospital Patients", which has been included in the review and contains more information relevant to the review than this present study
Poudel et al. 2016	Email authors to see if information exists relating to the prevalence of frailty	Sent	Yes	N/A	N/A	Included	All reviewers have agreed to include as the authors were able to provide information regarding the prevalence of frailty
Prudon et al. 2016	Email authors for full text (Only abstract available)	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Raveau et al. 2013	Email authors to obtain full English text (French)	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Ritt et al. 2016 - Prediction of one-year mortality	Email authors to see if information exists relating to the prevalence of frailty	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion

Ritt et al. 2016 - A comparison of frailty	Email authors to see if information exists relating to the prevalence of frailty	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Robinson et al. 2013	Email authors to confirm patients were not inpatients at the time of frailty assessment and that the operational definition of frailty utilised has been validated	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Robinson et al. 2011	Email authors to confirm patients were not inpatients at the time of frailty assessment and that the operational definition of frailty utilised has been validated	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Rockwood et al. 2008	Contact authors to see if information exists solely relating to the prevalence of frailty of the inpatient part of the sample	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as unfortunately the authors were unable to provide information regarding the prevalence of frailty within the inpatient cohort of the sample
Rodriguez-Pascual et al. 2016	Email authors to confirm when frailty assessments were conducted in regard to inpatient status.	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as the authors have confirmed that participants were not hospital inpatients
Rogers et al. 2018	Email author to confirm minimum age of participants. Also need to determine if operational definition of frailty used has been validated, not just in its individual parts but as a whole for the assessment of frailty	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Romanowski et al. 2015	Email authors to see if information exists relating to the prevalence of frailty	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude, as although the authors were able to provide information regarding the prevalence of frailty, these data were related to participants pre-admission frailty status, rather than their frailty status as inpatients. As such all reviewers have agreed to exclude.
Ronayne et al. 2016	Only abstract available - contact authors to see if a full text or preliminary data exists relating to this data	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a full a full English text is not available (poster presentation)
Rossiter et al. 2016	Only abstract available - contact authors to see if a full text or preliminary data exists relating to this data	Sent	Yes	N/A	N/A	Included	All reviewers have agreed to include as the authors were able to provide a published full text related to this data, which upon review, all reviewers agree is eligible for inclusion - Ibrahim et al. 2019 "The feasibility of assessing frailty and sarcopenia in hospitalised older people: a comparison of commonly used tools".
Rouge-Bugat et al. 2013	Email authors to confirm if the operational definition of frailty utilised has been validated	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors have confirmed that the operational definition of frailty utilised has not been validated
Roy et al. 2017	Only abstract - contact authors to see if a full text or preliminary data exists relating to this data	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Sabartes et al. 2003	Only abstract - contact authors to obtain full text	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Saber et al. 2016	Conference abstract - email authors to obtain full text of study this abstract relates to or to see if applicable preliminary data exits	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a full text does not exist relating to this poster presentation
Saia et al. 2016	Email authors to confirm that participants were inpatients at the time of frailty assessment and to confirm the minimum age of participants	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as although the authors have confirmed that patients were inpatients at the time of frailty assessments, authors have also confirmed that the minimum age of participants was <65
Saltvedt et al. 2002	Contact author to clarify if operational definition of frailty has been validated and also if information exists relating to the prevalence of frailty	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that the operational definition of frailty utilised has not been validated
Sepehripour et al. 2018	Email to see if information exists relatively to the prevalence	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Shahar et al. 2001	Email authors to obtain full text	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Shiraishi et al. 2015	Email authors to obtain full text	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as unfortunately no response was received from the author. *As there was only one author on this conference paper, a follow-up email was resent to the corresponding author as the second email inquiry
Simms et al. 2014	Only abstract - Email author to obtain full text	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response was not received from either author to the email inquiry. As such there remains insufficient data in this regard to facilitate inclusion
Singh et al. 2012	Email authors to request information regarding the minimum age of participants	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response was not received from either author to the email inquiry. As such there remains insufficient data in this regard to facilitate inclusion
Small et al. 2016	Oral abstract - email authors to see if full text exists relating to this data	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response was not received from either author to the email inquiry. As such there remains insufficient data in this regard to facilitate inclusion

Smets et al. 2014	Email authors to clarify if frailty assessments in the cancer cohort of the sample were conducted while they were inpatients.	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude, as while the authors have confirmed that frailty assessments were conducted, mostly during hospitalisation (though not always), the authors were unable to provide information regarding the prevalence of frailty solely within these participants assessed during inpatient hospitalisation, or clarification as to the reasons why all participants were not assessed during hospitalisation
Stapleton 2018	Poster abstract - Email author to see if full text exists, or if preliminary data exists relating to this data	Sent	No	Sent*	No	Excluded	All reviewers have agreed to exclude as unfortunately no response was received from the author. *As there was only one author on this conference paper, a follow-up email was resent to the corresponding author as the second email inquiry
Sundermann et al. 2011	Email authors to confirm that all participants were inpatients at the time of frailty assessment	Sent	Yes	N/A	N/A	Included	All reviewers have agreed to include as the authors have confirmed that all participants were inpatients
Sze et al. 2017	Email authors to confirm minimum age of participants and to see if information exists relating to the prevalence of frailty for CFS scores of 5 or greater	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that the minimum age of participants was <65 years
Tay et al. 2017	Meeting abstract - contact authors to see if full text exists relating to this data	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a full text does not exist relating to this poster abstract
Thourani et al. 2016	Email authors to confirm minimum ager of participants, if a clearly defined and validated operational definition was utilised for the classification of frailty, and if information exists relating to the prevalence of frailty	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Ticinesi et al. 2016 (Lung ultrasound and chest x-ray for)	Email authors to see if information exists relating to the prevalence of frailty of the entire sample	Sent	Yes	N/A	N/A	Included	All reviewers have agreed to include as the authors were able to provide information regarding the prevalence of frailty for the entire sample
Ticinesi et al. 2016 (An investigation of multimorbidity measures)	Email authors to see if information exists relating to the prevalence of frailty of the entire sample	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors have confirmed that information is not available regarding the prevalence if frailty for the entire sample of all patients admitted patients over the duration of the study
Tsai et al, 2014	Email authors to clarify if they utilised a clearly defined and validated operational definition for the classification of frailty and also if information exists relating to the prevalence of frailty.	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Valenza et al. 2016	Conference abstract - contact authors to see if full text exists relating to this data	Sent	No	Sent	No	Excluded	Although a response was not received from the study authors to either of the initial email inquiries regarding the procurement of a potential full text from this conference abstract, the authors were ultimately successful in locating a full text online. Upon screening of the full text, all reviewers have agreed to exclude as a validated operational definition for the classification of frailty was not utilised.
Van Der Ven 2015	Email authors to obtain full text in English (Dutch)	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that an English full text does not exist related to this study
Vidan et al. 2013	Abstract only - email authors to see if full text is available	Sent	No	Sent	Yes	Excluded	All reviewers have agreed to exclude as the authors have confirmed the full text that this abstract relates to is already included within the review (Vidan et al. 2014)
Wakefield et al. 1996	Abstract only - email authors to see if full text is available	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that this title relates to the title of a dissertation. The authors have provided all the published papers originating from this dissertation as well as the means to locate the original, none of which contains data, which is eligible for inclusion in the review, due to the lack of a clearly defined and validated operational definition for the classification of frailty, and lack of reporting regarding the prevalence of frailty.
Wall, Wallis 2014 - Frailty in the emergency	Only abstract available - email authors to see if full text exists	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Wall, Wallis 2014 - Can a frailty scale	Only abstract available - email authors to see if full text exists	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Westgard et al. 2018	Contact authors to enquire if some form of randomised selection of participants was employed with regarding to the initial approach to participate	Sent	No	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a randomised selection of participants was not employed with regard to the initial approach of participants
Winograd et al. 1988	Email authors to confirm if the operational definition of frailty utilised has been validated and if information exists relating to the prevalence of frailty	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion
Wong et al. 2010	Oral abstract - email authors to see if full text exists relating to this data	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a full text does not exist related to this abstract
Woodard et al. 2014	Only abstract available - email authors for full text exists	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a full text does not exist related to this abstract
Yamada et al. 2016	Conference abstract - email authors to obtain full text of study this abstract relates to or to see if applicable preliminary data exits	Sent	No	Sent	No	Excluded	All reviewers have agreed to exclude as a response to inquiry was not received from either of the contacted authors. As such there remains insufficient data in this regard to facilitate inclusion

Zulfiqar et al. 2018 - Identification of frailty by	Email authors to obtain full English text (Only abstract available)	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a full English text is not available (article only available in French)
Zulfiqar et al. 2017	Email authors to obtain full English text (Only abstract available)	Sent	Yes	N/A	N/A	Excluded	All reviewers have agreed to exclude as the authors have confirmed that a full English text is not available (article only available in French)
Emailed during data extraction for additional information regarding an element of stratified analysis							
Dal Moro et al. 2017	Email authors to confirm time period over which recruitment was conducted in order to determine from which time points GDP and health care expenditure data will be extracted	Sent	Yes	N/A	N/A	Included in analysis	The authors were able to provide all of the requested information to facilitate inclusion in the stratified analysis
Eeles et al. 2012	Email authors to confirm time period over which recruitment was conducted in order to determine from which time points GDP and health care expenditure data will be extracted	Sent	No	Sent	Yes	Included in analysis	The authors were able to provide all of the requested information to facilitate inclusion in the stratified analysis
Goldforb et al. 2018	Email authors with regard to breakdown of frailty prevalence by country (study recruited patients from multiple countries)	Sent	No	Sent	No	Excluded from analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Guidet et al. 2018	Email authors with regard to breakdown of frailty prevalence by country (study recruited patients from multiple countries)	Sent	Yes	N/A	N/A	Excluded from analysis	Excluded from specific stratified analysis as the author has confirmed that these data are not available
Heppenstall et al. 2011	Email authors to confirm time period over which recruitment was conducted in order to determine from which time points GDP and health care expenditure data will be extracted	Sent	Yes	N/A	N/A	Excluded from analysis	Unfortunately, the corresponding author was unable to provide this data, as such the study has been excluded from this aspect of the analysis due to absence of data
Joosten et al. 2014	Email authors to confirm time period over which recruitment was conducted in order to determine from which time points GDP and health care expenditure data will be extracted	Sent	No	Sent	Yes	Included in analysis	The authors were able to provide all of the requested information to facilitate inclusion in the stratified analysis
Juma et al. 2016	Email authors to confirm time period over which recruitment was conducted in order to determine from which time points GDP and health care expenditure data will be extracted	Sent	Yes	N/A	N/A	Included in analysis	The authors were able to provide all of the requested information to facilitate inclusion in the stratified analysis
Llao et al. 2018	Email authors to confirm time period over which recruitment was conducted in order to determine from which time points GDP and health care expenditure data will be extracted	Sent	Yes	N/A	N/A	Included in analysis	The authors were able to provide all of the requested information to facilitate inclusion in the stratified analysis
Morton et al. 2018	Email authors to confirm time period over which recruitment was conducted in order to determine from which time points GDP and health care expenditure data will be extracted	Sent	Yes	N/A	N/A	Included in analysis	The authors were able to provide all of the requested information to facilitate inclusion in the stratified analysis
Ritt et al. 2015	Email authors to confirm time period over which recruitment was conducted in order to determine from which time points GDP and health care expenditure data will be extracted	Sent	No	Sent	No	Excluded from analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Sikder et al. 2018	Email authors to confirm time period over which recruitment was conducted in order to determine from which time points GDP and health care expenditure data will be extracted	Sent	No	Sent	No	Excluded from analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Alonso Salinas et al. 2018	Contact authors to enquire if data exists regarding: 1) the mean age (and standard deviation) of participants; 2) a sex breakdown regarding the number of pre-frail and non-frail participants	Sent	Yes	N/A	N/A	1) Included in stratified analysis 2) Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis
Amblas-Novellas et al. 2018	Contact authors to enquire if data exists regarding: 1) the number of pre-frail participants; 2) a sex breakdown regarding the number of frail, pre-frail, and non-frail participants	Sent	Yes	N/A	N/A	1) Included in stratified analysis; 2) Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis
Andela et al. 2010	Contact authors to enquire if data is available regarding: 1) the recruitment duration; 2) the overall mean age (and standard deviation) of participants, and 3) a sex breakdown of the number of frail participants (as a whole, and within each ward: geriatric centre, traumatology, pulmonary/rheumatology, internal medicine, surgical medicine)	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Andrew et al. 2017	Contact authors to enquire if information exists regarding the mean age and standard deviation of all participants for which frailty assessments were conducted (presently this is only reported separately for each of the three frailty classification categories)	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Attinsano et al. 2017	Contact authors to enquire if information exists regarding: 1) the number of pre-frail participants; 2) a sex breakdown of the number of pre-frail participants	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Bo et al. 2016	Contact authors to enquire if information exists regarding: 1) the prevalence of pre-frailty and non-frailty; 2) a breakdown of frailty, pre-frailty, and non-frailty by sex	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Bo et al. 2015	Contact authors to enquire if information exists regarding a sex breakdown of the number of frail participants	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Cheung et al. 2016	Contact authors to enquire if information exists regarding: 1) the score breakdown for the Reported Edmonton Frailty Scale that would allow classification of those who were vulnerable and non-frail according to the original classification; 2) a sex breakdown of the number of vulnerable and frail participants	Sent	Yes	N/A	N/A	1) Included in stratified analysis 2) Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis
Chew et al. 2017	Contact authors to enquire if information exists regarding: 1) the number of pre-frail participants; 2) a sex breakdown of the number of pre-frail participants	Sent	No	Sent	Yes	1) Not included in stratified analysis 2) Not included in stratified analysis	The authors have informed that unfortunately a specific analysis for pre-frailty does not exist for this study
Chia et al. 2016	Contact authors to enquire if information exists regarding: 1) the mean age (and standard deviation) of the entire sample; 2) a sex breakdown of the entire sample; 3) the number of pre-frail/robust participants in the entire sample; 4) a sex breakdown of the number of frail, pre-frail and non-frail participants	Sent	No	Sent	Yes	1) Included in stratified analysis 2) Included in stratified analysis 3) Not included in stratified analysis 4) Not included in stratified analysis	The authors were able to provide the requested information regarding the mean age (and standard deviation), and sex breakdown of the sample to facilitate inclusion within the stratified analysis. Unfortunately, the authors were unable to provide information regarding the number of pre-frail and non-frail participants, or a sex breakdown of the prevalence of frailty, pre-frailty and non-frailty due to missing data in this regard
Chong et al. 2017	Contact authors to enquire if information exists regarding: 1) the number of pre-frail/vulnerable participants for each frailty assessment tool employed where applicable (i.e. the FRAIL Scale, Frailty Index, Clinical Frailty Scale); 2) a sex breakdown of pre-frail participants according to each frailty assessment tool	Sent	Yes	N/A	N/A	1) Included in stratified analysis 2) Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis
Crozier-Shaw et al. 2018	Contact authors with regard to obtaining data regarding: 1) the mean age and standard deviation of all participants; 2) the sex breakdown of the sample; 3) the prevalence of frailty stratified by sex (number of frail male and female participants).	Sent	No	Sent	Yes	1) Not included in stratified analysis 2) Included in stratified analysis 3) Not included in stratified analysis	The authors were able to provide information regarding the sex breakdown of the entire sample. However, the authors were unable to provide information regarding the mean age (and standard deviation) of the entire sample, or a sex breakdown of the prevalence of frailty

Dal Moro et al. 2017	Contact authors to enquire if information exists which: 1) classifies vulnerable and non-frail patients according to the initial Edmonton Frailty Scale (EFS) criteria (Paper reports those 0-4 as non-frail and 5-7 as vulnerable, however original scale classifies 0-5 as non-frail, and 6-7 as vulnerable; 2) provides a breakdown of the prevalence of frail, non-frail and vulnerable categories by sex.	Sent	No	Sent	Yes	1) Included in stratified analysis 2) Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis
Dent et al. 2015	Contact authors to: 1) confirm if the modified versions of the Fried frailty phenotype and FRAIL scale, as well as the classificatory criteria utilised for the FI-CF, FI-CGA-10, MPI, SHERPA, and HARP have been validated; 2) inquire if information exists regarding the mean age (and standard deviation) of the 170 participants with a SOF index assessment; 3) a sex breakdown of the 170 participants with a SOF index assessment; 4) a sex breakdown of the number of frail, pre-frail, and non-frail participants, as assessed by the SOF; 5) inquire if information is available regarding the number of participants with a FI-CD score of ≥0.25	Sent	Yes	N/A	N/A	1) Not included in stratified analysis 2) Not included in stratified analysis 3) Not included in stratified analysis 4) Not included in stratified analysis 5) Not included in stratified analysis	Although the author had indicated that these tools were validated, upon further inspection all reviewers agree on the following in this regard: Fried frailty phenotype criteria ("CHS Index") - specific modified version utilised not validated, FRAIL Index - modified version utilised not validated, FI-CD - not validated with regard to scoring criteria, FI-GCA10 - Not validated with regard to scoring criteria which operates under the assumption that all participants are frail - 0 - 7 = mild frailty, 7 - 13 = moderate frailty, > 13 = severe frailty, MPI - Adapted version of MPI utilised not validated, SHERPA - Not validated, HARP - Not validated. Regarding query 2 the authors have confirmed that this is a typo in text and that the total number of participants assessed using the SOF was 172, this is supported by the percentages provided alongside the figures. With regard to inquiries 2-5, unfortunately the authors were unable to provide these data.
Dorner et al. 2014	Contact authors to inquire if information is available regarding the mean age (and standard deviation) of participants	Sent	Yes	N/A	N/A	Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis
Drudi et al. 2018	Contact authors to inquire if information is available regarding: 1) the number of pre-frail participants (Fried frailty phenotype criteria = 1 - 2); 2) a sex breakdown of the number of frail and pre-frail participants; 3) a breakdown of the prevalence of frailty by country	Sent	No	Sent	Yes	1) Not included in stratified analysis 2) Not included in stratified analysis 3) Not included in stratified analysis	Unfortunately, the authors were unable to provide these data to facilitate inclusion in stratified analysis
Dutzi et al. 2017	Contact authors to enquire if information exists regarding the prevalence of frailty stratified by sex	Sent	No	Sent	Yes	Included in stratified analysis	The authors were able to provide all the requested information to facilitate inclusion in the stratified analysis
Eamer et al. 2018	Contact authors to enquire if information exists regarding a breakdown of the prevalence of frailty, pre-frailty and non-frailty by sex	Sent	No	Sent	Yes	Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis
Eeles et al. 2012	Contact authors to enquire if information exists pertaining to 1) a sex breakdown of the entire sample; 2) a sex breakdown by frailty status	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Ekerstad et al. 2011	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of the entire sample; 2) a sex breakdown of both vulnerable (pre-frail), and non-frail participants	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Engelhardt et al. 2018	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of the entire sample; 2) a sex breakdown of the entire sample; 3) a breakdown of the sample by frailty classification	Sent	Yes	N/A	N/A	1) Included in stratified analysis 2) Included in stratified analysis 3) Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis
Ferrero et al. 2017	Contact authors regarding the mean age and standard deviation of all patients within the sample.	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Ga et al. 2018	Contact authors to enquire if: 1) there is a sex breakdown of the level of frailty with the original classificatory criteria for the FRAIL-NH: non-frail 0-5, prefrail 6-7, frail 8+; 2) if information exists pertaining to the prevalence of frailty as defined by the Frailty Index.	Sent	Yes	N/A	N/A	1) Included in stratified analysis 2) Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis
Goldforb et al. 2018	Contact authors to enquire if: 1) information exists regarding the number of pre-frail (1-2), and non-frail (0) participants as defined by the Fried Frailty phenotype; 2) a sex breakdown exists regarding frail, pre-frail, and non-frail participants	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Guidet et al. 2018	Contact authors to enquire if information exists regarding the mean age (and standard deviation) of the entire sample for which frailty was assessed (presently reported as median and IQR)	Sent	No	Sent	Yes	Included in stratified analysis	The authors were able to provide all of the requested information in order to facilitate inclusion within the stratified analysis
Gullon et al. 2017	Contact authors to: 1) reconfirm that frailty assessments utilising the FRAIL scale were only conducted in 755/804 participants; 2) inquire if information exists regarding the prevalence of pre-frailty; 3) inquire if a sex breakdown of frail, pre-frail, and non-frail participants exists	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Hartley et al. 2017	Contact authors to enquire if information exists regarding: 1) mean age (and standard deviation) of the sample; 2) the number of patients specifically with a CFS score of 4 (vulnerable); 3) a sex breakdown of the number of participants with a CFS score of 4	Sent	Yes	N/A	N/A	1) Included in stratified analysis 2) included in stratified analysis 3) Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis
Hewitt et al. 2016	Contact authors to enquire if information is available regarding: 1) the mean age (and standard deviation), and age range, of the 408 participants for which a frailty score is available; 2) a sex breakdown of the number of frail, pre-frail, and non-frail participants	Sent	Yes	N/A	N/A	1) Excluded from stratified analysis 2) Excluded from stratified analysis	Unfortunately, the corresponding author was unwilling to attempt to provide the requested information to facilitate inclusion within the stratified analysis
Hewitt et al. 2015	Contact authors to enquire if information is available regarding: 1) the mean age (and standard deviation), and age range, of the 317 participants for which a frailty score exists; 2) confirmation of the sex breakdown of the frailty scale scores, as the numbers in column 4 of Table 1 on page 256 under the heading " Sex No. of women (%)", do not appear to add up	Sent	Yes	N/A	N/A	1) Excluded from stratified analysis 2) Excluded from stratified analysis	Similar to Hewitt et al. 2016, unfortunately the corresponding authors was unwilling to attempt to provide the requested information to facilitate inclusion within the stratified analysis
Hii et al. 2015	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of participants (reported mean age as 78, but no standard deviation) 2) the number, and sex breakdown, of patients classified as vulnerable (6-7 on the REFS)	Sent	N/A	Sent	Yes	1) Included in stratified analysis 2) Included in stratified analysis	The authors were able to provide all of the requested information in order to facilitate inclusion within the stratified analysis
Hilmer et al. 2011	Contact authors to enquire if information exists regarding: 1) the number of patients classified as vulnerable (6-7 on the REFS); 2) a sex breakdown of the number of patients classified as vulnerable (6-7 on the REFS)	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Ibrahim et al. 2019	Contact authors to inquire if information is available regarding: 1) the mean age (and standard deviation) of the 230 participants assessed using the FRAIL scale, and the 218 participants assessed using the Fried frailty phenotype criteria; 2) a sex breakdown of the 230 participants assessed using the FRAIL scale, and 218 participants assessed using the Fried frailty phenotype criteria; 3) a sex breakdown of the number of frail, pre-frail, and non-frail participants assessed using both of these tools?	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry

Induruwa et al. 2017	Contact authors to enquire if information exists regarding: 1) The mean age and standard deviation of participants; 2) the prevalence of frailty, vulnerability, and non-frailty by sex, or if data exists that would allow this calculation i.e. individual CFS scores	Sent	No	Sent	Yes	1) Included in stratified analysis 2) Not included in stratified analysis	The authors were able to provide information regarding the mean age and standard deviation of participants to facilitate inclusion in stratified analysis. The authors were also able to provide information regarding a sex breakdown of the prevalence of frailty, however the sex breakdown provided of the 419 participants varied from that provided in the published text. Unfortunately, the authors were not able to explain this discrepancy in the number of male and female participants reported in the text, and in the information provided as the data was on hospital computers which they no longer has access to. It was decided that the published data would be the data selected for inclusion, since no explanation could be given for this discrepancy, and as such the sex breakdown of the prevalence of frailty, provided by the authors (with a discrepancy in the sex breakdown (number of male and female participant) would not be included
Jacobs et al. 2017	Contact authors to: 1) enquire if information exists regarding the number of frail, pre-frail and robust patients according to the Fried Frailty phenotype classification; 2) confirm if information exists regarding those vulnerable and non-frail according to the frailty index classification; 3) enquire if information exists regarding the prevalence of frailty, pre-frailty and non-frailty, for each assessment by sex.	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Joosten et al. 2014	Contact authors to enquire if information exists regarding: 1) mean age and standard deviation of all participants; 2) a sex breakdown of the 3 pre-frail participants as defined by the Fried frailty phenotype criteria	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Joseph et al. 2014	Contact authors to enquire if information exists regarding the number of pre-frail participants	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Juma et al. 2016	Contact authors to enquire if information exists regarding the sex breakdown of the 5 participants with a CFS score of 4, and the 16 participants with a CFS score of < 4	Sent	No	Sent	Yes	Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis
Kang et al. 2015	Contact authors to enquire if information exists regarding: 1) the mean age (and standard deviation) of participants; 2) the number of participants with a CSHA score of 4 (vulnerable), and those with a score of <4 (non-frail); 3) a sex breakdown of these participants	Sent	No	Sent	Yes	1) Included in stratified analysis 2) Included ins stratified analysis 3) Not included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis, with the exception of a sex breakdown of vulnerable and non-frail participants
Karlekar et al. 2017	Contact authors to enquire if information exists regarding: 1) the mean age (and standard deviation) of the 64 participants screened for frailty; 2) a sex breakdown of frail, pre-frail and non-frail participants	Sent	Yes	N/A	N/A	1) Included in stratified analysis 2) Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis
Keevil et al. 2018	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of the entire sample; 2) The number of patients with a CFS score of 4 (vulnerable); 3) a sex breakdown of those with CFS scores from 1-3, 4, and > 4	Sent	Yes	N/A	N/A	1) Not included in stratified analysis 2) Included in stratified analysis 3) Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis, with the exception of the mean age and standard deviation of participants as this data was only available for 10660/10662 participants
Kenig et al. 2015	Contact authors to enquire if information exists regarding: 1) the prevalence of pre-frailty as assessed by the GFI and the Rockwood frailty assessment; 2) A sex breakdown of the prevalence of frailty, pre-frailty, and non-frailty for both the GFI and the Rockwood frailty assessment	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Khan et al. 2019	Contact authors to enquire if information exists regarding: 1) the number of pre-frail participants; 2) a sex breakdown of pre-frail participants	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Kobe et al. 2018	Contact authors to enquire if information is available regarding: 1) the total number of participants recruited from each country; 2) the recruitment duration within each country; 3) the mean age (and standard deviation) and prevalence of frailty among patients from each country; 4) the prevalence of frailty and non-frailty stratified by ex among patients from each country	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Koyama et al. 2018	Contact authors to enquire if information exists regarding the sex breakdown of frail, pre-frail and non-frail participants	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Lee et al. 2018	Contact authors to enquire if information is available regarding: 1) the number of male and female participants; 2) a breakdown of the prevalence of frailty stratified by sex	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Le Maguet et al. 2014	Contact authors to: 1) confirm if the adapted version of the Fried frailty phenotype utilised has been validated; 2) confirm if information exists regarding a sex breakdown of vulnerable (CFS = 4), and non-frail (CFS < 4) participants	Sent	Yes	N/A	N/A	1) Excluded from stratified analysis 2) Included in stratified analysis	The authors confirmed that the adapted version of the Fried frailty phenotype utilised has not been validation. Authors were able to provide all of the requested information regarding the clinical frailty scale measure to facilitate inclusion within the stratified analysis
Llao et al. 2018	Contact authors to confirm if information exists regarding: 1) the number of pre-frail participants; 2) a sex breakdown of the number of frail, pre-frail and non-frail participants	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Ma et al. 2013	Contact authors to enquire if information exists regarding a sex breakdown of frail, pre-frail and non-frail participants	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Madni et al. 2017	Contact authors to enquire if information exists regarding a sex breakdown of frail, pre-frail, and non-frail participants	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Martin et al. 2018	Contact authors to enquire if information exists regarding a sex breakdown of the number of frail and pre-frail participants	Sent	Yes	N/A	N/A	Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis
Mason et al. 2018	Contact authors to enquire if information exists regarding: 1) the number of pre-frail and non-frail participants; 2) a sex breakdown of all 435 participants for which a frailty assessment is available; 3) a sex breakdown of frail, pre-frail and non-frail participants	Sent	Yes	N/A	N/A	1) Included in stratified analysis 2) Included in stratified analysis 3) Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis
Maxwell et al. 2018	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of participants; 2) the number of male / female participants; 3) a sex breakdown of the number of frail, prefrail, and non-frail participants	Sent	Yes	N/A	N/A	1) Included in stratified analysis 2) Included in stratified analysis 3) Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis
McGuckin et al. 2018	Contact authors to enquire if information exists regarding a sex breakdown of the number of frail, vulnerable, and non-frail participants	Sent	Yes	N/A	N/A	Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis

McIsaac et al. 2018	Contact author to enquire if information exists regarding; 1) the mean age and standard deviation of all participants within the study (only reported by frailty group presently within the text); 2) the number of pre-frail participants if applicable	Sent	Yes	N/A	N/A	1) Not included in stratified analysis 2) Not Included in stratified analysis 3) Not included in stratified analysis	Unfortunately, the authors were unable to provide any of the requested data for stratified analysis
Morton et al. 2018	Contact authors to enquire if information exists regarding the number of participants classified as pre-frail (CFS score = 4)	Sent	Yes	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Muessig et al. 2018	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of all patients within the sample; 2) a sex breakdown of the number of pre-frail participants (CFS score = 4)	Sent	No	Sent	Yes	1) Included in stratified analysis 2) Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis
Muller et al. 2017	Contact authors to enquire if information exists regarding: 1) the mean age (and standard deviation) of participants; 2) a sex breakdown of the 156 patients for which a frailty assessment exists; 3) if a sex breakdown exists regarding the number of frail, pre-frail and vulnerable participants	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Myint et al. 2018	Contact authors to enquire if information exists regarding: 1) the mean age (and standard deviation), and age range, of the 644 participants for which frailty data is available; 2) a sex breakdown of the 644 participants for which frailty data is available; 3) a sex breakdown of the number of frail, vulnerable and non-frail participants	Sent	Yes	N/A	N/A	1) Not included in stratified analysis 2) Not included in stratified analysis 3) Not included in stratified analysis	Similar to Hewitt et al. 2015, and Hewitt et al. 2016, unfortunately the corresponding authors was unwilling to attempt to provide the requested information to facilitate inclusion within the stratified analysis
Nygen et al. 2016	Contact authors to enquire if information exists regarding: 1) the number of vulnerable participants (REFS 6 - 7) within the entire sample of 302 participants ;2) a sex breakdown of the number of vulnerable participants	Sent	No	Sent	Yes	1) Not included in stratified analysis 2) Not included in stratified analysis	Unfortunately, the authors were unable to provide the requested information (not in possession of these data) in order to facilitate inclusion with these aspects of stratified analysis
Nolan et al. 2016	Contact authors to enquire if information exists regarding a sex breakdown of the number participants classified as frail (CFS > 4) and vulnerable (CFS score = 4)	Sent	Yes	N/A	N/A	Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis
Oliveira et al. 2013	Contact authors to enquire if all participants were acute admissions	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Papageorgiou et al. 2018	Contact authors to enquire if a sex breakdown exists regarding the number of participants classified as frail (CFS > 4), vulnerable (CFS = 4) and non-frail (CFS < 4)	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Papakonstantinou et al. 2018	Contact authors to enquire if information exists regarding: 1) the mean, standard deviation, and age range of all participants for which a frailty assessment exists; 2) the number of participants classified as vulnerable (CFS = 4); 3) a sex breakdown of the number of participants classified as frail (CFS > 4), pre-frail (CFS = 4), and non-frail (CFS < 4)	Sent	Yes	N/A	N/A	1) Included in stratified analysis 2) Included in stratified analysis 3) Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis
Pasqualetti et al. 2018	Contact authors to enquire if information exists regarding a sex breakdown of the prevalence of frailty, pre-frailty, and non-frailty	Sent	Yes	N/A	N/A	Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis
Patel et al. 2018	Contact authors to enquire if information exists regarding: 1) the mean age (and standard deviation) of all participants; 2) the mean age and standard deviation of STEMI, and non-STEMI patients; 3) the number of pre-frail participants (overall within the sample and also specifically within STEMI and NSTEMI participants; 4) a sex breakdown of the number of pre-frail participants (overall, and within both STEMI and NSTEMI participants)	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Peel et al. 2017	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of all participants with three or more moves for which frailty data exists (n = 89); 2) the mean age and standard deviation of all geriatric medicine patients (n = 67), and general medicine patients (n = 22) with three or more moves for which frailty data exists; 3) a breakdown of the number of frail, vulnerable and non-frail geriatric, and general medicine patients; 4) a sex breakdown of all 89 participants, as well as a sex breakdown of geriatric, and general medicine participants, with three or more moves; 5) a sex breakdown of the number of frail, vulnerable and non-frail participants amongst all participants (n = 89), geriatric patients (n = 67), and general medicine patients (n= 22), with three of more moves; 6) confirmation of which group (geriatric or general medicine participants), the two participants with missing frailty data originate?	Sent	Yes	N/A	N/A	1) Included in stratified analysis 2) Included in stratified analysis 3) Included in stratified analysis 4 Included in stratified analysis 5) Included in stratified analysis 6) Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis
Pulaski et al. 2017	Contact authors to inquire if information is available regarding: 1) the mean age and standard deviation of the sample; 2) a sex breakdown of the prevalence of frailty, pre-frailty, and non-frailty	Sent	Yes	N/A	N/A	1) Included in stratified analysis; 2) Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within the stratified analysis
Perera et al. 2009	Contact authors to enquire if information exists regarding; 1) the number of vulnerable participants (REFS = 6-7) and non-frail participants (REFS < 5); 2) the number of male and female participants; 3) a sex breakdown of the number of frail, vulnerable and non-frail participants	Sent	Yes	N/A	N/A	1) Not included in stratified analysis 2) Not included in stratified analysis 3) Not included in stratified analysis	Unfortunately, the authors were not able to locate these data as the study was conducted too long ago, and these data were no longer easily available
Pollack et al. 2017	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of all participants; 2) the number of pre-frail participants; 3) a sex breakdown of the number of pre-frail participants	Sent	Yes	N/A	N/A	1) Included in stratified analysis 2) Included in stratified analysis 3) Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion within stratified analysis
Poudel et al. 2016	Contact authors to enquire if information exists regarding: 1) the number of pre-frail participants; 2) a sex breakdown of the number of frail, pre-frail (if applicable) and non-frail participants	Sent	No	Sent	Yes	1) Not included in stratified analysis 2) Partially included in stratified analysis	The authors were able to provide a sex breakdown of frail participants to facilitate inclusion within stratified analysis. However, unfortunately the authors were not able to provide information regarding the prevalence of pre-frailty, and non-frailty, or a sex breakdown of the number of pre-frail or non-frail participants
Purser et al. 2006	Contact authors to enquire if information exists regarding: 1) the number of pre-frail participants for both the Fried frailty phenotype (Composite A) and Rockwood frailty assessment (Composite B) 2) a sex breakdown of the number of pre-frail participants according to each assessment	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Ritt et al. 2015	Contact authors to enquire if information exists regarding the mean age (and standard deviation) of the sample	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Rose et al. 2014	Contact authors to enquire if a sex breakdown exists regarding the number of frail, vulnerable, and non-frail participants	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Sanchez et al. 2011	Contact authors to enquire if information exists regarding: 1) the number of pre-frail participants; 2) a sex breakdown of the number of frail, pre-frail and non-frail participants	Sent	No	Sent	No	Excluded from stratified analysis	Excluded from specific stratified analysis due to absence of data and no response from either author to email inquiry
Sanchis et al. 2015	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of the entire sample; 2) the number of pre-frail participants; 3) a sex breakdown of the number of pre-frail participants	Sent	Yes	N/A	N/A	1) Included in stratified analysis 2) Included in stratified analysis 3) Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion in the stratified analysis

Sundermann et al. 2014	This study is the full report of another study within our screening (Sundermann et al. 2011 (preliminary results)). Contact authors to enquire if information exists regarding: 1) a sex breakdown of the number of frail participants as assessed by the Comprehensive Assessment of Frailty (CAF) tool; 2) the number of frail, pre-frail (if applicable) and non-frail participants as defined by the FORECAST frailty assessment; 3) a sex breakdown of the number of frail, pre-frail and non-frail participants as defined by the FORECAST frailty assessment	Sent	No	Sent	Yes	1) Included in stratified analysis 2) Included in stratified analysis 3) Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion in the stratified analysis
Thai et al. 2015	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of the entire sample; 2) the number of vulnerable participants (6-7 on the REFS); 3) a sex breakdown of the number of pre-frail participants	Sent	Yes	N/A	N/A	1) Not included in stratified analysis 2) Not included in stratified analysis 3) Not included in stratified analysis	Unfortunately, the authors have confirmed that these data are no longer available
Ticinesi et al. 2016	Contact authors to inquire if information is available regarding: 1) the mean age (and standard deviation) of the entire sample; 2) the number of pre-frail within the entire sample; 3) a sex breakdown of the entire sample; 4) a sex breakdown of frail and pre-frail participants	Sent	Yes	N/A	N/A	1) Included in stratified analysis 2) Included in stratified analysis 3) Included in stratified analysis 4) Included in stratified analysis	The authors were able to provide all of the requested information to facilitate inclusion in stratified analysis
Timmons et al. 2015	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of the entire sample; 2) a sex breakdown of the number of frail, pre-frail, and non-frail participants; 3) a breakdown of the prevalence of frailty for both acute, and elective admissions	Sent	Yes	N/A	N/A	1) Included in stratified analysis 2) Included in stratified analysis 3) Not included in stratified analysis	The authors were able to provide all of the requested information regarding the first two inquiries to facilitate inclusion within the stratified analysis. Unfortunately, the authors were not able to provide information regarding a breakdown of the prevalence of frailty for both acute and elective admissions; as such there remains insufficient data to facilitate inclusion within this aspect of the stratified analysis.
Valentini et al. 2018	Contact authors to enquire if information exists regarding: 1) the number of male and female participants within the inpatient cohort of the sample; 2) a sex breakdown of the number of frail, pre-frail and non-frail participants within the inpatient cohort of the sample	Sent	Yes	N/A	N/A	1) Included in stratified analysis 2) Not included in stratified analysis	The authors were able to provide a sex breakdown of the sample. However the authors were not able to provide a full sex breakdown of the prevalence of frailty due to missing data linking these two variables, which the authors were not able to provide
Vidan et al. 2014	Contact authors to enquire if information exists regarding: 1) the number of pre-frail participants; 2) a sex breakdown of the number of frail, pre-frail and non-frail participants; 3) a sex breakdown of the number of frail, pre-frail and non-frail participants within each of the departments (cardiology, internal medicine, geriatrics)	Sent	No	Sent	No	1) Not included in stratified analysis 2) Not included in stratified analysis 3) Not included in stratified analysis	Unfortunately, a response regarding these inquiries was not received from either author; as such, there persisted insufficient data to facilitate inclusion within these
Wou et al. 2013	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of all 559 participants for which frailty index data is available; 2) a sex breakdown of the 559 participants for which frailty index data is available; 3) the number of pre-frail participants; 4) a sex breakdown of the number of frail, pre-frail and non-frail participants	Sent	Yes	N/A	N/A	1) Not included in stratified analysis 2) Not included in stratified analysis 3) Not included in stratified analysis 4) Not included in stratified analysis	Unfortunately, the corresponding author was not in a position time wise to provide the requested information. It was suggested that it may be possible to obtain the information if his colleague could join the writing team. The reviewers outlined that unfortunately they were not in a position to extend authorship in this regard, however, were always open to potential future collaborations, and that it was regrettable, if it was the case, that the data was not available on this occasion

Appendix 2.7. Master data extraction form

Data extraction form Part 1:

Study details						Study methods and participant characteristics													
Study	Author	Year of Publication	Study title	Journal of publication	Aim	Setting	Ward / Department / Unit / Hospital / Clinical population type	Study design	Recruitment duration	Age of participants (mean +/-SD)	Age of participants (range)	Country / location	Continent	5-year average GDP per capita PPP (current international $) (years preceding the study) (International Monetary Fund data)	5-year average healthcare expenditure per capita PPP (current international $) (years preceding the study) (World Health Organisation data)	Sample size (n)	Diagnosis / Prevalent morbidity (if applicable)	Any other relevant characteristics	Criteria utilised for the operational definition of frailty
1	Alonso Salinas et al.	2018	The Role of Frailty in Acute Coronary Syndromes in the Elderly	Gerontology	To clarify the role of frailty and its impact on the ACS process. The main goal was to evaluate the impact of frailty on mortality and reinfarction in patients aged ≥75 years with type 1 MI.	Three tertiary-level hospitals in Spain	Patients with Acute Coronary Syndrome (Type 1 Myocardial infarction) in three-tertiary hospitals in Spain	Prospective, observational study	30 months (October 2013 - December 2015)	82.46 +/- 4.95	78 - 88	Spain	Europe	32,520	2,914	285	Type 1 myocardial infarction	N/A	SHARE-FI
2	Amblas-Novellas et al.	2018	Frail-VIG index: a concise frailty evaluation tool for rapid geriatric assessment	BMC Geriatrics	To determine the capacity of the frail-VIG index to predict 24-month mortality in patients admitted to an acute geriatric unit	University Hospital of Vic (Barcelona, Spain)	Acute Geriatric Unit (AGU)	Prospective, observational, longitudinal study	12 months (January - December 2014)	86.4 +/- 5.6	85 +	Spain	Europe	32,208	2,913	590	N/A	N/A	Frail-VIG index
3	Andela et al.	2010	Prevalence of frailty on clinical wards: Description and implications	International Journal of Nursing Practice	To describe the prevalence and frailty level of patients aged 75 years upon admission to various clinical wards and the implication for care	Multiple: A large teaching hospital, and a university hospital	Multiple: five clinical wards of different specialisms in the large teaching hospital (geriatric centre, traumatology ward and pulmonary / rheumatology wards); and the university hospital (two general internal medicine wards, and a surgical ward)	Observational	6 months (2009)	-	75 +	Netherlands	Europe	41,787	3,721	276	N/A	N/A	Groningen Frailty Indicator (GFI)
	As above	*As above*	*As above*	*As above*	*As above*	*A large teaching hospital in the Netherlands*	*Geriatric centre*	*As above*	*6 months (2009)*	*83.8 (+/- 4.7)*	*75 +*	*As above*	*As above*	*As above*	*As above*	*32*	*N/A*	*N/A*	*As above*
	As above	*As above*	*As above*	*As above*	*As above*	*A large teaching hospital in the Netherlands*	*Traumatology*	*As above*	*6 months (2009)*	*83.3 (+/- 5.3)*	*75 +*	*As above*	*As above*	*As above*	*As above*	*69*	*N/A*	*N/A*	*As above*
	As above	*As above*	*As above*	*As above*	*As above*	*A large teaching hospital in the Netherlands*	*Pulmonary / Rheumatology*	*As above*	*6 months (2009)*	*79.8 (+/- 3.2)*	*75 +*	*As above*	*As above*	*As above*	*As above*	*71*	*N/A*	*N/A*	*As above*
	As above	*As above*	*As above*	*As above*	*As above*	*A University hospital in the Netherlands*	*Internal medicine*	*As above*	*1 month (2009)*	*81.2 (+/- 5.1)*	*75 +*	*As above*	*As above*	*As above*	*As above*	*76*	*N/A*	*N/A*	*As above*
	As above	*As above*	*As above*	*As above*	*As above*	*A University hospital in the Netherlands*	*Surgical medicine*	*As above*	*2 weeks (2009)*	*81.1 (+/- 4.9)*	*75 +*	*As above*	*As above*	*As above*	*As above*	*28*	*N/A*	*N/A*	*As above*
4	Andrew et al.	2017	The Importance of Frailty in the Assessment of Influenza Vaccine Effectiveness Against Influenza-Related Hospitalization in Elderly People	Journal of Infectious Diseases	To measure vaccine effectiveness (VE) against influenza hospitalization and serious outcomes in people aged ≥65 years, with particular focus on assessing the impact of frailty on VE estimates and an exploratory analysis of VE stratified by level of baseline frailty.	38 academic and community sentinel hospitals in Nova Scotia (2 hospitals), New Brunswick (1), Quebec (4), Ontario (29), Manitoba (1), and British Columbia (1)	Medical and coronary intensive care units (ICUs) and medical wards. Patients with influenza related hospitalisation	prospective, multi-centre, test negative case control	7 months (November 2011 - May 2012)	-	65 +	Canada	North America	39,165	3,845	505	Influenza related hospitalisation	N/A	Frailty Index (39 item)
5	Attinsano et al.	2017	SICI-GISE commuNity CAmpania Survey doNna TAVI (INCANTA): Perioperative and short-term outcome of transcatheter aortic valve implantation in women	Giornale Italiano di Cardiologia	To collect acute and 30-days safety and efficacy clinical data in high and intermediate risk women, who underwent TAVI with new generation devices, in the Campania region, Italy.	Several trans-catheter aortic valve implantation (TAVI) centres in the Campania region	Cardiac surgery patients (trans-catheter aortic valve implantation (TAVI))	retrospective observational study	12 months (January - December 2016)	83 +/- 7	80 +	Italy	Europe	35,408		331	Cardiac surgery patients (trans-catheter aortic valve implantation (TAVI))	N/A	Frailty Index

