Health assets and deficits in hospitalised older adults

Submitted in total fulfilment of the requirements of the degree

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by

Dr Katherine Jennifer Gregorevic

orcid.org/0000-0002-2248-761X

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Abstract

Frailty is a loss of physiological reserve that leaves individuals at risk of poor recovery when exposed to a stressor. Frailty has been identified as a risk factor for poor outcomes for older adults when they are admitted to hospital, although there are still some barriers to implementation of measurement tools. Some frail older adults will still make a good recovery. Health assets are factors that are associated with health and recovery and are also desirable in their own right. Inclusion of health assets in models of illness and recovery may improve prognostication and identify patient centred strategies to facilitate recovery.

Aims of the PhD

1. Determine whether is feasible to measure frailty based on routine clinical assessment
2. Examine whether health assets can be identified in hospitalised older adults
3. Investigate whether individual health assets improve outcomes for hospitalised older adults
4. Develop a health assets index
5. Validate the health assets index in hospitalised older adults

Methods

In addressing these aims, five phases of research were undertaken:

Phase 1: A systematic review of the literature was undertaken to identify health assets in the hospital setting. MEDLINE, EMBASE, CINAHL and PsycINFO were searched to identify studies examining outcomes for hospitalised older adults. Included studies examined at least one potential individual health asset, which was a psychosocial characteristic or health characteristic. Study quality was assessed, and findings are narratively described.
Phase 2: A prospective cohort study was conducted in an acute general medical unit to determine whether frailty could be measured based on routine clinical information by junior medical staff. All patients aged 65 and over admitted to a general medical unit during August and September 2013 were eligible for the study. CFS score at baseline was documented by a member of the treating medical team. Demographic information and outcomes were obtained from medical records. The primary outcomes were functional decline and death within three months.

Phase 3: A secondary analysis of an existing data set was conducted to examine the interaction between health assets and frailty. Patients of 1418 aged ≥ 70 years admitted to 11 hospitals in Australia were evaluated at admission using the interRAI assessment system for Acute Care, which surveys a large number of domains, including cognition, communication, mood and behaviour, activities of daily living, continence, nutrition, skin condition, falls and medical diagnosis. The data set was interrogated for potential health assets and a multiple logistic regression adjusted for frailty index, age and gender as covariates was performed for the outcomes mortality, length of stay, readmission and new need for residential care.

Phase 4: Based on phases 2 and 3, a health assets index was created. A pilot study was conducted to determine the feasibility of collecting this information in hospitalised older adults.

Phase 5: A prospective cohort study was conducted to determine whether the health assets index had predictive validity for older inpatients. Adults aged 70 and older with unplanned admission to hospital were eligible to participate. Frailty and other co-variates were measured. The primary outcomes were mortality at 30 days and functional decline at discharge.

**Results**

Phase 1: Nine prospective cohort and two retrospective cohort studies were identified. Subjective, functional and biological health assets were identified. Health assets were
associated with decreased risk of post-hospital mortality, functional decline, new need for residential care and readmission.

Phase 2: Frailty was assessed in 95% of 179 eligible patients. 45% of patients experienced functional decline and 11% died within three months. 40% of patients were classified as vulnerable/mildly frail, and 41% were moderately to severely frail. When patients in residential care were excluded, increasing frailty was associated with functional decline ($p = 0.011$). Increasing frailty was associated with increasing mortality within three months ($p = 0.012$).

Phase 3: Inpatient mortality was 3% and 4.5% of patients died within 28 days of discharge. Median length of stay was 7 days (IQR 4-11). In multivariate analysis that includes frailty, being able to walk further [OR 0.08 (0.01-0.63)], ability to leave the house [OR 0.35 (0.17-0.74)] and living alone [OR 0.28 (0.10-0.79)] were protective against mortality. The presence of a support person was associated with a decreased length of stay [OR 0.14 (0.08-0.25)].

Phase 4: It was feasible to measure health assets in older adults admitted to hospital. The time taken of 2-3 minutes indicated that it was not too onerous. Some questions were adjusted to make the wording clearer to participants.

Phase 5: There were 298 participants, with an average age of 84.7 and 66% were women. 80.1% had a frailty score of greater than 0.25, with a population mean score of 0.38 (SD 0.12). The mean HAI score was 10.86 (SD 2.87) with a minimum of 5.5 and a maximum of 15. 56.4% of participants had functional decline on discharge from hospital and there was 5.7% 30 day mortality. There was an inverse relationship between frailty and health assets. In a multivariate analysis that accounted for interaction, for those who were not frail, a higher number of health assets was associated with lower mortality. This relationship was reversed at higher levels of frailty.

**Conclusions**
It is possible to measure frailty using routine clinical information, but the time taken to enter data is likely to present an ongoing barrier to frailty measurement, which can be overcome with the use of an electronic medical record.

Health assets can be identified in older adults who have been admitted to hospital. A higher number of health assets is associated with a decreased level of frailty. Health assets may confer protection against mortality in more robust older adults. Further research could help to elucidate strategies that older adults identify as important and how these can be applied in the hospital setting.
Declaration

This thesis comprises only my original work toward the degree of Doctor of Philosophy.

I have clearly stated the contribution by others to jointly-authored works that I have included in my thesis.

The thesis is fewer than the maximum word limit in length, exclusive of tables, maps, bibliographies and appendices.

Dr Kate Gregorevic
Preface

This thesis was carried out with myself as the principal researcher and with two supervisors, Professor Wen Kwang Lim and Professor Ruth Hubbard. I would also like to acknowledge the assistance of Dr Nancye Peel. Their contribution to the published papers was mainly in an editorial role. The proportion of my input to all aspects was more than 90%. All work is original. The Northern Hospital Foundation and the Australian Postgraduate Association provided scholarships.

The study design and data collection for the study in chapter 3 was undertaken in 2012, prior to enrolment in the PhD. This work also contributed to the research required for fellowship of the Royal Australasian College of Physicians. The data analysis and preparation of the manuscript took place after enrolment in the PhD.

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Although a PhD is awarded as the achievement of one person, it really is the work of many, both in academic and personal support.

I had the privilege of two inspiring supervisors, who both gave invaluable guidance and assistance.

Professor Kwang Lim was the first person I approached as a supervisor when I decided to undertake a PhD. Professor Lim was always available with practical, actionable advice and has always made the entire undertaking always seem achievable.

Professor Ruth Hubbard introduced me to the concept of health assets, which is a key theme in my PhD. Professor Hubbard has helped me to improve my academic skills by always asking relevant and challenging questions to help crystallise my ideas.

I would also like to acknowledge the assistance of Dr Nancye Peel, and her assistance in study design and manuscript preparation.

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Undertaking a PhD with three small children means that this has required a village. My husband has provided endless emotional and practical support. Extended family, particularly my mother and mother-in-law have provided essential support for our young family.