6	Baldwin et al.	2014	The feasibility of measuring frailty to predict disability and mortality in older medical intensive care unit survivors	Journal of Critical Care	To test the primary hypothesis that Fried's frailty components could be measured in older ICU survivors of respiratory failure just prior to hospital discharge	Columbia University medical ICU (MICU)	Cardiac surgery patients (trans-catheter aortic valve implantation (TAVI))	a single-centre prospective cohort study	6 months (February - July 2012)	77 +/- 8.9	65 - 95	United States of America	North America	48,278	7,684	22	Survivors of respiratory failure	N/A	Fried frailty phenotype criteria
7	Blanco et al.	2017	Prognosis Impact of Frailty Assessed by the Edmonton Frail Scale in the Setting of Acute Coronary Syndrome in the Elderly	Canadian Journal of Cardiology	To assess the prevalence of frailty and its impact on all-cause mortality in a cohort of elderly patients admitted for ACS.	Tertiary care centre at the University Hospital of Toulouse	Patients with type 1 myocardial infarction admitted to tertiary care centre	Prospective observational study	15 months (May 2014 - July 2015)	85.9 +/-3.9	85 +	France	Europe	38,738	4,283	236	Acute Coronary Syndrome (ACS) - Type 1 myocardial infarction	N/A	Adjusted Edmonton Frailty Scale (EFS)
8	Bo et al.	2015	Health status, geriatric syndromes, and prescription of oral anticoagulant therapy in elderly medical in-patients with atrial fibrillation: A prospective observational study	International Journal of Cardiology	To investigate the prevalence of common geriatric syndromes and contraindications to OAs in real world older medical in-patients with AF, and whether these variables are associated with under-prescription of OAs at discharge	Several geriatric and internal medicine departments	Atrial fibrillation patients	Prospective observational study	4 months (January - April 2014)	81.7 +/- 6.8	65 +	Italy	Europe	34,839	3,195	513	Atrial fibrillation	N/A	Groningen Frailty Indicator (GFI)
9	Bo et al.	2016	Prevalence of and factors associated with prolonged length of stay in older hospitalized medical patients	Geriatrics & Gerontology International	To comprehensively define the characteristics of these contemporary older medical inpatients, and the variables associated with longer stay in hospital and delayed discharge.	Eight acute geriatric and medical wards of two large metropolitan university teaching hospitals ("Azienda Ospedaliera Città della Salute e della Scienza di Torino, Ospedale Molinette" of Turin and "Azienda Ospedaliero-Universitaria San Luigi Gonzaga" of Orbassano) and the hospital "Azienda Ospedaliera S. Croce e Carle" of Cuneo in Piedmont, northern Italy	Acute geriatric / medical wards	Prospective observational study	4 months (January - April 2012)	81 +/- 7.3	65 +	Italy	Europe	35,198	3,056	1568	N/A	N/A	Fried Frailty phenotype criteria
10	Cheung et al.	2017	A prospective cohort study of older surgical inpatients examining the prevalence and implications of frailty	Australasian Journal on Ageing	To identify the prevalence of frailty in a population of older surgical inpatients, and its association with adverse outcomes in hospital and three months thereafter	Tertiary referral centre in Sydney Australia	Orthopaedic, cardiothoracic, vascular, or colorectal surgical services	Prospective cohort study	5 months (March - July 2014)	78.0 +/- 7.0	65 +	Australia	Australasia	43,268	3,779	100	Surgical inpatients	N/A	Reported Edmonton Frailty Scale (REFS)
11	Chew et al.	2017	Impact of frailty and residual subsyndromal delirium on 1-year functional recovery: A prospective cohort study	Geriatrics & Gerontology International	To investigate the impact of frailty on incomplete delirium recovery at hospital discharge, defined as RSSD, and secondly, to examine the potential mediating role of RSSD on the relationship between frailty and 1-year functional recovery.	Department of Geriatric Medicine, Tan Tock Seng Hospital, Singapore	Geriatric Monitoring Unit (GMU)	Prospective observational cohort study	21 months (December 2010 - August 2012)	84.1 +/- 7.4	65 +	Singapore	Asia	65,975	1,982	234	Delirium	N/A	Frailty Index (FI)
12	Chia et al.	2016	'Start to finish trans-institutional transdisciplinary care': a novel approach improves colorectal surgical results in frail elderly patients	Colorectal Disease	To assess if a Start to Finish (STF) trans-institutional transdisciplinary model of care improves the surgical outcome of elderly patients undergoing major colorectal surgery.	Khoo Teck Puat Hospital (KTPH) acute hospital, Singapore	Department of general surgery (Colorectal surgery patients)	Prospective study	84 months (January 2007 - December 2014)	80.41 +/ 5.5	65 - 97	Singapore	Asia	62,564	2,012	117	Colorectal surgery	N/A	Fried Frailty Phenotype
13	Chong et al.	2017	Frailty and Risk of Adverse Outcomes in Hospitalized Older Adults: A Comparison of Different Frailty Measures	Journal of the American Medical Directors Association	To (1) compare the performance of frailty measures (FRAIL, CFS, and TFI) in identifying frailty, using the widely adopted FI as "gold standard," and (2) compare their ability to predict negative outcomes among hospitalized older adults.	Department of Geriatric Medicine, Tan Tock Seng Hospital, Singapore	Department of geriatric medicine	Prospective cohort study	2 months (November - December 2015)	89 +/- 4.6	65 +	Singapore	Asia	78,401	2,732	210	N/A	N/A	Multiple
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*210*	*As above*	*As above*	*Frailty Index*
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*210*	*As above*	*As above*	*FRAIL scale*
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*210*	*As above*	*As above*	*Tilburg Frailty Index (TFI)*
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*210*	*As above*	*As above*	*Clinical Frailty Scale*
14	Coleman et al.	2012	Outcomes among older people in a post-acute inpatient rehabilitation unit	Disability and Rehabilitation	To evaluate changes in function and Quality of Life following 6 weeks of multidisciplinary rehabilitation in an older inpatient population.	Three rehabilitation wards in a large urban hospital	Rehabilitation wards	Prospective observational study	4 months (September - December 2009)	82.9 +/- 6.35	65 +	Ireland	Europe	42,700	2,732	32	N/A	N/A	Clinical Frailty Scale (CFS)

15	Courtney-Brooks et al.	2012	Frailty: An outcome predictor for elderly gynaecologic oncology patients	Gynaecologic Oncology	To assess if frailty, as assessed by a previously validated measurement tool, is a predictor of risk of 30-day postoperative complications among gynaecologic oncology patients undergoing surgery.	Tertiary level hospital	Gynaecologic oncology patients	Prospective cohort study	10 months (March - December 2011)	73	65 - 95	United States of America	North America	47,555	7,540	37	Gynaecologic cancer	N/A	Fried frailty phenotype
16	Crozier-Shaw et al.	2018	Too frail for surgery? A frailty index in major colorectal surgery	ANZ Journal of Surgery	To demonstrate the validity of a frailty index in predicting post-operative outcomes in patients undergoing major colorectal surgery.	Tertiary referral private institution	Colorectal surgery patients	Prospective cohort study (Retrospective review)	180 months (2012 - 2016)	-	65 +	Ireland	Europe	47,616	4,623	206	Benign and malignant colorectal diseases	N/A	National Surgical Quality Improvement Program frailty index
17	Dal Moro et al.	2017	Frailty and elderly in urology: Is there an impact on post-operative complications?	Central European Journal of Urology	To analyse a cohort of older urological patients according to various frailty indices, to verify whether they are predictive of post-operative complications after urological procedures.	Tertiary level hospital	Urological surgery patients (both endoscopy and open surgery	Prospective observational study	16 months (January 2014 - April 2015)	78.51 +/- 3.88	70 - 94	Italy	Europe	34,839	3,195	78	Urological surgery (both endoscopy and open surgery)	N/A	Edmonton Frailty Scale (EFS)
18	Dent et al.	2013	Frailty and functional decline indices predict poor outcomes in hospitalised older people	Age & Ageing	To evaluate several common frailty and functional decline indices on their ability to predict poor Geriatric Evaluation and Management Unit (GEMU) outcomes, both at discharge and at 6 months.	Queen Elizabeth Hospital (TQEH), South Australia	Geriatric Evaluation Medical Unit (GEMU)	Prospective, observational study	14 months (October 2010 - December 2011)	-	70 +	Australia	Australasia	39,384	3,244	172	N/A	N/A	Study of Osteoporotic Fractures (SOF) index
19	Dorner et al.	2014	Association between nutritional status (MNA®-SF) and frailty (SHARE-FI) in acute hospitalised elderly patients	The journal of nutrition, health & aging	To explore the association between the impaired nutritional status and frailty in acute hospitalised elderly patients by using two tools, the MNA®-SF (Mini Nutritional Assessment® short-form) and the SHARE-FI (Frailty Instrument for Primary Care of the Survey of Health, Ageing and Retirement in Europe).	Two hospitals in Vienna; one a University hospital, and one an acute care hospital	Endocrinology and metabolism, and gastroenterology wards	Cross-sectional	June - October 2011	76.4 +/- 8.2	65 - 97	Germany	Europe	39,305	3,877	133	N/A	N/A	SHARE-FI
20	Drudi et al.	2018	Association of Depression With Mortality in Older Adults Undergoing Transcatheter or Surgical Aortic Valve Replacement	JAMA Cardiology	To determine the prevalence of depression and its association with all-cause mortality in a large representative cohort of older adults undergoing TAVR and SAVR	14 medical centres in three countries (United States of America, Canada, and France)	Transcatheter Aortic Valve Replacement (TAVR) and Surgical Aortic Valve Replacement (SAVR) patients	Prospective cohort study	54 months (November 2011 - April 2016)	81.4 +/- 6.1	70 +	Multiple (United States of America, Canada, France)	Multiple (North America, Europe)	-	-	1035	Transcatheter Aortic Valve Replacement (TAVR) and Surgical Aortic Valve Replacement (SAVR) patients	N/A	Fried Frailty Phenotype criteria
21	Dutzi et al.	2017	Cognitive Change in Rehabilitation Patients with Dementia: Prevalence and Association with Rehabilitation Success	Journal of Alzheimer's Disease	To assess the prevalence of change in global and domain specific cognition and to calculate the degree of improvement and decline based on sample specific reliable criteria for change; 2) to analyse differences in demographic, medical, or psychosocial variables in subgroups of patients which were associated with improvement or decline; and 3) to explore associations between cognitive change and ADL-change, as well as discharge home, as indicators for rehabilitation success.	Centre for geriatric medicine, University Hospital	Post-acute geriatric rehabilitation centre (two geriatric rehabilitation wards) / patients with mild-moderate dementia	Observational cohort study	11 months (February - December 2011)	83.7 +/- 5.9	65 +	Germany	Europe	39,305	3,877	154	mild-moderate dementia	N/A	Clinical Frailty Scale (CFS)
22	Eamer et al.	2018	Analysis of post discharge costs following emergent general surgery in elderly patients	Canadian Journal of Surgery	To identify independent predictors of overall cost and types of costs accrued by older patients within 6 months of discharge after acute abdominal surgery	Two tertiary referral teaching hospitals in Alberta, Canada	Emergency abdominal surgery patients	Prospective, observational study	21 months (January 2014 - September 2015)	75.5 +/- 7.6	65 - 96.5	Canada	North America	42,109	4,300	150	Emergency abdominal surgery	N/A	Clinical Frailty Scale
23	Eeles et al.	2012	The impact of frailty and delirium on mortality in older inpatients	Age & Ageing	To explore the relationship between delirium and frailty in older patients and determine their impact on survival.	District general hospital	Patients admitted acutely to a general medical service	Prospective cohort study	6 months (January 2001 - June 2001)	82.3 +/- 7.5	75 +	Australia	Australasia	26,598	-	273	N/A	N/A	Frailty Index
24	Ekerstad et al.	2011	Frailty Is Independently Associated With Short-Term Outcomes for Elderly Patients With Non-ST-Segment Elevation Myocardial Infarction	Circulation	To describe patients aged 75 + years with NSTEMI, especially in regard to the variables cardiovascular risk, comorbidity, and frailty, and to analyse the manner in which frailty is associated with short-term outcomes for these patients.	A University Hospital two County Hospitals in Sweden	Patients with non-ST-segment elevation myocardial infarction (NSTEMI)	Clinical, prospective, observational study	10 months (October 2009 - June 2010)	-	75 +	Sweden	Europe	38,869	2,388	307	Non-ST-segment elevation myocardial infarction (NSTEMI)	N/A	Canadian Study of Health and Ageing (CSHA) Clinical Frailty Scale (7-point)

25	Engelhardt et al.	2018	Frailty screening and a frailty pathway decrease length of stay, loss of independence, and 30-day readmission rates in frail geriatric trauma and emergency general surgery patients	Journal of Trauma and Acute Care Surgery	To reduce length of stay, loss of independence, and 30-day readmission rates for frail geriatric TEGS patients, by first implementing a frailty screening program using the Trauma Specific and Emergency General Surgery Specific Frailty Indices TSFI), and then develop and implement a novel frailty pathway for those frail geriatric patients.	An urban academic hospital (Level 1 trauma center), located in Chicago, Illinois.	Trauma and emergency general surgery patients	Prospective time series study	2.5 months (October - December 2016)	76.1 +/- 8.0	65 +	United States of America	North America	53,241	8,764	239	N/A	N/A	Trauma Specific and Emergency General Surgery Specific Frailty Indices
26	Ferrero et al.	2017	Ovarian Cancer in Elderly Patients: Patterns of Care and Treatment Outcomes According to Age and Modified Frailty Index	International Journal of Gynaecological Cancer	To assess the predictive value of age and modified Frailty Index on the treatment results of primary Epithelial Ovarian Cancer patients aged 70 years or older.	Mauriziano Hospital of Turin the University of Pisa.	Patients with ovarian cancer	Retrospective multi-centre study	108 months (2006 - 2014)	-	70 - 89	Italy	Europe	33,584	2,818	78	Ovarian cancer	N/A	modified Frailty Index
27	Ga et al.	2018	Use of the Frailty Index and FRAIL-NH Scale for the Assessment of the Frailty Status of Elderly Individuals Admitted in a Long-term Care Hospital in Korea	Annals of Geriatric Medicine and Research	To describe the frailty status of elderly individuals admitted in Long-Term Care Hospitals in Korea utilizing the FRAIL-NH scale that used the nurses' monthly assessment results obtained from the inpatients' data set (IDS).	Chronic care hospital located in Incheon, South Korea	Long-term care	Retrospective review	72 months (March 2011 - February 2017)	81.5 + / - 7.2	65 +	South Korea	Asia	30,504	1,911	100	Functional impairment and multi-morbidity	N/A	Multiple
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*100*	*As above*	*As above*	*FRAIL-NH scale*
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*100*	*As above*	*As above*	*Frailty index*
28	Gleason et al.	2017	FRAIL Questionnaire Screening Tool and Short-Term Outcomes in Geriatric Fracture Patients	Journal of the American Medical Directors Association	To use a screening frail questionnaire, the FRAIL scale, to categorize the level of frailty of elderly patients admitted with a fractures and determine the association of frailty category with postoperative and 30-day outcomes.	Level 1 trauma center	Geriatric fracture co-management service (orthopaedic trauma, geriatric services)	Retrospective cohort study	9 months (August 2015 - May 2016)	82.3 +/-7.4	70 +	United States of America	North America	51,568	8,451	175	Fracture related surgical patients	N/A	FRAIL Scale
29	Goldforb et al.	2018	Malnutrition and Mortality in Frail and Non-Frail Older Adults Undergoing Aortic Valve Replacement	Circulation	To assess the prevalence and prognostic association between malnutrition screening using the MNA-SF and short and midterm outcomes in a large multicenter cohort of older adults undergoing TAVR or SAVR.	14 centres in three countries (Canada, United States of America, France)	Cardiac surgery (transcatheter aortic valve implementation)	A prospective, single-arm, multinational, multicenter, observational study.	72 months (2012 - 2017)	81.8 +/- 6.2	80 +	Multiple (Canada, United States of America, France)	Multiple (North America, Europe)	-	-	1158	Cardiac surgery (transcatheter aortic valve implementation)	N/A	Fried frailty phenotype criteria
30	Guidet et al.	2018	Withholding or withdrawing of life-sustaining therapy in older adults (≥ 80 years) admitted to the intensive care unit	Intensive Care Medicine	To examine the incidence and determinants of LST limitation decisions (withholding and withdrawal) in patients older than 80 years admitted to ICUs in European countries.	39 Intensive Care Units in 21 European countries	Intensive Care Unit	Prospective observational	5 months (October 2016 - February 2017)	84.3 +/- 3.6	80 - 102	Multiple (Ireland, Great Britain, Portugal, Spain, France, Belgium, Denmark, Norway, Switzerland, Netherlands, Sweden, Russia, Germany, Austria, Poland, Czech Republic, Italy, Ukraine, Romania, Greece, Cyprus)	Europe	-	-	5021	N/A	N/A	Clinical Frailty Scale
31	Gullon et al.	2017	Baseline functional status as the strongest predictor of in-hospital mortality in elderly patients with non-valvular atrial fibrillation: Results of the NONAVASC registry	European Journal of Internal Medicine	To assess the global in-hospital mortality of elderly patients (aged 75 or more) with non-valvular AF (NVAF) hospitalised by any cause, and, to identify which clinical or functional characteristics and concomitant diseases, presented at admission, were associated with higher in-hospital mortality.	64 hospitals from all the Spanish regions	Internal Medicine departments	An observational, prospective, multicentre study,	8 months (October 2014 - May 2015)	85 +/- 5.1	75 - 101	Spain	Europe	32,208	2,913	755	Non-valvular atrial fibrillation	N/A	FRAIL Scale
32	Hartley et al.	2017	Clinical frailty and functional trajectories in hospitalized older adults: A retrospective observational study	Geriatrics & Gerontology International	To retrospectively study the association of the Clinical Frailty Scale with functional trajectories in acutely hospitalized older adults.	A large tertiary university National Health Service acute hospital in the UK	Department of Medicine for the Elderly wards	Retrospective observational study	6 months (December 2014 - May 2015)	86 +/- 5.8	70 +	United Kingdom	Europe	37,301	3,223	549	N/A	N/A	Clinical Frailty Scale
33	Heppenstall et al.	2011	Factors related to care home admission in the year following hospitalisation in frail older adults	Age & Ageing	To describe precipitants of residential care admission in the year following a successful home discharge from inpatient geriatric care.	Sub-acute geriatric unit	General wards	Prospective cohort study	-	80.9 +/-7.2	66 +	New Zealand	Australasia	-	-	158	Delayed discharge	N/A	Edmonton Frailty Scale (EFS)
34	Hewitt et al.	2015	Prevalence of frailty and its association with mortality in general surgery	American Journal of Surgery	Primary aim: to assess the prevalence of frailty in the acute older surgical patient and the frequency with which frail older people underwent surgery. Secondary aim: assessed the association of frailty with a range of outcomes including length of hospital stay, readmission to hospital within 30 days of discharge, 30- and 90-day mortality.	Acute general surgical admission units (1 site in each of Wales, England and Scotland)	Acute general surgical units	Multi-centre observational study	2 months (May - June 2013)	77.3 +/- 8.2	65 +	United Kingdom	Europe	36,808	3,012	317	Acute general surgery	N/A	Canadian Study of Health and Ageing (CSHA) scale
35	Hewitt et al.	2016	Prevalence of multimorbidity and its association with outcomes in older emergency general surgical patients: an observational study	BMJ open	To assess the prevalence of multimorbidity and its association with common outcome measures.	A UK-based multicentre (hospital) study	Emergency general surgery units (Emergency general surgery patients)	Cross-sectional observational study	4 months (July - October 2014)	-	65 - 98	United Kingdom	Europe	37,301	3,223	408	Emergency general surgery	N/A	Canadian Study of Health and Ageing (CSHA scale)

36	Hii et al.	2015	Frailty in acute cardiology: comparison of a quick clinical assessment against a validated frailty assessment tool	Heart, Lung & Circulation	Primary aim: To evaluate the utility of a quick clinical assessment against a validated frailty assessment tool to determine if an elderly patient is frail or not. Secondary aim: To evaluate the frailty status of elderly patients who have been offered coronary intervention or cardiac surgery at the Christchurch Hospital.	Christchurch hospital, New Zealand	Cardiology patients	Prospective study	1 month (February - March 2014)	78 +/- 6.1	72 - 90	New Zealand	Australasia	32,445	3,098	47	Percutaneous coronary intervention / cardiac surgery	N/A	Reported Edmonton Frailty Scale (REFS)
37	Hilmer et al.	2011	Gentamicin pharmacokinetics in old age and frailty	British Journal of Clinical Pharmacology	To evaluate the pharmacokinetics (volume of distribution and clearance) of gentamicin in frail and non-frail older hospital patients in Sydney, Australia. A secondary aim was to assess the accuracy of different estimates of body size and renal clearance as estimates of gentamicin volume of distribution and clearance in this population	Three teaching hospitals in Sydney, Australia: The Royal North Shore Hospital (RNSH), Hornsby Hospital and Ryde Hospital.	Urology patients (administered single dose of prophylactic intravenous gentamicin)	Prospective observational study	19 months (February 2008 - September 2009)	77.1 +/- 7.1	65 +	Australia	Australasia	34,406	2,713	31	Urology inpatients (administered single dose of prophylactic intravenous gentamicin)	N/A	Reported Edmonton Frailty Scale (REFS)
38	Ibrahim et al.	2019	The feasibility of assessing frailty and sarcopenia in hospitalised older people: a comparison of commonly used tools	BMC Geriatrics	To assess whether it is feasible to assess both frailty and sarcopenia, with a focus on the physical measurements central to the Fried Frailty Phenotype and the European Working Group on Sarcopenia in Older People (EWGSOP) criteria, among older people in hospital.	Acute wards in a tertiary level hospital in the UK	Acute wards	Cross-sectional prospective study	25 months (March 2014 - March 2016)	-	70 +	United Kingdom	Europe	37,929	3,349	224	N/A	N/A	Multiple
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	-	*As above*	*As above*	*As above*	*As above*	*As above*	*230*	*N/A*	*N/A*	*FRAIL Scale*
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	-	*As above*	*As above*	*As above*	*As above*	*As above*	*218*	*As above*	*As above*	*Fried frailty phenotype criteria*
39	Induruwa et al.	2017	Clinical frailty is independently associated with non-prescription of anticoagulants in older patients with atrial fibrillation	Geriatrics & Gerontology International	To investigate the association between the Clinical Frailty Scale (CFS) and community anticoagulant prescribing habits in patients aged ≥75 years with AF admitted acutely to hospital.	A tertiary teaching hospital in the UK	General medicine patients	Retrospective observational study	3 months (January - March 2014)	85.2 +/- 5.6	75 +	United Kingdom	Europe	37,301	3,223	419	Atrial fibrillation	N/A	Clinical Frailty Scale (CFS)
40	Jacobs et al.	2017	Clinical Relevance of Differences in Glomerular Filtration Rate Estimations in Frail Older People by Creatinine- vs. Cystatin C-Based Formulae	Drugs & Aging	To assess the clinical relevance of the differences in estimated glomerular filtration rate based on creatinine and cystatin C, by evaluating whether differences in estimated glomerular filtration rate would have consequences for drug therapy in these patients and if it would have consequences for staging of chronic kidney disease	Inpatient hospital (psychiatric ward)	Psychiatric ward	Explorative cross-sectional study	7 months (June - December 2014)	72.6 +/- 7.6	65 +	Netherlands	Europe	46,305	4,887	55	N/A	N/A	Frailty Index (44 items)
41	Jokar et al.	2016	Emergency general surgery specific frailty index: A validation study	Journal of Trauma & Acute Care Surgery	To develop and validate a simplified 15-variable emergency general surgery-specific frailty index (EGSFI) in elderly EGS patients. We hypothesized that frailty measured by EGSFI can reliably predict postoperative outcomes in elderly patients undergoing EGS	Acute care surgery–verified Level 1 trauma center.	Surgical inpatients	Prospective cohort study	24 months (2013 - 2014)	74.8 +/- 7.8	65 +	United States of America	North America	49,689	8,053	130	Emergency general surgery patients	N/A	Multiple
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*74.8 +/- 7.8*	*As above*	*As above*	*As above*	*As above*	*As above*	*200*	*As above*	*As above*	*Frailty Index*
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*75.4 +/- 7.8*	*As above*	*As above*	*As above*	*As above*	*As above*	*60*	*As above*	*As above*	*Emergency General Surgery-Specific Frailty Index (EGS-SFI)*
42	Joosten et al.	2014	Prevalence of frailty and its ability to predict in hospital delirium, falls, and 6-month mortality in hospitalized older patients	BMC Geriatrics	To evaluate the prevalence of frailty in hospitalized older patients, as determined by the CHS and SOF indexes, and to determine the extent that frailty can predict delirium and falls during hospitalization, and mortality 6 months after discharge	Tertiary care hospital	Acute geriatric ward	Prospective study	10 months (January 2010 - November 2010)	-	70 +	Belgium	Europe	38,015	3,360	212	N/A	N/A	Multiple
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*220*	*As above*	*As above*	*Fried Frailty Phenotype*
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*204*	*As above*	*As above*	*Study of Osteoporotic Fracture (SOF) Frailty Index*
43	Joseph et al.	2014	Superiority of frailty over age in predicting outcomes among geriatric trauma patients: A prospective analysis	JAMA Surgery	To assess the usefulness of the Frailty Index (FI) as an assessment tool in predicting outcomes in geriatric trauma patients. We hypothesized that the FI is an effective tool to predict adverse outcomes in this patient group.	Level 1 trauma center	Trauma center	Prospective cohort study	21 months (June 2011 - February 2013)	79 +/- 8.1	65 +	United States of America	North America	48,824	7,540	250	Trauma patients	N/A	Frailty Index
44	Joseph et al.	2016	The impact of frailty on failure-to-rescue in geriatric trauma patients: a prospective study	Journal of trauma and acute care surgery	To investigate the impact of frailty on failure to rescue in geriatric trauma patients	Level 1 trauma center	Trauma center	Prospective cohort study	24 months (2013 - 2014)	74.8 +/- 10.8	65 +	United States of America	North America	49,689	8,053	368	Trauma patients	N/A	Trauma Specific Frailty Index
45	Juma et al.	2016	Clinical Frailty Scale in an Acute Medicine Unit: a Simple Tool That Predicts Length of Stay	Canadian Geriatrics Journal	To determine the predictive ability of the Clinical Frailty Scale in acute care general medicine ward for length of stay	Acute care university hospital in London, Ontario, Canada,	General internal medicine clinical teaching units	Prospective observational study	10.5 months (April 2013 - February 2014)	81.4 +/- 8.8	65 +	Canada	North America	40,603	4,121	75	N/A	N/A	Clinical Frailty Scale
46	Kang et al.	2015	Is frailty associated with short-term outcomes for elderly patients with acute coronary syndrome?	Journal of Geriatric Cardiology	1) to figure out the prevalence of frailty and situation of geriatrics syndromes in Acute Coronary Syndrome patients in China; (2) will frailty be an independent risk factor of the prognosis (defined as unscheduled returned visit, or all-cause mortality) of these patients? (3) If so, does this index remain significant after controlling for co-morbidities?	Cardiology department and Geriatrics department of Peking Union Medical College Hospital	Cardiology and geriatric departments	Prospective cohort study	6 months (December 2014 - May 2015)	74 +/- 5.7	65 +	China	Asia	10,280	3,098	352	Acute Coronary Syndrome	N/A	Canadian Study on Health and Ageing (CSHA) scale

47	Karlekar et al.	2017	Creating New Opportunities to Educate Families on the Impact of Frailty and Cognitive Impairment in a Trauma Intensive Care Unit: Results of a Quality Improvement Project	Journal of Palliative Medicine	To determine the feasibility of incorporating a validated screening tool into the daily workflow of bedside clinicians to assess for both cognitive impairment and physical	Vanderbilt University Medical Center	Trauma intensive care unit	Quality improvement project	3 months (March - May 2015)	75.82 +/- 8.33	65 +	United States of America	North America	51,568	8,451	64	N/A	N/A	FRAIL Scale
48	Keevil et al.	2018	Care home residents admitted to hospital through the emergency pathway: characteristics and associations with inpatient mortality	Journal of the Royal College of Physicians of Edinburgh	Primary aim: To describe the characteristics and outcomes of older adults admitted as an emergency to a large National Health Service university hospital in England and compare care home residents with older adults admitted from their own homes. Secondary aim: To evaluate the association between care home status and hospital outcomes, primarily inpatient mortality at 30 days.	National Health Service university hospital in England.	University hospital	Retrospective observational study	26 months (October 2014 - November 2016)	-	75 +	United Kingdom	Europe	38,531	3,454	10662	Patients admitted to hospital as an emergency	N/A	Clinical Frailty Scale (CFS)
49	Kenig et al.	2015	Six screening instruments for frailty in older patients qualified for emergency abdominal surgery	Archives of Gerontology and Geriatrics	To compare the diagnostic accuracy of the above-mentioned screening methods in predicting frailty and postoperative morbidity and mortality.	Tertiary referral hospital	Surgical unit (Emergency abdominal surgery patients)	Prospective study	19 months (January 2013 - July 2014)	76.9 +/- 5.8	65 - 100	Poland	Europe	21,761	1,378	184	Emergency abdominal surgery	N/A	Multiple
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*184*	*As above*	*As above*	*Groningen Frailty Indicator (GFI)*
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*184*	*As above*	*As above*	*Rockwood frailty assessment*
50	Khan et al.	2019	Failure to rescue after emergency general surgery in geriatric patients: does frailty matter?	Journal of Surgical Research	To determine the impact of frailty on FTR among geriatric surgical patients. We hypothesized that frail patients are more likely to die after developing complications following emergency general surgery (EGS) than non-frail patients.	Banner University Medical Center, Tucson	Trauma centre (Emergency surgery patients)	Prospective study	24 months (2014 - 2016)	73.9 +/- 8	65 +	United States of America	North America	51,659	8,497	326	Emergency general surgery patients	N/A	Emergency General Surgery-Specific Frailty Index (EGS-SFI)
51	Kobe et al.	2016	Frailty Assessed by the Forecast is a Valid Tool to Predict Short-Term Outcome after Transcatheter Aortic Valve Replacement	Innovations: Technology and Techniques in Cardiothoracic and Vascular Surgery	To validate the Frailty predicts death one yeaR after Cardiac Surgery Test (FORECAST) in a cohort of transcatheter aortic valve replacement patients	Two heart centres in Switzerland and Germany	Heart centres (Transcatheter Aortic Valve Replacement (TAVR) patients)	Prospective cohort	39 months (September 2011 - November 2014)	83.3 +/- 4.3	75 +	Multiple	Europe	-	-	130	Transcatheter Aortic Valve Replacement (TAVR) patients	N/A	Frailty predicts death one yeaR after Cardiac Surgery Test (FORECAST)
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	-	-	*75 +*	*Switzerland*	*Europe*	-	-	-	*As above*	*N/A*	*As above*
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	-	-	*75 +*	*Germany*	*Europe*	-	-	-	*As above*	*N/A*	*As above*
52	Koyama et al.	2018	Preadmission frailty status as a powerful predictor of dependency after discharge among hospitalized older patients: A clinical-based prospective study	Geriatrics & Gerontology International	to examine whether the preadmission frailty status measured by the KCL can predict dependency after discharge in hospitalized older patients	St. Marianna University School of Medicine Hospital, Kawasaki, Japan	Internal medicine patients	Prospective study	14 months (November 2016 - December 2017)	77.2 +/- 6.9	65 +	Japan	Asia	38,756	4,191	151	Internal medicine problems	N/A	Kihon checklist
53	Kusunose et al.	2018	Prognostic Value of Frailty and Diastolic Dysfunction in Elderly Patients	Circulation Journal	To characterize frailty by quantifying differences in echocardiography and to determine the added prognostic utility of frailty and newly diagnosed DD grade in an elderly population.	Tokushima University Hospital	Echocardiography patients	Prospective study	8 months (December 2015 - July 2016)	75 +/- 7	65 +	Japan	Asia	37,755	3,958	191	Echocardiography patients	N/A	Fried frailty phenotype criteria
54	Lee et al.	2018	Toward Using Smart Watch to Monitor Frailty in Hospital Setting — Using a Single Wrist Wearable Sensor to Assess Frailty in Bedbound Inpatients	Gerontology	Toward Using Smart Watch to Monitor Frailty in Hospital Setting —Using a Single Wrist Wearable Sensor to Assess Frailty in Bedbound Inpatients	University hospital	Division of Trauma, Critical Care, and Emergency Surgery service	Cross sectional study	20 months (January 2014 - August 2015)	78.9 +/- 9.1	66 +	United States of America	North America	50,808	8,325	100	Patients admitted due to ground level falls	N/A	Trauma specific frailty index
55	Le Maguet et al.	2014	Prevalence and impact of frailty on mortality in elderly ICU patients: A prospective, multicenter, observational study	Intensive Care Medicine	To determine the prevalence of frailty and the impact of frailty on mortality in a prospective cohort of patients older than 65 years who were admitted to ICUs.	Four university-affiliated hospitals in France	Intensive Care Unit (ICU)	Prospective observational study	7 months (November 2011 - May 2012)	75 +/- 6	65 +	France	Europe	36,485	3,715	196	N/A	N/A	Clinical Frailty Scale (CFS)
56	Lin et al.	2017	Perioperative assessment of older surgical patients using a frailty index-feasibility and association with adverse postoperative outcomes	Anaesthesia and Intensive Care	To investigate the feasibility of using FI-CGA in the perioperative setting and evaluate whether a higher FI was associated with higher risk of several short- and long-term adverse outcomes.	A tertiary hospital in Queensland, Australia	Surgical patients	Prospective cohort study	7 months (July 2014 - January 2015)	79 +/- 6.5	70 +	Australia	Australasia	43,268	3,779	246	Surgical inpatients	N/A	Frailty Index - Comprehensive Geriatric Assessment (FI-CGA) (57 item)
57	Llao et al.	2018	Invasive strategy and frailty in very elderly patients with acute coronary syndromes	Euro intervention	To assess the impact of an invasive strategy on outcomes according to the degree of frailty in these patients.	44 Spanish hospitals	Non-ST-segment elevation acute coronary syndromes (NSTEACS)	Prospective observational study	7 months (March - September 2016)	84.3 +/- 4	80 +	Spain	Europe	33,038	2,994	531	Cardiac (non-ST-segment elevation acute coronary syndromes (NSTEACS)) patients	N/A	FRAIL scale
58	Ma et al.	2013	Recurrent hospitalisation with pneumonia is associated with higher 1-year	Internal Medicine Journal	To examine whether these clinical features were the predictors of all-cause mortality of older patients within 1 year of hospital discharge for CAP.	Prince of Wales teaching Hospital, Hong Kong	Pneumonia patients	Prospective observational study	12 months (October 2009 - September 2010)	-	65 +	China	Asia	6,344	254	428	Pneumonia patients	N/A	Canadian Study of Health and Ageing (CSHA) Clinical Frailty Scale

			mortality in frail older people															
59	Madni et al.	2017	The Relationship Between Frailty and the Subjective Decision to Conduct a Goals of Care Discussion With Burned Elders	Journal of Burn Care and Research	To determine the patient factors, including the performance of a GoC discussion, associated with frailty.	Level 1 burn center	Level 1 burn center	Retrospective review study	69 months (April 2009 - December 2014)	75.5 +/- 7.7	65 +	United States of America	North America	47,787	7,487	126	Burn patients	N/A	Canadian Study of Health and Ageing (CSHA) Clinical Frailty Scale
60	Martin et al.	2018	Effect of a Minimal-Massive Intervention in Hospitalized Older Patients with Oropharyngeal Dysphagia: A Proof of Concept Study	Journal of Nutrition, Health and Aging	To assess the effects of a MMI directed at assessing and treating OD, malnutrition and oral health in hospitalized older patients with OD and following hospital discharge.	Hospital de Mataró, Barcelona	Patients with Propharyngeal dysphagia in the Acute Geriatric Unit (AGU)	Prospective observational study	5 months (March - July 2014)	84.9 +/- 6	70 +	Spain	Europe	32,208	2,913	62	Patients with oropharyngeal dysphagia	N/A	Fried frailty phenotype
61	Mason et al.	2018	Establishing a proactive geriatrician led comprehensive geriatric assessment in older emergency surgery patients: Outcomes of a pilot study	International Journal of Clinical Practice	To record what undiagnosed medical conditions were identified and what interventions were made in these patients	Musgrove Park Hospital	Emergency surgery patients	Prospective observational study	9 months (November 2016 - July 2017)	81	70 +	United Kingdom	Europe	40,188	3,724	435	Emergency surgery patients	N/A	Canadian Study on Health and Ageing (CSHA) Clinical Frailty Scale
62	Maxwell et al.	2018	The FRAIL Questionnaire: A Useful Tool for Bedside Screening of Geriatric Trauma Patients	Journal of Trauma Nursing	To determine the extent to which the FRAIL instrument predicted geriatric trauma outcomes; thus, we retrospectively derived a five-item FRAIL score for patients in our prior study from separate data sources.	Inpatient hospital	Trauma patients (trauma, geriatrics, orthopaedic services)	Prospective observational study	6 months (October 2013 - March 2014)	77.46 +/- 8.91	69 - 88	United States of America	North America	49,015	7,936	188	Trauma patients	N/A	FRAIL Scale
63	McGuckin et al.	2018	The association of peri-operative scores, including frailty, with outcomes after unscheduled surgery	Anaesthesia	To evaluate the association of frailty, as measured by the Clinical Frailty Scale (CFS), as well as more traditional surgical prediction tools, in a population of elderly emergency surgical admissions.	University College Hospital London	Unscheduled non-cardiac surgery	Prospective observational	8 months (June 2012 - January 2013)	77.1 +/- 8.3	65 +	United Kingdom	Europe	36,503	2,907	164	Unscheduled non-cardiac surgery	N/A	Canadian Study on Health and Ageing (CSHA) Clinical Frailty Scale
64	McIsaac et al.	2018	Derivation and Validation of a Generalizable Preoperative Frailty Index Using Population-based Health Administrative Data	Annals of Surgery	Primary aim: To derive, validate, and evaluate a preoperative frailty index (pFI) using health administrative data in a population-based sample of older people having major surgery. Secondary aim: To test the generalizability of this frailty index in specific subgroups of elective surgery patients, and to measure the association and discrimination of the frailty index with mortality and institutional discharge.	Linked health administrative data in Ontario, Canada,	Elective non-cardiac surgery	Retrospective cohort study	156 months (April 2002 - March 2015)	-	66 +	Canada	North America	35,285	-	415704	Elective non-cardiac surgery patients	N/A	preoperative Frailty index (pFI)
65	Morton et al.	2018	Is Frailty a Predictor of Outcomes in Elderly Inpatients with Acute Kidney Injury? A Prospective Cohort Study	American Journal of Medicine	To assess whether a baseline Clinical Frailty Scale is an independent risk factor for acute kidney injury in elderly acute medical admissions and if this score could predict short term outcomes in this patient cohort.	inpatient hospital setting	Patient with acute kidney injury	Prospective cohort study	1 month (June - July 2017)	81.4 +/- 8.1	65 +	United Kingdom	Europe	40,781	3,850	164	Patients with acute kidney injury	N/A	Clinical Frailty Scale
66	Muessig et al.	2018	Clinical Frailty Scale (CFS) reliably stratifies octogenarians in German ICUs: a multicentre prospective cohort study	BMC Geriatrics	To test if the predictive value of Clinical Frailty Scale is still robust on a national level in very diversified and high-tech German Intensive Care Units	20 German ICUs	Intensive Care Units (ICU)	prospectively realised observational multicentre European VIP-1 study	5 months (October 2016 - February 2017)	84.6 +/- 3.8	80 +	Germany	Europe	45,468	4,944	308	Intensive Care Unit (ICU) patients	N/A	Clinical Frailty Scale
67	Muller et al.	2017	Impaired nutritional status in geriatric trauma patients	European Journal of Clinical Nutrition	To assess the prevalence of malnutrition in these patients and investigate if and to what extent the prevalence of malnutrition differs among risk groups by number of comorbidities, polypharmacy, mental and cognitive function, as well as frailty.	University Hospital Zurich, Switzerland	Geriatric Centre	Cross-sectional study	4 months (March - June 2016)	-	70 +	Switzerland	Europe	57,295	4,944	156	Trauma patients	N/A	Fried Frailty Phenotype
68	Myint et al.	2018	Is anemia associated with cognitive impairment and delirium among older acute surgical patients?	Geriatrics & Gerontology International	Primary aim: To examine the association between anemia and cognitive impairment as well as delirium in a cohort of older acute surgical patients. Secondary aim: To examine the link between anemia and cognitive impairment among older acute surgical emergency admissions, as little is known about this link in this patient population with a high prevalence of cognitive impairment.	Five UK hospitals: 1) University Hospital of Wales, Cardiff, 2) North Bristol NHS Trust, Bristol, 3) Aberdeen Royal Infirmary, Aberdeen, 4) Royal Alexandra Hospital, Glasgow and 5) Central Manchester Foundation Trust, Manchester	Acute geriatric surgical unit	Prospective cohort study	14 months (May 2013 - June 2014) (only recruited for 4 months within this time frame)	-	65 +	United Kingdom	Europe	37,301	3,012	644	Acute surgical patients	N/A	Canadian Study of Health and Ageing (CSHA) Clinical Frailty Scale
69	Nolan et al.	2016	Frailty and its association with rehabilitation outcomes in a post-acute older setting	International Journal of Therapy & Rehabilitation	Primary aim: To evaluate changes in physical function, quality of life and falls self-efficacy in older adults undergoing post-acute rehabilitation. Secondary aim: To evaluate the relationship of frailty with rehabilitation outcomes.	Post-acute rehabilitation unit	Post-acute rehabilitation unit	Prospective cohort study	6 months (August 2013 - January 2014)	80.3 +/- 7.1	65 +	Ireland	Europe	37,301	3,012	41	N/A	N/A	Clinical Frailty Scale
70	Nygen et al.	2016	Atrial fibrillation in older inpatients: are there any differences in clinical characteristics and pharmacological treatment between the frail and the non-frail?	Internal Medicine Journal	To investigate in frail and non-frail older inpatients with AF the differences in clinical characteristics, prescription of antithrombotic and antiarrhythmic medications, incidence of major bleeding and strokes over 6months, and to identify whether frailty is independently associated with prescription of these medications.	A tertiary referral teaching hospital in Sydney, Australia	Atrial fibrillation	Prospective cohort study	16 months (October 2012 - January 2014)	84.7 +/- 7.1	65 - 100	Australia	Australasia	41,762	3,531	302	Atrial fibrillation	N/A	Reported Edmonton Frailty Scale (REFS)
71	Oliveria et al.	2013	Prevalence of frailty syndrome in old people in a hospital institution	Revista Latino-Americana de Enfermagem	To measure the prevalence of frailty syndrome in the elderly in a hospital institution in terms of sociodemographic, clinical and anthropometric variables.	São Vicente de Paulo Hospital	Tertiary level hospital	Cross sectional study	1 month (November 2010)	74.5 +/- 6.8	65 +	Brazil	South America	12,435	1,019	99	N/A	N/A	Fried frailty phenotype
72	Ozturk et al.	2017	Quality of life and fall risk in frail hospitalized elderly patients	Turkish Journal of Medical Sciences	To investigate the prevalence of frailty and determine the correlations among frailty, Quality of Life, and falling risk in geriatric hospitalized patients.	Faculty of Medicine of Gaziantep University	Internal medicine clinics	Cross-sectional study	8 months (March - October 2015)	71.9 +/- 6.3	65 - 98	Turkey	Europe	20,092	951	420	N/A	N/A	Fried frailty phenotype