I have found this experience to be rewarding and enriching. Thinking about health from the perspective of how we create health, rather than avoiding disease has changed my ideas about health and how I practice medicine. I hope to continue to explore this further in years to come.
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List of Abbreviations

95%CI 95% confidence interval
HA Health assets
FI Frailty index
HAI Health Assets Index
CFS Clinical Frailty Scale
ADLs Activities of Daily Living
iADLs Instrumental activities of daily living
eFI Electronic Frailty Index
CFS study The Clinical Frailty Scale predicts functional decline and mortality when used by junior medical staff: a prospective cohort study for publication with revisions.
HA secondary analysis Do Health Assets have a Protective Effect for Hospitalised Frail Older Adults?
HA systematic review Are Health Assets Associated with Improved Outcomes for Hospitalized Older Adults? A Systematic Review
HAI validation study The Positive Impact of Psychosocial Resources in the Hospital Setting: Validation of the Health Assets Index
Chapter 1  Background and Introduction

1.1  Lay Summary
The immediate shared goal for an unplanned hospital admission for both patient and clinician is survival, but there are other outcomes that can cause significant distress, particularly functional decline. Around 97% of older adults who have an unplanned admission to hospital survive, but around 30-40% will leave hospital with a new disability, from which they may never recover.\textsuperscript{1-3} This has individual implications for quality of life as well as societal implications for service provision and care needs, particularly as around 5% will be discharged to residential aged care.\textsuperscript{4}

These differing patient trajectories will be familiar to all hospital clinicians. The combination of the degree of insult and the individual’s physical reserve can explain some of this variation. A collision with a truck will overcome the reserves of the most robust individual, but this person will have no functional decline with a viral upper respiratory tract infection. For a frail individual, this same upper respiratory tract infection can cause a significant physiological disturbance and lead to admission to hospital.

There have been significant advances in understanding the measurement of frailty, which is a loss of physiological reserve that leaves an individual vulnerable to significant decline from an insult or stressor. Frailty can be measured with the frailty index,\textsuperscript{4} which has predictive validity in the inpatient setting. The frailty index is a useful tool for clinicians to assess patient risk and for researchers to measure health status, but it is unsatisfying to measure something without a ready intervention to act on this knowledge. Although frailty is an important component of predictive models for older adults, it does not explain all variability in outcomes.

Health status can be conceptualised as a balance between protective factors and factors that contribute to harm. Health assets are factors that are associated with wellbeing and are also desirable in their own right.\textsuperscript{5} Identifying these factors could help to improve prognostication and to identify strategies to facilitate recovery.
There is evidence in the community setting that these factors act individually and cumulatively to improve long-term survival and health status, but it is unclear whether they have the same impact at the time of hospital admission.

This PhD was conceived to determine whether health assets improve outcomes for frail hospitalised older adults.

1.2 Summary

- Frailty is a loss of physiological reserve that is a valid predictor of increased risk for mortality and the development of new disability
- Frailty is linked with increased levels of inflammation which may be driven by immune changes due to accumulation of cellular damage with age
- Many different frailty measurement tools have been developed, but many have not been adequately validated
- Increasing frailty is a risk for mortality and functional decline in the hospital setting, and measurement tools have a role in identifying at risk groups
- Health Assets are factors associated with the creation of health that are desirable in their own right
- A higher number of Health Assets may lead to improved outcomes for frail older adults when they are admitted to hospital

1.3 Background

The large increase in the proportion of the population who are older adults has led to a significant increase in understanding of ageing as it has facilitated large population studies of older adults. Many of these studies have demonstrated that frailty is a better predictor of mortality than age alone for older adults. Frailty is a loss of physiological reserve which results in an individual being vulnerable to a physical decline in response to a physiological stress. As humans are complex systems, frailty manifests as a whole of system dysfunction, with the examples of falls, fluctuating disability and delirium. In a frail older adult, maintaining upright posture against gravity is so precarious, that a minor physical challenge is enough to cause a fall. Another common presenting complaint is that an individual has a
decline in their ability to self-care and mobilise. If this happens rapidly, over days or hours, and results in the older person unable to manage at home, it can result in a need for urgent assistance in activities of daily living that can only be accessed in hospital. Delirium is a failure of the ability to maintain attention and can present as a combination of sudden drowsiness, confusion, hallucinations or hyperalertness.\textsuperscript{10} These complex presentations are the result of an often minor challenge to a biological system that is running at a physiological limit.\textsuperscript{9}

Ageing is not a constant process with a predictable time determined rate; it varies between individuals. Ageing can be conceptualised as an accumulation of deficits. Our cellular organelles constantly undertake aerobic respiration to produce molecules to transfer energy to enable synthetic activities.\textsuperscript{11} A by-product of this is the production of free radicals, which can interact with DNA and cause damage. The accumulation of cellular damage and DNA errors can also be increased by external factors like smoking and UV radiation. Every day there are thousands of errors in DNA replication, and while some of these are repaired, over time this damage accumulates.\textsuperscript{11}

Stem cell populations are also diminished over time with the shortening of telomeres. Telomeres are sequences of DNA repeats at the end of each chromosome. During cellular replication, these are progressively shortened as the mechanism of DNA replication cannot be repeated to the very end of chromosomes. Without telomeres, the ends of the chromosomes would be unstable as they have ‘broken ends’, which means chromosomes can join or recombine.\textsuperscript{12} The deficiency can be resolved by the enzyme telomerase, which adds DNA repeats to the ends of chromosomes.\textsuperscript{12} Telomere repair processes cannot completely overcome the process of telomere loss and over the years of life, telomere length shortens. The flip side of the coin is that cancer cells, which have lost their replicative limit, have high levels of telomerase activity, so simply activating this enzyme is not the key to unlimited longevity.\textsuperscript{13}
Changes in mitochondrial function also limit the amount of energy available to the cell. The accumulation of deficits can manifest across any and all systems with changes observed in the musculoskeletal system, neurological system, gastrointestinal and endocrine system. Individuals who are frail are then particularly susceptible to a system failure as they are living at their physiological limit on a day-to-day basis.

If cells receive significant damage, such as an extreme temperature, they will die by necrosis. A high level of cumulative damage will result in apoptosis, a programmed cell death. A lower level of cumulative damage can lead to cells entering a state of senescence, which is a state of permanent growth arrest but not death. These cells are not inactive bystanders, they have distinct changes in gene expression and secretory profiles. Senescent cells may cause widespread tissue disruption by the production of radical oxygen species and secretion of pro-inflammatory cytokines.

These pro-inflammatory cytokines drive a chronic low-level immune activation, which is associated with frailty. Higher baseline levels of inflammation are linked to the development of type 2 diabetes, cardiovascular disease, osteoporosis and dementia. Paradoxically, frail older adults have a poor ability to respond to a stress due to reduction in stem cells, changes in T-lymphocyte production, blunting of the B-cell-controlled antibody response and decreased innate immunity, leaving people vulnerable to infection.

1.4 How do we measure frailty?
These cellular changes are associated with an overall decline in the functional capacity of various organs to maintain baseline tissue homeostasis and to respond adequately to physiological needs under stress. This loss of physiological reserve defines frailty, which affects around 25-50% of community dwellers aged 85 and older. Frailty has important implications for older adults, as it translates to an increased risk for mortality, development of new disability and a new need for institutional care. Measurement of frailty in older adults has the potential to guide medical treatments and establish individual goals.
This desire to capture the variability in rates of ageing and health status has driven the development of tools to measure frailty. A review identified 422 studies using 29 different frailty measures, with the frailty phenotype and the frailty index being the most commonly used.\(^{18}\) This large number of different frailty measurement tools highlights an important limitation in the frailty literature, as population studies have demonstrated that when different tools are applied to the same population the proportion diagnosed as frail varies greatly.\(^{19}\) Many frailty measures have not been adequately validated, or they have been modified from their original form.\(^{18}\) The two most commonly used measurement tools are the Frailty Phenotype and the Frailty Index.

### 1.5 The Frailty Phenotype versus the Frailty Index

Linda Fried’s seminal work provides a key conceptual underpinning that a frailty syndrome can be identified. This observation came from the cardiovascular health study, which was designed to determine the importance of cardiovascular risk factors for the outcomes of stroke and cardiovascular disease.\(^{20}\) The extensive baseline measurements of physical characteristics and follow up of seven years enabled Fried et al to identify factors that were associated with increased risk of mortality and a decreased ability to perform activities of daily living.\(^{21}\) This enabled the development of the Fried criteria for frailty, which is the presence of three or more of the following characteristics: weakness, fatigue, weight loss, slow gait speed and a low level of physical activity.

There are practical limitations to the application of this instrument in clinical practice. The original inception cohort excluded those with pre-existing limitations in activities of daily living or single diseases that could cause disability, such as stroke or Parkinson’s disease. People with depression or cognitive impairment were also excluded. The frailty phenotype also conceptualises people as either not frail, frail or pre-frail, without considering any further gradations of frailty. There is also no scope to measure gradations within frailty and a limited ability to measure change over time.\(^{21}\)
The frailty index is a count of deficits across a range of domains including medical, functional, cognitive, nutritional and psychological. Each factor must be associated with age, but not saturate with age and must be associated with health status. Each deficit is scored between one and zero, then the total is summed and divided by the denominator to give a score between 0-1. The 99th centile is 0.67, indicating a level beyond which further deficit accumulation is not compatible with life. An attractive feature of this measurement tool is that the deficits do not have to be the same between different cohorts. As it provides a continuous score frailty gradations of frailty can be measured.\textsuperscript{22}

Table 1.1   Comparison of the Frailty Phenotype and Deficit Model

<table>
<thead>
<tr>
<th>Frailty Phenotype</th>
<th>Frailty Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signs and symptoms</td>
<td>Requires comprehensive geriatric assessment</td>
</tr>
<tr>
<td>Categorical</td>
<td>Ordinal</td>
</tr>
<tr>
<td>Frailty as a pre-disability syndrome</td>
<td>Continuous variable</td>
</tr>
<tr>
<td>Limited utility in disabled people</td>
<td>Can be used for any individual regardless of functional state</td>
</tr>
</tbody>
</table>

Although there is convergence between the two predominant measurement tools, with comparable risk of mortality for people who are defined as frail by both the phenotype and the count of deficits, they do have differing practical implications.\textsuperscript{23} The frailty index has important advantages for use in the inpatient setting, as the phenotype relies on factors, which are likely to be affected by acute illness, such as gait speed. The frailty index can also measure degrees of frailty and can be used to monitor changes in health status over time.\textsuperscript{23}
The development of validated frailty measurement tools is an important step forward in individualising treatment for older adults, but there are also other factors that have an important impact on illness recovery.

### 1.6 Barriers to Implementation of Frailty Measurement in the Inpatient Setting

For any admission to hospital, incorporating frailty measurement has the potential to improve prognostication and inform more appropriate treatment decisions. This is important for those with unplanned admissions to hospital as well as those having elective surgery, as frail older adults are at increased risk of mortality and morbidity in both scenarios. ⁴,¹⁴,²⁴

A recent scoping review of frailty measurement in the acute setting identified 617 articles that identified participants as frail, but only 204 actually included a frailty measure rather than subjective judgement. ²⁵ This is an important distinction as subjective judgement correlates poorly with measurement. ²⁶ The Clinical Frailty Scale, the Frailty Index, and the Frailty Phenotype were the most common tools used to measure frailty. Multiple studies identified patients as frail without using a measure, which is problematic as subjective judgement correlates poorly with validated frailty measures. ²⁶ There was a shift in research methodology where more recent studies were more likely to use a validated measurement tool. ²⁵ Most of the studies identified an association between frailty and mortality, with the Frailty Index and the Edmonton Frailty Scale having the best predictive ability. ²⁵

#### 1.6.1 Recognising the Need for Frailty Measurement

Comprehensive geriatric assessment remains the gold standard for identification of frailty. This is a multimodal assessment covering medical, cognitive, psychological, nutritional and functional domains usually conducted by an interdisciplinary team including a geriatrician. ²⁷ This is time and resource intensive, and not currently feasible for all older adults presenting to hospital. While traditionally frailty was often determined by clinicians by an end of the bed examination, this correlates poorly with objective measurement. ²⁸
There has been a huge growth in the literature around frailty in the last six years. A search on PubMed identified that in the last five years that there have been 7098 publications with the word frailty in the title or abstract, compared to 1748 in the five preceding years. This increased awareness of frailty has increased interest in the utilisation of a clinical tool for frailty measurement, but in many hospitals this has not translated to wider practice.

1.6.2 Optimising the Use of Routine Clinical Data
As hospitalised patients are already subject to the collection of hundreds of data points including symptoms, living conditions, diet, measures of vital signs, weight, laboratory tests, any further burden to the patient from collecting additional information needs to be avoided. The current assessments can also be time consuming for staff and so the feasibility of frailty measurement in the acute setting depends on using routinely collected data. Nevertheless, with the advent of electronic medical records, it will become easier to operationalise routine clinical data to implement clinical measurement of frailty, if these are integrated automatically. Until these systems are in place in hospitals, any time taken to fill out additional paperwork for already busy staff will remain a burden and a potentially insurmountable barrier.

1.6.3 Validation of Measurement Tools
Theou et al highlight that many frailty measurement tools have been used in the acute setting without being properly validated. A tool that was developed in the community setting will not necessarily be valid in the acute setting. An example is the frailty phenotype, which relies on gait speed and measurement of handgrip strength, which are both likely to be impacted by an acute illness. The FI and the Clinical Frailty Scale (CFS) have both been validated against mortality and length of stay in multiple hospitals. As the review by Theou et al also highlights is that these are not predictive in all studies, and so there needs to be caution before they are implemented clinically. In a cohort of 172 inpatients, Frailty prevalence varied from 24 to 94% depending on the instrument used, which indicates these tools are identifying different populations, which is problematic when comparing studies.
A component of this is also ease of use, and inter-rater reliability. Any hospital wide screening tool is likely to be used by a large number of clinicians from different backgrounds. In particular, in many hospitals there will be new junior clinical staff every year, as new interns and residents start. A frailty tool that requires significant staff training will pose an extra challenge due to the need to train new staff. The Clinical Frailty Scale was developed to be used as a screening tool by non-geriatricians, and has demonstrated clinical utility for this purpose\textsuperscript{30}

1.6.4 Frailty Screening

Until there is the availability of frailty measures automatically derived from routine clinical data, a reasonable way to implement frailty measurement in clinical practice is to use a screening test. The Clinical Frailty Scale (CFS) is a nine item scale that has many attributes that make it attractive for this purpose: it can be completed based on routine clinical data, ease of use and interpretation, previous demonstration of good inter-rater reliability.\textsuperscript{30,31} The CFS was chosen as at the time of study design, instead of the FI, to minimise the impact on clinical staff of data entry, as this was thought to pose an excessive burden and there was no EMR to automatically generate an FI. The study in chapter three was designed to examine the use of the CFS in the general medical setting in an Australian hospital to determine whether the CFS is a feasible and valid frailty screening tool in routine clinical practice.
1.7 Why do some frail older adults recover well?

Measuring frailty is clinically useful and provides important predictive information for research purposes, but this reductionist approach can ignore the resources and strengths that each individual has. It also ignores the attitudes that older adults themselves hold to their own health and wellbeing, as even those who are identified as frail in a purely biomedical model, may not self-identify as frail due to their perception of positive personal characteristics. As well as considering deficits, it is important to also consider factors that contribute positively to health, which is where the concept of salutogenesis is a useful adjunct.