73	Papageorgiou et al.	2018	Frailty in elderly ICU patients in Greece: a prospective, observational study	Annals of Translational Medicine	To examine the prevalence of frailty syndrome in subjects aged 65 years who were hospitalized in an intensive care unit in Greece.	General Hospital	Intensive Care Unit (ICU)	Prospective, observational study	12 months (June 2016 - May 2017)	75.6	65 +	Greece	Europe	26,015	2,221	36	N/A	N/A	Clinical Frailty Scale
74	Papakonstantinou et al.	2018	Frailty Status Affects the Decision for Long-Term Anticoagulation Therapy in Elderly Patients with Atrial Fibrillation	Drugs and Aging	To evaluate the current anticoagulation management in hospitalized elderly AF patients in order to study the effect of bleeding risk, thromboembolic risk, and patients' frailty status on their long-term AT, and to record patients' all-cause mortality and hospital readmissions in a 1-year follow-up period after hospital discharge.	University Hospital of Heraklion, Crete, Greece	Department of Internal Medicine	Single-centre, observational perspective study	12 months (June 2015 - June 2016)	84.9 +/- 5	75 - 97	Greece	Europe	26,521	2,324	104	Atrial fibrillation	N/A	Clinical Frailty Scale
75	Parmar et al.	2019	Frailty in Older Patients Undergoing Emergency Laparotomy: Results From the UK Observational Emergency Laparotomy and Frailty (ELF) Study	Annals of Surgery	Primary aim: to determine the prevalence and influence of frailty on 90-day mortality in older adults undergoing emergency laparotomy. Secondary aim: To determine the influence of frailty on postoperative outcomes, including 30-day mortality, morbidity, and length of hospital stay.	Multiple (49 sites across the United Kingdom)	Emergency laparotomy patients	Multi-centred prospective cohort study	3 months (March - June 2017)	76 +/- 6.8	65 - 99	United Kingdom	Europe	40,781	3,850	937	Emergency laparotomy patients	N/A	Canadian Study of Health and Ageing (CSHA) Clinical Frailty Scale
76	Pasqualetti et al.	2018	Degree of Peripheral Thyroxin Deiodination, Frailty, and Long-Term Survival in Hospitalized Older Patients	The Journal of Clinical Endocrinology & Metabolism	To assess the potential impact of downregulation of deiodinase-I activity, as assessed by FT3/FT4 ratio reduction, on the clinical outcome (burden of comorbidity, frailty features, and long-term survival) of euthyroid older patients, hospitalized for acute disease.	University Hospital of Pisa	Geriatric wards	Prospective observational study	20 months (May 2015-December 2016)	83.8 +/- 7.4	66 +	Italy	Europe	35,300	3,235	643	Patients with acute disease admitted through the emergency department	N/A	Multi Prognostic Index
77	Patel et al.	2018	Frailty and outcomes after myocardial infarction: Insights from the CONCORDANCE registry	Journal of the American Heart Association	To explore the association of frailty in older Myocardial Infarction (MI) populations with the use of evidence-based therapies and outcomes after MI	CONCORDANCE registry (41 hospitals), a prospective, Australian registry of myocardial infarction patients	Myocardial infarction (ST-segment-elevation Myocardial Infarction (STEMI) and non-STEMI (NSTEMI)) patients	Multi-centred (registry based), prospective, observational study	96 months (2009 - 2016)	-	65 +	Australia	Australasia	41,664	3,557	3944	Myocardial infarction (ST-segment-elevation Myocardial Infarction (STEMI) and non-STEMI (NSTEMI))	N/A	Frailty index
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*ST-segment elevation myocardial infarction (STEMI)*	*As above*	*As above*	-	*As above*	*As above*	*As above*	*As above*	*As above*	*1275*	*ST-segment elevation myocardial infarction (STEMI)*	*As above*	*As above*
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*Non-ST-segment elevation myocardial infarction (NSTEMI)*	*As above*	*As above*	-	*As above*	*As above*	*As above*	*As above*	*As above*	*2669*	*Non-ST-segment elevation myocardial infarction (NSTEMI)*	*As above*	*As above*
78	Peel et al.	2017	Frailty and adverse outcomes: impact of multiple bed moves for older inpatients	International Psychogeriatrics	The aims of this study were to: 1) compare the number of ward moves that Older Person Evaluation Review and Assessment, (OPERA) and age- and sex-matched General Medicine patients undergo during a single admission; 2) explore the reasons for multiple bed moves; 3) to explore whether multiple bed moves were associated with negative outcomes.	Tertiary level hospital (geriatric medicine and general medicine databases)	Geriatric and general medicine patients with three or more transfers	Retrospective observational study	12 months (July 2012 - June 2013)	85 +/-6.2	65 +	Australia	Australasia	41,150	3,479	89	N/A	N/A	Clinical Frailty Scale (CFS)
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*Geriatric medicine*	*As above*	*As above*	*84.7 +/- 6.4*	*As above*	*As above*	*As above*	*As above*	*As above*	*67*	*N/A*	*N/A*	*As above*
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*General medicine*	*As above*	*As above*	*86.0 +/- 5.9*	*As above*	*As above*	*As above*	*As above*	*As above*	*22*	*N/A*	*N/A*	*As above*
79	Pelavski et al.	2017	Mortality, Geriatric, and Nongeriatric Surgical Risk Factors Among the Eldest Old: A Prospective Observational Study	Anesthesia and Analgesia	To determine the mortality rate for this group and to establish which preoperative conditions are the most robust predictors of important adverse postoperative outcomes.	Tertiary care hospital	Elective surgery patients	Prospective observational	49 months (October 2011 - October 2015)	87.5 +/- 2.3	85 - 96	Spain	Europe	32,414	2,821	127	N/A	N/A	Fried frailty phenotype
80	Perera et al.	2009	The impact of frailty on the utilisation of antithrombotic therapy in older patients with atrial fibrillation	Age & Ageing	Primary aim: To investigate the relationship between frailty and antithrombotic utilisation among older patients with Atrial Fibrillation (AF) in an acute-care clinical setting. Secondary aim: To assess the association of frailty with clinical outcomes associated with AF and its treatment (cardioembolic stroke, haemorrhage and death) over 6 months.	Teaching hospital	Atrial fibrillation patients	Prospective observational study	4 months (April - July 2007)	82.7 +/- 6.3	65 +	Australia	Australasia	34,406	2,713	220	Atrial fibrillation	N/A	Reported Edmonton Frailty Scale (REFS)
81	Pollack et al.	2017	The Frailty Phenotype and Palliative Care Needs of Older Survivors of Critical Illness	Journal of the American Geriatrics Society	To assess the physical and psychological symptom distress and end-of-life care preferences of older Intensive Care Units (ICU) survivors of mechanical ventilation, and to assess whether post-ICU frailty identifies those with the greatest unmet palliative care needs just prior to hospital discharge.	An urban tertiary-care hospital and community hospital	Intensive Care Unit	Prospective Cohort Study	49 months (February 2012 - February 2016) (only recruited for 29 months within this time frame)	74 +/- 8.1	65 +	United States of America	North America	50,125	8,069	125	Survivors of critical illness	N/A	Fried frailty phenotype criteria
82	Poudel et al.	2016	Adverse Outcomes in Relation to Polypharmacy in Robust and Frail Older Hospital Patients	Journal of the American Medical Directors Association	To determine the prevalence of polypharmacy and its association with adverse outcomes in hospitalized older patients and to assess the additional role of frailty	11 acute care hospitals in Queensland and Victoria, Australia	Tertiary level hospitals	Prospective study	59 months (May 2005 - July 2010)	81 +/- 6.8	70 +	Australia	Australasia	35,202	2,801	1418	N/A	N/A	Frailty Index (52 items)

83	Purser et al.	2006	Identifying frailty in hospitalized older adults with significant coronary artery disease	Journal of the American Geriatrics Society	To assess frailty in a hospitalized population of patients with significant Coronary Artery Disease (CAD) using several multidimensional composite scores as well as single-item performance measures	Duke University Medical Center	Cardiology ward (severe (minimum two-vessel) coronary artery disease)	Prospective observational study	10 months (May 2003 - February 2004)	77 +/- 5	70 +	United States of America	North America	35,744	-	309	Severe (minimum two-vessel) coronary artery disease	N/A	Multiple
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*309*	*As above*	*As above*	*Fried frailty phenotype*
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*309*	*As above*	*As above*	*Rockwood frailty assessment*
84	Ritt et al.	2015	Analysis of Rockwood et al's Clinical Frailty Scale and Fried et al's frailty phenotype as predictors of mortality and other clinical outcomes in older patients who were admitted to a geriatric ward	Journal of Nutrition Health & Aging	To evaluate the accuracy of the Clinical Frailty Scale and the frailty phenotype as predictors of mortality and other clinical outcomes based on a cohort of older patients in geriatric wards	Geriatrics Centre Erlangen (geriatric department of the Hospital of the Congregation of St. Francis Sisters of Vierzehnheiligen, Erlangen, Germany)	Geriatric wards	Prospective cohort study	-	-	65 +	Germany	Europe	-	-	307	N/A	N/A	Clinical Frailty Scale
85	Rose et al.	2014	Can frailty predict complicated care needs and length of stay?	Internal Medicine Journal	To describe the prevalence of frailty in an acute general medical unit and explore the associations between severity of frailty, discharge destination, mortality, and hospital length of stay	A private hospital in Melbourne	General medical unit	Prospective cohort study	2 months (May - June 2012)	86.5 +/- 6.1	70 +	Australia	Australasia	41,150	3,479	133	N/A	N/A	Reported Edmonton Frailty Scale (REFS)
86	Sanchez et al.	2011	Prevalence of geriatric syndromes and impact on clinical and functional outcomes in older patients with acute cardiac diseases	Heart	To assess the prevalence of geriatric syndromes in a cohort of unselected older patients admitted to a cardiology unit for an acute cardiac disease and assess their influence on short and mid-term clinical and functional outcomes.	University hospital in Madrid, Spain	Clinical cardiology unit	Observational prospective study	2 months (February - March 2008)	81.6 +/- 5	75 - 95	Spain	Europe	29,823	2,210	211	Acute cardiac diseases (direct urgent admissions)	N/A	Fried frailty phenotype criteria
87	Sanchis et al.	2015	Usefulness of Clinical Data and Biomarkers for the Identification of Frailty After Acute Coronary Syndromes	Canadian Journal of Cardiology	To investigate easily available clinical data and blood markers for the identification of frailty at the time of hospital discharge among survivors after an Acute Coronary Syndrome (ACS)	University Clinic Hospital, Valencia, Spain	Cardiology Department (patients with acute coronary syndromes)	Prospective, single centre cohort study	17 months (October 2010 - February 2012)	77.5 +/- 7.1	75 +	Spain	Europe	31,869	2,622	342	Patients with acute coronary syndrome	N/A	Fried frailty phenotype criteria
88	Sikder et al.	2018	Postoperative Recovery in Frail, Pre-frail, and Non-frail Elderly Patients Following Abdominal Surgery	World Journal of Surgery	To explore the association of frailty and recovery of functional status, cognition, mental health, and perception of quality of life over the course of a 6-month follow-up period, in elderly patients undergoing elective abdominal surgery	Two University hospitals	Elective abdominal surgery patients	Prospective study	-	77.8 +/- 5	70 +	Canada	North America	-	-	144	Elective abdominal surgery	N/A	Fried frailty phenotype criteria
89	Sunderman n et al.	2014	Frailty is a predictor of short- and mid-term mortality after elective cardiac surgery independently of age	Interactive Cardiovascular and Thoracic Surgery	To assess the ability of modified comprehensive assessment of frailty to predict one-year mortality.	Heartcenter of the University of Leipzig	Heart center (Elective cardiac surgery)	Prospective cohort study	19 months (September 2008 - March 2010)	79 +/- 4	74 +	Germany	Europe	36,095	3,413	450	Elective cardiac surgery	N/A	Multiple
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*450*	*As above*	*As above*	*Comprehensive Assessment of Frailty (CAF)*
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*As above*	*450*	*As above*	*As above*	*Frailty predicts death one yeaR after Cardiac Surgery Test (FORECAST)*
90	Thai et al.	2015	Prevalence of Potential and Clinically Relevant Statin–Drug Interactions in Frail and Robust Older Inpatients	Drugs and Aging	Primary aim: To describe the prevalence rates of potential and clinically relevant statin–drug interactions in older inpatients according to frailty status. Secondary aim: To describe the prevalence rates of potential and clinically relevant statin–drug interactions according to interactions listed in the Australian Medicines Handbook and three commonly used international drug interaction sources: the British National Formulary, Drug Interaction Facts and Drug-Reax	A large teaching hospital (Royal North Shore Hospital in Sydney)	Patients prescribed a statin	Cross-sectional study	2.5 months (July - October 2014)	-	65 +	Australia	Australasia	43,268	3,779	180	Patients prescribed statins	N/A	Reported Edmonton Frailty Scale (REFS)
91	Ticinesi et al.	2016	Lung ultrasound and chest x-ray for detecting pneumonia in an acute geriatric ward	Medicine (United States)	To evaluate the diagnostic accuracy for pneumonia of bedside Lung Ultrasound (LUS) and Chest X-Ray (CXR) (index tests), compared with comprehensive clinical and laboratory evaluation (reference standard), in a cohort of multimorbid frail elderly acutely hospitalized with respiratory symptoms, also stratifying for functional performance according to the Rockwood model	Teaching hospital	Acute care geriatric ward	Prospective cohort study	10 months (January - October 2015)	83 +/- 10	65 +	Italy	Europe	35,136	3,225	270	Multimorbid patients with acute respiratory complaints urgently admitted from the emergency department	N/A	Clinical Frailty Scale
92	Timmons et al.	2015	Dementia in older people admitted to hospital: a regional multi-hospital observational study of prevalence, associations and case recognition	Age & Ageing	To prospectively study all older people admitted to six hospitals, investigating differences in dementia prevalence between hospital types, acute and elective admissions, and admitting specialities; and identifying predictors and associations of dementia	Six hospitals (five public (two rural, three urban) and one private) in County Cork, South-West Ireland	All hospital inpatients	Prospective study	10 months (May 2012 - February 2013)	80.03 +/- 6.51	70 +	Ireland	Europe	43,849	4,308	248	N/A	N/A	SHARE-FI
93	Valentini et al.	2018	Frailty and nutritional status in older people: the Mini Nutritional Assessment as a screening tool for the identification of frail subjects	Clinical Interventions in Aging	To investigate the relationship between nutritional status and frailty in an elderly population including hospitalized older patients and community-dwelling older people (outpatient older subjects), aiming to evaluate the usefulness of Mini Nutritional Assessment (MNA) as a screening tool to predict frailty	The “Tor Vergata” Polyclinic in Rome	Orthopedic Department (hip fracture)	Observational study	13 months (March 2014 - March 2015)	79.9 +/- 7.7	65 +	Italy	Europe	34,839	3,195	62	Hip fracture patients	N/A	SHARE -FI

94	Vidan et al.	2014	FRAIL-HF, a study to evaluate the clinical complexity of heart failure in nondependent older patients: Rationale, methods and baseline characteristics	Clinical Cardiology	1) To describe the characteristics of elderly patients hospitalized for HF, including a comprehensive geriatric assessment; 2) To determine the role of some factors not usually evaluated in routine clinical practice, such as frailty and other geriatric conditions, or the coexistence of acute diseases, on HF prognosis; 3) To evaluate the real ability for HF self-care using a new specific scale of observed performance in essential care tasks; and 4) To explore the interaction between frailty and treatment prescription or frailty and ability for self-care as determinants of prognosis and potential goals for intervention after HF hospitalization	Department of cardiology at a large University hospital in Madrid, Gregorio Maranon General Hospital	Heart failure patients in the cardiology, internal medicine and geriatrics departments	Prospective cohort observational study	25 months (May 2009 - May 2011)	80 +/- 6	70 +	Spain	Europe	31,205	2,476	450	Heart failure	N/A	Fried frailty phenotype criteria
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*Cardiology department*	*As above*	*As above*	*78.6 +/- 5.2*	*70 +*	*As above*	*As above*	*As above*	*As above*	*311*	*As above*	*As above*	*As above*	
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*Internal medicine department*	*As above*	*As above*	*80.2 +/- 5.4*	*70 +*	*As above*	*As above*	*As above*	*As above*	*78*	*As above*	*As above*	*As above*	
	As above	*As above*	*As above*	*As above*	*As above*	*As above*	*Geriatrics department*	*As above*	*As above*	*87.3 +/- 5.7*	*70 +*	*As above*	*As above*	*As above*	*As above*	*61*	*As above*	*As above*	*As above*	
95	Wallis et al.	2018	Association of the clinical frailty scale with hospital outcomes	Quarterly Journal of Medicine (QJM)	To retrospectively study the association of the Clinical Frailty Scale (CFS) with patient characteristics and outcomes	A large tertiary university National Health Service acute hospital in the UK	University hospital	Retrospective observational study	12 months (August 2013 - July 2014)	84.6 +/- 5.9	75 +	United Kingdom	Europe	37,248	3,152	5,764	Emergency admissions	N/A	Clinical Frailty Scale (CFS)
96	Wou et al.	2013	The predictive properties of frailty-rating scales in the acute medical unit	Age & Ageing	To assess the predictive value of frailty-rating scales in older people presenting as medical emergencies	Two acute medical units in the East Midlands of the United Kingdom. One at Queen's Medical Centre, Nottingham, and the second at the Leicester Royal Infirmary, Leicester	Two Acute Medical Units	Observational cohort study	23 months (January 2009 - November 2010)	-	70+	United Kingdom	Europe	34,809	2,585	559	N/A	N/A	Frailty Index

Data extraction form Part 2:

		Results																				
Study	Author	Number of frail participants	Number of pre-frail participants	Number of robust / non-frail	Prevalence of frailty	Prevalence of pre-frailty	Prevalence of robust/non frail	Number of Male participants	Number of frail Male participants	Number of pre-frail Male participants	Number of non-frail / robust Male participants	Prevalence of frailty in Male participants	Prevalence of pre-frailty in Male participants	Prevalence of robust / non-frailty Male participants	Number of Female participants	Number of frail Female participants	Number of pre-frail Female participants	Number of non-frail / robust Female participants	Prevalence of frailty in Female participants	Prevalence of pre-frailty in Female participants	Prevalence of robust / non-frailty Female participants	Relevant authors comments	Relevant reviewers comments
1	Alonso Salinas et al.	109	85	91	38.2%	29.8%	31.9%	171	51	46	74	29.8%	26.9%	43.3%	114	58	39	17	50.9%	34.2%	14.9%	N/A	Contact authors to enquire if data exists regarding: 1) the mean age (and standard deviation) of participants; 2) a sex breakdown regarding the number of pre-frail and non-frail participants
2	Amblas-Novellas et al.	495	86	9	83.9%	14.6%	1.5%	251	206	42	5	82.1%	16.7%	2.0%	339	289	46	4	85.3%	13.6%	1.2%	N/A	Contact authors to enquire if data exists regarding: 1) the number of pre-frail participants; 2) a sex breakdown regarding the number of frail, pre-frail, and non-frail participants
3	Andela et al.	202	N/A	74	73.2%	N/A	26.8%	124	-	N/A	-	-	N/A	-	152	-	N/A	-	-	N/A	-	N/A	Contact authors to enquire if data is available regarding: 1) the recruitment duration; 2) the overall mean age (and standard deviation) of participants, and 3) a sex breakdown of the number of frail participants (as a whole, and within each ward: geriatric centre, traumatology, pulmonary/rheumatology, internal medicine, surgical medicine)
As above	*As above*	*29*	*N/A*	*3*	*90.6%*	*N/A*	*9.4%*	*11*	*-*	*N/A*	*-*	*-*	*N/A*	*-*	*21*	*-*	*N/A*	*-*	*-*	*N/A*	*-*	*As above*	*As above*
As above	*As above*	*48*	*N/A*	*21*	*69.6%*	*N/A*	*30.4%*	*26*	*-*	*N/A*	*-*	*-*	*N/A*	*-*	*43*	*-*	*N/A*	*-*	*-*	*N/A*	*-*	*As above*	*As above*

As above	*As above*	*50*	*N/A*	*21*	*70.4%*	*N/A*	*29.6%*	*42*	-	*N/A*	-	-	*N/A*	-	*29*	-	*N/A*	-	-	*N/A*	-	*As above*	*As above*
As above	*As above*	*61*	*N/A*	*15*	*80.3%*	*N/A*	*19.7%*	*31*	-	*N/A*	-	-	*N/A*	-	*45*	-	*N/A*	-	-	*N/A*	-	*As above*	*As above*
As above	*As above*	*14*	*N/A*	*14*	*50.0%*	*N/A*	*50.0%*	*14*	-	*N/A*	-	-	*N/A*	-	*14*	-	*N/A*	-	-	*N/A*	-	*As above*	*As above*
4	Andrew et al.	184	229	92	36.4%	45.3%	18.2%	208	68	99	41	32.7%	47.6%	19.7%	297	116	130	51	39.1%	43.8%	17.2%	N/A	Contact authors to enquire if information exists regarding the mean age and standard deviation of all participants for which frailty assessments were conducted (presently this is only reported as a breakdown by frailty classification)
5	Attinsano et al.	180	-	-	54.4%	-	-	0	N/A	N/A	N/A	N/A	N/A	N/A	331	180	-	-	54.4%	-	-	N/A	Contact authors to enquire if information exists regarding: 1) the number of pre-frail participants; 2) a sex breakdown of the number of pre-frail participants
6	Baldwin et al.	18	4	0	81.8%	18.2%	0.0%	15	13	2	0	86.7%	13.3%	0.0%	7	5	2	0	71.4%	28.6%	0.0%	N/A	N/A
7	Blanco et al.	49	68	119	20.8%	28.8%	50.4%	122	23	34	65	18.9%	27.9%	53.3%	114	26	34	54	22.8%	29.8%	47.4%	N/A	N/A
8	Bo et al.	426	N/A	87	83.0%	N/A	17.0%	207	-	N/A	-	-	N/A	-	306	-	N/A	-	-	N/A	-	N/A	Contact authors to enquire if information exists regarding a sex breakdown of the number of frail participants
9	Bo et al.	649	-	-	41.4%	#VALUE!	#VALUE!	712	-	-	-	-	-	-	856	-	-	-	-	-	-	N/A	Contact authors to enquire if information exists regarding: 1) the prevalence of pre-frailty and non-frailty; 2) a breakdown of frailty, pre-frailty, and non-frailty by sex
10	Cheung et al.	33	27	40	33.0%	27.0%	40.0%	42	10	10	22	23.8%	23.8%	52.4%	58	23	17	18	39.7%	29.3%	31.0%	N/A	Contact authors to enquire if information exists regarding: 1) the score breakdown for the Reported Edmonton Frailty Scale that would allow classification of those who were vulnerable and non-frail according to the original classification; 2) a sex breakdown of the number of vulnerable and frail participants
11	Chew et al.	159	-	-	67.9%	-	-	102	68	-	-	66.7%	-	-	132	91	-	-	68.9%	-	-	N/A	Contact authors to enquire if information exists regarding: 1) the number of pre-frail participants; 2) a sex breakdown of the number of pre-frail participants
12	Chia et al.	30		-	25.6%	-	-	47	-	-	-	-	-	-	70	-	-	-	-	-	-	N/A	Contact authors to enquire if information exists regarding: 1) the mean age (and standard deviation) of the entire sample; 2) a sex breakdown of the entire sample; 3) the number of pre-frail/robust participants in the entire sample; 4) a sex breakdown of the number of frail, pre-frail and non-frail participants
13	Chong et al.	156.5	53	As below	74.5%	25.2%	As below	64	46.5	16	As below	72.7%	25.0%	As below	146	110	37	As below	75.3%	25.3%	As below	N/A	Contact authors to enquire if information exists regarding: 1) the number of pre-frail/vulnerable participants for each frailty assessment tool employed where applicable (i.e. the FRAIL Scale, Frailty Index, Clinical Frailty Scale); 2) a sex breakdown of pre-frail participants according to each frailty assessment tool
As above	*As above*	*183*	-	*27*	*87.1%*	-	*12.9%*	*64*	*53*	-	*11*	*82.8%*	-	*17.2%*	*146*	*130*	-	*16*	*89.0%*	-	*11.0%*	*As above*	*As above*

As above	*As above*	*105*	*87*	*18*	*50.0%*	*41.4%*	*8.6%*	*64*	*36*	*22*	*28*	*56.3%*	*34.4%*	*43.8%*	*146*	*69*	*65*	*-10*	*47.3%*	*44.5%*	*-6.8%*	*As above*	*As above*
As above	*As above*	*168*	*N/A*	*42*	*80.0%*	*N/A*	*20.0%*	*64*	*51*	*N/A*	*13*	*79.7%*	*N/A*	*20.3%*	*146*	*117*	*N/A*	*29*	*80.1%*	*N/A*	*19.9%*	*As above*	*As above*
As above	*As above*	*170*	*19*	*21*	*81.0%*	*9.0%*	*10.0%*	*64*	*46*	*10*	*18*	*71.9%*	*15.6%*	*28.1%*	*146*	*124*	*9*	*3*	*84.9%*	*6.2%*	*2.1%*	*As above*	*As above*
14	Coleman et al.	32	0	0	100.0%	0.0%	0.0%	11	11	0	0	100.0%	0.0%	0.0%	21	21	0	0	100.0%	0.0%	0.0%	N/A	N/A
15	Courtney-Brooks et al.	6	10	21	16.2%	27.0%	56.8%	0	N/A	N/A	N/A	N/A	N/A	N/A	37	6	10	21	16.2%	27.0%	56.8%	N/A	N/A
16	Crozier-Shaw et al.	43	N/A	163	20.9%	N/A	79.1%	109	-	N/A	-	-	N/A	-	-	-	N/A	-	-	-	-	N/A	Contact authors with regard to obtaining data regarding: 1) the mean age and standard deviation of all participants; 2) the sex breakdown of the sample; 3) the prevalence of frailty stratified by sex (number of frail male and female participants).
17	Dal Moro et al.	17	13	48	21.8%	16.7%	61.5%	11	4	3	4	36.4%	27.3%	36.4%	67	13	10	44	19.4%	14.9%	65.7%	N/A	Contact authors to enquire if information exists which: 1) classifies vulnerable and non-frail patients according to the initial Edmonton Frailty Scale (EFS) criteria (Paper reports those 0-4 as non-frail and 5-7 as vulnerable, however original scale classifies 0-5 as non-frail, and 6-7 as vulnerable; 2) provides a breakdown of the prevalence of frail, non-frail and vulnerable categories by sex.
18	Dent et al.	120	45	7	69.8%	26.2%	4.1%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	N/A	Contact authors to: 1) confirm if the modified versions of the Fried frailty phenotype and FRAIL scale, as well as the classificatory criteria utilised for the FI-CF, FI-CGA-10, MPI, SHERPA, and HARP have been validated; 2) inquire if information exists regarding the mean age (and standard deviation) of the 170 participants with a SOF index assessment; 3) a sex breakdown of the 170 participants with a SOF index assessment; 4) a sex breakdown of the number of frail, pre-frail, and non-frail participants, as assessed by the SOF; 5) inquire if information is available regarding the number of participants with a FI-CD score of ≥0.25
19	Dorner et al.	72	29	32	54.1%	21.8%	24.1%	60	30	23	7	50.0%	38.3%	11.7%	73	42	6	25	57.5%	8.2%	34.2%	N/A	Contact authors to inquire if information is available regarding the mean age (and standard deviation) of participants

20	Drudi et al.	412	-	-	39.8%	-	-	608	-	-	-	-	-	-	427	-	-	-	-	-	-	N/A	Contact authors to inquire if information is available regarding: 1) the number of pre-frail participants (Fried frailty phenotype criteria = 1 - 2); 2) a sex breakdown of the number of frail and pre-frail participants; 3) a breakdown of the prevalence of frailty by country
21	Dutzi et al.	127	20	7	82.5%	13.0%	4.5%	29	27	1	1	93.1%	3.4%	3.4%	125	100	19	6	80.0%	15.2%	4.8%	N/A	Contact authors to enquire if information exists regarding the prevalence of frailty stratified by sex
22	Eamer et al.	23	26	91	15.3%	17.3%	60.7%	81	12	11	58	14.8%	13.6%	71.6%	69	11	15	33	15.9%	21.7%	47.8%	N/A	Contact authors to enquire if information exists regarding the breakdown of the prevalence of frailty by sex
23	Eeles et al.	111	N/A	162	40.7%	N/A	59.3%	112	-	-	-	-	-	-	161	-	-	-	-	-	-	N/A	Contact authors to enquire if information exists pertaining to: 1) a sex breakdown of the entire sample; 2) a sex breakdown by frailty status
24	Ekerstad et al.	149	78	80	48.5%	25.4%	26.1%	157	68	-	-	43.3%	-	-	150	81	-	-	54.0%	-	-	N/A	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of the entire sample; 2) a sex breakdown of both vulnerable (pre-frail), and non-frail participants
25	Engelhardt et al.	70	N/A	169	29.3%	N/A	70.7%	100	25	N/A	75	25.0%	N/A	75.0%	139	45	N/A	94	32.4%	N/A	67.6%	N/A	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of the entire sample; 2) a sex breakdown of the entire sample; 3) a sex breakdown of the sample by frailty classification
26	Ferrero et al.	23	N/A	55	29.5%	N/A	70.5%	0	N/A	N/A	N/A	N/A	N/A	N/A	78	23	N/A	55	29.5%	N/A	70.5%	N/A	Contact authors regarding the mean age and standard deviation of all patients within the sample.
27	Ga et al.	94.5	2.5	3	94.5%	2.5%	3.0%	53	48.5	2.5	2	91.5%	4.7%	3.8%	47	46	0	1	97.9%	0.0%	2.1%	N/A	Contact authors to enquire if: 1) there is a sex breakdown of the level of frailty with the original classificatory criteria for the FRAIL-NH: non-frail 0-5, prefrail 6-7, frail 8+; 2) if information exists pertaining to the prevalence of frailty as defined by the Frailty Index.
As above	*As above*	*89*	*5*	*6*	*89.0%*	*5.0%*	*6.0%*	*53*	*44*	*5*	*4*	*83.0%*	*9.4%*	*7.5%*	*47*	*45*	*0*	*2*	*95.7%*	*0.0%*	*4.3%*	*As above*	*As above*
As above	*As above*	*100*	*0*	*0*	*100.0%*	*0.0%*	*0.0%*	*53*	*53*	*0*	*0*	*100.0%*	*0.0%*	*0.0%*	*47*	*47*	*0*	*0*	*100.0%*	*0.0%*	*0.0%*	*As above*	*As above*
28	Gleason et al.	73	73	29	41.7%	41.7%	16.6%	44	19	19	6	43.2%	43.2%	13.6%	131	54	54	23	41.2%	41.2%	17.6%	N/A	N/A
29	Goldforb et al.	433	-	-	37.4%	-	-	677	-	-	-	-	-	-	481	-	-	-	-	-	-	N/A	Contact authors to enquire if: 1) information exists regarding the number of pre-frail (1-2), and non-frail (0) participants as defined by the Fried Frailty phenotype; 2) a sex breakdown exists regarding frail, pre-frail, and non-frail participants
30	Guidet et al.	2156	972	1893	42.9%	19.4%	37.7%	2617	1007	510	1100	38.5%	19.5%	42.0%	2404	1149	462	793	47.8%	19.2%	33.0%	N/A	Contact authors to enquire if information exists regarding the mean age (and standard deviation) of the entire sample for which frailty was assessed
31	Gullon et al.	380	-	-	50.3%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Frailty data only available for 755 / 804 participants	Contact authors to: 1) confirm that frailty assessments utilising the FRAIL scale were only conducted in 755/804 participants; 2) inquire if information exists regarding the prevalence of pre-frailty; 3) inquire if a sex breakdown of frail, pre-frail, and non-frail participants exists

32	Hartley et al.	426	55	68	77.6%	10.0%	12.4%	190	141	20	29	74.2%	10.5%	15.3%	359	285	35	39	79.4%	9.7%	10.9%	Frailty data only available for 549/663 participants	Contact authors to enquire if information exists regarding: 1) the mean age (and standard deviation) of the entire sample (549 participants for which a CFS score is available); 2) the number of frail (CFS > 4), vulnerable (CFS = 4), and non-frail (CFS < 4) participants; 3) a sex breakdown of the entire sample for which a CFS score is available (549 participants); 4) a sex breakdown of the number of frail (CFS > 4), vulnerable (CFS = 4), and non-frail (CFS < 4) participants
33	Heppenstall et al.	106	34	18	67.1%	21.5%	11.4%	58	39	13	6	67.2%	22.4%	10.3%	100	67	21	12	67.0%	21.0%	12.0%	Frailty data only available for 158 / 159 participants	Contact the author with regard to the specific recruitment duration to the study
34	Hewitt et al.	88	59	170	27.8%	18.6%	53.6%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Eight participants with missing data regarding frailty status	Contact authors to enquire if information is available regarding: 1) the mean age (and standard deviation), and age range, of the 317 participants for which a frailty score exists; 2) confirmation of the sex breakdown of the frailty scale scores, as the numbers in column 4 of Table 1 on page 256 under the heading " Sex No. of women (%)", don't appear to add up
35	Hewitt et al.	113	81	214	27.7%	19.9%	52.5%	199	-	-	-	-	-	-	209	-	-	-	-	-	-	Missing frailty data for 3/411 participants	Contact authors to enquire if information is available regarding: 1) the mean age (and standard deviation), and age range, of the 408 participants for which a frailty score is available; 2) a sex breakdown of the number of frail, pre-frail, and non-frail participants
36	Hii et al.	9	11	27	19.1%	23.4%	57.4%	26	5	7	14	19.2%	26.9%	53.8%	21	4	4	13	19.0%	19.0%	61.9%	N/A	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of participants (reported mean age as 78, but no standard deviation) 2) the number, and sex breakdown, of patients classified as vulnerable (6-7 on the REFS)
37	Hilmer et al.	14	-	-	45.2%	-	-	26	12	-	-	46.2%	-	-	5	2	-	-	40.0%	-	-	N/A	Contact authors to enquire if information exists regarding: 1) the number of patients classified as vulnerable (6-7 on the REFS); 2) a sex breakdown of the number of patients classified as vulnerable (6-7 on the REFS)
38	Ibrahim et al.	91	104	30	40.6%	46.2%	13.2%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Frailty data only available for 230/233 participants assessed using the FRAIL scale, and 218/233 assessed using the Fried frailty phenotype criteria	Contact authors to inquire if information is available regarding: 1) the mean age (and standard deviation of the 230 participants assessed using the FRAIL scale, and the 218 participants assessed using the Fried frailty phenotype criteria; 2) a sex breakdown of the 230 participants assessed using the FRAIL scale, and the 218 participants assessed using the Fried frailty phenotype criteria; 3) a sex breakdown of the number of frail, pre-frail, and non-frail participants assessed using both tools
As above	*as above*	*77*	*106*	*47*	*33.5%*	*46.1%*	*20.4%*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*As above*	*As above*
As above	*as above*	*105*	*101*	*12*	*48.2%*	*46.3%*	*5.5%*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*As above*	*As above*
39	Induruwa et al.	282	60	77	67.3%	14.3%	18.4%	189	101	32	43	53.4%	16.9%	22.8%	230	181	28	34	78.7%	12.2%	14.8%	N/A	Contact authors to enquire if information exists regarding: 1) The mean age and standard deviation of participants; 2) the prevalence of frailty, vulnerability, and non-frailty by sex, or if data exists that would allow this calculation i.e. individual CFS scores
40	Jacobs et al.	34	-	-	61.8%	-	-	23	-	-	-	-	-	-	32	-	-	-	-	-	-	N/A	Contact authors to: 1) enquire if information exists regarding the number of frail, pre-frail and robust patients according to the Fried Frailty phenotype classification; 2) confirm if information exists regarding those vulnerable and non-frail according to the frailty index classification; 3) enquire if information exists regarding the prevalence of frailty, pre-frailty and non-frailty, for each assessment by sex.

41	Jokar et al.	58	N/A	72	44.6%	N/A	55.4%	69	31	N/A	38	45.3%	N/A	54.7%	62	27	N/A	34.5	43.9%	N/A	56.1%	N/A	N/A
As above	*As above*	*98*	*N/A*	*102*	*49.0%*	*N/A*	*51.0%*	*104*	*52*	*N/A*	*52*	*50.0%*	*N/A*	*50.0%*	*96*	*46*	*N/A*	*50*	*47.9%*	*N/A*	*52.1%*	*As above*	*As above*
As above	*As above*	*18*	*N/A*	*42*	*30.0%*	*N/A*	*70.0%*	*33*	*10*	*N/A*	*23*	*30.3%*	*N/A*	*69.7%*	*27*	*8*	*N/A*	*19*	*29.6%*	*N/A*	*70.4%*	*As above*	*As above*
42	Joosten et al.	77	117.5	17.5	36.3%	55.4%	8.3%	91	36	-	-	39.0%	-	-	121	42	-	-	34.7%	-	-	N/A	Contact authors to enquire if information exists regarding: 1) mean age and standard deviation of all participants; 2) a sex breakdown of the 3 pre-frail participants as defined by the Fried frailty phenotype criteria
As above	*As above*	*88*	*129*	*3*	*40.0%*	*58.6%*	*1.4%*	*94*	*43*	*-*	*-*	*45.7%*	*-*	*-*	*126*	*45*	*-*	*-*	*35.7%*	*-*	*-*	*As above*	*As above*
As above	*As above*	*66*	*106*	*32*	*32.4%*	*52.0%*	*15.7%*	*87*	*28*	*42*	*17*	*32.2%*	*48.3%*	*19.5%*	*117*	*38*	*64*	*15*	*32.5%*	*54.7%*	*12.8%*	*As above*	*As above*
43	Joseph et al.	110	N/A	140	44.0%	N/A	56.0%	173	75	N/A	98	43.4%	N/A	56.6%	77	35	N/A	42	45.5%	N/A	54.5%	N/A	Contact authors to enquire if information exists regarding the number of pre-frail participants
44	Joseph et al.	136	139	93	37.0%	37.8%	25.3%	225	77	90	58	34.2%	40.0%	25.8%	143	59	49	35	41.3%	34.3%	24.5%	N/A	N/A
45	Juma et al.	54	5	16	72.0%	6.7%	21.3%	27	13	2	10	48.1%	7.4%	37.0%	48	41	3	6	85.4%	6.3%	12.5%	N/A	Contact authors to enquire if information exists regarding the sex breakdown of the 5 participants with a CFS score of 4, and the 16 participants with a CFS score of < 4
46	Kang et al.	152	66	134	43.2%	18.8%	38.1%	203	123	-	-	60.6%	-	-	149	29	-	-	19.5%	-	-	N/A	Contact authors to enquire if information exists regarding: 1) the mean age (and standard deviation) of participants; 2) the number of participants with a CSHA score of 4 (vulnerable), and those with a score of <4 (non-frail); 3) a sex breakdown of these participants
47	Karlekar et al.	24	21	19	37.5%	32.8%	29.7%	38	12	12	14	31.6%	31.6%	36.8%	26	12	9	5	46.2%	34.6%	19.2%	Frailty data only available for 64/131 patients	Contact authors to enquire if information exists regarding: 1) the mean age (and standard deviation) of the 64 participants screened for frailty; 2) a sex breakdown of frail, pre-frail and non-frail participants
48	Keevil et al.	5755	1846	3061	54.0%	17.3%	28.7%	4509	2173	841	1495	48.2%	18.7%	33.2%	6153	3582	1005	1566	58.2%	16.3%	25.5%	Frailty data only available for 10662 / 14777 included participants. An additional 17 (from a sample of 14794) were initially excluded as age and sex data was not available	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of the entire sample; 2) The number of patients with a CFS score of 4 (vulnerable); 3) a sex breakdown of those with CFS scores from 1-3, 4, and > 4
49	Kenig et al.	96	-	-	52.2%	-	-	98	-	-	-	-	-	-	86	-	-	-	-	-	-	N/A	Contact authors to enquire if information exists regarding: 1) the prevalence of pre-frailty as assessed by the GFI and the Rockwood frailty assessment; 2) A sex breakdown of the prevalence of frailty, pre-frailty, and non-frailty for both the GFI and the Rockwood frailty assessment
As above	*As above*	*100*	*-*	*-*	*54.3%*	*-*	*-*	*98*							*86*							*As above*	*As above*
As above	*As above*	*92*	*-*	*-*	*50.0%*	*-*	*-*	*98*	*-*	*-*	*-*	*-*	*-*	*-*	*86*	*-*	*-*	*-*	*-*	*-*	*-*	*As above*	*As above*
50	Khan et al.	127	-	-	39.0%	-	-	187	70	-	-	37.4%	-	-	139	57	-	-	41.0%	-	-	N/A	Contact authors to enquire if information exists regarding: 1) the number of pre-frail participants; 2) a sex breakdown of pre-frail participants
51	Kobe et al.	71	N/A	59	54.6%	N/A	45.4%	65	34	N/A	31	52.3%	N/A	47.7%	65	37	N/A	28	56.9%	N/A	43.1%	N/A	Contact authors to enquire if information is available regarding: 1) the total number of participants recruited from each country; 2) the recruitment duration within each country; 3) the mean age (and standard deviation) and prevalence of frailty among patients from each country; 4) the prevalence of frailty and non-frailty stratified by sex among patients from each country
As above	*As above*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*As above*	*As above*
As above	*As above*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*As above*	*As above*

52	Koyama et al.	34	57	60	22.5%	37.7%	39.7%	78	-	-	-	-	-	-	73	-	-	-	-	-	-	N/A	Contact authors to enquire if information exists regarding the sex breakdown of frail, pre-frail and non-frail participants
53	Kusunose et al.	38	117	36	19.9%	61.3%	18.8%	110	25	66	19	22.7%	60.0%	17.3%	81	13	51	17	16.0%	63.0%	21.0%	N/A	N/A
54	Lee et al.	49	N/A	51	49.0%	N/A	51.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Frailty data only available for 100/101 patients	Contact authors to enquire if information is available regarding: 1) the number of male and female participants; 2) a breakdown of the prevalence of frailty stratified by sex
55	Le Maguet et al.	46	62	88	23.5%	31.6%	44.9%	128	28	42	58	21.9%	32.8%	45.3%	68	18	20	30	26.5%	29.4%	44.1%	N/A	Contact authors to: 1) confirm if the adapted version of the Fried frailty phenotype utilised has been validated; 2) confirm if information exists regarding a sex breakdown of vulnerable (CFS = 4), and non-frail (CFS < 4) participants
56	Lin et al.	47	90	109	19.1%	36.6%	44.3%	118	20	35	63	16.9%	29.7%	53.4%	128	27	55	46	21.1%	43.0%	35.9%	N/A	N/A
57	Llao et al.	145	-	-	27.3%	-	-	322	-	-	-	-	-	-	209	-	-	-	-	-	-	N/A	Contact authors to confirm if information exists regarding: 1) the number of pre-frail participants; 2) a sex breakdown of the number of frail, pre-frail and non-frail participants
58	Ma et al.	166	59	203	38.8%	13.8%	47.4%	249	-	-	-	-	-	-	179	-	-	-	-	-	-	N/A	Contact authors to enquire if information exists regarding a sex breakdown of frail, pre-frail and non-frail participants
59	Madni et al.	34	43	50	27.0%	34.1%	39.7%	85	-	-	-	-	-	-	41	-	-	-	-	-	-	N/A	Contact authors to enquire if information exists regarding a sex breakdown of frail, pre-frail, and non-frail participants
60	Martin et al.	50	12	0	80.6%	19.4%	0.0%	33	24	9	0	72.7%	27.3%	0.0%	29	26	3	0	89.7%	10.3%	0.0%	N/A	Contact authors to enquire if information exists regarding a sex breakdown of the number of frail and pre-frail participants
61	Mason et al.	179	76	180	41.1%	17.5%	41.4%	195	79	33	83	40.5%	16.9%	42.6%	240	100	43	97	41.7%	17.9%	40.4%	Only 435/447 participants had a frailty assessment conducted	Contact authors to enquire if information exists regarding: 1) the number of pre-frail and non-frail participants; 2) a sex breakdown of all 435 participants for which a frailty assessment is available; 3) a sex breakdown of frail, pre-frail and non-frail participants
62	Maxwell et al.	63	71	54	33.5%	37.8%	28.7%	82	21	35	26	25.6%	42.7%	31.7%	106	42	36	28	39.6%	34.0%	26.4%	N/A	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of participants; 2) the number of male / female participants; 3) a sex breakdown of the number of frail, prefrail, and non-frail participants
63	McGuckin et al.	60	23	81	36.6%	14.0%	49.4%	60	23	8	29	38.3%	13.3%	48.3%	104	37	15	52	35.6%	14.4%	50.0%	N/A	Contact authors to enquire if information exists regarding a sex breakdown of the number of frail, vulnerable, and non-frail participants
64	McIsaac et al.	119824	-	295880	28.8%	-	71.2%	191058	60871	-	130187	31.9%	-	68.1%	224646	58953	-	165693	26.2%	-	73.8%	N/A	Contact author to enquire if information exists regarding; 1) the mean age and standard deviation of all participants within the study (only reported by frailty group presently within the text); 2) the number of pre-frail participants if applicable
65	Morton et al.	120	-	-	73.2%	-	-	77	54	-	-	70.1%	-	-	87	66	-	-	75.9%	-	-	N/A	Contact authors to enquire if information exists regarding the number of participants classified as pre-frail (CFS score = 4)
66	Muessig et al.	165	70	73	53.6%	22.7%	23.7%	154	75	31	48	48.7%	20.1%	31.2%	154	90	39	25	58.4%	25.3%	16.2%	N/A	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of all patients within the sample; 2) a sex breakdown of the number of pre-frail participants (CFS score = 4)
67	Muller et al.	34	93	29	21.8%	59.6%	18.6%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Frailty data only available for 156 / 169 participants	Contact authors to enquire if information exists regarding: 1) the mean age (and standard deviation) of participants; 2) a sex breakdown of the 156 patients for which a frailty assessment exists; 3) if a sex breakdown exists regarding the number of frail, pre-frail and vulnerable participants

68	Myint et al.	113	81	450	17.5%	12.6%	69.9%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Frailty data available for 644 / 653 participants	Contact authors to enquire if information exists regarding: 1) the mean age of the 644 participants for which frailty data is available; 2) a sex breakdown of the 644 participants for which frailty data is available; 3) a sex breakdown of the number of frail, vulnerable and non-frail participants
69	Nolan et al.	40	1	0	97.6%	2.4%	0.0%	18	17	1	0	94.4%	5.6%	0.0%	23	23	0	0	100.0%	0.0%	0.0%	N/A	Contact authors to enquire if information exists regarding a sex breakdown of the number participants classified as frail (CFS > 4) and vulnerable (CFS score = 4)
70	Nygen et al.	161	-	-	53.3%	-	-	151	75	-	-	49.7%	-	-	151	86	-	-	57.0%	-	-	N/A	Contact authors to enquire if information exists regarding: 1) the number of vulnerable participants (REFS 6 - 7) within the entire sample of 302 participants ;2) a sex breakdown of the number of vulnerable participants
71	Oliveria et al.	46	49	4	46.5%	49.5%	4.0%	49	23	24	2	46.9%	49.0%	4.1%	50	23	25	2	46.0%	50.0%	4.0%	N/A	N/A
72	Ozturk et al.	275	110	35	65.5%	26.2%	8.3%	212	116	70	26	54.7%	33.0%	12.3%	208	159	40	9	76.4%	19.2%	4.3%	N/A	N/A
73	Papageorgiou et al.	10	8	18	27.8%	22.2%	50.0%	22	-	-	-	-	-	-	14	-	-	-	-	-	-	N/A	Contact authors to enquire if a sex breakdown exists regarding the number of participants classified as frail (CFS > 4), vulnerable (CFS = 4) and non-frail (CFS < 4)
74	Papakonstantinou et al.	61	32	11	58.7%	30.8%	10.6%	51	22	22	7	43.1%	43.1%	13.7%	53	39	10	4	73.6%	18.9%	7.5%	N/A	Contact authors to enquire if information exists regarding: 1) the mean, standard deviation, and age range of all participants for which a frailty assessment exists; 2) the number of participants classified as vulnerable (CFS = 4); 3) a sex breakdown of the number of participants classified as frail (CFS > 4), pre-frail (CFS = 4), and non-frail (CFS < 4)
75	Parmar et al.	190	199	551	20.3%	21.2%	58.8%	397	75	87	235	18.9%	21.9%	59.2%	540	115	112	316	21.3%	20.7%	58.5%	N/A	N/A
76	Pasqualetti et al.	279	162	202	43.4%	25.2%	31.4%	300	118	78	107	39.33%	26.0%	35.7%	343	161	84	95	46.94%	24.5%	27.7%	N/A	Contact authors to enquire if information exists regarding a sex breakdown of the prevalence of frailty, pre-frailty, and non-frailty
77	Patel et al.	1094	-	-	27.7%	-	-	2603	757	-	-	29.1%	-	-	1341	337	-	-	25.1%	-	-	N/A	Contact authors to enquire if information exists regarding: 1) the mean age (and standard deviation) of all participants; 2) the mean age and standard deviation of STEMI, and non-STEMI patients; 3) the number of pre-frail participants (overall within the sample and also specifically within STEMI and NSTEMI participants; 4) a sex breakdown of the number of pre-frail participants (overall, and within both STEMI and NSTEMI participants)
As above	*As above*	*192*	-	-	*15.1%*	-	-	*865*	*133*	-	-	*15.4%*	-	-	*410*	*59*	-	-	*14.4%*	-	-	*As above*	*As above*
As above	*As above*	*902*	-	-	*33.8%*	-	-	*1738*	*624*	-	-	*35.9%*	-	-	*931*	*278*	-	-	*29.9%*	-	-	*As above*	*As above*
78	Peel et al.	81	5	3	91.0%	5.6%	3.4%	33	28	3	2	84.8%	9.1%	6.1%	56	53	2	1	94.6%	3.6%	1.8%	Frailty data only available for 89/91 participants with three or more moves	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of all participants with three or more moves for which frailty data exists (n = 89); 2) the mean age and standard deviation of all geriatric medicine patients (n = 67), and general medicine patients (n = 22) with three or more moves for which frailty data exists; 3) a breakdown of the number of frail, vulnerable and non-frail geriatric, and general medicine patients; 4) a sex breakdown of all 89 participants, as well as a sex breakdown of geriatric, and general medicine participants, with three or more moves; 5) a sex breakdown of the number of frail, vulnerable and non-frail participants amongst all participants (n = 89), geriatric patients (n = 67), and general medicine patients