The salutogenic framework relies on identification of an individual’s capacity to create health. This framework recognises that individuals are able to use their own resources and strategies to solve problems and move towards total wellbeing. Salutogenesis theory seeks to understand why people remain well, even in stressful situations. A key underpinning of this theory is that individual have capacity to identify and use their own resources to solve problems. The mechanism for this is described as a sense of coherence (SOC). SOC increases through the life span and it has strong positive correlations to perceived health, mental health, and quality of life. The positive impact of a higher SOC extends into the ninth decade of life and beyond, with people who have scores in the highest tertile having a decreased risk of mortality and functional decline.

Health assets’ are defined as an individual’s internal or external strengths or accessible resources which enhance ability to optimise health. Identifying health assets provides a way to identify factors associated with salutogenesis. Health assets can exist across multiple domains, such as biological, functional or subjective. A biological asset is an objectively measured health characteristic, such as a favourable blood lipid profile. Subjective health assets include psychological state and positive emotions, and are usually self-reported. A functional health asset relates to the ability to undertake community and social participation and includes physical ability.
Some health assets identified in the community setting are cardiorespiratory fitness, a stable marriage, positive emotions and social participation. An asset model recognises resilience and empowers people to take control over their own wellbeing.\(^5\)

There is strong evidence from multiple high quality studies to suggest self-rated health, life satisfaction, psychological well-being, social networks, engagement in leisure and social activities, education and financial resources are associated with health status in community dwelling older populations.\(^36\) Just as deficits associated with frailty act in an interdependent and additive way, it is likely that health assets perform the same way. In a longitudinal cohort of older adults in Beijing, those with a higher score of protective factors had decreased rates of mortality and were more likely to have improved health status in the first five to ten years of follow-up.\(^37\)

A key concept in positive health is that health assets should be desirable in their own right.\(^5\) This moves the concept of health to the present, rather than the abstract future and provides the motivation of immediate gratification. This reconceptualises health as something to be enjoyed today rather than the result of unpleasant health behaviours in the present. Encouraging people to identify and utilise assets has the potential to result in an immediate improvement in wellbeing. Enabling people to feel a greater sense of control and coherence may also lead to a decreased sense of stress and enhanced mood, which would provide immediate positive feedback.

### 1.8 The Biological Mechanism of Action of Health Assets

Although individual health assets will have different mechanisms of action, it is likely that there is also some commonality. Each asset may act in a multifaceted way. An individual with a stable marriage is likely to have increased emotional support, a person who will encourage health-seeking behaviours and may have increased financial resources compared to someone who is divorced. It is likely that many health assets, even if they are seemingly related to psychological well-being, also have a direct biological impact. In women aged 20-50, those with the highest levels of psychological stress had the shortest telomeres and the lowest levels of
telomerase activity.\textsuperscript{38} It is likely that the constant release of cortisol in response to this stress has an impact on immune function, which increases baseline, chronic inflammation. This immune activation acts to diminish cellular repair that occurs in response to the constant biochemical reactions.\textsuperscript{12}

1.9 Identification of the problem
Most studies on health assets have been conducted in the community setting.\textsuperscript{5} This provides the benefit of many years of follow-up to elucidate any links between health assets and adverse outcomes. Hospital admission is a time of great risk for older adults, particularly if they are frail. As there is frequently an acute, precipitating illness some older adults will not survive to discharge, or will die in the immediate period following.\textsuperscript{14} Around 30-40\% of older adults will leave hospital with a new disability in activities of daily living, also known as functional decline.\textsuperscript{2,39} Many of these people will lose the ability to live independently and have a new need for residential care. This new disability can arise even in a short hospital admission of less than a week.\textsuperscript{2} This also confers a poor prognosis, with only around one third of this group being able to return to baseline function at one year.\textsuperscript{2,40} Increasing frailty is predictive of mortality and functional decline, but it is not clear whether health assets confer benefits in the hospital setting as they do in the community.\textsuperscript{4}

As demographic shifts occur with an increase in absolute and relative numbers of older adults a traditional disease based model of care becomes increasingly inadequate for individuals with multiple chronic comorbidities and complex psychosocial circumstances.\textsuperscript{41} In older adults the insult that precipitates the admission to hospital may seem sudden, but often it is directly related to pre-existing frailty, social and economic factors. Inclusion of factors related to an individual’s life circumstances, both deficits and assets, has the potential to improve prognostication and to empower individuals to use their own strengths and resources to take an active role in their own recovery.
1.10 Hypotheses

1. It is feasible and valid to measure frailty in the inpatient setting using routine clinical data
2. Health Assets can be identified and measured in the inpatient setting
3. Health Assets mitigate outcomes for frail older adults with unplanned admission to hospital

1.11 Aims of the PhD

1. Determine whether is feasible to measure frailty based on routine clinical assessment
2. Examine whether health assets can be identified in hospitalised older adults through a systematic review of the literature
3. Investigate whether individual health assets improve outcomes for hospitalised older adults
4. Develop a health assets index
5. Validate the health assets index in hospitalised older adults

1.12 Thesis Outline

1. **Background**

   Health Assets allow identification and measurement of factors that are associated with good health. The cellular changes of ageing have been well characterised, as have the clinical manifestations of frailty. This chapter will review the definition of health assets and discuss their biological impact on the rate of accumulation of deficits that constitute ageing.

2. **Systematic Review: Are health assets associated with improved outcomes for hospitalised older adults?**

   A systematic review was conducted to determine whether, in hospitalised older people, individual health assets decrease the risk of post hospital mortality, functional decline, new need for residential care, readmission or longer length of stay. This showed that health assets are associated with improved outcomes for older adults, but the low number of studies identified highlighted the need for further research in this area.
3. The clinical frailty scale predicts functional decline and mortality when used by junior medical staff: a prospective cohort study.

The objective of this study was to determine whether the clinical frailty scale (CFS) could be used to identify patient baseline frailty status in the acute general medical setting when used by junior medical staff using information obtained on routine clinical assessment. This study showed that a simple frailty screening tool was acceptable to clinical staff and had predictive validity.

4. Do Health Assets have a Protective Effect for Hospitalised Frail Older Adults?

This was a secondary analysis of the InterRAI-AC study, which was a prospective cohort study with 1418 inpatients aged 70 and older to assess the predictive validity of a nursing assessment tool that enables measurement of frailty. Potential health assets were identified and the outcomes examined were mortality, functional decline, length of stay and readmission. The distance walked and whether an individual was able to leave the house in the days preceding admission were associated with a decreased risk of mortality.

5. Protocol for the validation of the Health Assets Index in the acute setting

A protocol was developed to validate the Health Assets Index in the inpatient setting. This chapter will describe the methods for the validation study.

6. Validation of the Health Assets Index for older adults with unplanned admission to hospital

A multi-centre prospective cohort study was undertaken to validate the Health Assets Index for older adults with unplanned admission to hospital. A higher number of health assets was associated with a decreased likelihood for frailty. A higher number of health assets was not associated with a decreased risk for mortality, functional decline or increased length of stay.

7. Discussion and Conclusions

The relationship between health assets and frailty highlights the importance of considering both negative and positive factors in the conceptualisation of health. A higher number of health assets is associated with a lower level of frailty. They also have a significant interaction and health assets decrease the risk of mortality for older adults who are more robust, but not those who are already frail.
Chapter 2  Health Assets Associated with Improved Outcomes for Hospitalised Older Adults? A Systematic Review.

Highlights

- Health assets are protective factors which support health and wellbeing, rather than risk factors that are associated with disease
- Many risk factors for adverse outcomes have been identified for hospitalised older adults
- Health assets are associated with improved outcomes for hospitalised older adults
- This review highlights the need for further research on the effect of health assets in hospitalised older adults

Key terms: Hospitalisation, Health Status, Aged, Health Assets, Frailty, Healthy Aging

This chapter is a lightly edited version of a publication in *Archives of gerontology and geriatrics*. 2016;67:14-20. (see appendix 10)
Abstract

Objective: Health assets are protective factors that support health and wellbeing, rather than risk factors that are associated with disease. This concept was developed in the community setting. In hospitalised older adults, the dominant approach has been to identify risk factors, with little examination of health assets. The purpose of this systematic review was to determine whether, in hospitalised older people, individual health assets decrease the risk of post hospital mortality, functional decline, new need for residential care, readmission or longer length of stay.

Methods: MEDLINE, EMBASE, CINAHL and PsycINFO were searched to identify studies examining outcomes for hospitalised older adults. Included studies examined at least one potential individual health asset, which was a psychosocial characteristic or health characteristic. Study quality was assessed, and findings are narratively described.

Results: Nine prospective cohort and two retrospective cohort studies were identified. Subjective, functional and biological health assets were identified. Health assets were associated with decreased risk of post-hospital mortality, functional decline, new need for residential care and readmission.

Conclusion: The complex interplay between health status and psychological and social factors is incompletely understood. Health assets are associated with improved outcomes for hospitalised older adults. The small number of studies suitable for inclusion indicates the need for further research in this area.

2.1 Background

Hospitalisation is a sentinel life event for many older adults. In addition to the risk of death, around 30-40% of older adults will leave hospital with a new, often persistent, disability leaving them reliant on family or needing formal care. Although disability can occur insidiously in community dwelling older people, the incidence of
onset increases markedly with hospitalisation. Older adults are also at increased risk for longer lengths of stay and readmission.

Pre-existing dependence in activities of daily living, malnutrition, depression and impaired cognition are well established as risk factors for poor recovery from unplanned hospitalisation. A higher level of frailty is predictive of increased risk of mortality, functional decline and increased length of stay for hospitalised older adults.

Only including factors with negative associations does not explain why some frail older adults recover well following hospitalisation. An individuals’ health status is also determined by resources they have at their disposal, which protect against negative health outcomes and promote wellness. ‘Salutogenesis’ describes an approach focusing on factors that support well-being and health rather than factors that cause disease. Inclusion of health assets in a model of illness and health allows operationalisation of the concept of salutogenesis. Health assets are determining factors that predict health and illness over and above conventional risk factors.

They can be biological, subjective or functional. A biological asset is an objectively measured health characteristic, such as a favourable blood lipid profile. Subjective health assets include psychological state and positive emotions. A functional health asset relates to the ability to undertake community and social participation and includes physical function and adequate finances. Health assets have primarily been examined in the community setting. Potential assets in this setting are cardiorespiratory fitness, a stable marriage, positive emotions and social participation.

Community studies have demonstrated that positive health factors can mitigate the consequences of frailty i.e. individuals with comparable frailty status have reduced mortality if they have a higher number of assets. An asset model is more empowering to individuals, as it encourages resilience and empowers people to be active participants in their own wellbeing.
The purpose of this systematic review was to determine whether individual health assets also improve outcomes in the acute hospital setting. The outcomes examined were post-hospital mortality, functional decline in activities of daily living, new need for residential care, readmission and length of stay.

2.2 Methods

2.2.1 Search Strategy
A search of MEDLINE, EMBASE, CINAHL and PsycINFO was conducted in February 2015. The MEDLINE search used a combination of Medical Subject Heading (MeSH) terms and keywords. Modified forms of the same terms were used for PsycINFO, EMBASE and CINAHL. Results were limited to articles published from 1990 onwards; English language, aged 65 and older and human subjects. Search terms were used to identify hospital inpatients, outcomes of interest, and studies looking at health determinants. These searches were then combined with the Boolean operator AND. A PubMed search was also conducted using keywords to identify any articles that had been published in the preceding two months and had not yet been assigned MeSH terms (see Appendix 1 for search strategies). The reference lists of included articles were also examined. The study protocol was registered with Prospero (http://www.crd.york.ac.uk/PROSPERO/, registration number: CRD42015019818)

2.2.2 Study selection

2.3 Inclusion criteria
Studies were included if the study population included adults aged 65 and older who had an unplanned hospitalisation. Health assets were only considered if they were examined independently. Studies where the health asset was identified in the community prior to admission were included. The domains included were biological, subjective and functional health assets. The outcomes examined were post hospital mortality, functional decline, new need for residential care, length of stay and readmission. Only articles which examined quantitatively an association between factor(s) of interest and adverse outcomes were included.
Studies were excluded if they looked at a specific patient population such as transplant recipients, patients undergoing a particular intervention, or stroke patients. Studies were excluded if the association was found with an established risk factor associated with negative outcomes defined as poor baseline function, co-morbidity, depression, malnutrition and cognitive impairment. Environmental and hospitalisation care processes were not examined.

Study quality was evaluated using an adapted version of the epidemiological appraisal instrument by Genaidy et al (see appendix 2)(KG reviewed all, KL and RM reviewed half each). The studies were characterised as low, medium or high methodological quality.

2.3.1 Data extraction
Each study was interrogated for general information, population characteristics, outcome of interest, method and timing of data collection. A list of health assets was generated from the included studies.

2.3.2 Data synthesis and analysis
The studies were grouped by type of health asset examined. Although two studies included the same cohort, both were included as they examined the outcome of different health related characteristics.

2.3.3 Results
2.3.4 Overview of included studies
Initial search, title and abstract review were performed by KG. Initial searches identified 3566 original articles. After review of the title, 3303 were rejected. The abstracts of the remaining 231 were reviewed, following which 41 articles were retrieved for full text review. Of these, 10 articles met the final inclusion criteria (see table 2.1). One additional article was identified after reviewing the references of articles that met the inclusion criteria, resulting in a total of 11 articles (figure 1). A
narrative approach was taken to the data analysis, as, due to the heterogeneity of study methods and populations, a meta-analysis was not possible.

Articles were identified which found health assets that decreased post hospital mortality, functional decline, new need for residential care and readmission (see table 2.1). No health assets were found to be associated with a shorter length of stay. The included studies were predominantly from English speaking countries. Two studies used data from the same cohort of patients based in New Haven, Connecticut.48,49 (see table 2.1).

2.4 Discussion
This review indicates that individual health assets are associated with improved outcomes of functional decline, mortality, new need for residential care and readmission in hospitalised older adults. Older adults are more likely to have positive outcomes after an inpatient episode if they have adequate social, psychological and financial resources. The small number of studies suitable for inclusion indicates the need for further research in this area. Many health assets included in this review were presented with the negative associations of their absence, which is reflective of the traditional focus on risk factors and ill health, rather than seeking factors that can lead to better health.

Although many of the studies were classified as being high quality, as the studies were all cohorts, definitive causation cannot be demonstrated. Many of the findings, such as the protective effect of a carer, education and social engagement were repeated in multiple studies, which adds further weight. For many health assets, randomised controlled trials are not possible. This highlights the need to perform further cohort studies to look for factors that confer protection while adequately controlling for risk factors.

Although some of the resources identified are not amenable to modification, such as education, presence of a carer and financial resources, a large number could lead to targeted interventions, such as social engagement, having a primary physician and
improving psychological health. This informs theoretical knowledge of factors that have a positive influence on health and highlights new directions to improve outcomes for this vulnerable patient group. In the community setting, frail patients who have a high degree of social vulnerability are protected from mortality if they live in countries with social models that provide a high level of formalised support, further demonstrating practical applications.