																						(n= 22), with three of more moves; 6) confirmation of which group (geriatric or general medicine participants), the two participants with missing frailty data originate?
As above	*As above*	*66*	*1*	*0*	*98.5%*	*1.5%*	*0.0%*	*24*	*23*	*1*	*0*	*95.8%*	*4.2%*	*0.0%*	*43*	*43*	*0*	*0*	*100.0%*	*0.0%*	*0.0%*	*As above*	*As above*
As above	*As above*	*15*	*4*	*3*	*68.2%*	*18.2%*	*13.6%*	*9*	*5*	*2*	*2*	*55.6%*	*22.2%*	*22.2%*	*13*	*10*	*2*	*1*	*76.9%*	*15.4%*	*7.7%*	*As above*	*As above*
79	Pelavski et al.	29	65	22	22.8%	51.2%	17.3%	57	12	27	18	21.1%	47.4%	31.6%	70	17	38	4	24.3%	54.3%	5.7%	Frailty data only available for 127/139 eligible participants	Contact authors to inquire if information is available regarding: 1) the mean age and standard deviation of the sample; 2) a sex breakdown of the prevalence of frailty, pre-frailty and non-frailty
80	Perera et al.	140	-	-	63.6%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	N/A	Contact authors to enquire if information exists regarding; 1) the number of vulnerable participants (REFS = 6-7) and non-frail participants (REFS < 5); 2) the number of male and female participants; 3) a sex breakdown of the number of frail, vulnerable and non-frail participants
81	Pollack et al.	107	16	2	85.6%	12.8%	1.6%	61	49	10	2	80.3%	16.4%	3.3%	64	58	6	0	90.6%	9.4%	0.0%	N/A	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of all participants; 2) the number of pre-frail participants; 3) a sex breakdown of the number of pre-frail participants
82	Poudel et al.	915	-	-	64.5%	-	-	638	373	-	-	58.5%	-	-	780	542	-	-	69.5%	-	-	N/A	Contact authors to enquire if information exists regarding: 1) the number of pre-frail participants; 2) a sex breakdown of the number of frail, pre-frail (if applicable) and non-frail participants
83	Purser et al.	139	-	-	45.0%	-	-	216	87	-	-	40.3%	-	-	93	52	-	-	55.9%	-	-	N/A	Contact authors to enquire if information exists regarding 1) the number of pre-frail participants for both the Freid frailty phenotype (Composite A) and Rockwood frailty assessment (Composite B) 2) a sex breakdown of the number of pre-frail participants according to each assessment
As above	*As above*	*84*	*-*	*-*	*27.2%*	*-*	*-*	*216*	*49*	*-*	*-*	*22.7%*	*-*	*-*	*93*	*35*	*-*	*-*	*37.6%*	*-*	*-*	*As above*	*As above*
As above	*As above*	*194*	*-*	*-*	*62.8%*	*-*	*-*	*216*	*125*	*-*	*-*	*57.9%*	*-*	*-*	*93*	*69*	*-*	*-*	*74.2%*	*-*	*-*	*As above*	*As above*
84	Ritt et al.	221	67	19	72.0%	21.8%	6.2%	99	79	17	3	79.8%	17.2%	3.0%	208	142	50	16	68.3%	24.0%	7.7%	N/A	Contact authors to enquire if information exists regarding the mean age (and standard deviation) of the sample
85	Rose et al.	67	23	43	50.4%	17.3%	32.3%	81	-	-	-	-	-	-	52	-	-	-	-	-	-	N/A	Contact authors to enquire if a sex breakdown exists regarding the number of frail, vulnerable, and non-frail participants
86	Sanchez et al.	86	-	-	40.8%	-	-	104	-	-	-	-	-	-	107	-	-	-	-	-	-	N/A	Contact authors to enquire if information exists regarding: 1) the number of pre-frail participants; 2) a sex breakdown of the number of frail, pre-frail and non-frail participants
87	Sanchis et al.	116	201	25	33.9%	58.8%	7.3%	196	47	129	20	24.0%	65.8%	10.2%	146	69	72	5	47.3%	49.3%	3.4%	N/A	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of the entire sample; 2) the number of pre-frail participants; 3) a sex breakdown of the number of pre-frail participants
88	Sikder et al.	25	87	32	17.4%	60.4%	22.2%	79	15	47	17	19.0%	59.5%	21.5%	65	10	40	15	15.4%	61.5%	23.1%	N/A	N/A

89	Sundermann et al.	251	N/A	200	55.7%	N/A	44.3%	227	115	N/A	112	50.7%	N/A	49.3%	223	135.5	N/A	88	60.8%	N/A	39.2%	N/A	This study is the full report of another study within our screening (Sundermann et al. 2011 (preliminary results)). Contact authors to enquire if information exists regarding: 1) a sex breakdown of the number of frail participants as assessed by the Comprehensive Assessment of Frailty (CAF) tool; 2) the number of frail, pre-frail (if applicable) and non-frail participants as defined by the FORECAST frailty assessment; 3) a sex breakdown of the number of frail, pre-frail and non-frail participants as defined by the FORECAST frailty assessment
As above	*As above*	*220*	*N/A*	*230*	*48.9%*	*N/A*	*51.1%*	*227*	*100*	*N/A*	*127*	*44.1%*	*N/A*	*55.9%*	*223*	*120*	*N/A*	*103*	*53.8%*	*N/A*	*46.2%*	*As above*	*As above*
As above	*As above*	*281*	*N/A*	*169*	*62.4%*	*N/A*	*37.6%*	*227*	*130*	*N/A*	*97*	*57.3%*	*N/A*	*42.7%*	*223*	*151*	*N/A*	*72*	*67.7%*	*N/A*	*32.3%*	*As above*	*As above*
90	Thai et al.	63	-	-	35.0%	-	-	95	27	-	-	28.4%	-	-	85	36	-	-	42.4%	-	-	N/A	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of the entire sample; 2) the number of vulnerable participants (6-7 on the REFS); 3) a sex breakdown of the number of pre-frail participants
91	Ticinesi et al.	161	65	44	59.6%	24.1%	16.3%	124	76	29	19	61.3%	23.4%	15.3%	146	85	36	25	58.2%	24.7%	17.1%	N/A	Contact authors to inquire if information is available regarding: 1) the mean age (and standard deviation) of the entire sample; 2) the number of pre-frail within the entire sample; 3) a sex breakdown of the entire sample; 4) a sex breakdown of frail and pre-frail participants
92	Timmons et al.	112	51	75	45.2%	20.6%	30.2%	112	34	31	47	30.4%	27.7%	42.0%	136	78	30	28	57.4%	22.1%	20.6%	Frailty data only available for 248 / 606 participants	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of the entire sample; 2) a sex breakdown of the number of frail, pre-frail, and non-frail participants
93	Valentini et al.	37	13	12	59.7%	21.0%	19.4%	15	-	-	-	-	-	-	47	-	-	-	-	-	-	N/A	Contact authors to enquire if information exists regarding: 1) the number of male and female participants within the inpatient cohort of the sample; 2) a sex breakdown of the number of frail, pre-frail and non-frail participants within the inpatient cohort of the sample
94	Vidan et al.	316	-	-	70.2%	-	-	227	-	-	-	-	-	-	223	-	-	-	-	-	-	N/A	Contact authors to enquire if information exists regarding: 1) the number of pre-frail participants; 2) a sex breakdown of the number of frail, pre-frail and non-frail participants; 3) a sex breakdown of the number of frail, pre-frail and non-frail participants within each of the departments (cardiology, internal medicine, geriatrics)
As above	*As above*	*210*	-	-	*67.5%*	-	-	*159*	-	-	-	-	-	-	*152*	-	-	-	-	-	-	*As above*	*As above*
As above	*As above*	*57*	-	-	*73.1%*	-	-	*44*	-	-	-	-	-	-	*34*	-	-	-	-	-	-	*As above*	*As above*
As above	*As above*	*49*	-	-	*80.3%*	-	-	*24*	-	-	-	-	-	-	*37*	-	-	-	-	-	-	*As above*	*As above*
95	Wallis et al.	3266	1024	1474	56.7%	17.8%	25.6%	2524	1251	499	774	49.6%	19.8%	30.7%	3240	2015	525	700	62.2%	16.2%	21.6%	Frailty data only available for 5764 / 7532 participants	N/A

96	Wou et al.	173	-	-	30.9%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Frailty data only available for 559 / 669 participants	Contact authors to enquire if information exists regarding: 1) the mean age and standard deviation of all 559 participants for which frailty index data is available; 2) a sex breakdown of the 559 participants for which frailty index data is available; 3) the number of pre-frail participants; 4) a sex breakdown of the number of frail, pre-frail and non-frail participants

Data extraction form Part 3:

Study details					5-year average Gross Domestic Product (GDP) per capita purchasing power parity (current international $) (years preceding the study*) (International Monetary Fund data)																	
Author	Year of Publication	Country / location	Recruitment start date	Recruitment end date	Year 5	Year 4	Year 3	Year 2	Year 1	Additional Year 1	Additional Year 2	Additional Year 3	Additional Year 4	Additional Year 5	Additional Year 6	Additional Year 7	Additional Year 8	Additional Year 9	Additional Year 10	Additional Year 11	Additional Year 12	Years	5-year average GDP per capita PPP (current international $) (years preceding the study*) (International Monetary Fund data)
Alonso Salinas et al.	2018	Spain	Oct-13	Dec-15	33,211.50	32,001.47	32,243.64	32,467.68	32,100.45	32,225.56	33,386.99	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2008 - 2014	32,519.61
Amblas-Novellas et al.	2018	Spain	Jan-14	Dec-14	32,001.47	32,243.64	32,467.68	32,100.45	32,225.56	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	32,207.76
Andela et al.	2010	Netherlands	2009	2009	37,393.60	39,255.86	41,777.42	44,420.10	46,087.59	N//A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2004 - 2008	41,786.91
Andrew et al.	2017	Canada	Nov-11	May-12	37,857.22	39,294.26	40,034.73	38,713.59	39,926.15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2006 - 2010	39,165.19
Attinsano et al.	2017	Italy	Jan-16	Dec-16	35,544.01	35,078.13	34,878.35	35,419.22	36,121.08	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2011 - 2015	35,408.16
Baldwin et al.	2014	United States of America	Feb-12	Jul-12	47,869.24	48,283.41	47,007.67	48,402.58	49,825.50	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2007 - 2011	48,277.68
Blanco et al.	2017	France	May-14	Jul-15	36,258.21	37,217.31	38,640.04	39,314.01	40,030.97	40,966.13	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2014	38,737.78
Bo et al.	2015	Italy	Jan-14	Apr-14	33,935.38	34,758.95	35,544.01	35,078.13	34,878.35	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	34,838.96
Bo et al.	2016	Italy	Jan-12	Apr-12	35,871.71	35,882.31	33,935.38	34,758.95	35,544.01	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2007 - 2011	35,198.47
Cheung et al.	2016	Australia	Mar-14	Jul-14	40,852.40	41,729.04	43,098.68	44,820.00	45,841.71	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	43,268.36
Chew et al.	2017	Singapore	Dec-10	Aug-12	60,068.13	64,555.79	63,516.24	61,724.39	70,696.49	75,290.06	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2006 - 2011	65,975.19
Chia et al.	2016	Singapore	Jan-07	Dec-14	42,558.75	45,944.22	51,043.47	55,260.81	60,068.13	64,555.79	63,516.24	61,724.39	70,696.49	75,290.06	78,072.24	82,036.99	N/A	N/A	N/A	N/A	N/A	2002 - 2013	62,563.97
Chong et al.	2017	Singapore	Nov-15	Dec-15	70,696.49	75,290.06	78,072.24	82,036.99	85,906.87	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2010 - 2014	78,400.53
Coleman et al.	2012	Ireland	Sep-09	Dec-09	38,913.25	41,393.62	43,546.41	45,754.96	43,889.57	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2004 - 2008	42,699.56
Courtney-Brooks et al.	2012	United States of America	Mar-11	Dec-11	46,213.51	47,869.24	48,283.41	47,007.67	48,402.58	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2006 - 2010	47,555.28
Crozier-Shaw et al.	2018	Ireland	Jan-12	Dec-16	45,754.96	43,889.57	41,700.89	42,782.25	45,117.39	45,869.30	47,035.83	51,707.58	64,686.50	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2007 - 2015	47,616.03
Dal Moro et al.	2017	Italy	Jan-14	Apr-15	33,935.38	34,758.95	35,544.01	35,078.13	34,878.35	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	34,838.96
Dent et al.	2014	Australia	Oct-10	Dec-11	36,049.25	37,602.35	39,553.98	40,516.04	40,852.40	41,729.04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2005 - 2010	39,383.84
Dorner et al.	2014	Germany	Jun-11	Oct-11	37,004.53	39,365.03	40,572.35	38,743.41	40,839.53	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2006 - 2010	39,304.97
Drudi et al.	2018	Multiple (United States of America, Canada, France)	Nov-11	Apr-16	-	-	-	-	-	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2006 - 2014	-
Dutzi et al.	2017	Germany	Feb-11	Dec-11	37,004.53	39,365.03	40,572.35	38,743.41	40,839.53	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2006 - 2010	39,304.97
Eamer et al.	2018	Canada	Jan-14	Sep-15	38,713.59	39,926.15	41,625.95	42,715.71	44,009.22	45,661.12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2014	42,108.62
Eeles et al.	2012	Australia	Jan-01	Jun-01	24,104.64	25,388.71	26,605.84	27,871.67	29,020.02	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1996 - 2000	26,598.18
Ekerstad et al.	2011	Sweden	Oct-09	Jun-10	34,847.68	36,796.74	39,406.67	41,526.95	41,764.88	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2004 - 2008	38,868.58
Engelhardt et al.	2018	United States of America	Oct-16	Dec-16	49,825.50	51,556.17	53,061.24	54,992.73	56,770.40	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2011 - 2015	53,241.21
Ferrero et al.	2017	Italy	2006	2014	29,844.56	30,371.73	30,873.52	31,968.81	33,025.56	34,557.94	35,871.71	35,882.31	33,935.38	34,758.95	35,544.01	35,078.13	34,878.35					2001 - 2013	33,583.92
Ga et al.	2018	South Korea	Mar-11	Feb-17	24,506.17	26,405.61	27,471.40	27,733.58	29,731.04	31,228.51	32,386.41	33,755.03	35,320.40	36,501.22	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2006 - 2015	30,503.94
Gleason et al.	2017	United States of America	Aug-15	May-16	48,402.58	49,825.50	51,556.17	53,061.24	54,992.73	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2010 - 2014	51,567.64

Goldforb et al.	2018	Multiple (Canada, United States of America, France) - Emailed authors for individual breakdown of frailty status per country	2012	2017	-	-	-	-	-	-	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2007 - 2016	-
Guidet et al.	2018	Multiple (Ireland, Great Britain, Portugal, Spain, France, Belgium, Denmark, Norway, Switzerland, Netherlands, Sweden, Russia, Germany, Austria, Poland, Czech Republic, Italy, Ukraine, Romania, Greece, Cyprus)	Oct-16	Feb-17	-	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2011 - 2015	-
Gullon et al.	2017	Spain	Oct-14	May-15	32,001.47	32,243.64	32,467.68	32,100.45	32,225.56	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	32,207.76
Hartley et al.	2017	United Kingdom	Dec-14	May-15	35,433.71	36,170.12	37,221.67	38,230.85	39,449.31	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	37,301.13
Heppenstall et al.	2011	New Zealand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hewitt et al.	2015	United Kingdom	May-13	Jun-13	36,984.75	35,433.71	36,170.12	37,221.67	38,230.85	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2008 - 2012	36,808.22
Hewitt et al.	2016	United Kingdom	Jul-14	Oct-14	35,433.71	36,170.12	37,221.67	38,230.85	39,449.31	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	37,301.13
Hii et al.	2015	New Zealand	Feb-14	Mar-14	30,574.78	31,251.53	32,311.26	33,568.33	34,516.70	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	32,444.52
Hilmer et al.	2009	Australia	Apr-07	Sep-07	31,437.36	32,508.68	34,432.55	36,049.25	37,602.35	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2002 - 2006	34,406.04
Ibrahim et al.	2019	United Kingdom	Mar-14	Mar-16	35,433.71	36,170.12	37,221.67	38,230.85	39,449.31	41,066.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2014	37,928.61
Induruwa et al.	2017	United Kingdom	Jan-14	Mar-14	35,433.71	36,170.12	37,221.67	38,230.85	39,449.31	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	37,301.13
Jacobs et al.	2017	Netherlands	Jun-14	Dec-14	44,508.51	45,397.55	46,844.21	47,075.51	47,701.11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	46,305.38
Jokar et al.	2016	United States of America	2013	2014	48,283.41	47,007.67	48,402.58	49,825.50	51,556.17	53,061.24	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2008 - 2013	49,689.43
Joosten et al.	2014	Belgium	Jan-10	Nov-10	35,275.72	37,021.74	39,055.80	39,817.55	38,902.60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2005 - 2009	38,014.68
Joseph et al.	2014	United States of America	Jun-11	Feb-13	47,869.24	48,283.41	47,007.67	48,402.58	49,825.50	51,556.17	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2006 - 2011	48,824.10
Joseph et al.	2016	United States of America	2013	2014	48,283.41	47,007.67	48,402.58	49,825.50	51,556.17	53,061.24	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2008 - 2013	49,689.43
Juma et al.	2016	Canada	Apr-13	Feb-14	40,034.73	38,713.59	39,926.15	41,625.95	42,715.71	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2008 - 2012	40,603.22
Kang et al.	2015	China	Dec-14	May-15	8,306.03	9,249.60	10,290.47	11,260.48	12,291.13	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	10,279.54
Karlekar et al.	2017	United States of America	Mar-15	May-15	48,402.58	49,825.50	51,556.17	53,061.24	54,992.73	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2010 - 2014	51,567.64
Keevil et al.	2018	United Kingdom	Oct-14	Nov-16	35,433.71	36,170.12	37,221.67	38,230.85	39,449.31	41,066.00	42,145.49	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2015	38,531.02
Kenig et al.	2015	Poland	Jan-13	Jul-14	19,363.75	20,051.00	21,078.77	22,575.12	23,377.42	24,119.46	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2008 - 2013	21,760.92
Khan et al.	2019	United States of America	2014	2016	47,007.67	48,402.58	49,825.50	51,556.17	53,061.24	54,992.73	56,770.40	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2015	51,659.47
Kobe et al.	2018	Multiple (Switzerland, Germany)	Sep-11	Nov-14	-	-	-	-	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2006 - 2013	-
Koyama et al.	2018	Japan	Nov-16	Dec-17	35,775.30	37,087.62	38,559.41	39,502.34	40,458.24	41,155.25	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2011 - 2016	38,756.36
Kusunose et al.	2018	Japan	Dec-15	Jul-16	35,148.79	35,775.30	37,087.62	38,559.41	39,502.34	40,458.24	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2010 - 2015	37,755.28
Lee et al.	2018	United States of America	Jan-14	Aug-15	47,007.67	48,402.58	49,825.50	51,556.17	53,061.24	54,992.73	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009-2014	50,807.65
Le Maguet et al.	2014	France	Nov-11	May-12	35,063.47	36,642.44	37,245.65	36,258.21	37,217.31	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2006 - 2010	36,485.42
Lin et al.	2017	Australia	Jul-14	Jan-15	40,852.40	41,729.04	43,098.68	44,820.00	45,841.71	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	43,268.36
Llao et al.	2018	Spain	Mar-16	Sep-16	32,467.68	32,100.45	32,225.56	33,386.99	35,009.46	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2011 - 2015	33,038.03
Ma et al.	2013	The Peoples Republic of China	Oct-09	Sep-10	4,438.58	5,064.09	5,849.00	6,823.65	7,585.54	8,306.03	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2004 - 2009	6,344.48
Madni et al.	2017	United States of America	Apr-09	Dec-14	41,629.86	44,025.56	46,213.51	47,869.24	48,283.41	47,007.67	48,402.58	49,825.50	51,556.17	53,061.24	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2004 - 2013	47,787.47

Martin et al.	2018	Spain	Mar-14	Jul-14	32,001.47	32,243.64	32,467.68	32,100.45	32,225.56	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	32,207.76
Mason et al.	2018	United Kingdom	Nov-16	Jul-17	37,221.67	38,230.85	39,449.31	41,066.00	42,145.49	43,013.11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2011 - 2016	40,187.74
Maxwell et al.	2018	United States of America	Oct-13	Mar-14	48,283.41	47,007.67	48,402.58	49,825.50	51,556.17	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2008 - 2012	49,015.07
McGuckin et al.	2018	United Kingdom	Jun-12	Jan-13	36,704.89	36,984.75	35,433.71	36,170.12	37,221.67	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2007 - 2011	36,503.03
McIsaac et al.	2018	Canada	Apr-02	Mar-15	25,442.38	26,504.27	28,048.19	29,884.28	30,760.91	31,843.48	32,711.04	34,305.36	36,163.55	37,857.22	39,294.26	40,034.73	38,713.59	39,926.15	41,625.95	42,715.71	44,009.22	1997 - 2013	35,284.72
Morton et al.	2018	United Kingdom	Jun-17	Jul-17	38,230.85	39,449.31	41,066.00	42,145.49	43,013.11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2012 - 2016	40,780.95
Muessig et al.	2018	Germany	Oct-16	Feb-17	43,248.92	44,299.70	45,224.52	46,887.76	47,678.02	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2011 - 2015	45,467.78
Muller et al.	2017	Switzerland	Mar-16	Jun-16	54,772.44	55,782.38	57,224.36	59,014.18	59,682.20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2011 - 2015	57,295.11
Myint et al.	2018	United Kingdom	May-13	Jun-14	35,433.71	36,170.12	37,221.67	38,230.85	39,449.31	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2008 - 2012	37,301.13
Nolan et al.	2016	Ireland	Aug-13	Jan-14	43,889.57	41,700.89	42,782.25	45,117.39	45,869.30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2008 - 2012	43,871.88
Nygen et al.	2016	Australia	Oct-12	Jan-14	39,553.98	40,516.04	40,852.40	41,729.04	43,098.68	44,820.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2007 - 2012	41,761.69
Oliveria et al.	2013	Brazil	Nov-10	Nov-10	11,069.89	11,724.75	12,636.31	13,398.64	13,347.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2005 - 2009	12,435.32
Ozturk et al.	2017	Turkey	Mar-15	Oct-15	16,895.68	18,908.81	19,953.47	21,728.48	22,975.43	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2010 - 2014	20,092.37
Papageorgiou et al.	2018	Greece	Jun-16	May-17	26,850.25	25,452.12	25,247.68	26,097.96	26,427.98	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2011 - 2015	26,015.20
Papakonstantinou et al.	2018	Greece	Jun-15	Jun-16	28,954.81	26,850.25	25,452.12	25,247.68	26,097.96	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2010 - 2014	26,520.56
Parmar et al.	2019	United Kingdom	Mar-17	Jun-17	38,230.85	39,449.31	41,066.00	42,145.49	43,013.11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2012 - 2016	40,780.95
Pasqualetti et al.	2018	Italy	May-15	Dec-16	34,758.95	35,544.01	35,078.13	34,878.35	35,419.22	36,121.08	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2010-2015	35,299.96
Patel et al.	2018	Australia	2009	2016	34,432.55	36,049.25	37,602.35	39,553.98	40,516.04	40,852.40	41,729.04	43,098.68	44,820.00	45,841.71	47,248.22	48,226.31	N/A	N/A	N/A	N/A	N/A	2004 - 2015	41,664.21
Peel et al.	2017	Australia	Jun-12	Jun-13	39,553.98	40,516.04	40,852.40	41,729.04	43,098.68	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2007 - 2011	41,150.03
Pelavski et al.	2017	Spain	Oct-11	Oct-15	31,341.49	32,750.30	33,211.50	32,001.47	32,243.64	32,467.68	32,100.45	32,225.56	33,386.99	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2006 - 2014	32,414.34
Perera et al.	2009	Australia	Apr-07	Jul-07	31,437.36	32,508.68	34,432.55	36,049.25	37,602.35	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2002 - 2006	34,406.04
Pollack et al.	2017	United States of America	Feb-12	Feb-16	47,869.24	48,283.41	47,007.67	48,402.58	49,825.50	51,556.17	53,061.24	54,992.73	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2007 - 2014	50,124.82
Poudel et al.	2016	Australia	May-05	Jul-10	29,020.02	30,042.58	31,437.36	32,508.68	34,432.55	36,049.25	37,602.35	39,553.98	40,516.04	40,852.40	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2000 - 2009	35,201.52
Purser et al.	2006	United States of America	May-03	Feb-04	32,833.67	34,494.54	36,317.74	37,101.10	37,971.28	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1998 - 2002	35,743.67
Ritt et al.	2015	Germany	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rose et al.	2014	Australia	May-12	Jun-12	39,553.98	40,516.04	40,852.40	41,729.04	43,098.68	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2007 - 2011	41,150.03
Sanchez et al.	2011	Spain	Feb-08	Mar-08	27,093.82	28,259.60	29,668.55	31,341.49	32,750.30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2003 - 2007	29,822.75
Sanchis et al.	2015	Spain	Oct-10	Feb-12	29,668.55	31,341.49	32,750.30	33,211.50	32,001.47	32,243.64	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2005 - 2010	31,869.49
Sikder et al.	2018	Canada	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sundermann et al.	2014	Germany	Sep-08	Mar-10	31,995.54	33,123.68	34,506.10	37,004.53	39,365.03	40,572.35	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2003 - 2008	36,094.54
Thai et al.	2015	Australia	Jul-14	Oct-14	40,852.40	41,729.04	43,098.68	44,820.00	45,841.71	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	43,268.36
Ticinesi et al.	2016	Italy	Jan-15	Oct-15	34,758.95	35,544.01	35,078.13	34,878.35	35,419.22	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2010 - 2014	35,135.73
Timmons et al.	2015	Ireland	May-12	Feb-13	45,754.96	43,889.57	41,700.89	42,782.25	45,117.39	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2007 - 2011	43,849.01
Valentini et al.	2018	Italy	Mar-14	Mar-15	33,935.38	34,758.95	35,544.01	35,078.13	34,878.35	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	34,838.96
Vidan et al.	2014	Spain	May-09	May-11	28,259.60	29,668.55	31,341.49	32,750.30	33,211.50	32,001.47	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2004 - 2009	31,205.49
Wallis et al.	2018	United Kingdom	Aug-13	Jul-14	36,984.75	35,433.71	36,170.12	37,221.67	38,230.85	39,449.31	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2008 - 2013	37,248.40
Wou et al.	2013	United Kingdom	Jan-09	Nov-10	31,727.77	33,487.50	35,139.28	36,704.89	36,984.75	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2004 - 2008	34,808.84

Data extraction form Part 4:

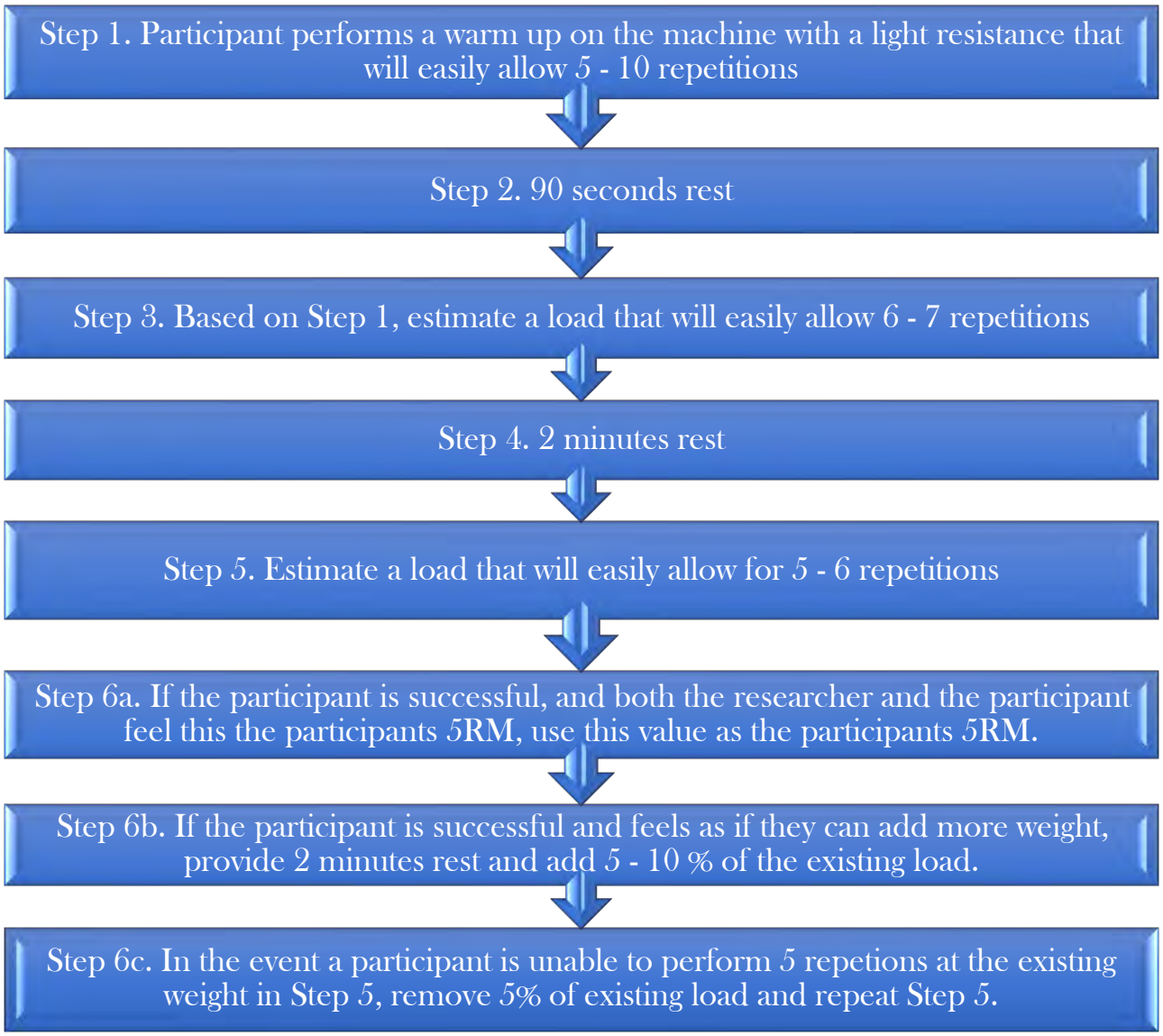
Study details					5-year average healthcare expenditure per capita price purchasing parity (PPP) (current international $) (years preceding the study*) (World Health Organisation data)																
Author	Year of Publication	Country / location	Recruitment start date	Recruitment end date	Year 5	Year 4	Year 3	Year 2	Year 1	Additional Year 1	Additional Year 2	Additional Year 3	Additional Year 4	Additional Year 5	Additional Year 6	Additional Year 7	Additional Year 8	Additional Year 9	Additional Year 10	Additional Year 11	Additional Year 12	Years	5-year average healthcare expenditure per capita PPP (current international $) (years preceding the study*) (World Health Organisation data)
Alonso Salinas et al.	2018	Spain	Oct-13	Dec-15	2,791.11	2,918.82	2,888.51	2,920.11	2,900.34	2,935.83	3,039.96	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2008 - 2014	2,913.53
Amblas-Novellas et al.	2018	Spain	Jan-14	Dec-14	2,918.82	2,888.51	2,920.11	2,900.34	2,935.83	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009-2013	2,912.72
Andela et al.	2010	Netherlands	2009	2009	3,023.33	3,457.75	3,730.90	4,021.30	4,370.68	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2004 - 2008	3,720.79
Andrew et al.	2017	Canada	Nov-11	May-12	3,491.38	3,652.67	3,794.13	4,082.16	4,204.98	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2005 - 2010	3,845.07
Attinsano et al.	2017	Italy	Jan-16	Dec-16	3,211.96	3,253.37	3,264.29	3,250.85	3,288.75	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2011 - 2015	3,253.84
Baldwin et al.	2014	United States of America	Feb-12	Jul-12	7,175.47	7,420.26	7,698.90	7,957.73	8,165.46	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2007 - 2011	7,683.56
Blanco et al.	2017	France	May-14	Jul-15	3,926.01	4,046.63	4,216.57	4,286.78	4,545.62	4,676	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2014	4,282.95
Bo et al.	2015	Italy	Jan-14	Apr-14	3,102.58	3,142.17	3,211.96	3,253.37	3,264.29	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	3,194.87
Bo et al.	2016	Italy	Jan-12	Apr-12	2,784.82	3,040.12	3,102.58	3,142.17	3,211.96	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2007 - 2011	3,056.33
Cheung et al.	2016	Australia	Mar-14	Jul-14	3,555.07	3,596.38	3,770.50	3,792.07	4,179.09	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	3,778.62
Chew et al.	2017	Singapore	Dec-10	Aug-12	1,594.68	1,689.92	1,783.06	2,036.47	2,107.02	2,278.87	2,380.78	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2005 - 2011	1,981.54
Chia et al.	2016	Singapore	Jan-07	Dec-14	1,447.65	1,610.34	1,540.51	1,594.68	1,689.92	1,783.06	2,036.47	2,107.02	2,278.87	2,380.78	2,629.38	3,045.21	N/A	N/A	N/A	N/A	N/A	2002 - 2013	2,011.99
Coleman et al.	2012	Ireland	Sep-09	Dec-09	2,823.63	3,128.89	3,373.35	3,697.23	4,059.45	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2004 - 2008	3,416.51
Chong et al.	2017	Singapore	Nov-15	Dec-15	2,278.87	2,380.78	2,629.38	3,045.21	3,326.29	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2010 - 2014	2,732.11
Courtney-Brooks et al.	2012	United States of America	Mar-11	Dec-11	6,819.39	7,175.47	7,420.26	7,698.90	7,957.73	8,165.46	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2006 - 2010	7,539.53
Crozier-Shaw et al.	2018	Ireland	Jan-12	Dec-16	3,697.23	4,059.45	4,377.58	4,562.29	4,845.09	5,006.70	4,966.17	4,960.70	5,132.81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2007 - 2015	4,623.11
Dal Moro et al.	2017	Italy	Jan-14	Apr-15	3,102.58	3,142.17	3,211.96	3,253.37	3,264.29	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	3,194.87
Dent et al.	2014	Australia	Oct-10	Dec-11	2,833.42	3,007.78	3,177.69	3,295.70	3,555.07	3,596.38	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2005 - 2010	3,244.34
Dorner et al.	2014	Germany	Jun-11	Oct-11	3,460.89	3,630.84	3,856.74	4,119.80	4,315.04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2006 - 2010	3,876.66
Drudi et al.	2018	Multiple (United States of America, Canada, France)	Nov-11	Apr-16	-	-	-	-	-	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2006 - 2014	-
Dutzi et al.	2017	Germany	Feb-11	Dec-11	3,460.89	3,630.84	3,856.74	4,119.80	4,315.04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2006 - 2010	3,876.66
Eamer et al.	2018	Canada	Jan-14	Sep-15	4,082.16	4,204.98	4,228.14	4,297.28	4,455.62	4,529.36	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2014	4,299.59
Eeles et al.	2012	Australia	Jan-01	Jun-01	-	-	-	-	2,147.54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1996 - 2000	-
Ekerstad et al.	2011	Sweden	Oct-09	Jun-10	2,012.97	2,144.08	2,411.13	2,579.31	2,791.11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2004 - 2008	2,387.72
Engelhardt et al.	2018	United States of America	Oct-16	Dec-16	8,165.46	8,438.34	8,638.82	9,053.43	9,524.35	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2011 - 2015	8,764.08
Ferrero et al.	2017	Italy	2006	2014	2,172.37	2,263.52	2,291.60	2,419.90	2,516.80	2,739.30	2,784.82	3,040.12	3,102.58	3,142.17	3,211.96	3,253.37	3,264.29	3,250.85	N/A	N/A	N/A	2001 - 2014	2,818.12
Ga et al.	2018	South Korea	Mar-11	Feb-17	1,339.81	1,497.73	1,629.59	1,729.95	1,895.75	1,975.7	2,076.4	2,156.6	2,307.2	2,502.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2006 - 2015	1,911.10
Gleason et al.	2017	United States of America	Aug-15	May-16	7,957.73	8,165.46	8,438.34	8,638.82	9,053.43	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2010 - 2014	8,450.76
Goldforb et al.	2018	Multiple (Canada, United States of America, France) - Emailed authors for individual breakdown of frailty status per country	2012	2017	-	-	-	-	-	-	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2007 - 2016	-

Guidet et al.	2018	Multiple (Ireland, Great Britain, Portugal, Spain, France, Belgium, Denmark, Norway, Switzerland, Netherlands, Sweden, Russia, Germany, Austria, Poland, Czech Republic, Italy, Ukraine, Romania, Greece, Cyprus)	Oct-16	Feb-17	-	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2011 - 2015	-
Gullon et al.	2017	Spain	Oct-14	May-15	2,918.82	2,888.51	2,920.11	2,900.34	2,935.83	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	2,912.72
Hartley et al.	2017	United Kingdom	Dec-14	May-15	2,960.60	3,052.57	3,094.73	3,154.48	3,854.73	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	3,223.42
Heppenstall et al.	2011	New Zealand	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hewitt et al.	2015	United Kingdom	May-13	Jun-13	2,795.59	2,960.60	3,052.57	3,094.73	3,154.48	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2008 - 2012	3,011.59
Hewitt et al.	2016	United Kingdom	Jul-14	Oct-14	2,960.60	3,052.57	3,094.73	3,154.48	3,854.73	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	3,223.42
Hii et al.	2015	New Zealand	Feb-14	Mar-14	2,940.25	2,984.61	3,088.92	3,141.44	3,335.74	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	3,098.19
Hilmer et al.	2009	Australia	Apr-07	Sep-07	2,428.97	2,548.36	2,747.12	2,833.42	3,007.78	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2003 - 2006	2,713.13
Ibrahim et al.	2019	United Kingdom	Mar-14	Mar-16	2,960.60	3,052.57	3,094.73	3,154.48	3,854.73	3,974.45	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2014	3,348.59
Induruwa et al.	2017	United Kingdom	Jan-14	Mar-14	2,960.60	3,052.57	3,094.73	3,154.48	3,854.73	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	3,223.42
Jacobs et al.	2017	Netherlands	Jun-14	Dec-14	4,519.98	4,645.03	4,857.29	5,100.30	5,311.22	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	4,886.76
Jokar et al.	2016	United States of America	2013	2014	7,420.26	7,698.90	7,957.73	8,165.46	8,438.34	8,638.82	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2008 - 2013	8,053.25
Joosten et al.	2014	Belgium	Jan-10	Nov-10	2,998.06	3,147.55	3,289.83	3,550.15	3,814.10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2005 - 2009	3,359.94
Joseph et al.	2014	United States of America	Jun-11	Feb-13	6,819.39	7,175.47	7,420.26	7,698.90	7,957.73	8,165.46	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2006 - 2011	7,539.53
Joseph et al.	2016	United States of America	2013	2014	7,420.26	7,698.90	7,957.73	8,165.46	8,438.34	8,638.82	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2008 - 2014	8,053.25
Juma et al.	2016	Canada	Apr-13	Feb-14	3,794.13	4,082.16	4,204.98	4,228.14	4,297.28	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2008 - 2012	4,121.34
Kang et al.	2015	China	Dec-14	May-15	2,940.25	2,984.61	3,088.92	3,141.44	3,335.74	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	3,098.19
Karlekar et al.	2017	United States of America	Mar-15	May-15	7,957.73	8,165.46	8,438.34	8,638.82	9,053.43	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2014	8,450.76
Keevil et al.	2018	United Kingdom	Oct-14	Nov-16	2,960.60	3,052.57	3,094.73	3,154.48	3,854.73	3,974.45	4,087.73	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2015	3,454.18
Kenig et al.	2015	Poland	Jan-13	Jul-14	1,167.31	1,268.03	1,353.13	1,424.49	1,477.89	1,575.05	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2008 - 2013	1,377.65
Khan et al.	2019	United States of America	2014	2016	7,698.90	7,957.73	8,165.46	8,438.34	8,638.82	9,053.43	9,524.35	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2015	8,496.72
Kobe et al.	2018	Multiple (Switzerland, Germany)	Sep-11	Nov-14	-	-	-	-	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2006 - 2013	-
Koyama et al.	2018	Japan	Nov-16	Dec-17	3,778.23	3,988.28	4,177.48	4,214.54	4,397.89	4,592.43	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2011 - 2016	4,191.47
Kusunose et al.	2018	Japan	Dec-15	Jul-16	3,192.89	3,778.23	3,988.28	4,177.48	4,214.54	4,397.89	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2010 - 2015	3,958.22
Lee et al.	2018	United States of America	Jan-14	Aug-15	7,698.90	7,957.73	8,165.46	8,438.34	8,638.82	9,053.43	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009-2014	8,325.45
Le Maguet et al.	2014	France	Nov-11	May-12	3,380.54	3,526.14	3,696.24	3,926.01	4,046.63	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2006 - 2010	3,715.11
Lin et al.	2017	Australia	Jul-14	Jan-15	3,555.07	3,596.38	3,770.50	3,792.07	4,179.09	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	3,778.62
Llao et al.	2018	Spain	Mar-16	Sep-16	2,920.11	2,900.34	2,935.83	3,039.96	3,175.13	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2011 - 2015	2,994.28
Ma et al.	2013	The Peoples Republic of China	Oct-09	Sep-10	188.11	210.17	229.24	248.92	292.06	357.18	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2004 - 2009	254.28
Madni et al.	2017	United States of America	Apr-09	Dec-14	6,099.51	6,451.47	6,819.39	7,175.47	7,420.26	7,698.90	7,957.73	8,165.46	8,438.34	8,638.82	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2004 - 2013	7,486.54
Martin et al.	2018	Spain	Mar-14	Jul-14	2,918.82	2,888.51	2,920.11	2,900.34	2,935.83	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	2,912.72
Mason et al.	2018	United Kingdom	Nov-16	Jul-17	3,094.73	3,154.48	3,854.73	3,974.45	4,087.73	4,177.82	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2011 - 2016	3,723.99
Maxwell et al.	2018	United States of America	Oct-13	Mar-14	7,420.26	7,698.90	7,957.73	8,165.46	8,438.34	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2008 - 2002	7,936.14
McGuckin et al.	2018	United Kingdom	Jun-12	Jan-13	2,633.36	2,795.59	2,960.60	3,052.57	3,094.73	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2007 - 2011	2,907.37
McIsaac et al.	2018	Canada	Apr-02	Mar-15	-	-	-	2,417.96	2,607.78	2,745.74	2,915.23	3,075.14	3,277.82	3,491.38	3,652.67	3,794.13	4,082.16	4,204.98	4,228.14	4,297.28	4,455.62	1997 - 2013	-

Morton et al.	2018	United Kingdom	Jun-17	Jul-17	3,154.48	3,854.73	3,974.45	4,087.73	4,177.82	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2011 - 2016	3,849.84
Muessig et al.	2018	Germany	Oct-16	Feb-17	4,577.56	4,696.40	4,944.61	5,173.84	5,328.90	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2011 - 2015	4,944.26
Muller et al.	2017	Switzerland	Mar-16	Jun-16	4,577.56	4,696.40	4,944.61	5,173.84	5,328.90	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2011 - 2015	4,944.26
Myint et al.	2018	United Kingdom	May-13	Jun-14	2,795.59	2,960.60	3,052.57	3,094.73	3,154.48	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2008 - 2012	3,011.59
Nolan et al.	2016	Ireland	Aug-13	Jan-14	4,059.45	4,377.58	4,562.29	4,845.09	5,006.70	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2008 - 2012	4,570.22
Nygen et al.	2016	Australia	Oct-12	Jan-14	3,177.69	3,295.70	3,555.07	3,596.38	3,770.50	3,792.07	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2007 - 2012	3,531.23
Oliveria et al.	2013	Brazil	Nov-10	Nov-10	902.62	966.80	1,034.28	1,075.83	1,115.30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2005 - 2009	1,018.97
Ozturk et al.	2017	Turkey	Mar-15	Oct-15	881.50	921.68	924.22	982.58	1,044.64	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2010 - 2014	950.92
Papageorgiou et al.	2018	Greece	Jun-16	May-17	2,374.41	2,237.59	2,188.33	2,126.94	2,180.17	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2011 - 2015	2,221.49
Papakonstantinou et al.	2018	Greece	Jun-15	Jun-16	2,694.12	2,374.41	2,237.59	2,188.33	2,126.94	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2010 - 2014	2,324.28
Parmar et al.	2019	United Kingdom	Mar-17	Jun-17	3,154.48	3,854.73	3,974.45	4,087.73	4,177.82	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2012 - 2016	3,849.84
Pasqualetti et al.	2018	Italy	May-15	Dec-16	3,142.17	3,211.96	3,253.37	3,264.29	3,250.85	3,288.75	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2010-2015	3,235.23
Patel et al.	2018	Australia	2009	2016	2,747.12	2,833.42	3,007.78	3,177.69	3,295.70	3,555.07	3,596.38	3,770.50	3,792.07	4,179.09	4,305.78	4,423.48	N/A	N/A	N/A	N/A	N/A	2004 - 2016	3,557.01
Peel et al.	2017	Australia	Jun-12	Jun-13	3,177.69	3,295.70	3,555.07	3,596.38	3,770.50	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2007 - 2011	3,479.07
Pelavski et al.	2017	Spain	Oct-11	Oct-15	2,411.13	2,579.31	2,791.11	2,918.82	2,888.51	2,920.11	2,900.34	2,935.83	3,039.96	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2006 - 2014	2,820.57
Perera et al.	2009	Australia	Apr-07	Jul-07	2,428.97	2,548.36	2,747.12	2,833.42	3,007.78	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2001 - 2006	2,713.13
Pollack et al.	2017	United States of America	Feb-12	Feb-16	7,175.47	7,420.26	7,698.90	7,957.73	8,165.46	8,438.34	8,638.82	9,053.43	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2007 - 2014	8,068.55
Poudel et al.	2016	Australia	May-05	Jul-10	2,147.54	2,269.46	2,428.97	2,548.36	2,747.12	2,833.42	3,007.78	3,177.69	3,295.70	3,555.07	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2000 - 2009	2,801.11
Purser et al.	2006	United States of America	May-03	Feb-04	-	-	4,559.89	4,910.55	5,328.07	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1998 - 2002	-
Ritt et al.	2015	Germany	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rose et al.	2014	Australia	May-12	Jun-12	3,177.69	3,295.70	3,555.07	3,596.38	3,770.50	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2007 - 2011	3,479.07
Sanchez et al.	2011	Spain	Feb-08	Mar-08	1,902.86	2,012.97	2,144.08	2,411.13	2,579.31	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2003 - 2007	2,210.07
Sanchis et al.	2015	Spain	Oct-10	Feb-12	2,144.08	2,411.13	2,579.31	2,791.11	2,918.82	2,888.51	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2005 - 2010	2,622.16
Sikder et al.	2018	Canada	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sundermann et al.	2014	Germany	Sep-08	Mar-10	3,098.19	3,166.23	3,267.63	3,460.89	3,630.84	3,856.74	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2003 - 2008	3,413.42
Thai et al.	2015	Australia	Jul-14	Oct-14	3,555.07	3,596.38	3,770.50	3,792.07	4,179.09	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	3,778.62
Ticinesi et al.	2016	Italy	Jan-15	Oct-15	3,142.17	3,211.96	3,253.37	3,264.29	3,250.85	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2010 - 2014	3,224.53
Timmons et al.	2015	Ireland	May-12	Feb-13	3,697.23	4,059.45	4,377.58	4,562.29	4,845.09	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2007 - 2011	4,308.33
Valentini et al.	2018	Italy	Mar-14	Mar-15	3,102.58	3,142.17	3,211.96	3,253.37	3,264.29	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2009 - 2013	3,194.87
Vidan et al.	2014	Spain	May-09	May-11	2,012.97	2,144.08	2,411.13	2,579.31	2,791.11	2,918.82	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2004 - 2009	2,476.24
Wallis et al.	2018	United Kingdom	Aug-13	Jul-14	2,795.59	2,960.60	3,052.57	3,094.73	3,154.48	3,854.73	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2008 - 2013	3,152.12
Wou et al.	2013	United Kingdom	Jan-09	Nov-10	2,244.64	2,339.62	2,537.41	2,633.36	2,795.59	2,960.60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2004 - 2009	2,585.20

Appendix 3.1. Five-repetition maximum assessment protocol

Leg strength will be assessed by an estimated one repetition maximum (1RM) obtained from participants five repetition maximum (5RM) on the leg press and leg extension machines pre- and post-intervention. The protocol for this assessment can be found below:



Supplementary Material Figure 1: Five repetition maximum (5RM) assessment protocol adapted from (1).