A health asset is an enabling factor, empowering individuals to use their own resources and resources around them to improve their health outcomes. In this context, it is easily apparent how some assets, such as a higher level of educational attainment or the ability to pay for basic health and personal expenses are protective. The mechanistic link between a higher level of social engagement and a lower chance of post hospital mortality or functional decline is less easily apparent. Psychosocial stress is associated with increased inflammation, which may be the conduit for this association. Dent et al found that psychosocial factors conferred protection against adverse outcomes for frail adults in a hospitalised cohort. In contrast, this was not found in a community cohort which also included frail older adults and examined mortality and functional decline. The study by Dent et al. had a higher mortality rate compared to Hoogendijk et al, with 23% vs 6.8%. The participants had a far higher rate of frailty in the study by Dent et al, at 57%, with only 16.8% of the patients in the study by Hoogendijk et al being classified as frail, despite using the same method of measurement which could contribute to the different result. If the community cohort were followed for a longer time period, as mortality rates increase, an effect may be seen.

Oral health was associated with better functional outcomes in an analysis that accounted for social supports, cognition, but not nutritional status. It is possible that oral health is a reflection of higher socio-economic status, but it may also indicate an ability and willingness of the individual to take care of their health. This is consistent with the finding that having a primary health care provider is a health asset.
Although some studies found associations with gender, the findings were not consistently positive for one gender in particular to include this as a health asset.

No biological health assets were identified in this review. Lower levels of interleukin-6 (IL-6) and insulin-like growth factor -1 (IGF-1) are associated with better functional outcomes in patients following unplanned hospitalisation when combined with another predictive model. As IL-6 and IGF-1 were not examined independently of the risk prediction model, this study was not included, but this does suggest that neuroendocrine reserve and diminished inflammation could be health assets. It is possible that biological health assets are not predictive in the acute setting due to the overriding impact of the antecedent illness.

The theory of salutogenesis was developed in the community setting with a focus on maintaining and improving wellness. Health assets in the community may not provide benefit when someone is hospitalised. Conversely there may be factors, which only come into effect once someone is hospitalised. In the community setting environmental factors and community resources also affect health outcomes. It has been well described that in the hospital setting, admission to an Acute Care of the Elderly unit instead of a general medical unit improves the likelihood of a positive functional outcome, so this could also be considered a health asset.

The quality of hospital processes, including in-hospital nutrition and mobility; also have positive impact on health status outcomes. Mobility in hospital is partly a result of the quality of hospital processes. It may also represent a health asset, as in studies where the statistical model has controlled for illness severity, functional status, co-morbidity and cognition, higher levels of mobility were associated with better long-term functional status and mortality.

Limitations of the present study include the heterogeneity of measures used to identify similar variables, which precluded meta-analysis. Many of the studies also examined similar populations, with 3 studies looking at populations from the same small city in the USA. Berkman and Wilcox examined different outcomes for a
very similar characteristic in the same population. Both studies were included as the outcome of interest for the characteristic was different. Nevertheless, the number of studies from a limited population raises concerns about generalisability. Loss to follow up was not reported in some studies nor was completeness of follow-up. Only one study set in a subacute care unit examined subjective health assets, so this finding may not be generalisable to all inpatients. The health assets identified by Smith,\textsuperscript{54} and Goodwin,\textsuperscript{58} need to be interpreted in the context of being retrospective studies based on large computerised data sets. Examining these assets in a prospective cohort would strengthen these findings. It is possible that confounding accounts for some of the effects of the health assets identified. As an example, it is possible that the effect of higher financial resources is accounted for by increased level of education. However, even if independence of factors can be demonstrated statistically, this is a convention that is not well grounded in biological reality, and it is likely that two associated factors would still have an additive effect. This is something that could be explored in further research.

Although a systematic search strategy was used, it is possible that relevant articles were not identified. The identification of an article on hand search of the references indicates that this strategy was not fully sensitive.

Some studies were lacking in details of measurement. Drame et al.\textsuperscript{59} identified that having a large number of children was protective against the need for residential care, but the number of children was not specified.

Our findings must be interpreted with caution due to the low number of studies identified for inclusion and the lack of duplication of findings for most health assets. There are many candidate health assets, which have been examined in younger hospitalised populations, but not in older people. Being married and being resident in the country of birth have both been identified as health assets in younger inpatient cohorts,\textsuperscript{60,61} but these factors have not been examined in older cohorts. There are perceived difficulties in including older adults in research studies, such as a perception of older people as ‘vulnerable’. As this group make up a high proportion
of hospitalised older adults, it is imperative to design inclusive studies. Studies in younger adults tend to focus predominantly on mortality, rather than functional decline, which could be considered an outcome of almost equal importance by many older adults, due to the adverse prognostic implications.

There is increasing need across many health systems to try and improve care for older people, not only for the outcome of mortality, but for the outcomes of functional decline and readmission. Greater understanding of the role of health assets in the hospital setting could help individuals to play a greater role in their own recovery. It could also lead to improvements in hospital systems to facilitate the role of the individual as the driver of their own return to wellbeing. This could also promote more granular risk stratification and resource allocation as patients with fewer health assets may require increased assistance to ensure recovery following hospitalisation.

2.5 Conclusion
The complex interplay between health status and psychological and social factors is incompletely understood. A health asset allows an individual to better understand the situation they are in and to use their own resources and resources around them to improve their health outcomes. A hospital admission is a time of great risk to older people and so it is critical to identify health assets that can improve outcomes and promote patients as active agents of their wellbeing. Health assets in older adults are associated with a decrease in mortality, functional decline, readmission and new need for residential care. Some health assets identified in younger age groups have not been explored in older age groups. Identification of health assets will allow collection of this information in the clinical setting, which may facilitate better allocation of healthcare resources and better patient outcomes. This review has identified many targets for further research.
**Conflict of interest statement:** The authors have no conflicts of interest to declare.

**Sources of funding**

This work was supported by PhD scholarships from the Australian Postgraduate Association and the Northern Hospital to KG.
Figure 2.1 Summary of Literature Search and Selection

MEDLINE (n=2023)  EMBASE (n=1442)  CINAHL (n=290)  PsycINFO (n=126)

Duplicates removed (n=315)

Title review (n=3566)

Excluded (n=3326)

Abstract review (n=240)

Excluded (n=199)
Risk factors = 52
Not outcome of interest = 76
Wrong population = 29
Not original research = 14
Not relevant = 28

Full text review (n=41)

Excluded (n=29)
Risk factors = 11
Not outcome of interest = 3
Wrong population = 8
Not original research = 1
Not relevant = 6

Eligible articles (n=12)

References of eligible articles (n=1)

Excluded due to low quality (n=2)

Total (n=11)