1. Haff, GG, Triplett, NT. Essentials of strength training and conditioning 4th edition. [Internet]. Human kinetics; 2015.

Appendix 4.1. Semi-structured interview transcripts

Interview transcript: Participant 1003 post-intervention interview verbatim

Setting: Side room on the Harborne ward.

Audio commences.

(Audible screams of a female patients on the ward)

(Pause)

Interviewer: Okay. So, this is participant 1003.

(Brief pause)

Interviewer: *(Calm, clear, deliberate vocal tone)*. Alright, *(interviewer uses participants name)*, so, em, well, I suppose we'll just, we'll just get started then with the, with the interview, and I'll, I'll read you the, the script. So, em, thank you for your help thus far with the study. Em, I'm going to ask you some questions related to your participation in, and your opinions about the study. Em, we are very interested in getting your thoughts and opinions on the study, and any feedback you can provide us would be invaluable. Eh, as mentioned previously, this interview will be recorded for future reference, and anything you say will be used in a *(interviewer corrects himself)*, and anything you say may be used in a future publication or report, however your name will not be included. If this is okay with you, whenever you are ready, we will begin.

Participant: Yeah, (that) s'alright.

Interviewer: So, em, okay, so we'll start off, kind of em, quite broad, I suppose. Em, the more information that you can give me, kind of, the better, about how you felt in the study. So, em how would you say that you found the study; what were your general impressions about it, in terms of…

Participant: Well, I think it's good, as far as I can see. (**Interviewer: Mmm-hmm)** Em, and because em, I'm having to do exercises, I'm just hoping that it'll do, do me good (**Interviewer: Mmm-hmm)** basically, but I'm happy with the way I've been treated (**Interviewer: Mmm-hmm)**, yeah.

Interviewer: And how did you find, I suppose, in addition to the exercise portion, how did you find the, the, kind of, the tests, before and after?

Participant: Fine.

Interviewer: Fine, yeah? (Participant: Yeah) **Okay. Em, so, do you think that the study has had an impact on you in any way, in, in your health or how you feel?**

Participant: No, not really, no (**Interviewer: No? Oh okay.)**

Interviewer: Em, and we'll say, for example, if you were, em, in this study, and you had to sign up to do all of the assessments, but you'd be randomised into either the exercise group or another group that didn't do any exercise at all, do you think that would be something that you'd be, you'd still be interested in?

Participant: I don't mind doing the exercise (**Interviewer: Mmm-hmm).** I quite enjoy doing that. **(Interviewer: Yeah? Ah okay, but if you were in the study and the exercise wasn't part of it, do you still think you'd be interested in doing the, the assessments before and after?)**

Participant: Probably not as keen. (**Interviewer: Probably not as keen, yeah, yeah.) **Both laugh.***

Interviewer: Em, so if, if you could, how would you describe, I suppose, your experience in the study, in maybe one sentence?... over the last…

Participant: The experience of doing that? *(Participant points to the room, next to the side room, where the exercise equipment is).*

Interviewer: Em, well, doing the, doing the exercises, but also, I suppose, our testing before and after, you know our questionnaires…

Participant: I think this is important. I think.... nine out of ten.

Interviewer: Nine out of ten? Ah okay. Very good. (brief pause). So, em, what were your opinions about the assessment sessions in the study?

Participant: The assessment?

Interviewer: The assessment, yeah.

Participant: This… doing this? *(Participant taps table, indicating he is referring to the present interview).*

Interviewer: Em, yeah, well, it would have been the things that we're just after finishing that we did two weeks ago as well.

Participant: Oh, fine, fine.

Interviewer: How did you find them? They weren't too burdensome on you, or you thought maybe there was too much of them or they were, they were, okay?

Participant: Yeah, I reckon; they were good.

Interviewer: Em, okay so could you tell me what you thought was the best thing about the study?

Participant: About the best of this? (participant points back in the direction of the ward)

Interviewer: Em, yeah, the best thing about the, the overall study, I suppose.

Participant: The Harborne ward?

Interviewer: Well, mostly your time with…

Participant: Personally, I think the hospital's badly managed (**Interviewer: Oh okay).** I think the nurses have a rough time (**Interviewer: Mmm-hmm)**, having to put up with patients' stupidity. I have complained, a couple of times about the treatment of the nurses, from the patients. I don't think it should be handled (**Interviewer: Mmm-hmm)**. If they'd, one in particular, if he'd have done what he does in here, outside, the police would have gone and took him away (**Interviewer: Mmm-hmm)**, but because he's in there he's a protected species. Shouldn't be (**Interviewer: Yeah, mmm-hmm),** and he upsets everybody else (**Interviewer: Mmm-hmm)**, and I don't think that's right.

Interviewer: Mmm, and you found it, kind of, kind of upsetting yourself, you did yeah? (Participant: Yes, yeah, yeah**) And would you say that, kind of, I suppose, having, having something to do, kind of, changed… (**Participant: Well…**) your, your opinion about it, or changed…**

Participant: … I've made two, ummm, complaints, about one in particular (**Interviewer: Mmm-hmm)**, and he shouts, and he's aggressive at night; and em, one night, eh, a male nurse, *(participant names nurse)*, a very, very good nurse, very kind, him and somebody else was attacking him, and I got up and stood in between em, and I said, 'Leave him alone, he's only trying to look after ya." (**Interviewer: Mmm-hmm)** "Back off." (**Interviewer: Yeah)** and as I went like that *(participant raises his arm)*, I caught him, he went flying back in the.. bed. (**Interviewer: Mmm-hmm)** And I said, 'Now fuck off and leave him alone" (**Interviewer: Mmm-hmm)** and everybody around's going "Ayyyye", but you don't come into hospital, for it to be like that. (**Interviewer: No, definitely not, definitely not.)** Something should be done about people like that. (**Interviewer: Yeah, mmm-hmm)** Because aggression feeds other people's aggression. (**Interviewer: Mmm-hmm)** Before you know it, here you are, you've got

three or four men. (**Interviewer: Yes, exactly. Exactly)** You know, and it's not good. (**Interviewer: Yeah)** Not good.

Interviewer: And would you say that's, that's something kind of, I suppose, stressed out when you were, kind of, on the ward, yeah?

Participant: Yes, that's right, yeah. (**Interviewer: Mmm-hmm)** I mean, there's an Afghanistan man, in there now (**Interviewer: Mmm)**, and when he came in on the first night, he was shouting and screaming, but I thought it was in fear (**Interviewer: Mmm)**. I think he was worried. I don't think he speaks English (**Interviewer: Mmm-hmm)**, and that, one or two men was having a go at him, and I said to him, "Leave him alone, cause he's frightened" (**Interviewer: Mmm-hmm)**. "Leave him, back off, leave him alone" (**Interviewer: Yeah)** and they did, and he went quiet. (**Interviewer: Mmm-hmm)** I felt as if I did the right thing. (**Interviewer: Yeah, mmm)** I think he was frightened.

Interviewer: Yeah, well, well he could have well been, yeah, not being able to communicate as well, yeah.

Participant: He can't speak English, he's in a foreign country, in a foreign hospital, he doesn't know what to expect. (**Interviewer: No, yeah, exactly.)** The only thing you have to watch with him, when he grabs your hand, he tries to bite your hand. (**Interviewer: Oh okay)**

Participant: So, eh, nurses know that (**Interviewer: Mmm-hmm)**, and when he's trying to do it, the male nurse, *(participant names nurse)*, ought to say "Don't do that, (be)cause he tries to bite your hand" and tell you (**Interviewer: Yeah)**, but I've said to him many, one or two times "Be a good lad, they're looking after you" and he goes "Ruh ruh ruh". I'm sure he don't understand a word (**Interviewer: Mmm-hmm)**, but he needs somebody, if possible, who can understand his language (**Interviewer: Yeah, an interpreter yeah)** to speak to him (**Interviewer: yeah)**, but I have seen two women there (**Interviewer: Mmm)**, and when I see them, I thought, oh, I'll go and say hello and ask them if they speak English. If one of them can (**Interviewer: Mmm-hmm)**, ask them to talk to him, (**Interviewer: Yeah, mmm)** but that's what the nurses ought to be doing.

Interviewer: Mmm-hmm, and is there anything else, kind of, on, on top of that, I suppose? Obviously, the ward, there's some, I suppose, behavioural issues with, with some of the patients. Em, is there anything else that you kind of, you found, kind of, unnerving or, or, or anything like that while you were on the ward, yeah?

Participant: Oh, yes, it can. It can be unnerving. (**Interviewer: Mmm-hmm)** You're frightened to go to sleep in case one of them, does something silly, you know (**Interviewer: Mmm-hmm yeah)** because the one in particular that I have complained about him, and he knows, and the nurse will say, "Oh, it's his condition", but if he's that bad, and he's dangerous, he shouldn't be amongst other patients. (**Interviewer: Mmm-hmm, yeah).** That's just my opinion.

Interviewer: Mmm-hmm, and do you think that, I suppose, did being on, I suppose, this study and doing these exercises, did that, kind of, have any effect on you in terms of the other stuff? Did it maybe take your mind off of it or anything like that?

Participant: No, not really. I think, em, like I've said to you before, I'm finding myself having a lot more patience than, than I have done (**Interviewer: Mmm-hmm)**, you know, and at one time, I used to be aggressive, but I'm not now (**Interviewer: Mmm-hmm)**, and I look on people and see, like him, I just saw him and I thought the fear is in his eyes (**Interviewer: Mmm-hmm)**, you know. I believe that you can tell a lot of things from people with their eyes. (**Interviewer: Yeah, definitely, yeah)** Like dogs, I've got two dogs. (**Interviewer: Mmm-hmm)** A dog, if it's got fierce eyes (**Interviewer: Yeah, yeah, yeah)**, be careful. (**Interviewer: Mmm-hmm)** If they've got nice, soft eyes, they're alright (**Interviewer: Yeah, yeah)**, and I think people are the same.

Interviewer: Mmm-hmm, yeah, I think so too. I think there's something, something about the eyes (Participant: Yeah, yeah), the window to the soul or something (Participant; Yeah yeah), yeah, definitely. Definitely. Em, so, what did you, kind of, think was the worst thing about the study itself, as opposed to the ward? Was there anything that you particularly didn't like or wish that could be done better, I suppose, in the future?

Participant: Ehhh, I don't know the answer to that. I think the hospital itself isn't managed so well as Worcester hospital. (**Interviewer: Mmm-hmm)** Em, some of the nurses like their job, others don't, (**Interviewer: Yeah)** and they show it. (**Interviewer: Yeah, you can tell, yeah.)** And that's not good, not for them, or us. (**Interviewer: Yeah, mmm-hmm, exactly)** Em, and I think whoever manages these places, they should be going to somewhere to be retrained (**Interviewer: Mmm-hmm)** on management courses.

Interviewer: Yeah, or even perhaps maybe talking to the patients (Participant: Yeah) and seeing, and seeing, getting their opinion on it, yeah.

Participant: Yeah, definitely. (**Interviewer: Mmm-hmm)** Definitely.

Interviewer: Em, so, I suppose in hindsight, now that you're, kind of, you're through the, all the exercises and all the assessments, if you were to go back three weeks ago, eh, when I first came to you, do you think it would still be something that you'd, you'd, em, sign your name to participate in, or…

Participant: Mmm-hmm.

Interviewer: Yeah?

Participant: Yes.

Interviewer: Okay. Em, so, if you were to be kind of designing, I suppose, the study, so where we come in and we do some assessments, and then we try and see how much

exercise we can get in in two weeks, and then some assessments afterwards, is there anything that, that you would include in that, that perhaps you, you thought, at any stage, "Oh, it would be nice if we perhaps had this or had that as well"?

Participant: Hmmm… I don't know.

Interviewer: You take, you can take a moment to think there, maybe. (Participant: Hmmm?**) You can take a moment to think there, if you want, it's a hard thing to answer on the spot.**

Participant: I don't quite understand what you've said.

Interviewer: So, em, I suppose, if you were designing the study, that you just did…

Participant: Designing a study?

Interviewer: Designing it, yeah. Em, is there anything that you'd, kind of, add to it or take away to make it, kind of, more enjoyable for yourself?

Participant: Em… I think, err, activities could help, you know, a bit of em, exercising in the ward, eh…

Interviewer: Mmm-hmm, kind of in groups, maybe, as opposed to (Participant: Yeah, yeah**), by yourself?**

Participant: Yeah, because a friend of mine, who's, who was *(participant names his ex-girlfriend)*'s husband (**Interviewer: Mmm-hmm)**, he used to sit in a chair, play music and do exer-, simple exercise (**Interviewer: Yeah, yeah, yeah)** with it you know (**Interviewer: Yeah)**. I think that can help (**Interviewer: Mmm)**, because if they're lying there, bored stiff (**Interviewer: Yeah)**, they get them out, get them in their chairs (**Interviewer: Exactly)**, and you're doing this, you know. (**Interviewer: Yeah, and it encourages everybody else…)** Yeah **(kind of, to come into…)**

Participant: And you find, then, people gather. (**Interviewer: Mmm-hmm)** Perhaps come out of other wards. Girls, women will like it (**Interviewer: Yeah, yeah)**, you know, and I think there's, something set-up, like.

Interviewer: And then the men'll see the women, and then they'll want to get involved too (Participant: Yeah) **yeah **Both laugh.***

Participant: Yeah, and I think the women ought to be protected from men, (**Interviewer: Mmm-hmm)** because them dirty old buggers, most of them in there (**Interviewer: Okay, yeah)**, you know, and I don't like the way they go on. The one, *(participant names another patient)*, he goes like this, he's got his hand going up there (**Interviewer: Oh right, yeah)**, and I think, "You dirty bastard" (**Interviewer: Yeah, yeah)** and the nurses shouldn't have to put up with that. (**Interviewer: No, no, definitely not)** You know. It ain't nice (**Interviewer: Mmm-**

hmm)… and I think men of their age shouldn't be thinking like that (**Interviewer: No)** but they do.

Interviewer: Yeah, but they do, yeah. Em, so, do you think that there's em, well, what would you say are the benefits that you've gotten from being in the study, and doing these assessments, and doing the exercise. As opposed to if you just, you were just in here for the last three weeks and didn't have any of that?... So, do you think that there's any benefits that you could see yourself…

Participant: I think it's helped a lot, getting me out of that room (**Interviewer: Mmm-hmm)**, doing exercises, and em, being helped to do them; proving to you that it's things you can do (**Interviewer: Mmm-hmm)**, you know, where you'd think "Oh, I don't know whether I can do that" (**Interviewer: Yeah)** but I know now I can, (**Interviewer: Mmm-hmm)**. That helps your confidence.

Interviewer: Yeah, so you think maybe someone there beside you, kind of (Participant: Yeah), encouraging you is…

Participant: Yeah, that's right, yeah. (**Interviewer: Mmm-hmm)** Yeah, and you feel comfortable, because you know, the person you're with, you know, you know what you're doing (**Interviewer: Mmm-hmm)**, and if I was in trouble, you're there. (**Interviewer: Yeah)**

Interviewer: Em, so, do you, do you think that there's any way that participation in the study has been kind of detrimental to you? I know you've said that your back is kind of at you. Maybe now, I don't know if you think that was maybe kind of caused by the…

Participant: I mean, it's burning there now.

Interviewer: Mmm-hmm, and you think that's, that's kind of, caused by the machines, or was it something maybe that existed before?

Participant: I don't know.

Interviewer: You're not sure?

Participant: Might be. The left side, always been a problem (**Interviewer: Mmm-hmm)**, but like, standing, with your feet together (**Interviewer: Mmm-hmm)** can be a problem, with, definitely when I put one foot in the other, is a problem.

Interviewer: Yeah, yeah, we kind of saw that on the balance test (Participant: Yeah**), yeah.**

Participant: So, I can be walking, and maybe pop up the right foot in front of that one (**Interviewer: Mmm-hmm)** to go left. That's probably where I fall. (**Interviewer: Yeah)** That's where I lose-, that's where I realise then (**Interviewer: Mmm-hmm)**, could be where I'm losing my balance (**Interviewer: Yeah, ah I'd say it is, and you would say that that's been worse after the exercises, or would you say that it was, kind of, the same as before?**

Participant: About the same, about the same.

Interviewer: About the same as before? Okay. Em-,

Participant: Like I said, I like gardening (**Interviewer: Yeah, you really were saying that yeah, and then)**, and I like digging hole to put a plant in it (**Interviewer: Mmm)**. Bumped me head here, (**Interviewer: Yeah, mmm-hmm)** and, that's one of the reasons *(participant names ex-girlfriend)* don't want me back home, because when I do things, it upsets her (**Interviewer: Mmm-hmm)**, and she's got to try and get me up (**Interviewer: Mmm-hmm)**, you know and it's horrible for her.

Interviewer: Yeah.

Participant: I can understand her, to some extent.

Interviewer: So, you think she's, kind of, I suppose, worried that something bad will happen (Participant: Yeah**) and she won't be able to help?**

Participant: That's right, I do. I do.

Interviewer: So, em, I suppose just, kind of, to wrap it up really, em, if you could describe to me, kind of, what you think about the study, maybe in a few sentences, if you could describe what the study, well, meant to you, I suppose, and I know it obviously didn't mean…

Participant: How it's made me feel?

Interviewer: How it's made you feel, pretty much, yeah.

Participant: Well, at the moment, the back of my neck's aching (**Interviewer: Mmm-hmm)** Em…

Interviewer: And you think that that's, kind of, caused by the exercises or it's (Participant: Yeah**), yeah.**

Participant: I think it does. I don't normally have that. (**Interviewer: Mmm-hmm)** Em, me shoulders a problem, because-, and it's, like, working its way around my arm, and sometimes, I feel as though I'm losing the use from my arm. (**Interviewer: Mmm-hmm)** I don't think I am, but it feels like it (**Interviewer: Yeah, mmm-hmm)**. Em, I think this has been good for me because it gets me out that room (**Interviewer: Mmm-hmm)**, gives me something else to think about instead of the sadness in me life (**Interviewer: Yeah, mmm-hmm)**, and I've started to feel more confidence in me future, and I've got the back-up of *(participant names one of his children)* who's been amazing (**Interviewer: Mmm-hmm)**, and he's fetching me out of here tomorrow at eleven o'clock (**Interviewer: Yeah)** going to sign some documents. (**Interviewer: Mmm-hmm. Looking forward to that, then yeah?)**

Participant: Yeah, yeah.

Interviewer: And, em, ehhhh… oh I lost, lost my trail of thought there. **Participant laughs* You said something, I was going to pick up on it, and I lost my trail of thought *Both laugh*. Em, so, I think you were-, oh yes, sorry, you were saying, so, kind of, I suppose your back is maybe at you a bit, and your neck, and your shoulder (Participant: Yeah) Em, w**ould you say that the-, that the benefits, I suppose, that you think you've got from the exercise, kind of, outweighs that, or do you think it's a 50-50, or do you think you'd be better off having not done it at all?**

Participant: No, I think it's been good! (**Interviewer: Mmm-hmm)** and I hope I can carry it on, because *(participant names one of his children)* has shown me a gym. (**Interviewer: Yeah, you were saying that actually, yeah)**

Participant: And he said we could go there, £20 a month (**Interviewer: Mmm-hmm)**, which is pretty good.

Interviewer: Yeah, very good, yeah.

Participant: And what I'll do is start doing what I'm doing here (**Interviewer: Mmm-hmm)**, and that's for a-, what do they call them there, em, somebody who looks after you?

Interviewer: I suppose a personal trainer kind of a thing, is that it yeah ?

Participant: Yeah, that's it, yeah (**Interviewer: Mmm-hmm)**, tell him what I've been doing and why (**Interviewer: Yeah)** and ask him to help me.

Interviewer: Yeah, and then he can, kind of, build on that (Participant: Yeah, yeah, build it up**) and get you progressively better (**Participant: That's it**), yeah.**

Participant: But I don't think it's a good idea to go into a gym and I think oh, I'll do that, and I'll do that.

Interviewer: No, so that is-, that is when you hurt yourself, yeah.

Participant: I'd probably be doing more harm than good (**Interviewer: Yeah, yeah)** there would have to be a personal trainer.

Interviewer: Yeah, and would you say that, I suppose, doing these exercises the past two weeks has, kind of, encouraged you more, then, to do that with (Interviewer names one of participants children) (Participant: Yeah**), or you would say that, yeah?**

Participant: Yes, definitely (**Interviewer: Mmm-hmm)**. It's given me more confidence to do it (**Interviewer: Yeah)** yeah.

Interviewer: And you think that, I suppose, your future involvement in exercise, how do you kind of see that in your life, in terms of, I suppose, the benefits that it might give you? For example, I know that you were saying you like to be around people. (Participant; Yeah**) It's when you, kind of, feel (**Participant: Yeah**) feel your best.**

Participant: I do, I love being around people. Em… I'm hoping one day that I can get to a stage where I used to go and get up and sing and get people up dancing and that. That's what I used to do. (**Interviewer: Mmm-hmm)** I'd love-, so now, with the way I… fall over, (**Interviewer: Mmm-hmm)** I ain't got the confidence to do that (**Interviewer: Yeah, mmm-hmm)**. But I'm hoping one day I will.

Interviewer: Yeah, and then, em, you were saying as well that you thought it would be a good idea to try and get everyone on the ward, kind of, involved with one kind of exercise thing, and you mentioned music there as well. Em, I suppose, what are your opinions on, kind of, incorporating music maybe into it?

Participant: Well, some of the music is what older people like (**Interviewer: Mmm-hmm).** It depends who comes to it (**Interviewer: Mmm-hmm)**, but in here, there's a lot of people getting on (**Interviewer: Mmm)**, and they enjoy the older type music.

Interviewer: The older music, yeah.

Participant: Yeah, and they could connect with it.

Interviewer: Yeah, maybe might start a few…

Participant: When the music's playing, they start to do what they you know (**Interviewer: Yeah, yeah)**, you might think, 'Bloody hell,' **Interviewer laughs* but the point is it's giving them exercise.

Interviewer: Yeah, exactly, getting them to do something (Participant: Yeah). **Better than doing nothing, yeah.**

Participant: Yeah.

Interviewer: So, em, well, that's kind of us finished now *(Interviewer names participant)*. So, I suppose, are there any, kind of, closing comments about any of the aspects of the study or the ward itself, or you yourself, that you'd like to, kind of, make, I suppose, you think might be beneficial, beneficial for the record before we finish?

Participant: I mean, *(participant names ex-girlfriend's deceased husband)* when he started it, he used to say to people, "Tell me what music you like" (**Interviewer: Mmm-hmm)** you know, (**Interviewer: Yeah)** and they would, so we could get the music (**Interviewer: Yeah)** play it, and they'd go, 'Oh, I know this one, yeah.'

Interviewer: Mmm-hmm, yeah, yeah, so you think that might be a good thing to, kind of, incorporate into this?

Participant: I do, yeah, (**Interviewer: Yeah)** I do, cause sometimes with older people, them stuck in their ways.

Interviewer: Mmm-hmm.

Participant: And if you played a modern song "Wuh wuh wuh, what's that?" (**Interviewer: Mmm-hmm)** and you might, they might ask to play so and so, and they might think, "Oh, what the bloody hell is that" **Interviewer laughs* but if it does the job, that's the main thing.

Interviewer: Yeah, exactly, yeah, as long as it, kind of, encourages them, I suppose, yeah.

Participant: I mean, *(participant names ex-girlfriend's deceased husband)* used a song called 'Dominic the Donkey' (**Interviewer: Mmm-hmm)**, and, and they used to love that for (**Interviewer: Oh yeah?)**, bloody hell, it was funny, and, when he died *(participant names ex-girlfriend)* bought him a donkey, (**Interviewer: Ah, okay)** and they put the ashes in it.

Interviewer: Ahhh right. And who was *(interviewer names ex-girlfriend's deceased husband)*?

Participant: It was *(participant names ex-girlfriend)'s* husband.

Interviewer: Oh *(Interviewer names participant's ex-girlfriend)'s* husband (Participant: Yeah) **Ah, okay. Very good.**

Participant: Yeah.

Interviewer: And he was kind of into exercise and things like that, he was yeah?

Participant: Only gentle exercise.

Interviewer: Ahhh, okay.

Participant: Just to keep the limbs working, basically.

Interviewer: Yeah, yeah, that was, kind of, as he got, kind of, older in life (Participant: Yeah)**, he got involved in…**

Participant: Also, it gives them something to think about, but you know (**Interviewer: Yeah)**, it's only simple, but it helps (**Interviewer: Yeah, yeah, exactly)**. Definitely helps.

Interviewer: Mmm-hmm. (Participant: I know)**. So, err, that's us-, that's us pretty much finished then anyway *(interviewer names participant)*, unless you have-, unless you have anything else that you…**

Participant: When are you going to take me blood, another day?

Interviewer: Take your blood? *_Both laugh_ Another day, yeah, yeah. Alright. I'll just stop this here.

Interview transcript: Study support staff interview (1001) - Senior nurse (F), who departed from the ward several months after study commencement.

Setting: Senior nurses office in Norman Power.

Audio commences.

Interviewer: So, okay. Actually. Alright. So, eh, thank you for being here at this interview, and for your h-, your help with the study. Em, so, the purpose of this interview is to get your opinion on the study and its various aspects, from its, eh, practicality and integration into the ward, eh, to the impact you believe it's had on the participants. So, as mentioned previously, this interview will be recorded for future reference, and anything that you say may be used in a future publication, or report, however your name will not be included. Eh, so if this is okay with you, we'll begin?

Study support staff: Okay, yeah.

Interviewer: Okay. So eh yeah, we'll start off quite broad, so what were your eh, kind of, I suppose, general opinions and impressions about the study?

Study support staff: Um **ward staff member coughs*, to begin with, I thought, well, to begin with, I thought, it was probably, a little bit of a hard work on my part Paul, because, um, first of all, it was kind of getting the equipment in, which was fine, that wasn't a problem. I didn't have to do anything **(Interviewer: Mmm-hmm)**, but it was just making sure that all the staff didn't go in and the patients **(Interviewer: Yeah)**, other patients on the ward, so making sure the room was safe, and then I didn't realise, as well, that we'd have to get, kind of, all different departments in to do, kind of, some health and safety testing and some risk assessments to make sure it was alright **(Interviewer: Mmm-hmm)**, and so those people were coming in. I didn't realise, and that all impacted on me, cause it added to my workload a bit **(Interviewer: Mmm, yeah)**, so-, and, kind of, then, other people wanted to be on board, so the resus team wanted to be involved to make sure, if anything happened, there was enough trollies around the ward and everything **(Interviewer: Mmm-hmm)**. So, I think it was a bigger impact than I thought it was **(Interviewer: Mmm-hmm)** perhaps put to me in the first place, as in, we're just going to have a bit of exercise equipment **(Interviewer: Yeah)** to see how we're going **(Interviewer: Mmm-hmm)**. So, I think that was a bigger thing. So, I think, you know, if you were thinking about doing it again, there's bigger things to think about **(Interviewer: Mmm-hmm**, um, and what was the question again, sorry? I've gone off from there.

Interviewer: Emmm. no, no, no it was a perfect kind of answer, it was just generally quite broad, what were your general impressions on the study (Study support staff: Yes)**, so I think that was when, when you started off, it was more work than what you thought** (Study support staff: Yes) **it actually would be?** (Study support staff: Yes, yeah)

Interviewer: Yeah, and what, well, do you have any specific, kind of, suggestions on things that we could perhaps do if we were doing it again, to kind of take that load off of someone in your position?

Study support staff: I think it might be just knowing that perhaps you needed to perhaps approach the health and safety team or somebody like that **(Interviewer: Mmm-hmm)** beforehand to let them know and get them on board, cause nobody actually knew that it was going to take part, really, did they? I think it was a conversation between…

Interviewer: Yeah, it was more, kind of, with *(names associate medical director/geriatrician who oversees the ward)* and *(names local Principal Investigator)* **mainly** (Study support staff: Yes)**, then with the, with the actual staff on the ward initially yes.**

Study support staff: Yes, yeah. Yeah, **(Interviewer: Mmm-hmm)** so I think perhaps just trying to involve everybody who might be involved to get the assessments done **(Interviewer: Mmm-hmm)** before we started…

Interviewer: Yeah, from the onset, yeah.

Study support staff: Yes, yeah.

Interviewer: Em, yeah, so, em, how would you kind of, I suppose, assess the suitability of the study for the, for the setting?

Study support staff: So…

Interviewer: Kind of exercise interventions in that kind of setting…

Study support staff: I thought it would be really positive **(Interviewer: Mmm-hmm)**. I, I think there were some downfalls with it, but I thought that it could have been very positive **(Interviewer: Mmm-hmm)**, and maybe in a different setting **(Interviewer: Mmm-hmm)**, it might have been more positive, because I don't, I think one of the negativities of it, and you might come to it in a bit, is that the patients weren't there long enough **(Interviewer: Mmm-hmm)** to get a good picture of whether they were progressing or not **(Interviewer: Yeah, mmm-hmm)**, so I think that was difficult really **(Interviewer: Mmm)**, and finding the right patients, because remember, when we first started, we were, we were, like, worried about the patients with dementia, because it wasn't going to be the patients with dementia **(Interviewer: Yeah)** to begin with, was it, **(Interviewer: and we had to put in an amendment to include them, yeah)** and then we had to put that in, so it was then, kind of, compliance with it as well, and then measuring the outcomes afterwards, cause I expect that was quite difficult to measure whether there had been any positive outcomes **(Interviewer: Mmm-hmm)**. I don't know. **(Interviewer: Mmm-hmm, yeah, yeah).**

Interviewer: Mmm-hmm, so you kind of think maybe it would be more appropriate for a setting where the patients are in there longer and perhaps are more cognitively aware (Study support staff: Yes, yes)**, kind of, of what the study is** (Study support staff: Yeah) **yeah?**

Study support staff: I think so, yeah.

Interviewer: Mmm-hmm. Em, so what would your opinions be on, kind of, having an intervention like that on a ward of that nature, long term? What would kind of be some of the things you think would have to be done to make that feasible, or perhaps you don't think it is feasible on a, on a delayed transfer of care (delayed discharge) ward?

Study support staff: I don't think it's not feasible **(Interviewer: Mmm-hmm)**, but I think, em it depends what outcomes you're looking for, doesn't it? **(Interviewer: Mmm-hmm)**. Cause I think it's really hard to measure, and like I say, if people hadn't been so cognitively impaired, you might have seen some improvement, but I think it's hard to measure the improvement, and perhaps they weren't long enough there for you to measure that improvement **(Interviewer: Mmm-hmm)**. So, I don't think it's a bad idea, but it might be better in a more EAB(transitional care)-type setting, not a hospital setting **(Interviewer: Mmm-Hmm)**, where perhaps people are there for a longer period of time, because the people who were on that ward who were there for a long period of time, were the more challenging patients that couldn't take part in that survey **(Interviewer: Mmm-hmm)**, in that study.

Interviewer: Yeah, yeah (Study support staff: Yeah)**, so it's kind of, yeah, they're not representative even of the general geriatric patients in the hospital, so…**

Study support staff: No! No! Because I think on that ward, there were more challenging patients, than anywhere else in the hospital. **(Interviewer: Yeah)** I think that's where they, kind of, were cohorted, in that area.

Interviewer: Mmm-hmm, and what about then, perhaps, if it was, kind of, in a-, in a setting that was more of a general kind of hospital setting? Do you think that might, kind of…

Study support staff: I think that would work better, yes, yeah, but again, if it was more on a general ward, the length of stay might be shorter than what you'd need it for **(Interviewer: Mmm-hmm, yeah)**, yeah.

Interviewer: Um, so what were your opinions on the, em, kind of, the implementation and the integration of the study into the existing, kind of, practices and procedures on the ward? I think you might have touched on that, kind of, in your, in your initial, kind of, answer, that it was the integration of the study to begin with was a lot more than what you thought it would be.

Study support staff: Yes, yes, probably, yeah, probably **(Interviewer: Mmm-Hmm)**, but then when you came and you saw the patients, I don't think that had any impact on the ward at all

then, because you're on the ward, seeing the patients **(Interviewer: Mmm)**. I don't think it was, I don't remember, now, which patients you saw, but, um, I don't think, once it was up and running, it had any impact on the ward at all **(Interviewer: Mmm)**. Do you know what I mean? **(Interviewer: Yeah)** Because you just take them into the little room to do it, see them then, you know.

Interviewer: Yes, it didn't interfere with anything…

Study support staff: It didn't interfere with anything then, no, and then you were-, you know, you were quite flexible about the times you could come in and who you were seeing, so it wasn't always set times particularly, was it? So…

**Phone rings*

Interviewer: Do you want to take that, I can put this on pause?

Study support staff: If that's okay?

**Audio pauses*

**Audio recommences*

Interviewer: Em, alright so, em, I suppose then what would be kind of, on the flip side of that, what, what were your opinions on the time commitment to the patients within the study? Did you think it was maybe too burdensome on the patients, or…

Study support staff: No, not particularly, I don't think so **(Interviewer: Mmm-Hmm)**. I never heard anybody moan about it **(Interviewer: Okay)**,no **Both laugh*, so no, I don't think so. In fact, I could imagine that if patients, had capacity, they'd probably quite enjoy doing it, and it would be a bit of a change from the normal daily hospital routine wouldn't it really? **(Interviewer: Yeah, mmm-hmm, yeah)**

Study support staff: So, I imagine, but I never heard anything, I never heard them talk about it at all. Sorry.

Interviewer: So, em, are there any other opinions you have on any aspects of the study related to its practicality within the setting?

Study support staff: No, not really. I just, em, I thought it was difficult because of the type of patients, really. At first, I was, like, thinking, "Oh, this'd be really great" but then when we started looking at, it and there were so many patients with dementia who couldn't be that compliant, or you couldn't measure the outcomes as well, I think we could of-, perhaps if we'd have thought about that beforehand **(Interviewer: Mmm-hmm)**, perhaps picked a different group of patients **(Interviewer: Yeah, mmm-hmm)** so.

Interviewer: Em, was it, I think perhaps when we were initially talking to Zoe about the ward, em, it could have been maybe a year-and-a-half before it actually started. Were the patients slightly different, or , or was it…

Study support staff: Not particularly, no. No.

Interviewer: No, they were, they were kind of the same?

Study support staff: No. I don't know whether that was something we just overlooked completely and thought, "Oh, our patients would enjoy that", and then actually thinking about it **(Interviewer: Yeah)**, maybe not **(Interviewer: Mmm-hmm)**, yeah.

Interviewer: Yeah, so maybe more consideration, kind of, to the…

Study support staff: To the type of-, yes.

Interviewer: To the specifics on the ward.

Study support staff: Yeah.

Interviewer: Yeah. So, em, if you were to design a study like this, em in the future, or in a similar setting, what kind of alterations would you make?

Study support staff: Well, I don't think that I'd probably make any alterations, I think what would be useful is perhaps, em, obviously if we'd, em, kind of, considered the patient group, so we had the, kind of, right type of patients **(Interviewer: Mmm-hmm)**, then I think perhaps, em, because you were recruiting on certain specific things, weren't ya **(Interviewer: Mmm-hmm, yeah)**, but perhaps we could, like, have advertised it to more wards, and perhaps encouraged people to, and perhaps other staff on the ward to be more aware of it **(Interviewer: Mmm-hmm)**. Um, because I think some of the staff didn't know that it was going on. **(Interviewer: Yeah)** It was quite low-key, wasn't it **(Interviewer: Mmm-hmm)**, really, but perhaps, we perhaps should have involved more staff; but then they weren't involved in recruiting the patients anyway, were they **(Interviewer: Mmm)**, but they would perhaps have benefit from perhaps being involved and coming in and observing what you were doing, and things like that. They might have quite enjoyed it as well. I don't know **(Interviewer: Mmm-Hmm)**, so perhaps more of an involvement in the ward team as well.

Interviewer: Yeah, so, so, what were, kind of, some of the-, I suppose, do you have any specific suggestions, like maybe posters for the study, or…

Study support staff: Yeah, posters and leaflets and things like that, yeah, or perhaps when you were taking patients in, you could have said are there any nurses free who wanted to come in and see what you were up to then. That might have got more people on board, but if you had the patients who had capacity and consented to go, then you wouldn't, they could have then got

some more feedback from the patients about how they felt it was going as well, the staff, if they knew more about it, couldn't they?

Interviewer: Yeah.

Study support staff: So, say I knew about it and you'd taken somebody, then that afternoon I could say "Oh, how did it go in the gym, and what happened" and get some more verbal feedback about what had happened, really.

Interviewer: Mmhmm, yeah.

Study support staff: Yeah.

Interviewer: Mmm-Hmm, Em, so, are there any aspects that you think you wouldn't change, then, about the study, or you think are well-suited for the setting?

Study support staff: I think for, I think it was well-suited for the setting, but just not the group of patients really, yeah.

Interviewer: Okay, mmm-hmm. Em, so yeah, that's pretty much, that's pretty much it, so are there any, kind of, closing comments you'd like to make, em about any aspect of the study, or…

Study support staff: No, it was fine. It didn't cause any trouble really, did it? **Both laugh* No, it was fine. Yeah, I don't think there's anything I'd like to add at all.

Interviewer: Okay, perfect.

Study support staff: Okay.

Interviewer: Thank you very much for…

Study support staff: Can you turn the tape off? **Both laugh*

**Audio stops*

**Audio recommences*

**Both laughing*

Interviewer: Alright, so, whenever, whenever you're ready there. Em, yeah so, em, I suppose would you be able to tell me a little bit about, em, how Harborne might differ from other, kind of, delayed transfer of care, em, settings, and in particular in relation to how Norman Power is, kind of, eh, associated.

Study support staff: So, I think Harborne had patients that, kind of, cohorted a lot of the very challenging patients from across the medical wards at the Queen Elizabeth Hospital and the patients that were really difficult to place and find placements for. So, I think they had a higher percentage of challenging patients **(Interviewer: Mmm-hmm)** than other medical units or EAB settings. Obviously places that, um, long-term placements, say Bromford Lane, that is for challenging patients, so you wouldn't be looking to go somewhere like that **(Interviewer: Mmm-hmm)** but somewhere like Norman Power, we've got physios, OTs, social workers on site, we're pushing patients to get home. We're really, kind of, pushing this home first ethos. So, we would have less challenging patients and probably, less patients without capacity, or more patients with capacity, than there was on Harborne.

Interviewer: Ah, okay, so you think perhaps that even in a delayed transfer of care setting there could be more suitable places than perhaps what Harborne was at the time?

Study support staff: Yes! I believe so. Yes, definitely.

Interviewer: Alright. I'll take you off record again.

Interview transcript: Study support staff interview (1002) - Senior nurse (F), who came onto the ward several months after the study had commenced.

Setting: Senior nurses office on the Harborne ward.

Audio commences.

Interviewer: Okay, so, em, thank you for being here at this interview and for your help thus far with the study. Em, so the purpose of this interview is to get your opinion on the study, and it's, em, various aspects, from its practicality and integration into the ward, to what you believe the impact has been on participants. So, as mentioned previously, this interview will be recorded for future reference, and anything you say may be used in a future publication or report, however your name will not be included. If this is okay with you, whenever you're ready we'll begin.

Study support staff: Okay.

Interviewer: Okay. So, eh, okay, so let's start off I suppose quite broad. What, I suppose were your initial, em, initial, kind of, opinions when you first heard about the study being implemented in this setting?

Study support staff: Initially?

Interviewer: Mmm-hmm.

Study support staff: Yeah, obviously I know that this ward is like, what we say elderly ward with medically fit patient that's ready for discharge. Although we've got some, twelve patients as well, twelve acute beds when I came over in March and things like that. So, we've got two consultants that's on the ward, and the equipment's there, I know from the fact that it can, kind of, em, help with the patients that are having a little bit more of rehab as possible, because not all our patient, who are medically fit are having physio input.

Interviewer: Mmm-hmm.

Study support staff: Right? So, having this kind of study that you've got, it will be nice for our patient on the ward, em that have a little bit of rehab in a way. Although they, yeah, they can mobilise, but then, sometimes if we haven't got a time for them to walk all the time **(Interviewer: Mmm-hmm.)**, unless they go to the toilet and that will be it, isn't it? So, having this one, if they are suitable to use this equipment, I thought that would be great and it probably give a little bit of, um, what do you call this? A little bit of boost to this patient.

Interviewer: Mmm-hmm.

Study support staff: But, as we know, not all our patient here are able to cooperate and able to, kind of, follow your instruction.

Interviewer: Mmm-hmm.

Study support staff: It's just unfortunate, that most of them are having bit of cognitive impairment and they might not follow the instructions. So, that stopping them to, kind of, use this. But if all our patient are cooperative and able to follow instruction, I thought, it will be great and I'm sure give a little bit more of, um, you know, some change in their lifestyle.

Interviewer: Mmm-hmm.

Study support staff: Isn't it? In their condition in some ways.

Interviewer: Yeah.

Study support staff: Yeah

Interviewer: Mmm-hmm. Yeah, so I suppose now that we're, kind of, coming towards the, the end of the study. Eh, how you would you, kind of, I suppose assess the suitability of the study for this particular setting?

Study support staff: I would say…

Interviewer: I think you mentioned perhaps that some might people might have too much cognitive impairment within this setting?

Study support staff: Yeah, it varies, isn't it?

Interviewer: Mmm-hmm.

Study support staff: Because at one point, I told you that most of them are just like, it's either mildly confused or just really confused, **(Interviewer: Mmm-hmm)** because the patient that we were having, the majority has dementia, Alzheimer's, or vascular dementia even. So, some of them yeah. But you think that they might able to follow but then I don't think with the time frame that you need to be with them in there, might not be able to, kind of, complete **(Interviewer: Mmm-hmm)** whatever you normally do or, you know, the, the, you know, the input that you needed.

Interviewer: Yeah, mmm-hmm, yeah.

Study support staff: And, it, it's difficult as well, each week we've got some, kind of, good turnovers **(Interviewer: Mmm-hmm)**, we might have a patient that's suitable to go for it, or all of a sudden, then none.

Interviewer: Due for discharge, yeah.

Study support staff: Yeah, so, it varies really, yes, so-,

Interviewer: So, maybe perhaps the, the, kind of, the two considerations for suitability you'd say is the, the prevalence of I suppose cognitive impairment which doesn't facilitate inclusion?

Study support staff: Yeah.

Interviewer: And um, then perhaps also the, the turnaround of patients?