No additional results were identified from the PubMed search
<table>
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<th>Study and Sample size</th>
<th>Quality</th>
<th>Location and setting for recruitment</th>
<th>Duration of Follow-up</th>
<th>Health Asset</th>
<th>Functional decline</th>
<th>Post hospital mortality</th>
<th>Discharge to RACF</th>
<th>Readmission</th>
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<td>6 months</td>
<td>Emotional support</td>
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<td>(12.6, 63)</td>
<td>Low vs. high</td>
<td></td>
</tr>
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<td>Chen et al. (2008)</td>
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<td>USA General medical ward of hospital</td>
<td>6 months</td>
<td>Education</td>
<td>35% for high vs. 45% for low</td>
<td></td>
<td></td>
<td></td>
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<td>Dent and Hoogendijk</td>
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<td>Australia subacute ward of hospital</td>
<td>12 months</td>
<td>Sense of control</td>
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<td>(134.6, 72)</td>
<td>Low vs. high</td>
<td>OR 2.97</td>
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<td>Dume et al. (2011)</td>
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<td>France Multi-centre trial in acute hospitals</td>
<td>Time of discharge</td>
<td>Sense of wellbeing</td>
<td>OR 2.26</td>
<td>(101.5, 04)</td>
<td>low vs. high</td>
<td>HR 0.8</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Social engagement</td>
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<td>(101.12)</td>
<td>low vs. high</td>
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<td></td>
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<td>Many children</td>
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<td></td>
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<td>Goodwin et al. (2011)</td>
<td>high</td>
<td>USA 5% of all Medicare recipients</td>
<td>Retrospective cohort</td>
<td>Primary care physician (PPI)</td>
<td>OR 0.75</td>
<td>(0.74, 0.77)</td>
<td>PPI vs. no PPI</td>
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<td></td>
<td>(1.67, 1.68)</td>
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<td>Li et al. (2005)</td>
<td>high</td>
<td>USA General medical service of two hospitals</td>
<td>90 days for ADLs</td>
<td>Financial resources</td>
<td>OR 1.59</td>
<td>(107.2, 37)</td>
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<td></td>
<td></td>
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<td>12 months mortality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(100.187)</td>
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<td>Rodriguez-Artalejo et</td>
<td>high</td>
<td>Spain Acute hospital wards of four hospitals</td>
<td>Median 6.5 months</td>
<td>Social engagement</td>
<td>OR 1.59</td>
<td>(107.2, 37)</td>
<td>Low vs. high</td>
<td>OR 1.1</td>
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<td></td>
<td></td>
<td>(1.67, 1.68)</td>
</tr>
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<td>Smith and Stevens (2009)</td>
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<td>Retrospective cohort</td>
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<td>Low vs. high</td>
<td>OR 0.74</td>
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<td>(0.55, 0.97)</td>
</tr>
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<td>6 months</td>
<td>Social engagement</td>
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<td>(19, 4.1)</td>
<td>No carer</td>
<td>OR 2.9</td>
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</tr>
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<td>moderate</td>
<td>France Two hospitals</td>
<td>Time of discharge</td>
<td>Carer</td>
<td>OR 2.9</td>
<td>(19, 4.1)</td>
<td>No carer</td>
<td></td>
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Chapter 3  The Clinical Frailty Scale predicts functional decline and mortality when used by junior medical staff: a prospective cohort study

Running title: The CFS as a predictive tool in clinical practice

1. Corresponding Author: Dr Kate Gregorevic: Honorary fellow, Department of Aged Care, Northern Hospital, 185 Cooper St, Epping Vic 3076; PhD candidate, North West Academic Centre, University of Melbourne, Australia

Phone: 0402016869

Fax: (03) 8405 8524

Email: kate.gregorevic@gmail.com

2. Dr Ruth Hubbard, Associate Professor of Geriatric Medicine Deputy Director, Centre for Research in Geriatric Medicine, The University of Queensland, Australia

3. A/Prof Benny Katz: Director of Geriatric Medicine, St Vincent’s Hospital, Melbourne; Clinical Associate Professor, University of Melbourne; Adjunct Associate Professor, La Trobe University, Australia

4. A/Prof Kwang Lim: Associate Professor, University of Melbourne; Chief Medical Officer, Northern Hospital, Australia

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3.1 Abstract

Aim: Increasing frailty is associated with risk of mortality and functional decline in hospitalized older adults, but there is no consensus on the best screening method for use by non-geriatricians. The objective of this study is to determine whether the clinical frailty scale can be used to identify patient baseline frailty status in the acute general medical setting when used by junior medical staff using information obtained on routine clinical assessment.

Methods: Prospective cohort study in an acute general medical unit. All patients aged 65 and over admitted to a general medical unit during August and September 2013 were eligible for the study. CFS score at baseline was documented by a member of the treating medical team. Demographic information and outcomes were obtained from medical records. The primary outcomes were functional decline and death within three months.

Results: Frailty was assessed in 95% of 179 eligible patients. 45% of patients experienced functional decline and 11% died within three months. 40% of patients were classified as vulnerable/mildly frail, and 41% were moderately to severely frail. When patients in residential care were excluded, increasing frailty was associated with functional decline (p=0.011). Increasing frailty was associated with mortality within three months (p=0.012).

Conclusions: A high proportion of eligible patients had the frailty measure completed, demonstrating the acceptability of the CFS to clinicians. Despite lack of training for medical staff, increasing frailty was correlated with functional decline and mortality supporting the validity of the CFS as a frailty screening tool for clinicians.

Keywords: Aged, Frailty, Hospitalization, Survival, Frail elderly, Activities of Daily Living
3.2 Background

Frailty can be used to identify older adults who are at increased risk of mortality and functional decline when they are hospitalized\(^2\), but there is no consensus on the most appropriate way for non-geriatricians to identify frailty at the time of hospital admission\(^14\). Traditionally subjective opinion has been used by non-geriatricians to identify frailty, but this correlates poorly with objective measures of frailty\(^26\).

The frailty phenotype\(^21\) and the frailty index\(^22\) have both been validated against adverse outcomes in large community cohorts. Fried’s frailty phenotype requires measurement of gait speed\(^21\) which is likely to be affected by an acute illness. The frailty index based on a comprehensive geriatric assessment (FI-CGA) at the time of hospital admission predicts increased risk of mortality and need for residential care\(^14,63\), but requires geriatrician input. Screening for frailty by non-geriatricians may identify patients most likely to benefit from a CGA\(^14\).

The Clinical Frailty Scale (CFS) (http://geriatricresearch.medicine.dal.ca/clinical_frailty_scale.htm) was developed to enable frailty to be measured in the outpatient clinical setting\(^64\). It has demonstrated very good inter-rater reliability\(^31,64\). When used by trained assessors it predicts short-term and long-term mortality in acutely hospitalized older adults\(^31,65-67\) grouped as frail or not frail. A large retrospective cohort study demonstrated that increasing frailty on the CFS has a linear relationship with inpatient mortality and increased length of stay\(^30\).

The objective of this study is to determine the predictive validity of the CFS when used by untrained junior medical staff in the acute general medical setting using only routine clinical information.

3.3 Methods

3.3.1 Subjects and setting

The study took place at St Vincent’s Hospital, a university associated tertiary hospital in inner-Melbourne, Australia. All patients admitted under a general medical unit
during August and September 2013, who were aged 65 years or older were included. There were four general medical units consisting of one registrar and two interns, as well as admitting night and day registrars, meaning there were 14 possible candidates to complete the CFS. As the primary focus of the study was to assess utility of the clinical frailty scale, not the doctors, data collection was anonymous to protect staff privacy. Patients were excluded if they were transferred to a different specialty unit or they were expected to die within twenty-four hours. 179 eligible patients were admitted during this time period. Ethics approval was obtained. As the project used data that was collected as part of routine medical care, the ethics committee determined that individual consent was not required.

3.3.2 Measures and data collection
Copies of the Clinical Frailty Scale (CFS) were placed in the work-rooms of the junior medical staff. The CFS was completed by an intern or registrar of the treating medical team. These doctors were asked to record a CFS score based on the patient’s functional status prior to admission using only routine clinical assessment. The CFS could be completed at any time during the admission, so patients admitted after hours and on weekends were included. No specific training or incentives were provided. Inter-rater reliability was not measured as this has been demonstrated in prior studies\textsuperscript{31,64} and it was felt that it would apply additional stress to the junior doctors completing the CFS. Demographic data and baseline characteristics were obtained via electronic medical records and chart review. Co-morbidities were measured using the Charlson comorbidity index\textsuperscript{68,69}.