Study support staff: Yeah, **(Interviewer: Yeah)**. Because I think before, it's just medically fit for discharge and waiting for placement of package of care **(Interviewer: Mmm-hmm)**, but since we've recently become having like twelve beds and sometimes going to over to eighteen medical acute patient. **(Interviewer: Mmm-hmm)** And it's just, kind of, em, eh, it's a little bit like it depends on that point, how is their cognitive or if this patient having this cognitive impairment **(Interviewer: Mmm)** So, it just varies really, isn't it? So.

Interviewer: Mmm. I think, em, *(interviewer names previous senior nurse on ward)* had mentioned actually during her interview as well, that, kind of, Harborne is nearly the ward where the most challenging patients (Study support staff: Yes) **perhaps get placed** (Study support staff: That's right) **in the whole hospital?**

Study support staff: Because obviously when we say challenging patient, in a way is, when they come from different wards, a speciality **(Interviewer: Mmm)**, and when they become medically fit whatever this patient has been treated for, it's down as to go to medical, bed, isn't it?

Interviewer: Yeah, mmm-hmmm

Study support staff: And, this is the place that they normally, because we can keep the patient and waiting for long-term placement to go to, but at the end of the day, um, it seem to be like, having those challenging patient, we cannot just refuse them to come over **(Interviewer: Mmm-hmm)**, "No, we can't have them because we've got too many challenging patient here on the ward now." We can if we can't facilitate staff, **(Interviewer: Mmm-hmm)** but then at the end of the day, they still has to come here because they're now medically fit and awaiting for placement.

Interviewer: Mmm-hmm.

Study support staff: So, yes, mostly Harborne ward has got all those challenging patients because obviously they're medically fit, they're just waiting for the where to go to or package of care.

Interviewer: Mmm-hmm, so what would your opinion be on, em having…

Phone rings

Interviewer: Get that there, and I'll put it on pause there.

Study support staff: Can I, pick up?

Interviewer: Yeah, I can put it on pause for you, no problem.

Audio paused

Audio recommences

Study support staff: Challenging

Interviewer: Challenging, that was it, yeah. **So, I guess, kind of, based on that it's such a challenging, eh, setting, what would your opinions be on having such an intervention on the ward long-term or do you think perhaps maybe it's suited to somewhere else in the hospital if…**

Study support staff: Well, I, I can't say that they'll be suited for the other wards or something, but because Harborne ward has been created to be a ward with all these medically fit patients, right?

Interviewer: Mmm-hmm.

Study support staff: And, obviously if this patient from other ward is waiting for a placement, like a specialist placement for them as because being challenging behaviour, they will still ended-up on this ward, purely because they cannot keep this patient from the specialised ward while waiting for the placement to go to. So for me, as because this ward's been created as medically fit, so it still ended-up here, but I'm, as what I said to you before, that we might be change in the next few months **(Interviewer: Mmm-hmm)** to become more general acute ward **(Interviewer: Mmm-hmm)**, so there's no longer medically fit ward.

Interviewer: Mmm.

Study support staff: As, you know, as not us from the other wards transferring here. No longer like that, that's what they've, I've been told.

Interviewer: Mmhmm. Medically fit in terms of, eh, eh suitable for discharge but just there's nowhere for them to go?

Study support staff: Yes.

Interviewer: Rather than medically fit for the, the study as such?

Study support staff: What do you mean?

Interviewer: So, I was just trying to make the distinction (Study support staff: Oh) **say between the, like the, sort of, they're medically fit in terms of they don't need the special geriatric care (medically stable versus medically fit, is the distinction here) on whatever ward they're on, but they mightn't necessarily be medically fit to participate in something like this?**

Study support staff: Well, when they said medically fit, for example, I've got those twelve beds and one of them, eh doctor *(names consultant geriatrician), *study support staff member corrects themselves*, doctor (study support staff member names consultant geriatrician)*

Interviewer: Yes.

Study support staff: And, then when she said, "Medically fit for discharge", then, that's the time we, kind of, do the transfer of care (discharge) waiting for social, referral to the social worker. And, so that's the other medically fit, that waiting for the social input

Interviewer: Yeah, yeah, I get you, yes.

Study support staff: For the medical acute patient for *(names consultant geriatrician)*. But, when patient under *(names other consultant geriatrician)*, they are medically fit before they even come to the ward. **(Interviewer: Mmm-hmm)** So, when they arrive on the ward, they are totally medically fit and we've got the plan *(*Member of staff walks into office without knocking. Member of staff: "Oh sorry")*… to whether, are they waiting for package of care or are they waiting for placement? So, there's two kind of, depending on to the consultant.

Interviewer: Yeah, definitions, yeah

Study support staff: Yeah

Interviewer: Now, what is, what's, kind of, I suppose the main reason why they are delayed transfer (delayed discharge)?

Study support staff: Mostly… you mean transfer where?

Interviewer: Em…

Study support staff: Discharge or…

Interviewer: Eh, yeah, for discharge. Why, why are they, kind of, delayed mostly?

Study support staff: Mostly is-, oh, not mostly but one is sometimes when we've done the transfer of care **(Interviewer: Mmm-hmm)**, they are waiting for the allocation social worker and then of course, if the social worker only been picked up after a couple of days, so two days has been delayed already, isn't it?

Interviewer: Mmm-hmm.

Study support staff: And, then the other thing is these challenging patient. So, although they've been picked up from the, before they even come here as medically fit awaiting for placement. **(Interviewer: Mmm-hmm)** When they do the assessment, they've been referred to different sorts of, um, eh, what do you call that? Care home (assisted living facility).

Interviewer: Mmm-hmm.

Study support staff: Right? On the care homes list or care home, what do you call that? Select.

Interviewer: Okay, yeah.

Study support staff: Care home select, yeah?

Interviewer: Yes, yeah, yeah.

Study support staff: So, the family will offered, "There is a care home select, blah, blah, blah." And, then if for example, one of the care homes has been picked **(Interviewer: Mmm-hmm)** and then they will assess this patient on the ward, but unfortunately the patient is possible keep falling.

Interviewer: Okay, mmm-hmm.

Study support staff: And, all this care home has got some criteria as well, isn't it?

Interviewer: Whether they'd accept them or not?

Study support staff: Whether they will accept or not. So, they will just say, okay they've been referred for example to Kenrick Centre **(Interviewer: Mmm-hmm)** and then the Kenrick Centre will wait until they say, "We'll come over to come and assess this patient", and, then possibly tomorrow, so they will come tomorrow, see the patient. They will just say, "We'll come back to you, we'll ring you if we're accepted with the outcome." **(Interviewer: Mmm-hmm)** and then we won't hear anything today or from the day that they've been assessed. Tomorrow we will ring them to chase, "Do you know what the outcome? Are you accepting this?" And, then all of a sudden, "Oh, by the way, no we don't accept this patient." So, that's, kind of, having delay. **(Interviewer: Yeah)** That, kind of, referring to care home, care home will pick it up. It's either they will come on the ward and assess themselves of this patient or over the phone if we say something like, they don't like, they will just say, "We'll come back to you."

Interviewer: Yes, mmm-hmm.

Study support staff: And then of course for us, we can easily chase, if we've got time **(Interviewer: Mmm-hmm)** as a nurse on the ward. But at the end of the day, the, the, you

can't get any answer on the same day (**Interviewer: Yeah)** You have to, kind of **(Interviewer: I understand)**, wait for the following day and if we don't ring, these homes mostly they weren't gonna ring the ward.

Interviewer: Yeah, I get you. Yeah.

Study support staff: Some of them are quite good, they will ring back to say that, "Oh yeah, we'll accepted them.", "Oh, no, no, we won't accepted them." **(Interviewer: Mmm)** but it's not all care homes has got those kind of routine to, kind of, ring the ward to say, "Oh yeah, we will accept." Unless sometimes they, we will ring them to get the answer, so that's, kind of, having a little, in delays in terms of chasing, giving us the answer. You know what I mean?

Interviewer: Yeah, I get you, yeah.

Study support staff: And then one of them as well is, because of this challenging behaviour. The complex discharge nurses will come and identify the home, for this patient and then one the reason that having a little bit longer, is the family not happy for them to go there.

Interviewer: Okay, mmm-hmm.

Study support staff: Maybe because of the distance where they live **(Interviewer: Mmm-hmm)**, eh, and sometimes they know the specific care home and we have got the idea or perception from probably previous experience from the family or friends, that this home is not really good. So, one of those things that, hindrance for the family to say, "No, no, we don't like our patient to go there **(Interviewer: Mmm)**. I don't like my Dad to go there. **(Interviewer: Yeah)** I heard a lot of bad, things about this one." **(Interviewer: Mmm-hmm)** So, those are the things, that a little bit taking longer because you have to take those considerations. Because it's not just, kind of, for us to, kind of, "Yeah, no, you can't say anything. We have to send this patient in there." But, according to the co, the manager from the social services, is once they identified and the family say, "No." We shouldn't really, kind of, listen to the family because at the end of the day, this is the, the place that they identify for the patient for what the care they needed. **(Interviewer: Mmm-hmm)** But we tend to say, "Would you mind explaining that to the family?" because our side, as the nursing, we've done our bit **(Interviewer: Mmm-hmm)** the explanation, of how can we say it, but if they still insisting that they don't, not happy at all, why you guys to speak with them? (**Interviewer: Yeah)** You know what I mean? **(Interviewer: rather than…)**

Interviewer: Yeah, rather than you guys doing it

Study support staff: Rather than us **(Interviewer: Yes)** because they know more. They know more about this care home **(Interviewer: Mmm-hmm)**, that's why they are referred the patient over there. So, one of those things that, eh, as a nurse, we are the mediator all the time.

Interviewer: Yeah, mmm-hmm.

Study support staff: And at the end of the day, if we discharge this patient and the family is not happy we will, they will come back with a complaint to us.

Interviewer: Mmm-hmm.

Study support staff: So, that's why I keep telling them that for, for the social worker and I said, "Have you spoken to the family?" And, they said, "No, no." And, I said, "Well, you are really the one who need to speak to them because at the end of the day you should be liaising with them. We can only just do the safe discharge for this patient. If the family is not happy, you need to give your part, **(Interviewer: Yeah)** to explain things isn't it?"

Interviewer: And, of course you're doing this with 30 odd patients (Study support staff: Yeah) **as well, so it, kind of, it's very chaotic if you like.**

Study support staff: Yes, so quite a few, possibly since I came up here, or since I started, possibly around about less than ten, like having the family is not happy **(Interviewer: Okay)** and complaining that they won't let the patient go there, things like that. So, those things that, kind of, making more longer, **(Interviewer: Yeah mmm-hmm)** the patient stays here **(Interviewer: Mmm)**, because of those reasons **(Interviewer: Yeah)**. Family not happy, long distance from where they live, um, yeah.

Interviewer: Mmm-hmm and would you say that I suppose, when, when care homes you said that sometimes they reject the patient. Is that mostly down to that they can't facilitate the care needs of that patient yeah?

Study support staff: Yeah, because they've got their own criteria, eh before accepting patient, isn't it? **(Interviewer: Yeah)** And nowadays because of possibly no equipment or facilities or you know. They just say, "No, we can't." **(Interviewer: Yeah)** But we can't do anything **(Interviewer: Yeah)** about it **(Interviewer: Yeah, exactly)** because at the end of the day, the patient is moving there to there **(Interviewer: mmm-hmm)**, to their hands and if they don't feel this patient will be safe it's up, you know, **(Interviewer: Yeah)** they are the ones to say, "No" for it **(Interviewer: Yeah)**, yeah. **(Interviewer: Ofcourse)**

Interviewer: Em, so, what are your opinions on I suppose the implementation and the integration of the study into the existing practices and procedures on the wards? I think you mentioned, kind of, at the start it might have been a bit of a, I suppose, misunderstanding about the, the, eh, implementation of the study on the ward between yourself and *(names consultant geriatrician)* or something like that? But I guess it's, kind of, an odd question for you because you came in half-way through, kind of?

Study support staff: Yeah. I think it's just for me not knowing really when I come in, what is it about.

Interviewer: So, maybe I suppose if we were more proactive, kind of, when you started, kind of, informing you?

Study support staff: Yeah, kind of, informing, but it's not your fault, it's just so happened that obviously you don't know that *(names previous ward manager)* is going and then who is coming in and things like that. And, it's just me probably being naïve.

Both laugh

Interviewer: Okay.

Study support staff: Like, and I even asked the staff. They knew that they've got a study going on **(Interviewer: Mmm-hmm)** but they don't know (**Interviewer: Yeah, the specifics, yeah)** anything much more. Specifically to tell me what is it about (**Interviewer: Mmm)** until you said to me that it depends to the suitability of the patient. **(Interviewer: Yeah)** So, if I don't, kind of, ask those questions, I won't really know what is it about **(Interviewer: Mmm-hmm)**. I thought you just taking patients wherever like, you know, to use that. But of course it depends if they're suitable anyway, but I don't have the, I didn't know what's the criteria **(Interviewer: Yeah)**, really what are you looking for.

Interviewer: Mmm-hmm. So, maybe, maybe perhaps I suppose if there had been more of a general understanding within the whole ward of the (Study support staff: Mmm-yeah)**, the specifics of the study** (Study support staff: Yeah)**, it might have helped you perhaps with that?**

Study support staff: Yeah, because at one point, um, when I was on 518, we've got a study as well there in terms of medically fit patient as well. That they will pick up patient from, like a journey about discharge, delayed discharge.

Interviewer: Oh, yes of course, the qualitative study. Yeah, yeah, mmm-hmm.

Study support staff: So, obviously when they spoke to me about it from the beginning, so I know what is going to be happening. As a manager, obviously I spoke to all my Band 6's, that if I'm not around, this person will coming in and do this bit **(Interviewer: Mmm-hmm)**, because they are going to look for the notes and things like that.

Interviewer: Yes, mmm-hmm.

Study support staff: And, they might question, "Hang on in a minute, who are you?" Things like that. **(Interviewer: Yeah, mmm-hmm)** So, I even like, um, introduced him to some of the staff **(Interviewer: Mmm-hmm)**, that when you see him and this is what he normally do **(Interviewer: Yeah)**. You've got the poster for the study. I know that you've got the poster and, but it's just I think it's me, just being just went in **(Interviewer: Mmm-hmm)**, not even like the Band 6 telling me what is it about. **(Interviewer: Mmm-hmm)** You know what I mean? So then, I ask, and eh doctor (names doctor) is eh, a bit mad for not knowing **(Interviewer: Mmm)**

Interviewer: So, perhaps if we had more, kind of, I suppose, well posters and perhaps more engagement with the staff maybe at the start of the study, might have helped with that?

Study support staff: Yeah, something like that. But I think it just so happened that it's me just step in **(Interviewer: Yeah)** and not knowing at all **(Interviewer: Yeah, yeah, yeah)**. But what I am saying is when I was on the other ward, if we started, like, I was there and if I'm not around, even like take him to the MDT meeting, this, um, gentleman. MDT meeting. I even like ask him to go to the, um, what we call discharge coordinators **(Interviewer: Mmm-hmm)**, so that he will know how they work the system when we do the discharges and things like that **(Interviewer: Mmm-hmm)**. So, it's like mostly staff, even HCAs, knew who he is.

Interviewer: Yes, to get more awareness, kind of?

Study support staff: Yes. Yeah, yeah. But it's different **(Interviewer: Mmm-hmm)** because obviously I just stepped in and you already have this, and Harborne is not always same. It's just me not knowing it and then, yeah, so that is it. Most of them, although they knew that this study was in there, but they don't really actually know what it's for.

Interviewer: Yeah, the specifics. I think that was something (*Interview names study support staff 1001)* had, kind of, kind of, brought up as well. That perhaps if we had have had some posters (Study support staff: Yes)**, maybe a training day** (Study support staff: Mmmm) **or an evening where we talked about the study** (Study support staff: Mmmm)**, it might've perhaps helped a wee bit.**

Study support staff: And even like, you know, first time we met in the MDT meeting. I didn't know that you were the one involved there, and you didn't know, so I'm really sorry.

Interviewer: Yeah, I didn't know you were the new manager either, yeah *Both laugh*, so, lack of communication somewhere without a doubt. Yeah. Yeah.

Study support staff: Yes, it's just those things that you can't sometimes avoid. You can't avoid, yeah.

Interviewer: Yeah and hopefully we'll, we'll know better for the future.

Study support staff: Yeah.

Interviewer: Eh, so then we, I guess in terms of, um, practicality, eh, what I suppose were your opinions on things like the time commitment involved within your role in the study? So, kind of, identifying patients and stuff? Was it, kind of, too burdensome or…

Study support staff: Yeah, I think the way you're, you know on the phone, or e-mailing me to say that, "Is there any chance that we can catch up about your patient?" It's like that. (**Interviewer: Yes.)** Having some kind of, because for example, every morning we've got two

teams, medical team. In the morning, if I pick up something like after the handover, when they come on at 09:00, I'll just say, “Paul, this patient, it needs to be like this and that, that.” But of course, when we're expecting something like I know that you're coming this morning, I'll just, I know that, um, we're going to sit down and discuss patient

Interviewer: Mmm-hmm. Yeah, yeah, its pre-planned exactly rather than a sporadic timescale.

Study support staff: Yes, but it's sometimes because it's not always having suitability patient. Obviously you come in every day and asking about this, you might say that, “Oh, it's a waste of time to come over and I've got nobody to be” **(Interviewer: Mmm)** you know. But when you mentioned to me that even on the bedside you can do something, isn't it?

Interviewer: Yes, with the, with the intervention, yeah.

Study support staff: Which is I think it's more, kind of, for me, probably more…

Interviewer: Practical…

Study support staff: Practical in the future, purely because some of them can walk short distance and if they just walked toilet and back and things like that and especially some of them having low impaired, even like, I probably squeeze something. They probably can do it, isn't it?

Interviewer: Yeah, but maybe not the machines as such.

Study support staff: Yeah, not just to follow, “Oh, you have to hold it in there and” you know, more probably step-by-step procedure is a little bit too much for them. **(Interviewer: Mmm-hmm)** To those patients that we've got here.

Interviewer: Yeah, mmm-hmm.

Study support staff: Yeah, but the bedside ones could be possibility more, err, kind of, em, practical.

Interviewer: Yeah, mmm-hmm. Then I suppose what were your, kind of, opinions on the commitment to participants within the study? So, do you think that something like this might be too burdensome to them or perhaps it's, kind of, fine given that they have some time on the ward maybe?

Study support staff: I, for me it depends really to the individual, isn't it?

Interviewer: Okay, yeah of course. Yeah, yeah.

Study support staff: Because obviously I will just say to you, “Paul, I think bed one is suitable.” But when you go there, they don't like to be participated, isn't it? **(Interviewer: Mmm-hmm, yeah)** So, it's up to them really to, kind of,

Interviewer: Make up their own decision?

Study support staff: Make their decision, yeah. Because I can't make this so they're, "Come on *(names patient on the ward)*, you can do that and you will be able to" and obviously, they "Who are you to tell me that?" You know what I mean? Especially if they are, have they got capacity?

Interviewer: Yeah, mmm

Study support staff: They have to, kind of, it's up to them really, isn't it? So, or to agree.

Interviewer: Mmm. So, are there any other opinions you have I suppose, on any aspects of the study related to its practicality within, within the setting?

Study support staff: In what way, like?

Interviewer: Um, I, I suppose is there a, kind of, anything that you see is not really practical to do in this particular ward or in this setting? Or is there, I suppose, is it, well I suppose you've mentioned, you mentioned some before. That perhaps the patients, a lot of patients are too cognitively impaired, kind of, just…

Study support staff: Mmm, or sometimes-, although we've got two, two different teams and they've got different patient speciality. The acute one, maybe there's a possibility but sometimes when they are really acute, that's stopping **(Interviewer: Mmm, yeah, yeah)** them, isn't it?

Interviewer: Yeah.

Study support staff: And, then when they, kind of, um… and also it depends if they agree.

Interviewer: Would, would the acute patients here be, kind of, representative of the rest of the hospital geriatric setting or are they perhaps-, I don't say worse, but are they, do they have more, kind of, care needs here?

Study support staff: Not, when I said medical acute, mostly the Heritage Building don't have the, we don't accept those patient having CPAP or extra kind of equipment that they need. When I said acute here, it's either they just been treated for chest infection, just on oral, IV antibiotics, IV fluids. Um, but not needing extra, kind of, cardiac monitor, um, kind of, you know, NIB, things like that. It needs to be, go over to the new building because obviously we're a little bit far if something, emergency happened. So, in terms of accepting medical acute patient here from CDU or MAU, it needs to be like, they are elderly.

Interviewer: Mmm-hmm.

Study support staff: They're just, kind of, not, no special equipment that we need to attach to the patient and yeah, one of those that, and of course don't get me wrong, eh, most of the patients, even though they, kind of, um, medically acute, even though they have a sign of, 'Do

not resuscitate,' but they still active treatment. So, that's the kind of, um, we still, we still doing the acute treatment until obviously if the medical team and the family decided not to go, to continue further.

Interviewer: Mmm-hmm. Yeah.

Study support staff: They, they can always, you know. But that's what I am saying is, when they said medical acute beds. It's still be counted as like the other, West 1, West 2, kind of thing.

Interviewer: Yeah.

Study support staff: So, yeah.

Interviewer: Mmm-hmm, yeah. That's, that's perfect, yeah. Um, so, we're nearly done. Just one or two more questions. Em, so if you were to design a future study to take place in a similar setting, em, I suppose, what alterations would you make to either the study itself or perhaps how it was set up or, I think you had mentioned before that perhaps if there was a, I suppose, some more posters or awareness of the staff to the specifics of the study, it might help? Is there anything, kind of, else? Or…

Study support staff: Um, in some ways, possibly. It's, it's difficult, because it depends as well, as what we said. Like, um, it varies what patient we have (**Interviewer: Mmm-hmm)** and then of course with the patient as well I think it would be good for example, on each bay I will just say to, first thing in the morning, I'll just say, "Oh, would you like to" you know. We can even like say to the patient that, "Oh, I've got somebody who is coming today" Like, you know, um, "Maybe if you can do a little bit of workout with them" At least then pre-warn.

Interviewer: Yeah, they're ready, rather than arriving right there on the spot if you like.

Study support staff: Yeah, yeah. Because at least then, if I say to you, "Oh, she is suitable but she doesn't want to do it" Like you know?

Interviewer: Yeah, mmm-hmm, exactly.

Study support staff: Something like that, for us, for you to come and I would "Oh, before Paul come in, I know which bed is suitable." Those.

Interviewer: Mmm-hmm, and I suppose, are there any aspects that you, you wouldn't change or that you think are, kind of, perhaps more suitable to the setting? I think you had mentioned that perhaps that if they could do it in the bed, it would be more applicable to more, more patients?

Study support staff: Yeah.

Interviewer: So, perhaps if there was anything else, kind of, like that, that you can think of?

Study support staff: Um, I suppose as for me, having like a come together, eh (**Interviewer: More of a group kind of a thing?)** Yes, group, group, group work or something like that.

Interviewer: Yeah, mmm-hmm, because it's better for the patients as well. They can, kind of, socialise with each other and stuff.

Study support staff: Yeah, yeah. Because others, other patients-, don't get me wrong, they were lonely. They were lonely at home, haven't they? And, having this, not all of them, because others were just saying, "No, no, I'm not interested." But most of them, they are a bit lonely at home, so it's nice to, kind of, giving them with a little bit of time to, kind of, chat with other. Do a bit, the same time with the other, you know.

Interviewer: Yeah. I suppose we're, kind of, at the end now. So, are there any kind of closing comments you'd like to make about any aspect of the study or I suppose, any aspect of your involvement that you, kind of, haven't commented on before that you'd like to comment on?

Study support staff: For me, it's just, kind of equipment **(Interviewer: Mmm-hmm)** I think it's just obviously depending on what we have on the ward and it's just I think possibility is I don't think this is the right place in the beginning to put that.

Interviewer: Yeah, mmm-hmm.

Study support staff: Possibly the bedside one is okay, but the equipment that you probably, um, invested in, um-,

Interviewer: Oh, we got them for free don't worry.

Study support staff: Oh is it? Yeah, because it looks nice. Like, you know, I just thought, "Wow, it's like high-tech for me." But obviously they just not able doing different things like that. And, it's probably more on those patient who, but you can't tell really, isn't it?

Interviewer: Yeah.

Study support staff: Those elderly-,

Interviewer: Probably not, no the machine probably isn't as feasible for this specific setting, but-,

Study support staff: Yeah, for this specific setting, yeah.

Interviewer: Would, eh, I suppose you mentioned if it's in the bed, it might be a bit more feasible. I suppose, if there, now we don't have anything at the moment, but if there was

something that perhaps was a machine like the ones down there, but perhaps you could attach it to the bed? I've seen things like, you know, exercise bikes in beds and such. Do you think that might be a bit more feasible or…

Study support staff: If, if-, yeah. You know, I've seen some, this is years ago with the physios. They've got this, kind of, err, even just a little bit of like a bike rolling thing.

Interviewer: Yeah, mmm-hmm.

Study support staff: Or even for the hands for them to do like this.

Interviewer: Yeah.

Study support staff: Rather than go and taking them away from the bedside, they can easily like even they just sitting up in the bed-, they can do it. Like this, isn't it?

Interviewer: Yeah.

Study support staff: So, it's, kind of, more I would say they don't have to go anywhere. They can do it while they are chatting to you and they can, other part of your patient might wanted to get involved as well if they see, "Oh, that's nice" like, you know. Because you can do that without drawing the curtain, isn't it?

Interviewer: Yeah, yeah and it's, kind of, I suppose with the equipment as well it, kind of, it gets more people, kind of, "Oh what are they doing over there?" People didn't really seem interested in bed exercise with no equipment.

Study support staff: Oh, "What is that?"' Yeah.

Interviewer: Rather than just with their own hands or something like that, yeah.

Study support staff: So, those much be, might be, much smaller or handy, would make this much better or suitable here, rather than, um, yeah, that one there.

Interviewer: Mmm-hmm. Right, that's, that's perfect. WelI think we're…

Study support staff: Is that alright?

Interviewer: Pretty much there. Em, yeah, so I suppose, em, just to conclude, are there other things you, kind of, things that perhaps we perceived different about the ward, at the beginning before we started, that perhaps once we got up here wasn't the actuality, em…

Study support staff: Mmm, yeah, because obviously if I, for example for you, when you say Harborne ward, this is our medically fit patients, who just are waiting for placement or package of care. But then it will be, kind of, "Oh yeah, this is, eh I think much suitable because they

might stay here longer on the ward **(Interviewer: Mmm-hmm)** because they're just waiting for how many weeks? How many days?" And at least then having this, kind of, programme it will be, kind of, divert for their mind. But then in reality when you look after this patient and when they give you the actual information, what is the patient like? Although medically fit, but in reality because of some kind of cognitive impairment they might not be able to follow what you wanted for them to do when you take them to that equipment or what instruction you're going to tell them because it's either they suffer with dementia, they, kind of, really having memory problem. So, that's the things but when you actually only saying medically fit ward, sounds suitable **(Interviewer: Yeah)**, isn't it, for them? But in reality is something, kind of, giving them the, you know, the hindrance of how they, are they able to follow instruction?

Interviewer: Yeah. So, medically fit in terms of the acute care in hospital but not medically,

Study support staff: Not really medically…

Interviewer: Fit to do the study as such, yeah.

Study support staff: Mentally fit to do it, yeah.

Interviewer: Yeah. Well, that's perfect.

Audio ends

Interview transcript: Study support staff interview (1003) – Associate medical director who oversee's Harborne ward / consultant geriatrician (F).

Setting: Side room on the Harborne ward.

Audio commences.

Interviewer: So, eh, thank you for being here at this interview and for your help thus far with the study. Em the purpose of this interview is to get your opinion on the study and its various aspects, from its practicality and integration into the ward, to the impact you believe it's had on participants. Em, as mentioned previously, this interview will be recorded for future reference and anything you say may be used in a future publication or report, however your name will not be included. If this is okay with you, whenever you're ready, we'll begin.

Study support staff: That's fine.

Interviewer: Okay. So, em, I suppose we'll start off kind of quite broad. What were your, kind of, general impressions on the study when it was, kind of, initially brought to you, or proposed to you?

Study support staff: Okay. Initial thoughts on the study were very, very good. It's an importance piece of work. We need to know about exercise in older people and how do we address this with people who aren't the fit, well, free-range group of older people.

Interviewer: Mmm-hmm

Study support staff: But I think what's come out was the time it takes when you start talking about a study to actually being able to carry it out.

Interviewer: Mmm-hmm

Study support staff: And then putting that on top of a rapidly changing health and social care environment has actually had a major impact on the study which has been unfortunate.

Interviewer: Mmm-hmm. And what, I suppose, are, kind of, some of the specifics in that regard?

Study support staff: So, if we were sitting here five years ago (**Interviewer: Mmm-hmm)**, we'd have been able to do the study well. It would have been able to recruit, I think, much more successfully. (**Interviewer: Mmm-hmm)** There would have been people still within the hospital environment who would have been able to take part, em, and really benefited from it, and it would have all been much more straightforward. **(Interviewer: Mmm-hmm)** but, em, because of the changes in which we're delivering health and social care to older adults, and

particularly in Birmingham where we've been very, very backwards **(Interviewer: Mmm)** compared to other parts of the country, changing the way we do things has really accelerated over the last, em, eighteen months or so **(Interviewer: Mmm-hmm)** which has had a direct impact on the piece of work (**Interviewer: Mmm)** So, for example, all of the em people who would have been able to participate, now aren't in hospital waiting for their, em next step in their social care or em planning to go home **(Interviewer: Mmm)**. They're either in their own homes, and that's something that we've been able to achieve more of over the last six months, or they're out em in one of the off-site units which is where we now provide EAB, which stands for Enhanced Assessment (transitional care), which was previously provided within care homes (assisted living facilities) **(Interviewer: Mmm-hmm)** and not working. Em, so, we, em…

Interviewer: And this is sites like, em, Norman Power that I think you've mentioned before.

Study support staff: This is Norman Power, yeah. So, em we're now providing that rather than in privately provisioned care homes, we have 32 beds all in one place which is nurse and therapy led, joint run, really, with the local authority, and that's where the cohort of patients who would have been on this ward five years ago **(Interviewer: Mmm-hmm)** are now sitting.

Interviewer: Yeah, and so, kind of, now it's more patients that are maybe medically unfit when it comes to being able to participate.

Study support staff: Yeah, so, so the actual criteria for the ward has changed. So, when we started talking about this research, this ward was entirely for people who were delayed transfer of care (delayed discharge) **(Interviewer: Mmm-hmm)**. So, medically ready to leave hospital. A unilateral decision by the division made just over a year ago, em, introduced acute patients, em, on to the ward **(Interviewer: Mmm-hmm)** and it would be without accompanied changes in staffing levels. So, it would be fair to say that's impacted **(Interviewer: Mmm-hmm)** how even those who are delayed transfers are able to be looked after by the nursing staff in a negative way **(Interviewer: Mmm)**, but, despite concerns being raised, nobody bothered to listen. Em, that's actually led to us really accelerating the, the work out of hospital with the aim of being able to get those people out.

Interviewer: Mmm-hmm, yeah. So, em, well, the next question was, kind of, I suppose, was how would you assess the suitability in this setting, but I guess, kind of, from what you've said it (Study support staff: Yeah.) **was perhaps was more suitable in the past but…**

Study support staff: Yeah **(Interviewer: has changed)**. Five, five years ago it would have been ideal (**Interviewer: Mmm-hmm)** As this sits, em with, with the state now, I'd say, certainly out in Norman Power, with actually how we're envisaging things changing over the next, em few years. So, this is all consistent with the Birmingham Solihull STP plan, the Ageing Well strategy **(Interviewer: Mmm-hmm)** We will even, I mean, I'd even say the right place for, you know, any specialist equipment, or any classes or groups, is going to be out in those care centres, of which Norman Power is one, but, prospectively, with people who are receiving the bulk of their therapy in their own homes, actually then coming in, you know **(Interviewer:**

Mmm-hmm), and using the equipment. So, coming in to one of those centres, using the equipment and going out, as well as it being used for people who are **(Interviewer: Mmm-hmm)** staying in one of those intermediate care centres.

Interviewer: And so you mentioned that in the last few years you've kind of been able to facilitate people getting home quicker. What were, kind of, some of the things that you were able to implement that facilitated that?

Study support staff: Well, the, the background to the Birmingham system is, em, eh, the key partners in it have had very, very poor working relationships for a number of years. **(Interviewer: Mmm-hmm)** So, that's the local authority, the acute trusts when there were more than, when there was more than one acute trust. Em, we used to have three CCGs. eh, rather than just the one, um, and if you look at how Birmingham Community Healthcare Trust was formed, um that it was mostly, so, some areas of the country have had, em, much more of a community trust for a longer time. (**Interviewer: Okay. Mmm-hmm)** Whereas, in Birmingham it was formed when the, em, purchase provider split happened which was when it was still PCT. So, just before CCGs were formed. So, it was quite complicated medical politics **(Interviewer: Mmm-hmm)** but poor relationships that existed when there were PCTs have then been continued through. (**Interviewer: Okay. Mmm-hmm)** Em what has happened over the last, em, well, two years or so, there's been organisational mergers. Em, so, Heart of England, um, well, UHB merged by acquisition so in other words took over Heart of England Foundation Trust. Em, so, that's Heartlands, Good Hope, Solihull and Queen Elizabeth hospitals now all under one organisation, plus Solihull Community Services.

Interviewer: So, kind of, more harmonisation of the whole network, if you like.

Study support staff: Yeah. Yeah. One clinical commissioning group. So, the three CCGs, em, all merged to become one **(Interviewer: Mmm-hmm)** Em, changes in chief exec(utive), um, in the different organisations plus the mergers, um, and a real realisation of, the city can't keep working in this way cos it isn't working. We had a damning CCG systems review which was actually very helpful **(Interviewer: Mmm-hmm)** because it showed us everything that we knew **(Interviewer: was wrong)** was there. Um and it was confirmation **(Interviewer: Yeah, hmm-hmm)**. By the time they came in and did that systems review, actually we were really well on the way to, you know, sitting down talking together **(Interviewer: Hmm-hmm)**. So, em, when the CQC came and, sort of, did their, their summit, which is what they call it when they give you the result, they said that Birmingham is unusual and the first systems review where, actually, where actually, when they came in to do the, um, inspection, everybody was aware of what the problems were and actually how we were going to solve them. (**Interviewer: Mmm-hmm)** Em for an example, one of my meetings that I go to every Thursday, it, we have mental health, acute trust, community trust, CCG, GP contribution, we have our external partners Newton, and we are all sitting down together to solve the problems we're encountering in the system. Em, what we have all done together is um, and then the STP is very much an enabler for this. It's a good excuse for us to be able to do it. We'd, we may have got round to being able to do it without the STP but actually it's a good, you know, it's there as sort of a

driver and an enabler (**Interviewer: Yeah. Mmm-hmm)** So, what we're looking at doing is having front-door multidisciplinary assessment for older people accessing care at a point of crisis for them (**Interviewer: Mmm-hmm)**, um, and that's a, going with the evidence base that, all of the multidisciplinary teams only work when you have got senior clinical decision-maker presence in there. So, there's a lot of evidence that, where you have community teams that are just therapy-led or just nursing-led, they can do so much (**Interviewer: Mmm-hmm)**, but, actually (**Interviewer: Yeah)**, um, you know, it's having that senior clinical decision-maker availability. So, not involved with any, with every patient by all means, but just having that there. So, at the front doors of our hospitals having a multidisciplinary team that sits within the hospital because there are, we can get tests done quickly. We can get people assessed (**Interviewer: Mmm-hmm)** but actually sitting at the front door of the hospital and facing outwards. So, making sure that people only come in to acute beds if they genuinely need what the acute hospital offers. Then setting up community services almost to run a hospital at, at home and we're a long way from that yet but having, again, multidisciplinary, so, this person doesn't need to be in an acute bed but they need more than they have at the moment. Birmingham has been a very, very heavily bedded system. So, well, in some ways we say, "Oh, you don't need an acute bed, but, but we'll put you in one of our other beds." Again, it's getting away from that and saying, "Actually, this person should be in their own home." **(Interviewer: Mmm-hmm)** So, how do we build up the nursing and therapy teams to give antibiotics at home? To give, you know, one dose of IV fluids a day? If you picture it that, um, if somebody lives in their own home and say they already have, three care calls a day and their daughter might pop in, and their neighbour might pop in and they might have a spouse there with (**Interviewer: Mmm-hmm)** them and then we add in a little bit extra to enable them to have, perhaps, a bit of mobility input at home, that doesn't necessarily need to be from a physiotherapist after the first visit. You know, it could be a rehab assessment. Perhaps a nurse coming in to do some observations once a day. Maybe give her once-a-day medication (**Interviewer: Mmm-hmm)**. Compare that person to sitting on a hospital ward where they may be one of the least sick people there (**Interviewer: Mmm-hmm)**, where they're disabled so the toilet is so far away, there isn't a kitchen. So, they're not walking themselves to the toilet like they would do at home. They're not going to get their own drinks like they would do at home. We're actually providing a lesser level of support in an acute hospital than we would be by and enhanced community system.

Interviewer: Mmm-hmm, yeah. So, it's, kind of, nearly like a home hospital, if you like (Study support staff: Exactly! Yeah) **and integrated within the community.**

Study support staff: Yeah, and then looking for those who actually can't go straight home, em, to their own bed. How do we provide a level of intermediate care that provides what they need but is constantly focused on getting them home (**Interviewer: Mmm-hmm)**. Again, which has not been done, so, people go into our community beds and sit there. People were going in to the EAB beds out in the private care homes and sitting there for six weeks, nobody making any attempt to, eh, you know, for any enablement, any therapy input, any greater assessment of needs. We've already, so, we've seen, since we've been undergoing this, um, programme of work, we've seen massive increases in the number of patients being seen by the pre-existing

team at the front door here at the Queen Elizabeth, um, and we're now working on building that team so that we can meet our unmet, eh, need. Um, with the Norman Power centre, we've seen length of stay go down compared to the beds in care homes. We've seen…

Interviewer: That's the Norman Power that you…

Study support staff: Staying in Norman Power yeah. We've seen level of ability going up. So, more people moving more and that is both those having specific physiotherapy, so they've gone there with therapy needs, aims, but also those who have just gone there and don't need ongoing physio but just need to be encouraged to get up, move about and do that So, increased mobility levels. We've seen lower numbers of people going to long-term, so, permanent care. Higher numbers of people going back to their own homes and people going back to their own homes with lower levels of care than were anticipated when they went in to the Norman Power centre.

Interviewer: Okay. Yeah. Yeah.

Study support staff: So, it shows you what it can achieve.

Interviewer: Yeah, yeah. Mmm-hmm.

Study support staff: We haven't yet got the community teams up and running properly (**Interviewer: Mmm)**. We, it's not for lack of trying, em, we're further on than we were but that is our, our big (**Interviewer: That's the goal. Yeah.)** gap at the moment. But that's what we're going for. So, we're, we're seeing, you know, benefits from it already, and it's just really unfortunate that this piece of research got caught in the middle of it.

Interviewer: Yeah, yeah, got, got in the middle, exactly. (Study support staff: Yeah, yeah) **And is that, kind of, I suppose, the standardised, kind of, direction of the NHS trusts in England is going towards that more home-based care** (Study support staff: Yeah, so) **or is it…**

Study support staff: So there's examples where it's done really, really well. Um, up in Scotland, um, there's some, em, north side of Edinburgh I've got a colleague, um, em, Trish Canley, em, Cantley. She has a different surname on Twitter to she does at work **Both laugh*, um, but Trish runs a phenomenal 'hospital at home' service up there that I've been to see. There's little pockets down in Kent. Um, eh, Amy Peacock runs an awesome service down there, em, and little pockets elsewhere. We've got the, eh, long-term view, um, which is the national guidance on what needs to be done and a lot of that is acknowledging that acute hospital isn't the right place for many older people. The important thing on it is, previous governments, previous politicians, and, and they still do it every now and then, "Oh, old people shouldn't be in hospital," and that's not the case (**Interviewer: Mmm-hmm)** Old people who don't need to be in hospital shouldn't be in hospital (**Interviewer: Mmm-hmm)**. If you need to be in hospital, you, you, you know, you need to be here. **(Interviewer: Yeah. Mmm-hmm)** Um then, as, sort of, part of the enablers for the long-term plan, there's this, it's horrific. It's called Right Care and it's just, in some ways it's awful, but it's, em, and it's a bit too focused on, "Euwww, let's do a frailty

assessment," when you don't actually do anything about it, but we've actually got stuff coming out from the centre encourage, starting to encourage people to think this way. (**Interviewer: Mmm-hmm)** Em, it is the key bit in the, um, Birmingham Solihull STP Ageing Well strategy. It's in there. Um, within the Ageing Well, we've got our own little bit of, so, you've got the overarching STP strategy of which Ageing Well is one of the work streams, then within our Ageing Well work stream we've got much more detail on it. It's UHB's strategy, em, sort of, over the next five years to provide this front door care, but, you know, much more community **(Interviewer: Yeah, hmm-mmm)** focused. It, one of the big things it, well, it needs two things. So, it needs the workforce to do it. We've got a lot of that workforce. The workforce is used in the wrong place. The biggest challenge is mindset **(Interviewer: Hmm-mmm)**. So, many doctors, many senior clinicians feel that hospital is safe. They feel that somebody is safe if they are in a hospital bed and they're not **(Interviewer: Yeah)**. It's all about perceived control, em, and risk. One of the, um, big issues we're having with the community teams is understanding that and, and because of relationships within the system, the community have always seen, actually, "Well, if we don't like what's going on, well, we can send the person to the acute trust." **(Interviewer: Okay, yeah. I get ya yeah, mmm-hmm).** Em so, a lot of what the different work streams are doing, so, in all, we've got, sort of, five work streams. Um, they are having regular case review meetings where you'll have somebody from the Opal team at the front door, we'll have the early intervention community teams, those are the ones that aren't fully formed yet **(Interviewer: Mmm-hmm)**. We'll have somebody from the discharge hub. We'll have somebody from social work and it'll be, "Right. This person was discharged but then ended up coming back to hospital. Why?", and then looking at that with all the different partners in an open way without the previous ways of working which is always to blame somebody else **(Interviewer: Mmm-hmm)**, and that's a really good way of starting to draw, em, these things out. You, you can see which teams and which individuals are much further ahead in this thinking, but the actual mindset is important and then also the PR and comms we need to do for the people of Birmingham who have grown up and grown up, grown old, in a city which is bed-based. Which is, "You can't manage at home, we put you in a bed." **(Interviewer: Okay, yeah)** So, we've got a lot of expectations to manage there, you know, "Well, mum's not well and we're going on holiday." Well, actually, your mum's fine. You might be going on holiday but we are not going to admit her to hospital. That's a big, big, um, you know, change that **(Interviewer: Yeah, mmm-hmm)**, um

Interviewer: So, I suppose maybe kind of fitting into, kind of, a system similar to that would be nearly, this study would be better based kind of at that home hospital kind of setting, or…

Study support staff: At that, at that, sort of, you know, the interface that's slightly out of, em, out of the hospital. We've got three, three work streams within early intervention which are enabling all this, and one of them is prevention. That one's chaired by the local authority **(Interviewer: Mmm-hmm)** and it very much that, you know, much more traditional public health. So, keeping people fit and well at home. That's the em, you know, the healthy communities. All that sort of thing. We've then got early intervention which is where Opal and the front door and the discharge hubs and everything sit. So, it's, you know, something's

happened and the person is catapulted in **(Interviewer: Mmm-hmm)** and then we've got ongoing personalised support which is where, you know, this would sit. So, that's for the people who have got ongoing needs. You know, it's not just been a short burst. They're not completely well and independent again but actually how do we enable those people to be as well as possible and, realistically, people are going to dip in to different bits of those work streams at different times.

Interviewer: Mmm-hmm. Yeah. So, I suppose then, em, well, of the patients that should actually be in hospital rather than kind of are just put there, kind of (Study support staff: Yeah)**, because that's where people think they need to be, what would be, your opinion be on having an intervention like this on, maybe a less of a, less of a delayed transfer of care ward and more of a just a general, kind of, geriatric ward or…**

Study support staff: If patients are well enough to take place in this, part in this study **(Interviewer: Mmm-hmm)**, they are too well to be in hospital.

Interviewer: Too well to be in hospital.

Study support staff: They have needs that we should be able to meet with our in-house **(Interviewer: yeah, mmm-hmmm)** out of hospital services.

Interviewer: Okay, so you're saying, kind of, "If you're well enough to be able to do exercise, you're well enough to be at home."

Study support staff: Yeah **(Interviewer: Yeah, mmm)**, but having very much that, you know, level of import, input, and, you know, that programme availability at home whereas **(Interviewer: Mmm-hmm)** em, you know, things things have changed but let's go back, you know, six years. If I wanted somebody to have physiotherapy at home, we would put a referral in to the community physio team and they would go and they'd wait for twelve weeks **(Interviewer: Mmm, yeah, yeah)** for anybody to even come in and assess them **(Interviewer: Mmm-hmm)**. So, I had to keep them in hospital to have **(Interviewer: Yeah, mmm)** that going on in hospital because if I sent them home they would get nothing. (**Interviewer: Mmm-hmm)** What we're now able to do through, you know, hard work of colleagues in the acute trust, in the community trust working together thinking, "We can't do this the way we're currently doing," **(Interviewer: Mmm-hmm)** is actually to, you know, we're, we're, we're you know, we're able to do that. We're able to go home and know they've got a team coming in to them at home. It's not as well-formed as it needs to be yet but it happens now and six years ago it just didn't happen so we had to keep people in acute beds for any type of rehabilitation.

Interviewer: Mmm-hmm. It's obviously exciting times, I can kind of tell the enthusiasm (study support staff: It is!) **in your, in your voice when you're speaking about it…**

Study support staff: It is, and you feel that you've done absolutely nothing and got nowhere and then sometimes it's really helpful to be able to look back and think, "My god. It really was awful." **(Interviewer: Mmm-hmm)** I mean, ideally, this ward, as a delayed transfer of care

ward, shouldn't need to exist and what we're hoping is within the next few months, actually we'll go back to everybody looking after their own delayed transfer of care patients because **(Interviewer: Mmm-hmm)**, you know, it is much, much smaller numbers. I think, as well, in running a ward in this way, I've seen, so there are other colleagues who are absolutely not geriatricians who are really not skilled at this sort of thing (**Interviewer: Mmm-hmm)** That's, and I think, you know, we, we certainly provide a service for them because somebody will come to us and it will be, "Well, hang on, you know, X, Y and Z hasn't been sorted out" but you're a, you're an, you know, an organologist **(Interviewer: Mmm)**, and I wouldn't expect you to be able to do that. So, while we've got the person here, let's do that, you know, tidying **(Interviewer: Yeah, mmm-hmm)** up and that sort of thing. Em what I've seen over the last eighteen months, two years, is that fellow geriatricians who should be doing that sort of, you know, tidying up **(Interviewer: Mmm-hmm, yeah)** and neatening up of the edges, they're not doing it either. So, I think, you know, if you've got a, em, a way out of something, it's almost automatic isn't it, to take the **(Interviewer: Mmm-hmm)** slightly easier option for yourself. So, em I think we've certainly seen a little bit of that over the last couple of years, so, I would welcome us not having a specific in-hospital area for delayed transfer of care any more.

Interviewer: Mmm-hmm, yeah. So, em, I suppose then in terms of, well, the practicality of the study if you like and if we were doing another study and perhaps, well, we might not do it in this setting but a different setting (Study support staff: Yeah) **But what was, kind of, the practicality relating to your time commitment involved in the study? Do you think it was too burdensome? Em, perhaps you could be involved, integrated more into the initial design of the study might have been helpful.**

Study support staff: I did feel initially I wasn't listened to.

Interviewer: Okay. In what aspects, in what regards?

Study support staff: Em so, I was saying at the start of this that, em, you know, what was happening **(Interviewer: Mmm-hmm)** and why this might not work **(Interviewer: Mmm)**, um, and not by you, but by other people **(Interviewer: Okay)** included in the study. I was not listened to. **(Interviewer: Okay, mmm-hmm)** Em…

Interviewer: You think it was, kind of, maybe pushed through with, kind of (Study support staff: Yeah.) **that conception, rather than a different kind of conception (**Study support staff: Yeah, yeah) **and I suppose what, what, em, what, well, I suppose actually that's not really a question… em, what kind of alterations would you, would you make now, kind of, well, you've said now it would, kind of, be more, I guess, not within this setting (**Study support staff: Yeah) b**ut, at the time, that was, kind of, your perception as well?**

Study support staff: We would have been able to, we would have been able to get this set up out in Norman Power.

Interviewer: Ah, okay, and Norman Power is a.. care home, is it?

Study support staff: No. So, Norman Power, so, there were four centres built by the local authority about eight, ten years ago to really, really high spec **(Interviewer: Mmm-hmm)**. So, Norman Power is based up at Five Ways. We've then got the Kenrick Centre which is about a mile down the road **(Interviewer: Mmm)** from QE. We've got Anne-Marie House, em, and Perry Trees. Perry Trees is Erdington and Anne-Marie House is Castle Vale. So, they fit with the four, so, em, they fit with City Hospital, QE, Heartlands and Good Hope **(Interviewer: Mmm-hmm)**. City Hospital is a whole different political set and we haven't, haven't resolved that bit yet. The, em, these areas, these buildings have got 32 beds upstairs, 32 beds downstairs. They're all en-suite. They've got big gyms. They've got big communal areas. They're built within communities with areas to invite communities to come in to them **(Interviewer: Mmm-hmm)** as well. Um, Kenrick Centre has been run several different ways and there's a covenant on the land, which is what limits it somewhat but they have downstairs as a care home for people with dementia and upstairs has been, well, labelled reablement, but actually much more convalescent cause they've been really unable to take anybody with any needs **(Interviewer: Mmm)**. Um, Anne-Marie House and Pemy Trees have both got care home beds downstairs and upstairs, um, is, sort of rehabilitation, sort of intermediate care, run by Birmingham Community Healthcare Trust but without much doctor input. So, just GP input. Kenrick Centre had been mothballed. It was empty, completely empty for eighteen months. (**Interviewer: Okay. Right *Both laugh)** Um, UHB went in and took the upstairs and we ran it really as a, I'm calling it "winter pressures" but it was for people to, who just needed a bit of therapy, didn't meet community hospital rehab criteria **(Interviewer: Mmm-hmm)**, to actually go out there and have some of that therapy whilst not being in an acute bed and it's fair to say that those people are already the ones who are now having it in their own home. And then, once we got it back online and up and running, it became our test site through the early intervention work for how do we look at intermediate care differently across the city. So, the work that we've done at Norman Power so far is actually informing, um, we're looking at intermediate care beds across the city. So, that's ones in the other care centres, it's the ones with community hospitals. So, West Heath and Moseley Hall **(Interviewer: Mmm-hmm)**, it's CU27, which is a ward out at Good Hope hospital which always sounds a bit like an insult to me (**Interviewer: Okay. Mmm-hmm)** Um and a, and something they've, yeah called Homeward, which is downstairs from CU27 but, again, it's basically intermediate care **(Interviewer: Mmm)**. So, we're, you know, we're taking that knowledge and using it to, what do the people of Birmingham need **(Interviewer: Mmm-hmm)** to provide, you know, this, sort of, step away from hospital which isn't the perceptions of the staff working within the system and what we've always done is actually what, what do people need **(Interviewer: Yeah)** to get them back, and as independent and well and at home **(Interviewer: Mmm)** as quickly as possible.

Interviewer: Yeah. So, there's kind of maybe a, is there, patient and public involvement in (Study support staff: Massively) **kind of designing that yeah?**

Study support staff: Yeah. So, um, eh, the joys of doing anything with the local authority means you can't, em, you can't not have, um, patient, public involvement. At the moment we're doing a lot of it. So, there's, um, we have health watch involved, um, who were doing quite a lot of that representation because also we know that when you take things to, um, when you have,

em, PPI involvement, it's important to get it at the right time. So, the ideas have to be, sort of, very formed **(Interviewer: Mmm)**, but also, we, you know, we are doing something radically different across the city and if it's something that the healthcare professionals are feeling uncomfortable with, which, you know, we know they are, so, discomfort in its, that it's so different **(Interviewer: Mmm)**. So, there were lots and lots of workshops and consultation events and where you really get the staff able to say what they want, the messages that are coming out are absolutely the same. So, it's, it's person-focused. So, whether we're using the term "patient" or "citizen", depending on who's doing it, but it's person-focused. Enabling that person to be at home. One team working around them. Not all the hand-offs from, you know, one team to another team and then all those delays. Nobody rejecting referrals saying "Oh, they don't meet our criteria." It's absolutely getting rid of all of that. **(Interviewer: Mmm-hmm)** So, everyone's signed up to it but then when it comes to actually doing it and having to work in a different way, that's where, um, eh, so, we have, em, we've been working with Newton Europe, who are a healthcare consultancy but not in the same way as, as the big five, um, and what they've been doing with is helping us with that organisation development. That, that delivery. That having the, so, the ideas come from up here **(Interviewer: Mmm-hmm)**, um, but the actual designing how to deliver those ideas is done by the teams working on the ground. **(Interviewer: Okay. Kind of ground, yeah. Mmm-hmm.)**, and that's the really important way and that's why it's working. Why we're, we're starting to see, see changes already.

Interviewer: Fantastic. Em, so I suppose then in terms of a future study, even if it was kind of based in participants' homes, what are kind of some of the considerations, well, with this study, that you see, maybe, in the time commitment involved of participants? Do you think that, you know, they, they kind of, they have the time to do a couple of hours of questionnaires beforehand and then also to do the training every single day or…

Study support staff: Certainly not the staff working in the service.

Interviewer: Oh no, this, this would be the, this would be the, the parti…

Study support staff: The research team.

Interviewer: Yes. The research team will come in to be separate to the staff in the service.

Study support staff: There would be absolutely no reason that wouldn't be possible. So, it would be similar on here really. So, you'd want the community teams, the teams in, in the em intermediate care beds, you know, identifying people who are likely to be suitable. Um, no, I see that it would be entirely achievable. **(Interviewer: Okay)** We've also split the city up into em, eh, very logical geographical areas **(Interviewer: Mmm-hmm)** Um so, all of the, all of the work across health and social care, um, we split the city up. So, Solihull, um, is on its own, um, and then it's paired constituency wards, um, but logically that fit in with the type of populations because if you get to know Birmingham **(Interviewer: Mmm)** it's a big, big city but it's like lots of villages (**Interviewer: Yeah. Yeah. Mmm-hmm)** Um and you can, you can, you know, you can almost draw a line **(Interviewer: Yeah. Yeah)**, um down them. So, these paired constituencies, 250,000 people per paired constituency. So, a really manageable

size **(Interviewer: Mmm-hmm)**. Um, the local authority have gone for, sort of, two neighbourhood network partners to deliver, you know, the, or coordinate the voluntary services. You know, make sure all of that's provided (**Interviewer: Mmm-hmm)** The primary care networks fitting within that. The community trust and mental health trust are changing their boundaries for the services that they deliver to fit within the paired wards **(Interviewer: Mmm-hmm)**. So, again, in terms of having researchers having to travel a lot, you wouldn't. You'd say, "Right, you're Edgbaston. You're Northfield." **(Interviewer: Yeah)** You know, it's **(Interviewer: Yeah)**, you've actually got that logical **(Interviewer: Mmm-hmm)**, um, sort of, cohesiveness as well and, um, and the interesting thing would be perhaps you would see what worked for people in the south of the city might work differently for those, em, out in… **(Interviewer: Mmm-hmm. Maybe different cultural considerations or)** Absolutely. Um, and it would be a really exciting piece of work. So, you've got the same aim, so, we want to be able to deliver resistance training **(Interviewer: Mmm)** for older adults **(Interviewer: And Birmingham's kind of the perfect, maybe, setting for that because it is such a diverse kind of…)** Yeah, and you could have two separate research, you know, one study but you could have somebody based in the south **(Interviewer: Mmm-hmm)**, um, and somebody based East Birmingham **(Interviewer: Mmm-hmm)** and actually what works for those different **(Interviewer: Yeah)** communities. What is the better way of delivering it? **(Interviewer: Mmm-hmm)** You know, and that would be really, really interesting.

Interviewer: Yeah, it would be. Definitely. Em, yeah so, I think that's, that's pretty much all of our questions. Em, so, are there any closing comments or any, anything you'd like to mention about any aspect of the study, kind of, before we finish?

Study support staff: Em well, we know it's such an important piece of work. You know, we've got all the stuff coming about the importance of resistance training in older adults. **(Interviewer: Mmm-hmm)** You know, it's actually being understood. Nobody's really cracked, and it's easy how you do that with the fit, well, active cohort, so, those who fit within that **(Interviewer: Yeah)** prevention **(Interviewer: Mmm-hmm)** circle because those are quite often well-motivated people. The fact that they're living in, you know deep old age at that level of, sort of, fitness **(Interviewer: Mmm)** and healthiness more, obviously not in every case, but more often than not these are people who the way they live their lives **(Interviewer: Yeah, mmm)** incorporates exercise. **(Interviewer: Yeah)** Um they probably don't label it as exercise, but that's just how they **(Interviewer: Yeah)** live and how they've always lived **(Interviewer: Mmm-hmm)**. Um, it's cracking that nut. Getting to the group who, em, either they did used to do it and then they've, and they're no longer able to because of circumstance or ill-health **(Interviewer: Mmm-hmm)**. So, those are the sort of people who are likely to grasp and go "Oh, I can do that. I can, perhaps, start feeling me a little bit more." um, but getting a possibly exercise naïve group, you know, actually doing something and then seeing the benefits **(Interviewer: Mmm-hmm)** from it (**Interviewer: cause they're the eh…)** because they will see benefits **(Interviewer: Yeah)** from it, and yeah it's whoever can crack it **(Interviewer: Mmm-hmm)** is definitely on to a winner. **(Interviewer: So, its nearly a behaviour change kind of thing, in a way)** Well it's, it's a bit of both really **(Interviewer: bit of both yeah)**. Yeah, it's sort of behaviour and, um, yeah, it's the whole thing of getting people

to understand that exercise is actually good for you **(Interviewer: Mmm-hmm)** and it's never too old to start **(Interviewer: Mmm-hmm)**. And then also you have the, um, don't you? You have families that go, "Oh well, you know, just sit down, mum. You don't need to do anything. **(Interviewer: Yeah)** Just take it easy," and it's actually we're like, "No. Up. Do as much as, you know, do as much as you're absolutely able to do," which is where, perhaps, this programme would fit in because it's seen as nice and safe and medicalised and under control **(Interviewer: Mmm-hmm)** but actually could be that, sort of, you know, useful bridge in perhaps changing some of the **(Interviewer: Yeah)** attitudes of the relatives of the people **(Interviewer: Mmm-hmm)** you want to do the intervention with rather than just the people…

Interviewer: Yeah, and I suppose, well, what are your thoughts or do you have any specific thoughts on how that might be achieved in a more home-hospital setting? Any kind of ideas in your mind or…

Study support staff: It's just talking to people. (**Interviewer: Just talking. Yeah. Just kind of…)** Talking to people. Showing people that it works. It's that start small and then (**Interviewer: Yeah. Mmm-hmm)**
kind of and then, yeah roll it out.

Interviewer: That's pretty much us finished then, unless you have anything else.

Study support staff: No. No.

Interviewer: Okay. Perfect.

***Audio ends**

Interview transcript: Study support staff interview (1004) – Specialist register (F)

Setting: Junior doctor's office on the Harborne ward.

Audio commences.

Interviewer: Alright, so, em, thank you very much for being here, em, at this interview and for your help thus far with the study. (Study support staff: No problem) **So, the purpose of this interview is to get your opinion on study and its various aspects from its practicality and integrations of the ward to the impact you believe it's had on participants. So, as mentioned previously, this interview will be recorded for future reference, and anything you say may be used in a future publication or report, however your name will not be included. If this is okay with you, whenever you're ready, we'll begin.**

Study support staff: Sure.

Interviewer: Okay, perfect. So, em, okay, so I suppose let's start off kind of quite broad. What were your general opinions, kind of, on the study or having exercising interventions on the ward when you maybe first heard about it?

Study support staff: We were very excited and glad **(Interviewer: Mmm)** and we were thinking that patients will be probably much more motivated and it, when the staff will be much more motivated to get involved and we'll be getting, but we were mindful that, probably because of the nature of the patients here, we might not be able to catch too many patients into the trial **(Interviewer: Mmm-hmm)** because of restriction of their psychological and mental health problems, rather than physical health problems **(Interviewer: Mmm-hmm)**. But, if they do, it depends on, their mood from day-to-day basis too, but they all were very excited **(Interviewer: Mmm-hmmm)** and surely would want to know the results **(Interviewer: Mmm-hmm)** and how many can be recruited.

Interviewer: Mmm-hmm. So, em, then I suppose now that the study's, kind of, completed if you like, how would you, kind of, assess the suitability of the setting, em, to the study? Is it, kind of, maybe the best setting in the hospital for this or would it belong somewhere else?

Study support staff: Mmm the good thing is that it was within the ward **(Interviewer: Mmm-hmm)**, taking them off the ward might be, em, a little bit, they feel a bit more apprehensive **(Interviewer: Mmm-hmm)** and so it has its, probably, pros and cons. But, I think it was well suited being in the ward with their familiar staff surrounding them around **(Interviewer: Mmm-hmm)**. So, and, and it's a bit, a quiet ward, em, so they can get easily some time out, eh, in much more spacious environment. **(Interviewer: Mmm-hmm)** and we do have the room available **(Interviewer: Yeah, mmm-hmm)** for that as well. **(Interviewer: Yeah)** Em, which is a bit quieter, in the quieter area of the ward **(Interviewer: Mmm-hmm)**, so, probably with

that it was, fine **(Interviewer: Yeah, you'd want it, you'd want it close to the participants. Yeah. Mmm-hmm)** Yeah, rather than, em, like, **(Interviewer: Yeah, transfer, yeah)** we do have to, sometimes take patients to other wards or other places, um, and then be land into any trouble and we are being called there, so there was in our mind as well, that they are here **(Interviewer: Yeah)** if needed for anything **(Interviewer: Mmm-hmm)** they are just close by.

Interviewer: So, so, how do the, the patients on Harborne kind of differ from, I suppose, the rest of the hospital in terms of the geriatric, the general, kind of, geriatric population.

Study support staff: The general notion is throughout the hospital, it's a dementia specialist ward **(Interviewer: Mmm-hmm)**, which in a way, it is. So, most of the patients who are here are having their diagnosis of dementia, they've been made already or in the process of getting it done formally. They do have their limited cognition, limited functioning, in terms of their mental and psychological health, and many of them do depict challenging behaviour **(Interviewer: Mmm-hmm)** so, they are difficult, to… handle, if we say **(Interviewer: Yeah)** in various ways, from medics' point of view, from nursing point of view and from therapist point of view as well. Because their cognition is quite limited along various areas **(Interviewer: Mmm-hmm)**, it's difficult to communicate with them, eh, so it's much more relying on very simple, basic language. Em, sometimes just prompting them or using other clues or body language or, em, sometimes we mostly rely on relatives because they know, or the carers who know the patient best **(Interviewer: Mmm-hmm)** to be there because they could be really anxious or angry or unpredictable. So, in Harborne, the main difficulty with the patients is their unpredictability **(Interviewer: Mmm-hmm)** in terms of mood and, getting their trust and cooperation is quite difficult **(Interviewer: Mmm-hmm)** and challenging. Em, so, when, when they are in a good mood, it's a bit easier. **(Interviewer: Mmm-hmm)** and when they are not in a good mood, it could be really difficult along all areas. So, simple things like when changing them, feeding them, examining them from doctors' point of view could be really hard **(Interviewer: Mmm-hmm)**, but, the staff is quite well trained for those, sort of, patients **(Interviewer: Yeah)**, so I think we don't get those, as big problems with similar patients as compared to when they are in any other ward **(Interviewer: Mmm)**. So, em, I've worked in other acute wards as well, in there we would be sending any patients which is a bit difficult in terms of behaviour **(Interviewer: Mmm-hmm)** straight away to Harborne ward (**Interviewer: Yeah *Both laugh*)** That was of a notion before **(Interviewer: Yeah)**, but obviously there is a criteria. If they match that criteria, to come to the Harborne ward then they are, em, put on the waiting list **(Interviewer: Mmm)**, otherwise not.

Interviewer: So, I suppose, kind of, the mains thing kind of Harborne is more challenging patients, if you like (Study support staff: Behaviour…**), that's the common thing.**

Study support staff: … yeah, rather than medical issues, it's much more their behaviour issues **(Interviewer: Mmm-hmm)**. Em, and social issues.

Interviewer: Mmm-hmm. Em, okay, so, I suppose what, what would your opinion be, so obviously we've had the intervention here for the study, but what would you opinion be in, kind of, having something on the ward full time, like this, em, for the patients? Or perhaps you think might be more suited to a less, kind of, challenging ward or more general ward, or?

Study support staff: I think it will be, be difficult **(Interviewer: Mmm-hmm)** for having full time here **(Interviewer: Yeah)**. Purely because if we find out how many patients would be suitable, there will be verrrry few (**Interviewer: Yeah, mmm-hmm)** and eh, now, because, acute patients have started to come in the ward as well, so either they are medically limited by their acute illness **(Interviewer: Mmm)**, or they are, em, functionally limited because of their behaviour issues **(Interviewer: Mmm-hmm)**, and on the other hand, previously, patients used to be here for a very good, long period of time **(Interviewer: Mmm-hmm)**, but now with social services moving a little bit more faster **(Interviewer: Mmm-hmm)**, we are moving along the patient towards discharge much more quicker. So, the turnover has increased, but at the same time, eh, the, the nature of the patients remain the same.

Interviewer: Mmm-hmm, yeah. So, em, what, what are your, kind of, general opinions on the, the implementation and the integration of the study onto the existing practices and procedure in the ward? So, I suppose in your role, I know you only identified participants, a couple of times, em, was it, kind of, burdensome, perhaps to you or, is there anything…

Study support staff: Yeah, em, we need to put more dissemination with the new staff **(Interviewer: Mmm-hmm)** as well, because I think most of new staff didn't really know **(Interviewer: Yeah)** much about the study **(Interviewer: Mmm-hmm)** and, like were meeting yourself, mostly, in the MDT **(Interviewer: Mmm-hmm, yeah)**, and around the ward, probably more information dissemination will be helpful **(Interviewer: Mmm-hmm)** so that everyone knows why it was being done **(Interviewer: Mmm)**, what to look out for the patients, then we can, even all the staff will be helpful to find out the right **(Interviewer: Yeah)** probably recommend who is more suitable **(Interviewer: Mmm-hmm)** It will be much more easier if new patient has been transferred, we haven't seen them yet so we won't be able to identify (**Interviewer: Yeah)** Then, em, I didn't feel I have contributed much as I could have done **(Interviewer: Mmm-hmm)** but probably it was, em, all of the responsibilities I didn't thought of em, it as my responsibility **(Interviewer: Mmm-hmm, yeah, yeah. Of course, yeah)**, I just was, when available, I would contribute. **Interviewer: Mmm)** otherwise not. But, if, if it's been actively my role, I would be feeling much more responsible **(Interviewer: Yeah)** and be productive. (**Interviewer: Yeah)** and then, em, I think the staff has started, there were many changes in between **(Interviewer: Mmm-hmm)**, that is why things were a little bit unsure. (**Interviewer: Mmm-hmm)** But now, if, we have a good background and we know we have the new staff, a lot of new staff now **(Interviewer: Mmm-hmm)**. So, if we do include it in ward meeting, we do have regular ward meetings it's on the agenda to identify and help in the identification of such patients which could be recruited, and then contacting you or a designated member of ward staff who is regularly here, then we can, em, let you know via them

(**Interviewer: Yeah)** So, it, yeah, incorporated into the ward meetings, everybody knows more about it.

Interviewer: Yeah, yeah, exactly, Em, so I know you mentioned, kind of, about the practicality about the study that a lot of the patients, kind of, or some of them have functional impairments, a lot of them have more cognitive and social, kind of, difficulties, if you like. Are there any other, kind of, em, practicalities about the study on the ward which you, kind of, you perhaps have in your mind or if there's anything, just practical or aids impracticability? Or that's, kind of, the general-, the main, general things, I suppose?

Study support staff: Yeah, again, it's a bit difficult **(Interviewer: Mmm-hmm)** with this kind of patient **(Interviewer: Yeah)**. It's unpredictability of their behaviour **(Interviewer: Mmm-hmm)**, so it can be really challenging and **(Interviewer: Mmm-hmm)** I, I, I think, em, and we get to know them, we take a little bit of time when they are new to the ward **(Interviewer: Mmm)**, we really don't know much about them. Even they have been in the hospital since long, but still, we are quite, eh, having limited information about them, and we rely on background history a lot and collateral history a lot. And most of the times, we feel that, even staying in the hospitals since a month, the very general information which we wanted, it's still missing. So, we don't know them much, we don't know about them much. So, it's like taking things from scratch again. **(Interviewer: Mmm-hmm, yeah, mmm-hmm)** So, we are limited in our own way. Em, so if we know the patient much more, detail their routines, their likes, dislikes, then probably we can establish the rapport much more quickly. And then we can, em, seek their consent a bit more. **(Interviewer: Mmm-hmm. So, perhaps that's, em, more suited to perhaps less challenging patients, it would be fair to say, or?** Yes, probably, yeah. (**Interviewer: Yeah. Mmm-hmm)** Yeah, because with really challenging patients on Harborne, I don't think so they are suitable at all **(Interviewer: Mmm-hmm)**. Em, we can hardly do their very basic stuff, so getting something like that **(Interviewer: Yeah, yeah)** will be nearly impossible **(Interviewer: Mmm-hmm)**

Interviewer: So, em, if you were to design a future study to take place in a similar setting, em, to this, what kind of alterations, perhaps, would you make? Or, perhaps, the setting would be an alteration that you, you'd even make…

Study support staff: I would probably look into what kind of results we got from this study **(Interviewer: Mmm-hmm)**, what, what are our limitations **(Interviewer: Mmm-hmm)** and try to maximise our, our, find out our restrictions there. **(Interviewer: A design that's based on that. Yeah, mmm-hmm)** So, it's, it's just the very beginning and it will be definitely telling us that what were the errors we can, em, counter in the next study if we are planning to, but, I can't imagine it's, it's different and difficult **(Interviewer: Mmm-hmm)**, em, and it's the unpredictability, you really, if you're planning anything and things are not according to your plan **(Interviewer: Mmm-hmm)**, you have a back-up plan somewhere, but for such, kind of, patients, at times you really can't design a back-up plan, even. And then how soon they are gonna be discharged is beyond our control, as well. Because sometimes, eh, we are waiting,

awaiting a nursing home or a care home (assisted living facility) will be coming to assess them, there are funding issues, budgeting issues, em, social services won't keep us updated, and all of a sudden we come to know that there is a place available for them. Within few hours, matter of a few hours, even over the weekend, they are gone. **(Interviewer: Yeah, mmm-hmm)** So, ugh we are not even prepared for that discharge at that time **(Interviewer: Mmm-hmm)**, so similar is with any studies. If we are thinking that we'll be taking some readings or we'll be taking them again, by the time you'll be back, they have gone **(Interviewer: Yeah, mmm-hmm)**. So, it's the unpredictability of not just only the patient, but the discharge planning as well, which is beyond our control due to various factors. Em, one of them is communication with the social services **(Interviewer: Mmm)**, which at times is good if you keep nudging them, and at times it's, it feels like we are two separate departments rather than having everyone together. And at times, it's, from the settings, discharge plays itself that we are not sure that how soon they will, there will be bed available (**Interviewer: Yeah)**, including many of the EAB (transitional care) and other places, where, as soon as we get the hint that it's ready, they'll be just transferred (discharged) without any delay. (**Interviewer: Yeah, mmm-hmm)** So, we can't… (**Interview: Yeah, I think, I think that is something we've noticed, yeah, kind of, we'd recruit some people and then we go to come in the next day and, yeah, they'd just maybe gone, or we give out information sheets, someone says they're interested, and then (**Study support staff: They're disappeared) **the next day they're gone)** So probably, if it's in your domain, you can still follow-up them there? Em where they go if that's in part of your study?

Interviewer: Yeah, we did want to, but we, we couldn't get ethics for that, yeah.

Study support staff: Right, ah yeah.

Interviewer: Initially, yeah, because it's, kind of-,

Study support staff: Yeah. Once they are out of your area.

Interviewer: Yeah. If it was a different research site and we didn't know where we're going, so it's kind of, yeah

Study support staff: Yeah, so, we can easily lose, and they will be the one who will be going first as well, because they are not challenging, they are functionally well (**Interviewer: Yeah)** cognitively well (**Interviewer: Mmm-hmm)** they are medically fit, they can take part, so those are the one who should be going away.

Interviewer: Yeah, the patients that we might be able to get (Study support staff: Yeah) **are the ones that leave first, yeah, mmm-hmm. So, I suppose, em, are there any aspects that you wouldn't change, you know perhaps something related to the int, so for example, do you think that the intervention's, perhaps, if you were able to get participants perhaps from elsewhere, do you think it's something that would be beneficial to them in any way?**

Study support staff: It certainly should, yes, because most of them are quite keen that, if they get a, kind of, em little bit targets to, em, walk or get out of the bed, which is not always possible with the staff, because they're so much busy in their own routines (**Interviewer: Mmm-hmm)** and, em, eh, the care element of that, so perhaps we can happily send them over (**Interviewer: Mmm-hmm)** in, kind of, practising more. (**Interviewer: Yeah.)** and I think they will be quite keen and entrusted to come (**Interviewer: Mmm)** and they will be certainly, and by looking at such patients, either would be quite motivated and I would say that's something really interesting (**Interviewer: Mmm-hmm)**, would be beneficial for them in terms of their motivation.

Interviewer: Yeah, definitely. Em, so, any, I suppose, are there any closing comments, that you'd like to make about any aspect of the study before we finish that we haven't, kind of, touched on previously?

Study support staff: I think we, we were good, as we could in our own limitations, it's not that easy. When we see from the outlook, we can plan a lot of things, but when we look into the type of the patients and all limitations, at the end of the day, we'll be recruiting a very few.

Interviewer: Yeah, so perhaps it's nearly, we, we, kind of, had the hardest participants to, kind of, try and recruit them as well. In terms of the general…

Study support staff: That's right, yeah. Yeah. So, I think, still, it was quite good, even to know this.

Interviewer: Mmm-hmm. Yeah, no, that's, eh, that's perfect, unless you have anything, eh, anything else you want to add, we can stop it there.

Study support staff: No.

Interviewer: Okay, perfect.

Audio concludes

Interview transcript: Study support staff interview (1005) – Consultant geriatrician on acute side of the ward, which was established several months prior to the conclusion of the study (F)

Setting: Side room on the Queen Elizabth Hospital Birmingham

Audio commences.

Interviewer: Okay. So, em, thank you for being here for this interview and for your help thus far with the study. Eh, the purpose of this interview is to get your opinion on the study and its various aspects from its practicality and integration to the ward, to the impact you believe it has had on participants. As mentioned previously this interview will be recorded for future reference and anything you say may be used in a future publication or report, however your name will not be included. If this is okay with you, whenever you're ready we'll begin.

Study support staff: That's fine. Yeah.

Interviewer: Okay. Okay, so I suppose I'll start off quite broad. So, when you first heard about the study, what were kind of your initial impressions?

Study support staff: Em, I wondered how many patients, particularly my acute side of the ward would be eligible **(Interviewer: Mmm)** or, em, practically able to participate. Em, I suppose there was a concern that those that were, probably weren't going to be in hospital long enough for the follow-up for the study **(Interviewer: Mmm-hmm)**. Em, but from a, I think from a patient point of view the days on the ward can be quite long and monotonous, and actually I think a lot of them embraced having a discussion, about something, for them, a little bit off the wall, something they possibly weren't expecting when they came into hospital, em, and the few that were cognitively able to engage, I think quite enjoyed it.

Interviewer: Mmm-hmm. And you mentioned that, em, so your patients are, kind of, the acute side of the ward (Study support staff: Yes) **so maybe could you kind of describe kind of the general type of patients you would have or perhaps it varies so much?**

Study support staff: Em, so they're a very heterogenous group **(Interviewer: Mmm-hmm)**, em, but my, em, part of the ward are the acute geriatric patients or those with acute medical problems, so it can be anything from, em, delirium and an infection to, em, progression of a chronic disorder, whether that's dementia or any other, eh, chronic process, em, it can be anything it's so varied **(Interviewer: Mmm-hmm)**, it can, it may be organ specific or it may be more general, em, any organ system can be affected.

Interviewer: Mmm, and they kind of, they vary in terms of cognition and things like physical function, or are they kind of nearly…

Study support staff: Yeah, so they can, so they can have, em, cognitive impairment, be that a delirium so acute or more chronic in a dementia type process. They can be, em, functional so they might have em come in with a em, fall or reduced mobility, they can just be acutely unwell **(Interviewer: Mmm-hmm)**, so whether that's, eh, pneumonia, urinary tract infection, constipation, em, MI. It's **(Interviewer: It varies so much, yeah)** so varied what comes onto my side of the ward, yeah **(Interviewer: Mmm-hmm).**

Interviewer: Alright. So, em, how would you assess was the suitability then of this type of study; exercise interventions within this type of setting, eh, delayed transfer of care (delayed discharge) slash, kind of, acute, or post-acute ward.

Study support staff: Eh, so, I think for the delayed transfer of care patients I don't know from your results what, em, what percentage of my patients and the delayed transfer of care patients were suitable **(Interviewer: I think…)** and you actually got to… **(Interviewer: I think it might have only been one, one of your patients I think during the whole study** (Study support staff: Yeah)**, yeah, so, and actually they had moved over to** ***(names other geriatrician on the ward who oversaw delayed transfer of care patients)***

Study support staff: Yeah, yeah. So, and I think my guess as to why that was the case was probably because, em, whilst they're in hospital they're acutely unwell **(Interviewer: Mmm, yeah)** and therefore practically, whether that's from a cognitive or a functional viewpoint, not "well enough" in inverted commas to participate in a study **(Interviewer: Mmm-hmm)**. Whereas the 'detoc' (delayed transfer of care) patients can be functionally, physically, em, a bit more capable and have got a little bit more time, but cognitively usually not quite as capable, em, I don't know whether that would be true from your observations.

Interviewer: That's kind of what we found, yeah. (Study support staff: Yeah) **Maybe your participants might've been a bit more cognitively aware but obviously not medically** (Study support staff: Physically less, yeah) **fit to participate. Delayed transfer of care were, kind of, well they're delayed transfer, I suppose, for a reason** (Study support staff: Yeah) **which is usually, you know, advanced cognitive impairment, or behavioral issues** (Study support staff: Yeah)**. So, em, so what would your opinion be on having an intervention like this on the ward long term for participants or do you think perhaps it's better suited to a different type of setting?**

Study support staff: I think it would probably, I'm not saying you couldn't do it in an acute trust, and the way that, em, there's ward moves afoot, so we're going to lose our delayed transfer of care ward **(Interviewer: Mmm-hmm)** which will mean that every ward within the hospital that is currently an acute ward will end up with their own delayed transfer of care patients on their ward **(Interviewer: Mmm-hmm)** and I think an exercise intervention such as this has a value because there is a risk while patients remain in hospital that once they've completed their medical intervention, they've completed their therapy intervention, actually there's a risk they stagnate and functionally de-condition whilst in hospital **(Interviewer: Yeah)**, or awaiting whatever it is that's stopping them from, from leaving. So, I do think it has a role, and could

probably be more-wider **(Interviewer: Mmm-hmm)** but it's about patient selection I suppose, isn't it?

Interviewer: Yeah, mmm-hmm. Alright, so I suppose, em, in terms of the practicality, what was your opinion on things, like, the time commitment involved in your role in the study? I think it was, eh, kind of a fairly minimal role, you know…

Study support staff: Minimal **Both laugh* (**Interviewer: Yeah, yeah I think I might, might have talked to you just a few of times since you joined about certain acute patients** (Study support staff: Yeah)**, but, em, I suppose maybe more generally how do you, kind of, think it could work, or did work you know, with someone on the ward, em, looking for, you know, either senior nurses or geriatricians to, kind of, you know, screen patient every few days and say, "Oh, I think they'd be suitable for this type of study." Eh, what do you think are the practicalities around that?**

Study support staff: I suppose it's, it will all depend what your, what your screening tool is.

Interviewer: Mmm-hmm, eh yeah well in this study you know it was mostly just, kind of, (Study support staff: function) **if they had the functional ability to, kind of, go down** (Study support staff: Yeah) **to the machines, or engage in the bed, and the cognitive ability to, kind of, follow basic instructions** (Study support staff: Yeah)**, so, and just, kind of, be a, I'm sure, well they would nearly have it off the top of their heads, if they knew the patient.**

Study support staff: Em, yeah, I don't see why they couldn't do it and, em, certainly the way that, em, *(names other consultant geriatrician on the ward)* and I would identify patients would tend to be in the MDT **(Interviewer: Mmm-hmm)** Em, so em, there's no reason the staff nurses or the junior doctors, the ward team, wouldn't be able to otherwise identify patients.

Interviewer: Mmm-hmm. Alright, so, then in terms of the time commitment to the patients themselves, do you, kind of, foresee that being an issue or within this present study, did you kind of foresee it being an issue, kind of, coming in?

Study support staff: Just remind me what the time commitment was…

Interviewer: The time commitment was, so a couple of, well two to three hours, kind of, at baseline (Study support staff: Yeah)**, there were questionnaires and measurements** (Study support staff: Yeah), **and then it was, em, ten intervention sessions throughout a two-week period or however long they're on the ward and then following up with several hours of testing afterwards.**

Study support staff: I mean, because I only had the one patient **(Interviewer: Mmm-hmm)**, who was then under *(names other consultant geriatrician on the ward)* going to the study and I didn't personally **(Interviewer: Yeah, it's)** have any direct feedback from them (**Interviewer: yeah, difficult to say, yeah)** Em, based on what you've told me, I would have thought for a lot of our patient cohort that that's probably, em, more than they could manage

(**Interviewer: Mmm-hmm, yeah. Just in terms of the time, or?)** Yeah, probably in terms of the, em, both the concentration that's required to fill in the assessments and then for the physical bit. If, I think if it was a different group, then potentially you'd have more patients that would be eligible **(Interviewer: Mmm-hmm)** or would manage it. So, I can't, I think, em, because I work on the surgical wards as well and a lot of those patients will take part in research studies but their time commitment is quite short so the face-to-face at the start might be fifteen, twenty minutes **(Interviewer: Mmm-hmm)** and then everything else, although it's not a physical intervention a lot of the time, a lot of that will be very short, kind of, aliquots of time quite, quite, quite regularly and I think some patients might cope with that a little bit better **(Interviewer: Mmm-hmm)**. Em, and you might, well, I don't know, I don't have any evidence for this but you might see more carry-over between sessions.

Interviewer: Carry-over in terms of?

Study support staff: In terms of, eh their cognitive and functional ability between sessions **(Interviewer: Ah, okay, mmm-hmm)** A bit like, well you're a physio by background aren't you?

Interviewer: Well sports science, yeah

Study support staff: Sports science, yeah. So, em, the physiotherapists for example tend to do quite, em, short focused therapy sessions with patients **(Interviewer: Mmm-hmm)**, em, so they, kind of, do what they need to do, get to the point of fatigue, and then leave it **(Interviewer: Mmm-hmm)**. And I think if, those sessions tend to be, kind of, fifteen, twenty minutes with a view to then repeating that in a day, two days depending on the patient **(Interviewer: Mmm-hmm)** to progress whatever it is they're working on and they tend to see more carry-over so that the patient's able to retain what they've done in the previous session **(Interviewer: Yeah)** and then progress it. Whereas I think with a lot of our patients if you were to do a half hour long session, it's probably **(Interviewer: Too much for them? Mmm)** longer than a lot of them can concentrate for or physically able to do something for half hour at a time and sustain that physical capability.

Interviewer: Mmm-hmm, so, you think maybe short, I think we, well our exercise sessions were, they were about 25 minutes, 30 minutes, but you think maybe even just ten minutes, kind of, might even…

Study support staff: Yeah, maybe, kind of, yeah, fifteen minute cut off.

Interviewer: Mmm-hmm. Alright, em, so, do you have any other opinions, kind of, on any aspects of the study related towards practicality?

Study support staff: Em, only, only that if we look at our average length of stay for the patients that aren't delayed transfer of care patients, our average length of stay across all of geriatric medicine is less than ten days **(Interviewer: Mmm-hmm)** but acutely unwell for most of that, so, most of our patients aren't going to be here **(Interviewer: Yeah)** for follow-up.

(**Interviewer: Yeah, that's, yeah, we did find that, yeah, even with the delayed transfer of care)** which is probably what you found…

Interviewer: Yeah, we put in, we actually put in, an interven, **(Interviewer corrects themselves)* **or "an intervention", em, an amendment back in February or so, to kind of, recruit anyone that we, kind of, could, and even if they were only there for a few days** (Study support staff: Yeah) **but, kind of, didn't really yield much results when discharges were accelerated because, well the people that were going to be leaving they, kind of, they were leaving within a day** (Study support staff: Yeah, yeah)**, so there wasn't enough time to do the assessments or then get them into the exercise intervention, and then some you know, thought they were leaving so didn't want to sign up to do anything when they thought they aren't going to be around for more than a few hours** (Study support staff: Yeah, yeah) **Em, but yeah, so if you were to design a future study to take place in a similar setting ****Both laugh***, em what alterations or different considerations would you, eh, would you take into account? I suppose you've mentioned one already with the, the, kind of, the shorter time perhaps…**

Study support staff: Yeah **(Interviewer: Mmm-hmm)**, and I can't remember now whether in your study, em, you had caveats for those that weren't able to consent themselves to take part in the study?

Interviewer: Mmm-hmm, yeah, we were to get a consultee, so either a personal or a professional consultee (Study support staff: Okay) **em, for them, that was another amendment we had to put in towards the start. Now I don't think we had anyway that lacked capacity into the study (**Study support staff: Okay**), em, just kind of, well**

Study support staff: Yeah, because sometimes, we do, we do have, and again I don't have data for this, but sometimes we do you know, we've got patients that are significantly cognitively impaired but physically quite fit **(Interviewer: quite fit, yeah, mmm-hmm)** and so those patients, there's not much you can do about their cognitive decline **(Interviewer: Mmm)**, but actually if you can keep them as functionally independent as possible, that for us is, is the aim isn't it **(Interviewer: Mmm-hmm)** in hospital? We try and discharge patients with the, ideally the same cognitive and functional independence that they came in with

Interviewer: Yeah, mmm-hmm absolutely so you do think it's really important then to kind of try include people that aren't, kind of, don't have capacity?

Study support staff: Yeah, em, because there is, there's a misnomer that, em, patients with cognitive impairment can't rehab **(Interviewer: Mmm-hmm)**, em, and I think they can **(Interviewer: Yeah)** it's just that there is obviously an inherent issue with retention and carry-over **(Interviewer: Yeah, mmm-hmm)** but there are ways around that **(Interviewer: Mmm-hmm)**, em, and I think studies like this may well get rid of those misnomers that patients with dementia don't have, like, the traditional, kind of, rehab goals **(Interviewer: Mmm-hmm)**. Em, because we, we know they do, it's just that you have to approach it in a slightly different way.

Interviewer: Yeah, yeah. Kind of, at the beginning even we didn't have the ethics to recruit people without capacity (Study support staff: Yeah) **we, kind of, went back and did another amendment and then got the ethics for that. What we, kind of, found was that when patients didn't have capacity if they were physically quite fit they weren't there long** (Study support staff: Yeah)**, and they had to be frail to participate in the study anyway. Then, kind of, others when we wanted them initially to express their interest in the study at least before we contacted a consultee** (Study support staff: Yeah) **but some didn't really seem to be too interested in it for different reasons. Em, so yeah, I guess, are there any aspects, kind of, of the study that you, you wouldn't change? So, perhaps, I don't know, something to do with the nature of the interventions or would you perhaps add something in there?**

Study support staff: Em, I don't, I don't think I would add anything. Em, it's just, the, the suitability of the patient, em, and then how long they're on the ward.

Interviewer: Mmm-hmm, yeah Em, yeah so, em, do you have any other, eh, closing comments about any aspect of the study before we finish?

Study support staff: No. I think, as a researcher you've been very open and, em, non-forceful, because sometimes researchers, sometimes patients can feel that their care is going to be compromised if they don't participate in a study **(Interviewer: Mmm-hmm)**, but certainly we've had none of that on the ward, em, it's always been seen as, kind of, an, as added extra **(Interviewer: Mmm-hmm)**, and I think your approach to the patients has been really good.

Interviewer: Okay. Fantastic, well, eh, we'll end it there then (Study support staff: Wonderful) **I think?**

Study support staff: No problem.

Interviewer: Perfect.

Audio concludes

Appendix 4.2. Reflective journal

17/07/2018

Reflective journal entry #1

Today I met with the ward manager/ senior nurse for my local site induction and commencement of the study, during which I was informed that there had recently been significant alterations on the ward and presently no patients with capacity to consent, whereas prior to this we were led to believe ~50% would have capacity. Ward manager/senior nurse also expressed that she didn't think the patients would be suitable for the study in terms of their medical fitness irrespective of capacity and later informed that there were plans to close the ward in the immediate future. Given that this is the first day of the study, and with the previous issues regarding the sale of the KARE research site, during the meeting I went from being extremely enthusiastic and excited to finally begin, to a little bit disheartened and frustrated, but very much with the conviction that we had to get this sorted. Directly following this meeting I met with the local PI Thomas Jackson in another part of the hospital (consultant geriatrician at UHB) regarding issues relating to potential ward closure, lack of patients with capacity and getting staff on board with the study, as it was evident given the recent structural changes the staff on the ward, given their own uncertainty, no longer had the same favourable opinion regarding the suitability of the study for the setting as they did during prior site visits. Following this I drafted an email to ethics committee with regard to obtaining permission to recruit those lacking capacity and we submitted a substantial amendment to this effect and arranged a meeting with Zoe Wyrko (Associate Medical Director/geriatrician at who oversees the ward), Thomas Jackson and Carolyn Greig to discuss ward closure.

27/07/2018

Reflective journal entry #2

Today we had the above referenced meeting and were reassured that the ward is no longer closing. Zoe very enthusiastic and on board with the study, however informed us that research is not something that has been attempted up there before, so will require some mindset change getting everyone on board and suggested it best to start the study several weeks from now, in early September when the ward has settled down a bit after recent uncertainty and structural changes. During the interim I will be attending weekly multi-disciplinary meetings on the Harborne ward, with the geriatricians, senior nurses and junior doctors and staff nurses, and similarly calling up to Harborne ward at mealtimes to get integrated into the ward: get to know the general routine, staff and patients on the ward after recent structural alterations.

02/08/2018

Reflective journal entry #3

Today I had a meeting at Russell's Hall Hospital with my primary supervisor to discuss the potential of conducting an arm of SPAA at this site. This meeting was initially arranged as a back-up given the issues with the Harborne ward and its potential closure. During the meeting, all were extremely interested in the study, though issues about how long it would realistically take to set up, and how that related to my remaining time were discussed. Ultimately, after options were explored regarding

conducting an arm of SPAA at the hospital, it was concluded that we would be best having this as a potential back-up if the other site fell through, but there were issued regarding time and set-up.

02/09/2018

Reflective journal entry #4

Today I again met with ward manager to identify potential participants with capacity while waiting on response to amendments from the NHS REC. Only two patients on the ward had been identified as having capacity.

03/09/2018

Reflective journal entry #5

Today I met with the study's first consented participant. It was a slightly striking just how frail he was. He was unable to speak clearly, although after some adaptation it was possible to interpret what he was attempting to say. Following having spent some time with the participant it was apparent that he was completely bed bound, not able to effectively and independently even reposition himself in the bed without assistance, but capable to move his limbs. The gentleman is 98 years of age.

04/09/2018

Reflective journal entry #6

I called up to the participant today, who was sleeping when I called at 10 am. Numerous times I have called up to the ward since starting recruitment to the study, anywhere from 1 – 5 times per day, because a patient was either sleeping or having examinations. A research nurse could help to alleviate this, or even just more involvement of the ward staff, as they would be able to inform of the patient's current state, or if they have events scheduled throughout the day, which the ward staff are unaware of or fail to divulge. It still feels as if the general staff on the ward are not overly open to the study, and view it potentially as a nuisance which may get in the way of their nursing duties, with staff members commenting that the ward is quite under staffed after recent structural changes and uncertainties, and they wouldn't have the time to engage with the participants about participation the study i.e. to go with the researchers at first approach to the patients, as they are familiar with the patient, aid in transferring patients to the exercise equipment, and even identification does appear to be seen as a burden.

05/09/2018

Reflective journal entry #7

Today when I called up to the ward to complete baseline assessments with the participant, I was informed that he is unwell, and no longer medically fit to participant in the study. I also again discussed participation with the sole other patient previous identified as suitable for approach regarding participation in the study. Again, he reiterated that he was unsure if he would participate as he wasn't sure how long he would be there and was anxious about what will happen to him so doesn't want to occupy his mind with anything else right now like a study, but to maybe ask him again in a day or two.

06/09/2018

Reflective journal entry #8

Today when I called up to the ward, the recruited participant, who was subsequently deemed medically unfit due to an infection, was discharged from the ward without prior notice.

28/09/2018

Reflective journal entry #9

It appears that this may not be the correct population, or setting for such a study i.e., a ward with the majority of patients with very advanced dementia, makes such a study inexorably difficult, to even recruit, especially with an intervention component. Many of the patients cannot engage in or comprehend basic conversation, while others will stare vacantly when approached. Ward staff, junior nurses, senior nurses, and geriatricians have all now expressed that they think the ward is not suitable in its current iteration for a study, which was not what was proposed, or we were led to believe beforehand during site visits with regard to the ward becoming a "living lab" with a multitude of research studies taking place. In reality no studies have taken place on the ward previously, and it is now an extremely difficult patient population and compounded by a dynamic setting, where any patient identified as potentially being suitable for the study by the ward staff, are often discharged imminently, sometimes just after receiving the participant information sheet, and expressing interest. This is quite frustrating, however, as this is a feasibility study, I suppose this does all feed into the feasibility of the study within the setting, and to the researcher's knowledge such a study has never been attempted before in this participant population, or setting which are generally regarded as being outside the preview of such research, however, this study may be able to provide information on aspects of this.

20/10/2018

Reflective journal entry #10

Local site PI had discussed with NIHR via email regarding clinical research nurse support, as we have done several time prior, in an email exchange on 19/10/2018:

"This is an incredibly difficult patient population to recruit to this type of study. No one has ever done anything similar to date. This is difficult, yet vital research. CRN support for screening/identification is difficult to access at QE due to how to money is handled. I would argue we have recruited enough over the past 5 years to be eligible for some support – and it may be that nursing support to Paul to help identify potential recruits would be really positive."

07/11/2018

Reflective journal entry #11

Today I recruited two participants to the study, and there are a couple of other patients who I may have the possibility to recruit, if they remain on the ward, as they have expressed their interest on receipt of the participant information sheet. One of the recruited participants is quite difficult to

communicate with, while another has moderate depression and was tearful multiple times throughout the assessments.

09/11/2018

Reflective journal entry #12

Today I visited the ward to complete the baseline assessments with the two recruited participants. I called up at 10 am and myself and participant 1003 went down the room with the exercise equipment to assess his estimated 1RM, derived from his 5RM, on the leg press and leg extension, which he really seemed to enjoy and even surprised himself at how well he was doing. You could really seem him come alive during, and afterward, which was great to see as he has an unusual case for a patient on the ward, so to have something he can do and then look forward to seems to have a big impact on him.
Following this I completed the rest of the baseline assessments with participant 1002, including height, SPPB and gait speed test. The functional differences between the two participants is quite obvious, and while both have been operationally defined as frail by the Fried frailty phenotype criteria, participant 1002 is evidently quite a bit more frail. However, once we got him onto the machines he also seemed to "light up" and really enjoyed the exercise. In the afternoon I called back up to the ward at 2pm to complete the final assessments, the blood sample. The sample obtainment from participant 1003 was unsuccessful in either arm; he has quite poor veins for venepuncture and the ward staff had also missed several times. I will try again on Monday and may attempt the vein in the side of the wrist if visible, which only occurred to me afterwards. Participant 1003's son also called to the ward during the assessments and sat in, during which I told him about the study his father was in and he expressed that he thought it was such a good idea. He also told me that he is quite close to finding his father a place in a home close to him and does not think he will be on the ward for much longer than the end of next week, so I told him that we would continue with the exercise sessions with his father anyway as a contingency for if he is in the ward longer than expected now. I then collected a sample from participant 1002, who does not like needles. The first tube went fine and on insertion of the second tube he expressed that would like to stop. I removed the tube 3/4 full and also did not attempt the 3rd epigenetic tube. I also met the main geriatrician in the ward Zoe and said a brief hello and had a quick screen of potentially eligible new patients admitted to the ward, of which there were none. Two nurses, not usually on the ward, also seem keen in the study in that they are interested by having seen some of the assessments and recognizing them from a channel 4 programme Zoe had been in previously and asked if they could do some of the assessments out of interest to see what scores they would get. Following this, I then returned to the lab to process the samples. There was more than enough in the first tube and just enough in the second to fill 4 eppendorfs. I then took these samples to the freezer in the lab upstairs for storage.

22/11/2018

Reflective journal entry #13

Today one of the participants was discharged. However, this was not relayed to me by ward staff ahead of time, and as such the participant is discharged having completed seven intervention session and no post-intervention sessions. Had prior notice been given, post-intervention assessments could have been expedited. I discussed this with the ward manager/senior nurse for future scenarios, as this had also happened before with the first recruited participant, though they had been declared medically unfit. I am continuing with remaining participant, who is, according to himself from conversations with his son, due to be discharged next week. In general, some ward staff are a little bit cold to the study in its entirety.

23/11/2018

Reflective journal entry #14

I called up to the ward today (Saturday) to complete the 9th of 10 exercise sessions with the participant 1003, however he was "having a bad day", and was quite down. I sat with him for a few minutes to have a chat, but he wasn't up for doing anything that involved leaving the room he was in, so I will call up again tomorrow (Sunday) to see how he is feeling.

24/11/2018

Reflective journal entry #15

I called up to the ward again (Sunday), however, the participant was again feeling too unwell to leave his room. We again had a chat, and on the way out asked about him to one of the ward staff, who mentioned that's he been quite low since been moved into the side room by himself, which he had also mentioned during our conversation prior.

26/11/2018

Reflective journal entry #16

I called up to the ward to commence post-intervention assessments with participant 1003. I was a bit hesitant as to how successful it would be on the way over to the ward as he had not being feeling well the prior several days. However, when I called up he was much cheerier and expecting me. We went to the end of the corridor and into a private room and completed the questionnaire proportion of the assessments as he was feeling too tired to perform the physical components. He really enjoyed the questionnaires and opened up quite a lot about himself again as he had previous and referred to me as "a good friend", which I think shows the importance of the study even just with regard to engagement with participant on a one-to-one basis. I will be calling up to complete the remainder of the post-intervention assessment with participant tomorrow. Something of note however, is that this patient is not the typical type of patient on the ward, and although frail, is probably more akin to the general geriatric hospital inpatient population. He was initially admitted after an unexplained fall, and a subsequent alteration in relationship status during his time in hospital meant that when he had finished his acute care, he had nowhere to go, hence his extended stay.

27/11/2018

Reflective journal entry #17

Called up to the ward to finish post-intervention assessment with participant. I felt it went very well. We started off with SPPB, and he has definitely made some improvements in terms of balance and walking speed (albeit not complete improvements but better than baseline). He was also sustainably stronger on each of the exercise machines during the 5RM assessments. I still feel a lot of the staff are however not on board with the study and the participant did mention in the semi-structured post-intervention intervention that one would question how much they actually like their jobs or want to be there, which was something reiterated by the participant in his semi-structured interview at quite a length. I think the study is very feasible in a more general geriatric hospital inpatient setting there is little doubt in my mind, albeit difficult and tricky but viable in my opinion with adaptability, however it would be made infinitely more viable by a strong supporting network on the ward which is

something I would really emphasis for any subsequent clinical trials. Some of the more senior staff are very approachable, very friendly, however may not on the ward itself a great deal. I do feel a better initial site induction would have been better, however there seems to be quite a dismissive attitude to research either way and perhaps limited prerequisite knowledge or understanding on how exercise could be beneficial to these patients, although comments about patients functional inabilities are often vocalised but it seems to be considered that little can be done about this. I think as well what might be quite useful is to record all sessions as it allows thing to flow naturally as opposed during the interview where the patient has expressed valuable information to you prior however may not in the interview on the spot. Although it is possible that by recording all sessions this prevents rapport being built as "the camera is always on" so to speak.

30/11/2018

Reflective journal entry #18

I think as some staff on the ward have seen the intervention and study as a whole go on they have become a bit more receptive and have adapted to adopt a more positive outlook on the study, whereas at the commencement it was not looked positively upon, but rather as something that would cause a burden or interfere with their everyday activities and increase burden on them and also something they didn't really understand, as I am not sure the staff appreciate the importance of research in improving treatment, they know what they have been thought in University of during placement and that's how it is and they are not looking forward to new innovations in care but to things the way they are and how they have been though, not realising that that also cam e from research, which is a point I think eludes them, but perhaps through this process seeing it from the practice start of the study to the end and the results of the study that may open their eyes to it but I would say a better understanding and appreciation of research and the role it plays in the advancement of care is important and more should be done to educate on this level, and also to the reinforce that everything they are currently froing is also a result of evidence based research, and it is not the holy grail, it is still ignorant to so many things like everything, and why we need to research continue to advance and test what is effective and what can be improved.

08/01/2019

Reflective journal entry #19

Approached a number of patients with PIS sheets, two exprese4ed interest, one sign ed PIS but was discharged the next day. The other that declared interest was then due to be discharged the following day. Of the 7 PIS handed out, several more expressed interest but were then due to be or had been discharged prior to consent.

10/01/2019

Reflective journal entry #20

Three times now a participant have been discharged without any warning or being informed by the staff of the ward. This really exemplifies the importance of having a research environment where there has been previous integration with research, and also a culture and desire to facilitate or aid with research, which appears slightly absent, though the unpredictability of the setting does not help. It would have been really beneficial to have the assistance of a research nurse for this exact reason, as well as to aid in recruitment, but more importantly to keep the researcher adequately informed to any

changes in patients' status, particularly in such a dynamic environment. However, applications for study support were made several times, to the NIHR, and within the trust, with no real success and a back and forth merry-go round from one to the other. This is important for any form of clinical trial potentially conducted in a similar extremely dynamic setting. Additionally, this site had been selected under the believe that research has been conducted in the setting before and it would be turned into a "living lab", where patients would be constantly engaged in research. However, this was not the case, and it has been expressed to me on a half dozen occasions by the ward manager that it "isn't really the right place for the study", given the types of patients now on the ward, increasing turnover, and recent organisational changes, and the receptiveness, readiness and openness of the ward toward research studies.

21/01/2019

Reflective journal entry #21

Of 7 approachable patients the first week in the New year, all were discharged within 5 days of identification. Similarly, the following week an additional 5 patients were identified, all were also discharged days after identification. There is a fast turnover on the ward which was not present before and this in addition to the majority of patients being deemed non approachable by the staff, makes it difficult to actually conduct the study at all. Additionally, it is apparent that there really needs to be someone within the core staff on the ward it who deeply involved and invested in the study, as at present it is me coming from outside and people give little bits and pieces of information, but staff are not really too interested with it. Really needs to be that someone working permanently on the ward with access to the relevant information is deeply involved and one of the main people on the study.

23/01/2019

Reflective journal entry #22
In such a ward with approximately 80% of patients being identified by the care team as being unable to do very basic activities, and a relatively high turn over the study, proposed future clinical trial, really does not appear feasible. However, in a more appropriate setting it may be and may also be beneficial to participant. Between the design and implementation of this study the dynamics of the ward underwent a major alteration, so much that an alternative ward was sought but no such ward or patients were available.

05/02/2019

Reflective journal entry #23

Four new patients have been identified to me and I will be approaching them later today. It has also become apparent to me that approaching patients and introducing oneself as "a PhD student" generally has a better reception than as a "a researcher".

07/02/2019

Reflective journal entry #24

Again, really need a staff member on the ward who is there all the time and heavily invested in the research study so they can relay important developments such as discharge, Of all the patients I had given a PIS to since the new year following identification, all thus far were discharged a few days

later. Additionally, when this site was first assessed appropriate for me to conduct this study in, I was led to believe that an enormous amount of research went on on the ward hence why was to be developed into “a living lab”, and that there has been a lot of engagement with the ward in previous research. However, this was not the case no research has been conducted on the ward prior. Also, could have done with a research nurse to keep track of patients discharge progression but were turned down at every juncture for research nurse support, from the NIHR twice, after they offered for us to apply.

11/02/2019

Reflective journal entry #25

Some patients on the ward are really pleasant to talk to of those capable of engaging in conversation, which is the small minority, however of those able to do so, they are generally the ones who are discharged quickly. Additionally, with the changing of the nature of the ward there are a lot more dementia patients on the ward than there were when the study was designed and set up. There is also a much shorter turnover. When first visiting the ward a couple of years ago nearly now, the average length of stay was 4 weeks, This is not the case anymore as of very recently, i.e., just before the study was due to commence, when there was also talk of shutting the ward down.

12/02/2019

Reflective journal entry #26

Participants keep getting discharged as do those that are identified. Another thing that has to come to mind is that it would be beneficial to actually record all assessment sessions with participants not only semi structured interviews as often in general conversation between testing there will be some nuggets that would be very useful to have a record of in terms of the participants experience within the study in order to advise feasibility and the design of a future trial.

13/02/2019

Reflective journal entry #27

Notes of setting:

The formation of the ward underwent alterations between the ethical approval and commencement of the study, with the ward being threatened to be closed at one stage. Now patients remain on the ward for a shorter duration and also there is now about a 50% prevalence of acute patients whereas before the ward was comprised of patients awaiting discharge to assisted living facilities. Additionally in order to combat against the low levels of eligible participants that resulted, we went back to the REC to try to recruit those lacking capacity and were successful. I also instead of solely getting patients at the start of each round would get patients information at the start of each week on a Monday and then subsequently on Thursday mornings would have meeting to discuss any potential new patients.

19/02/2019

Reflective journal entry #28

Today I called up to the ward to visited 2 participants I had given PIS to on Monday. Upon arriving at the ward one had been discharged to a nursing home the previous day despite being identified to me as expected to stay on the ward less than 24 hours earlier. The other was crying and upset as she was going to a nursing home the next day but did not want to go. This has been a reoccurring theme since the start of the New Year and is incredibility frustrating. The setting is not feasible and identification even of those expected to remain on the ward for a short period is poor and not really reliable. Either patients are deemed medically unfit and unable to participate or they are deemed to be fit but will discharged imminently. The setting is not appropriate and probably should not have been suggested in the first place. Two of the wards four bays have also been closed for over 2 weeks now due to a norovirus, reducing an already limited potential participant population. Also, of note, the ward manager has left.

25/02/2019

Reflective journal entry #29

A catch-22 exists that while patients are on the ward, or expected to stay a long period of time, they are deemed by the medical team to be medically unfit to participate in the study. While patients who are slightly "healthier" are generally a much shorter stay (< 1 week) and are discharged quite soon post-admission. This is the main issue with the ward, as it serves a dual purpose: 1) as a setting for geriatric patients who are post-acute care, but due to profound and chronic functional and cognitive deficits, find it difficult with regard to transfer of care (discharge) from hospital, as assisted-living facilities are often hesitant to agree to take them i.e., the hospital says they are not acutely unwell, and should be discharged to assisted-living facilities, while assisted-living facilities say that the patients are too unwell to cope in their facilities, and often have an issue taking the patient; 2) The ward serves now as an acute unit for those who are acutely unwell, also often with profound functional and cognitive issues, but less so than the delayed transfer (discharge0 part of the ward, but are generally deemed medically unfit due to their acute illness. Once these patients are well enough to be declared medically fit to participate, they are generally expected to be discharged imminently, as there is no need for them to be in hospital and this is generally facilitated sooner due to the absence of chronic functional and cognitive impairment. Recruitment is quite difficult in this regard. A number of actions have been taken in an attempt to increase recruitment over the duration of the study, which include:

1) Submission of an amendment to the NHS REC to allow recruitment of patients lacking capacity.

2) Initially patients were identified to the researcher at the beginning of the research round (over a one-week period), this was increased to every week to try to capture as many patients as possible through continuous recruitment. This was then further advanced to identification of patients formally twice per week (at a weekly MDT meeting, and a meeting with the ward manager), and informally on separate occasions throughout the week.

3) Submission of an amendment to allow inclusion of patients who may not remain on the ward for long enough to take part in the entirety of the study, but for whom some baseline characteristics may be obtained, and some exercise sessions completed, and potentially post-intervention assessments moved forward if sufficient time (i.e., if information session has been completed).

12/03/2019

Reflective journal entry #30

Ward staff, as they are not included in the study directly are generally largely relatively uninterest in the study. It is difficult even to get identification of participants now that the ward manger has left. Some things can be gained from going to each patient on the ward, but discharge plans are not always obvious or possible to be relayed by patients. It would be a lot better if a member of the care team was directly involved in the study and has a vested interest in ensuring the study goes well at the site and patients are identified. Informed by several staff that they are had never been a prior study on the ward, and that they don't believe that these patients are really suitable to be involved in interventional research such as the present study.

29/03/2019

Reflective journal entry #31

Meeting with new ward manager on the Harborne Ward. Have agreed to meet every day to identify new patients as they come in.

30/03/2019

Reflective journal entry #32

Yesterday during meeting with new ward manager, a couple of patients were identified to me as potentially eligible. One patient was provided with an information sheet and expressed a lot of enthusiasm regarding participation, remarking "Oh yes, I would very much like that". However, at the MDT meeting that afternoon, it was expressed that the patient would most likely be discharged that day. Upon returning to the ward the following day to consent the patient, the patient had indeed been discharged and unable to consent.

30/03/2019

Reflective journal entry #33

Going to increase SPAA recruitment end date from 24th of May to start of August, in an attempt to potentially recruit more participants.

03/04/2019

Reflective journal entry #34

Today I called up to the ward to commence baseline assessments with a consent patient. After completing a few assessments, however, the participant was very tired, which showed, so the assessments were cut short, and I will call back later to recommence if the participant is feeling up to it, and if not, tomorrow morning. This has occurred with a few participants, sometimes it is due to fatigue, sometimes participants just do not feel like doing the assessments at the time you said you would call up or doing the intervention on days they feel down. Also distributed PIS one new patient on the ward, however, as was evident from this interaction, but has been true of previous interactions with some patients, some are quite exercise adverse given their current physical condition, which has been largely the case with rejections to take part following PIS distribution thus far. Another common reason in this regard is participants being unwilling to sign up anything new when they are uncertain

of what is going to happen to them, or believing they will not be there, even later that day, which sometimes turns out to be relatively accurate, as a lot of identified participants are discharged relatively quickly following identification as suitable to approach regarding participation.

08/04/2019

Reflective journal entry #35

A lot of patients are also for the first time in their life in a very vulnerable, uncertain and transitionary period as they will be awaiting placement to a place they have never been before, and this can be quite an upsetting time where patients don't want to take on extra burden of being involved in a research study and doing exercise as they are still trying to cope with this fact which is still very fresh to some of them.

29/04/2019

Reflective journal entry #36

I called up to the ward today for participant identification. The majority of patients are bed-bound, or require a hoist (sara stedy), 2-1 care when in use. Additionally, a lot pf patients are quite confused, and it was believed during ward staff screening that they would not be able to follow any form of instruction. These have been reoccurring themes during the potential participant identification meetings.

11/05/2019

Reflective journal entry #37

The majority of patients on the ward are either medically unfit, or if not, due for imminent discharge i.e., they do not remain on the ward long. Medically unfit, specifically relating to involvement in the study, for example unresponsive to attempts at communication, profound sensory or cognitive impairments, that impair ability to be involved in the study. Also, many are completely bedbound and unable to transfer to resistance machines. It may be that the machines are largely not suitable to this setting in particular. Interventions, if they are to be used in majority of patients in this setting, will require them to be capable of being implemented in bed as the overwhelming majority of patients in recent months are completely bedbound. It may be possible, though perhaps not practical, to have bedbound patients transferred in some instances by multiple nursing staff, though unfortunately, this was not an option within this present study.

08/07/2019

Reflective journal entry #38

After returning from three week secondment in Finland, and a PANINI ITN meeting the week I got back, I returned to the ward, having arranged a meeting with the ward manager to resume identification of suitable participants, explained that as we have switched to a Move It Or Lose It based intervention that patients can do in the bed, activities like squeezing stress balls, pulling a very light resistance band, raising their legs - very light activities, so I am hoping there will more suitable to participate. Unfortunately, this was not the case.

15/07/2019

Reflective journal entry #39

Called up to the ward once again today for identification of patients. Since returning from Finland there are very few patients eligible, or those that are, they seem less interested in completing the MIOLI intervention, and several have expressed that they think the machines look good, but not the resistance bands or balls, which they have little interest in and appear to view as less prestigious.

18/07/2019

Reflective journal entry #40

A number of suggestions to make such a study more feasible, perhaps in a different setting:

1. Although delayed transfer of care (delayed discharge) patients would seem like a good population to conduct such an intervention in, the reality is that there is a reason for their delayed transfer, which is usually profound functional or cognitive deficits which makes such an intervention difficult to implement in many patients.
2. The importance of having an intimate member of the research team embedded within the core ward team cannot be understated and was something that was lacking in this feasibility study, and which would have made identification better in the researcher's opinion.
3. Instead of having a set intervention period, a better approach is to have participant enrol into the study and then conduct as many sessions as possible during their stay. By having a senior member of the ward staff intimately involved in the study and with an investment in it, this would also facilitate this as not only would the researchers be notified of a potentially eligible participant immediately upon admission to the ward, but they would also be informed as soon as any discharge plans had been made, allowing them to conduct post-intervention assessments prior to discharge. This aspect would have a huge impact on feasibility and was really lacking in this present feasibility study, but perhaps this is meritorious, as it really highlights the importance of this aspect with the majority of participants being discharged and the researcher not being notified beforehand.

22/07/2019

Reflective journal entry #41

The delayed transfer of care setting also represents a period of uncertainty and transition for patients as compared to normal geriatric patients they are nearly exclusively returning to a place they did not come from which can be quite upsetting and unsettling and while some patients were pleasant, they weren't willing to get involved in anything additional during this complex and often confusing time.

As such while the delayed transfer of care setting displays some promising potential in terms of potential to intervene in particular the delayed length of stay, there are deeper aspects at play such as the reason for this delayed transfer (delayed discharge) often profound functional or cognitive deficits, or an unsettling and upsetting time that make this extremely difficult, in addition to the imminent discharge of most participants that would be suitable for participation. Future studies solely regarding efficacy may wish to remain with the general population of geriatric inpatients in this regard while those which wish to future examine efficacy based on the findings of this study should focus on finding ways to increase the suitability of the interventions and ensure that there is complete organizational support from the entire ward if such a thing is to be possible.

Another thing, however, is that patients have actively expressed little interest in the move it or lose it intervention with resistance bands and stress balls, that can be performed in the bed, in particular, and

it appears in this regard from the engagement with patients that is possible that many perceive the machines to be more prestigious and better, if they could use them. This raises an interesting point, that while machines are better received as being the superior intervention and more prestigious, they are impractical for the bedbound patient. In this regard, particularly in this setting, for bedbound patients, with profound cognitive and functional deficits, a machine-based piece of exercise equipment which would be attached to the hospital bed, in the form of for example a leg press, or exercise bike, in particular for the lower limbs, may be of interest, and the most appropriate form of equipment for this setting, given the constraints of participants. However, even at this, is an extremely difficult patient population to facilitate engagement with, in general, and especially when it comes to these forms of interventions. However, to the researcher's knowledge, nothing of this sort, has been attempted with such patients, ever, at least in the scientific literature, as they are generally regarded as outside the purview of such interventions. Which, we are finding in this study for some participants may be true, however if all else fails, the suggested exercise equipment attached to the bed, may be the final possible attempt one could make at intervention this patient population. As it relates to frailty, it is an interesting dynamic, though these patients are far past the functional impairment required to score 5/5, or as frail as possible, on many frailty instruments, including the Fried frailty phenotype, and are profoundly frail, frailty as defined as a loss of physiological reserve, serves as an interesting dichotomy with exercise, which requires at least some degree of physiological reserve to be sacrificed during exercise, to promote subsequent adaption. As such, there is likely a point, which holds true theoretically, that a patient can have such limited physiological reserve, that the deficit they can give during an exercise intervention to promote adaption, is meniscal, if even realistically possible for some patients, particularly those who are expending the majority of their remaining physiological capabilities just to facilitate basic body functions.

29/07/2019

Reflective journal entry #42

Most patients are confused delirious or severe dementia to the point where the ward staff during initial identification rule them out as they will not be capable of following instructions or in most cases engaging in coherent dialogue.

08/08/2019

Reflective journal entry #43

Participants generally were not as interested in the MIOLI intervention as opposed to the machine-based resistance training intervention. On several occasions bedbound patients would express interest during MIOLI recruitment pointing to the machines on the PIS and saying, "Oh that looks good", however once told that they would be doing the other intervention their interest waned.

In more severe functional and cognitive impairment setting the researchers suggest that an intervention which is high status in terms of perception and one which can do in bed could be combined to produce the most eligibility and interest in these interventions. As such an adapted piece of resistance training equipment that could be attached to the hospital bed or chair would an area that further research should examine. Though the optimal design of such a piece of equipment would likely require a degree of trial and error and collaboration with non-health related professions such as engineers, some basic form of this has been attempted previously in other populations, though not in a research content within this population or similar populations to the researchers knowledge, however, the researcher was able to find images of similar prototypes such as exercise bikes which can be performed while lying in bed, or frames, however, all appear to be in younger populations.

09/08/2019

Reflective journal entry #44

The issue of physiological reserve still remains. Frailty is a disease characterised by a lack of physiological reserve. While exercise is an activity which produces adaptation brought about by acute reductions in physiological reserve, which causes adaptions which progressively elevate baseline physiological reserve. Severely compromised patients have such a lack of physiological reserve that in some cases they do not have this initial reserve to give to facilitate adaption.

15/08/2019

Reflective journal entry #45

Frailty is characterized by a loss of physiological reserve, while exercise has been proposed as the best form of treatment for frailty, in order to conduct exercise, patients must have some degree of physiological reserve from which to pool from an use during the exercise session

19/08/2019

Reflective journal entry #46

In order to combat the low eligibility rates due to the structural reorganisation of the ward just prior to the commencement of data collection, two amendments were submitted. One to attempt to recruit those lacking capacity and another on the 3rd of March to attempt to recruit those who were not expected to remain on the ward but could still at a minimum be on the ward for a duration to complete some baseline assessments.

04/09/2019

Reflective journal entry #47

Machine that can be attached to the beds in the form of a leg press machine or cycling bike. The machine should be pneumatic and adapted for both active and also more passive movement. This passive movement may be good for very cognitively impaired patients. The active exercise could be employed in all bed or chair bound patients and still provides this degree of high quality associated with the resistance training machines. Additionally, while allowing active movement against a pneumatic loading in patients more cognitively aware, the passive movement component may be negotiable to non-cognitively aware patients or patients that find it difficult to engage, with encouragement and this passive movement this may encourage at least a degree of effort to be employed. A core aspect of the passive setting of the machine should be that it can measure the effort of the participant as well in real time so that encouragement can be given accordingly, and measurements of actual loading obtained. Due to the loss of mobility and muscle mass associated with bed stay, even these passive movements if they encourage any degree of effort may be beneficial to these bed bound patients with difficulty engaging.

Appendix 4.3. Patient eligibility and uptake, participant retention and exercise session adherence, demographic and limited-efficacy testing data, and semi-structured interview schedule.

Patient eligibility and uptake

Recruitment round start date	Patients on the ward	Patient initially identified as suitable to approach	Of those initially identified, those still expected to remain on the ward, 24 hours after receiving / being approached with the PIS	PIS accepted of those initially identified	PIS refused of those initially identified (reasons for refusal in comments)	Reasons for PIS refusal	Reason for non-participation of those accepting PIS	Lacking capacity (of those initially identified suitable)	Lacking capacity (of those PIS distributed to)	Unable to participate due to being identified as ineligible (medically unfit to participate or expected to be discharged imminently)	Due to being determined to be medically unfit to participate	Due to imminently planned discharge from the ward (within the next several days)	Other (Details)	Recruited	Completed study	Discharged	Withdrew	Uptake rate % (those identified as suitable to approach and expected to remain on the ward, 24 hours after receiving PIS / being approached)	% Unable to participate due initially being identified as being ineligible by care team	% Unable to participate due initially being identified as medically unfit	% Unable to participate due to being identified as planned to be imminently discharged	% Unable to participate due to other reason identified by care team
03/09/2018	30	2	2	1	1	Refused as patient was still trying to deal with the fact of being in hospital and not being able to return home, did not want to become involved in anything extra until he could work out everything in his head	N/A	0	0	28	25*	3	0	1	0	*1*	0	50	93.33	83.33	10.00	0.00
08/10/2018	31	7	2	4	3	All three refused PIS due to lack of interest	2 interested but due to be discharged imminently, 2 not interested	7	4	24	17	5	2 (Perceived to be too unpredictable and violent by care staff)	0	0	0	0	0	77.42	54.84	16.13	6.45
05/11/2018	31	8	2	6	2	Refused due to perceiving that they would not be on the ward long	One interested but to be discharged imminently, 3 not interested	6	4	23	17	5	1 Perceived to be too unpredictable and violent by care staff)	2	1	1	0	100	74.19	54.84	16.13	3.23
08/01/2019	30	7	1	6	1	Refused due to lack of interest	5 additional patients in addition to recruited patient interested but discharged within several days of PIS distribution	4	2	23	17	5	1 (Perceived to be too unpredictable and violent by care staff)	1	0	0	0	100	76.67	56.67	16.67	3.33
16/01/2019	31	5	0	5	0	N/A	Three were interest in taking part but due to be discharged imminently, two expressed a lack of interest	1	1	26	18	7	1 (Perceived to be too unpredictable and violent by care staff)	0	0	0	0	0	83.87	58.06	22.58	3.23
21/01/2019	30	4	2	3	1	Refused due to perceiving that they would not be on the ward long	1 patient interested, but discharged imminently following PIS distribution, 1 patients discharged imminently following to PIS distribution	`1	1	26	18	7	1 (In the country illegally)	1	0	1	0	50	86.67	60.00	23.33	3.33
28/01/2019	31	4	1	3	1	Refused due to perceiving that they would not be on the ward long	2 patients expressed interest in participation but discharged imminently following PIS distribution. One further patients discharged imminently following PIS distribution	1	1	27	18	8	1 (In the country illegally)	0	0	0	0	0	87.10	58.06	25.81	3.23
05/02/2019	31	4	0	4	0	N/A	3 patients expressed interested in participation but discharged imminently following PIS distribution. One further patient who accepted PIS discharged imminently following PIS distribution	2	2	27	15	11	1 (In the country illegally)	0	0	0	0	N/A	87.10	48.39	35.48	3.23
11/02/2019	25	1	0	1	0	N/A	1 patient expressed interest in participation, but discharged imminently following PIS distribution	0	0	24	16	7	1 (In the country illegally)	0	0	0	0	N/A	96.00	28.00	28.00	40.00
18/02/2019	25	1	0	1	0	N/A	1 patient expressed interest in participation, but discharged imminently following PIS distribution	0	0	24	14	9	1 (In the country illegally)	0	0	0	0	N/A	96.00	56.00	36.00	4.00
25/02/2019	29	4	1	3	1	Refused due to lack of interest	2 patient expressed interest in participation but discharged imminently following PIS distribution. One further patient not interested in participation, and also discharged shortly after	1	1	25	18	5	1 (In the country illegally)	0	0	0	0	0	86.21	62.07	17.24	3.45
04/03/2019	30	1	1	1	0	N/A	Patient not interested in participation owing to perceiving that they would not be on the ward for more than a few hours, discharged the following day	0	0	29	15	14	0	0	0	0	0	0	96.67	50.00	46.67	0.00
11/03/2019	30	5	3	4	1	Refused due to lack of interest	1 interested but discharged imminently following PIS distribution. 1 discharged imminently following PIS distribution. 2 not interested	2	2	25	16	7	2 (One patient in the country illegally, one patient under the age of 45)	0	0	0	0	0	83.33	53.33	23.33	6.67
18/03/2019	30	4	1	3	1	Refused due to perceiving that they would not be on the ward long	2 interested but discharged following PIS distribution. 1 discharged following PIS distribution	2	1	26	18	7	1 (One patient under the age of 45)	0	0	0	0	0	86.67	60.00	23.33	3.33
01/04/2019	30	7	3	5	2	Refused due to lack of interest	2 expressed interest but were discharged within 24 hours. 1 discharged within 24 hours. 1 not interested in participation	5	3	23	20	2	1 (One patient under the age of 45)	1	0	1	0	33.33	76.67	66.67	6.67	3.33
08/04/2019	30	5	3	3	2	2 refused due to lack of interest	1 interested but discharged imminently following PIS distribution. 1 discharged imminently following PIS distribution. 1 not interested	2	0	25	19	5	1 (One patient under the age of 45)	0	0	0	0	0	83.33	63.33	16.67	3.33
29/04/2019	30	2	0	2	0	N/A	2 discharged imminently following PIS distribution	1	1	28	23	4	1 (One patient under the age of 45)	0	0	0	0	N/A	93.33	76.67	13.33	3.33

06/05/2019	29	3	2	2	1	Refused due to perceiving that they would not be on the ward long	1 patient imminently discharged. 1 patient declared medically unfit	1	1	26	22	4	1 (One patient under the age of 45)	0	0	0	0	0	89.66	75.86	13.79	3.45
13/05/2019	30	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	30	24	6	0	0	0	0	0	N/A	100.00	80.00	20.00	0.00
20/05/2019	30	1	1	1	0	N/A	1 patient not interested in participation as they believed they would not be on the ward for much longer, discharged shortly thereafter.	0	0	29	24	5	0	0	0	0	0	0	96.67	80.00	16.67	0.00
08/07/2019	30	5	1	3	2	1 refused due to perceiving that they would not be on the ward long and discharged shortly after. 1 refused due to lack of interest	1 patient not interested in participation; 2 patient discharged imminently after receipt of PIS	3	2	25	18	7	0	0	0	0	0	0	83.33	60.00	23.33	0.00
15/07/2019	29	4	3	2	2	2 refuse due to lack of interest in MIOLI intervention	2 patients not interested in intervention	2	0	25	16	9	0	0	0	0	0	0	86.21	55.17	31.03	0.00
22/07/2018	30	5	3	3	1	1 refused as perceived they would not be staying on the ward long enough	1 not interested in intervention, 2 discharged	3	2	25	18	7	0	0	0	0	0	0	83.33	60.00	23.33	0.00
29/07/2019	30	4	3	2	2	2 refuse due to lack of interest in MIOLI intervention	1 discharged, 1 not interested	3	1	26	20	6	0	0	0	0	0	0	86.67	66.67	20.00	0.00
08/08/2018	30	3	1	3	0	N/A	2 discharged, 1 not interested in intervention	1	1	27	19	8	0	0	0	0	0	0	90.00	63.33	26.67	0.00
18/08/2019	31	8	4	4	4	Not interested in MIOLI	2 patients discharged shortly after receipt of PIS. 2 patients expressed lack of interest in MIOLI intervention	5	2	23	14	9	0	0	0	0	0	0	74.19	45.16	29.03	0.00

Total rounds of recruitment	***Total patient screenings***	***Total patients initially identified as suitable to approach***	***Total - of those initially identified as suitable, who were still expected to remain on the ward 24 hours after receiving / being approached with the PIS***	***Total PIS accepted***	***Total PIS refused (reasons for refusal in comments)***	**Total reasons for PIS refusal**	**Reason for non-participation of those accepting PIS**	***Total Lacking capacity (of those suitable)***	***Total Lacking capacity (of those PIS distributed to)***	***Unable to participate due to being identified as ineligible (typically due to acute illness, severe sensory impairments, or terminal illness / end of life care)***	***Total due to being determined to be medically unfit to participate***	***Total due to imminently planned discharge from the ward (within the next several days)***	***Total other***	***Total Recruited***	***Total Completed study***	***Total Discharged***	***Total Withdrew***	***Uptake rate (%) (those identified as suitable to approach and expected to remain on the ward 24 hours after receiving PIS / being approached)***	***% Unable to participate due to initially being identified as ineligible by care staff***	***% Unable to participate due initially being identified as medically unfit***	***% Unable to participate due to being identified as planned to be imminently discharged***	***% Unable to participate due to other reason identified by care team (reasons provided in comments)***
26	773	104	40	75	29	Lack of interest (n=19); anxiety regarding imminent discharge (n=10)	Discharged (n=46, of which n=29 expressed interest prior following receipt of PIS); Not interested; (n=22); Subsequently declared medically unfit (n=1)	52	32	669	479	172	18	6	1	4	0	15.00	86.55	60.80	22.25	3.49

*=*At this stage, also includes those lacking capacity.*

Participant retention

Participant ID	Status
1001	Discharged after nine days - declared medically unfit three days after recruitment (Could not complete all of baseline assessment, specifically blood sample and max strength not collected, and was unable to take part in any exercise sessions due to acute illness, and subsequent discharge)
1002	Discharged after completing baseline testing and seven exercise sessions (Could not complete post-intervention sessions as was not informed of patient discharged until after the fact)
1003	Completed study
1004	Discharged within hours of signing consent form (Unaware of any discharge plans prior to signing consent form)
1005	Discharged 24 hours after signing consent form (Not informed of any discharge plans prior to signing consent form, partial baseline data)
1006	Discharged two days following recruitment, mid-way through baseline data assessment for secondary, limited-efficacy testing, dependent variables

Exercise session adherence

Adherence	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8	Session 9	Session 10	Total adherence
Participant 1001	-	-	-	-	-	-	-	-	-	-	-
	Did not complete exercise sessions as declared medically unfit and the subsequently discharged from ward (Researcher not informed of discharge by ward staff)										
Participant 1002	100%	100%	100%	100%	50%*	50%**	50%**	-	-	-	79%
	Discharged without prior notice on 22/11/2018 (Researcher again was not informed of discharge ahead of time by ward staff)										
Participant 1003	100%	100%	100%	100%	100%	100%	100%	100%	-***	-****	80%
	Completed entire study with 80% exercise session adherence										
Participant 1004	-	-	-	-	-	-	-	-	-	-	-
	Participant discharged prior to completion of baseline assessments										
Participant 1005	-	-	-	-	-	-	-	-	-	-	-
	Participant discharged prior to completion of baseline assessments										
Participant 1006	-	-	-	-	-	-	-	-	-	-	-
	Participant discharged prior to completion of baseline assessments										

** = Reason: Participant has cellulitis on his shins and is presently unable to perform leg extension as the performance of the exercise would cause the skin, which is already scabbed to open and bleed; **= Similar to previous session participant could not perform leg extension exercise due to cellulitis sores; ***= Participant was "having a bad day", feeling very upset and did not feel like exercising. Called up the next day which was supposed to be a rest day to see if he wanted to perform the exercise. When I called up at 2pm I was informed by a nurse that he was out on day release looking at carpets but would be back at 5pm. I called back up at 5:30pm Saturday evening, however he still was not back and the nurses on call did not know when he would be back; ****= Patient was again "feeling unwell" and didn't feel up to exercising; he seems to have become very low spirited since being moved into a side room by himself, from initially being in a bay with other patients.*

Limited-efficacy testing data
Part 1:

Demographic data																
Participant ID	Date of birth	Age (years)	Country of Origin	Sex	Height (cm)	Weight (kg)	BMI	No. of medications during hospitalisation	No. of medications at point of discharge	Ethnicity	Current Martial status	Education	Years in school	Main occupation before retirement	Number of children	Total length of stay in hospital (including prior to transfer to the ward) (Days)	Total length of time in study (Days)
Participant 1001	19/05/1921	97	England	Male	1.86	78.2	22.6	33	15	British	Married	Secondary education	9	Army / Police officer	2	53	2
Participant 1002	27/10/1932	86	England	Male	1.65	73	26.8	18	7	British	Never married	Primary education	5	Cemetery worker	0	48	15
Participant 1003	04/10/1942	76	England	Male	1.7	80	27.7	19	10	British	Separated / divorced	Secondary education	12	Tool maker	2	47	24
Participant 1004	12/10/1945	73	England	Male	1.53	50.5	21.6	20	17	British	Discharged	Discharged	Discharged	Discharged	Discharged	38	<1
Participant 1005	30/06/1933	85	England	Female	1.52	56	24.2	12	6	British	Widowed	Secondary education	9	Comptometer	1	11	1
Participant 1006	02/07/1936	82	Northern Ireland	Female	1.54	76.9	32.4	16	6	British	Discharged	Discharged	Discharged	Discharged	Discharged	19	1

Part 2:

Limited-efficacy testing data														
Participant ID	Leg press 1RM (derived from 5RM) (kg) Baseline	Leg press 1RM (derived from 5RM) (kg) Post-Intervention	Leg extension 1RM (derived from 5RM) (kg) Baseline	Leg extension 1RM (derived from 5RM) (kg) Post-intervention	Short Physical Performance Battery (SPPB) Baseline	Short Physical Performance Battery (SPPB) Post-intervention	SPPB (Balance test) Baseline	SPPB (Balance test) Post-Intervention	SPPB (Gait speed) Baseline	SPPB (Gait speed) Post-intervention	SPPB (chair stand test) Baseline	SPPB (chair stand test) Post-intervention	Katz Index of Activities of Daily Living Baseline	Katz Index of Activities of Daily Living Post-intervention
Participant 1001	Participant declared medically unfit prior to attempt, and subsequently discharged	Discharged	Discharged	Discharged	0	Discharged	0	Discharged	0	Discharged	0	Discharged	1	Discharged
Participant 1002	70kg	Discharged	11.7	Discharged	1	Discharged	0	Discharged	1	Discharged	0	Discharged	5	Discharged
Participant 1003	87.5	112	23.3	32	9	11	2	3	3	4	4	4	6	6
Participant 1004	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged
Participant 1005	Discharged	Discharged	Discharged	Discharged	0	Discharged	0	Discharged	0	Discharged	0	Discharged	0	5
Participant 1006	Discharged	Discharged	Discharged	Discharged	0	Discharged	0	Discharged	0	Discharged	0	Discharged	Discharged	Discharged

Part 3:

Limited-efficacy testing data (continued)												
Participant ID	Fried Frailty Phenotype (FFP) (Overall score) Baseline	Fried Frailty Phenotype (FFP) (Overall score) Post-intervention	FFP Unintentional weight loss criteria Baseline	FFP Unintentional weight loss criteria Post-Intervention	FFP CES-D criteria Baseline	FFP CES-D criteria Post-intervention	FFP Handgrip criteria (kg) Baseline	FFP Handgrip strength criteria (kg) Post-intervention	FFP Gait Speed criteria (15-foot walk) (m/s) Baseline	FFP Gait Speed criteria (15-foot walk) (m/s) Post-intervention	FFP MLTAQ criteria (active kcal per week) Baseline	FFP MLTAQ criteria (active kcal per week) Post-intervention
Participant 1001	5	Discharged	Yes	Discharged	Yes	Discharged	15	Discharged	Unable to walk	Discharged	0	Discharged
Participant 1002	5		Yes	Discharged	Yes	Discharged	16	Discharged	19.5	Discharged	122.5	Discharged
Participant 1003	4	2	Yes	Yes	Yes	No	25	26	6.9	6.8	35	1,155
Participant 1004	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged
Participant 1005	5	Discharged	Yes	Discharged	Yes	Discharged	16	Discharged	Unable to walk	Discharged	0	Discharged
Participant 1006	3	Discharged	No	Discharged	Yes	Discharged	15	Discharged	Unable to walk	Discharged	560	Discharged

Part 4:

Limited-efficacy testing data (continued)													
Participant ID	Geriatric Depression Scale (GDS) Baseline	Geriatric Depression Scale (GDS) Post-intervention	Hospital Anxiety and Depression Scale (HADS) Baseline	Hospital Anxiety and Depression Scale (HADS) Post-intervention	Hospital Anxiety and Depression Scale (HADS) - Depression Baseline	Hospital Anxiety and Depression Scale (HADS) - Depression Post-intervention	Hospital Anxiety and Depression Scale (HADS) - Anxiety Baseline	Hospital Anxiety and Depression Scale (HADS) - Anxiety Post-intervention	Standardized Mini-mental State Examination (SMMSE) Baseline	Standardized Mini-mental State Examination (SMMSE) Post-intervention	Interpersonal Support Evaluation list Baseline	Interpersonal Support Evaluation List Post-intervention	Mini Nutritional Assessment (MNA) Short form Baseline
Participant 1001	8	Discharged	24	Discharged	18	Discharged	6	Discharged	21	Discharged	21	Discharged	5
Participant 1002	16	Discharged	22	Discharged	9	Discharged	13	Discharged	7	Discharged	18	Discharged	6
Participant 1003	15	7	8	7	5	4	3	3	24	26	22	25	11
Participant 1004	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged
Participant 1005	14	Discharged	17	Discharged	10	Discharged	7	Discharged	22	Discharged	28	Discharged	8
Participant 1006	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	Discharged	9	Discharged	Discharged	Discharged	Discharged

Post-intervention / post-study semi-structured interview schedule

Participant ID	Post-intervention / post-study semi-structured interview status
Participant 1001	Discharged without notice prior to post-intervention assessments
Participant 1002	Discharged without notice prior to post-intervention assessments
Participant 1003	Completed
Participant 1004	Discharged without notice prior to post-intervention assessments
Participant 1005	Discharged without notice prior to post-intervention assessments
Participant 1006	Discharged without notice prior to post-intervention assessments
Ward staff 1001	Completed
Ward staff 1002	Completed
Ward staff 1003	Completed
Ward staff 1004	Completed
Ward staff 1005	Completed