The two outcomes investigated were mortality and functional decline. Mortality was measured at three months. This was obtained from hospital records. Functional decline was measured at the time of discharge from the acute hospital. Functional decline was defined as the need for subacute care, patient being assessed as below pre-morbid function by allied health, or the need for increased services on discharge. Patients who died during the admission were excluded from the analysis of functional decline. This was obtained from hospital records and chart review.
3.3.3 Analysis
Patients were divided into four groups based on their frailty scores. Patients who were scored at 1-3 on the CFS were defined as not frail (group 1), patients who were scored at 4-5 (group 2) as vulnerable-mildly frail, patients who scored 7-8 (group 3) as moderately to severely frail and patients who scored 9 were terminally ill but not otherwise frail (Group 4). All statistical analysis was performed using Stata version 12.1. The level of statistical significance was set at 0.05. Baseline characteristics between the groups were compared using the chi squared statistic, where applicable (see table 3.1). Univariate analysis was performed for all variables (Table 3.2). Multivariate analysis was performed using two models. All variables which had a P value of less than 0.1 were included in the multivariate analysis. Usual residence was also included in a model for functional decline due to theoretical concern regarding confounding.

3.4 Results
3.4.1 Baseline Characteristics
179 eligible patients were admitted during the time period of the study. Frailty scores were obtained for 95% of patients. 40% of patients were vulnerable/mildly frail, and 41% were moderately to severely frail. Only 17% were not frail (table 3.1). There were no significant differences in age, gender or co-morbidity score across the groups. Patients who were more frail were less likely to live home alone (p<0.01). Patients who were moderately to severely frail were most likely to live in residential care (P<0.01).

3.4.2 Outcomes
Overall mortality at three months was 11%. At the time of discharge from the acute hospital, 45% of patients experienced functional decline. Mean length of stay was 6.7, which was not significantly different across frailty groups. Patients who were more frail were more likely to live with others or in residential care (p<0.01). There were no other significant differences in baseline characteristics when grouped by frailty score (table 3.3).
When people who lived in residential care were excluded, in univariate analysis patients who were more frail were also more likely to experience functional decline (OR 1.8, 95% CI 1.13, 2.87) (figure 3.1). No other variable was associated with functional decline in univariate analysis. In the multivariate model with usual residence, the association between frailty and functional decline remained significant.

In univariate analysis increasing frailty was associated with increased risk for mortality (OR 2.5, 95% CI 1.19, 5.3) (table 3.2). Gender was included in the multivariate model, the OR for this model was 2.4 (95% CI 1.15, 4.97)

### 3.5 Discussion

This study demonstrates the utility of the Clinical Frailty Scale in the acute general medical setting. The CFS correlates with the important outcomes of death and functional decline. This is the first study the authors are aware of, where no training was provided to junior doctors in order to examine how the CFS functions in a real world setting. This study also shows that this scale is highly acceptable to medical staff as there was a 95% completion rate. It was completed with information obtained on routine assessment at the time of admission, so the additional workload for junior medical staff was minimal. The combination of acceptability and prognostic guidance supports the role of the CFS as a tool to identify patients most suitable for comprehensive geriatric assessment.

Other studies have looked at the CFS as a predictor of mortality in the acute hospital setting, but this is the first study the authors are aware of to also look at functional outcomes. Failure to return to pre-morbid functional status predicts mortality and institutionalisation. Patients who are at high risk for functional decline are also at high risk for mortality, so it is not possible to differentiate between these groups with a simple screening tool.
There was no association found between length of stay and frailty score, which is not consistent with other studies\textsuperscript{30}. This may be as length of stay was measured as time in an acute ward, where other studies also include time in subacute geriatric wards.

The risk of mortality and of functional decline increased with increasing levels of frailty, which further supports the validity of the use of the CFS by untrained junior medical staff. This finding is consistent with frailty assessed by the FI-CGA\textsuperscript{14} and further supports the idea that it is important to assess the degree of frailty, not just its presence or absence.

Wallis et al looked at the predictive qualities of the CFS in a large cohort of emergency admissions. The CFS was completed by junior medical or nursing staff, who were provided with training at induction. Despite the lack of training provided for the junior medical staff in our study, the OR for inpatient mortality was 1.6, 95% CI 1.48 1.74, which was comparable to the three-month mortality rate in our study of 1.82, 95% CI 1.14, 2.91. Although the overall trend was for increasing mortality with increasing frailty, the least frail group (group 1) had the same mortality as patients who were moderately to severely frail (group 3). Wallis et al also found that the least frail patients had a higher mortality than the next group. This may be due to patients who are more robust only needing to be hospitalized for more a more severe interceding illness.

This is the first study the authors are aware of where functional outcomes were examined. It is important to identify patients who are at risk of experiencing functional decline as hospital associated functional decline frequently persists and is associated with one year mortality\textsuperscript{2}.

The study has certain strengths. A high proportion of eligible patients were included. Since individual consent / assent was not required and the CFS could be completed at any time during the hospital stay there were no barriers to recruitment of patients with communication, language or cognitive difficulties or those admitted outside routine working hours. This increases the generalisability of our findings.
We also acknowledge methodological weaknesses. This is a single centre study, and so the results may not be applicable to other sites.

The measure of functional decline was indirect, as it was the need for subacute care, the need for increased services on discharge or the opinion of an allied health team member that the patient was below pre-morbid function. Although this is not a validated measure of frailty, the proportion of patients who experienced functional decline was similar to other studies in similar settings\textsuperscript{1,2}. Patients who were from residential care were excluded from the analysis of functional decline, as some of the criteria used to define functional decline were not applicable to this group. The measure used may have lacked sufficient sensitivity to detect functional decline in those who already had low baseline function, for example people receiving full time care from family members. These limitations could be overcome by conducting further research with an objective measure of function at the time of hospitalization and the time of discharge.

We were unable to include some potential confounders in the multivariate analysis. Only information that was routinely collected for patients as part of standard medical, allied health and nursing care was available, so we were unable to obtain a measure of nutrition, cognition or delirium.

### 3.6 Conclusions

It is increasingly recognised that frailty rather than chronological age predicts adverse outcomes in hospitalised older adults. Identification of frailty in the acute setting within time and resource limitations is a major challenge. This is the first trial that the authors are aware of to demonstrate that the Clinical Frailty Scale can predict functional decline and mortality when completed by untrained junior medical staff in the acute general medical setting. As the CFS is quick and easy to use, it is acceptable to busy junior clinicians. Future research should investigate how the CFS correlates with more precise measures of frailty, particularly the frailty index derived from comprehensive geriatric assessment and if multifaceted interventions
including management of cognition, nutrition and social factors can improve outcomes for patients with different levels of frailty.

**Abbreviations**

CFS: clinical frailty scale; FI-CGA: frailty index based on a comprehensive geriatric assessment; CGA: comprehensive geriatric assessment

**Disclosure statement**

The authors have no financial or non-financial competing interests to declare

**Author’s contributions**

KG: Study design, data collection, statistical analysis, interpretation of results, development of discussion, preparation of the manuscript

RH: Editorial input for manuscript

BK: Guidance with study design, editorial input for manuscript

KL: Guidance with study design and statistical analysis, editorial input for manuscript
When grouped by frailty score (Table 3). Gender was included in the multivariate model, the OR for this model was 2.4 (95% CI 1.15, 4.97).

Functional decline (exclude all patients in residential care) was associated with functional decline in univariate analysis. Patients who were more frail were also more likely to experience functional decline. Mean length of stay was 9.3 months (6-8).

Overall mortality at three months was 11%. At the time of death and functional decline. This is the first study that looked at factors associated with frailty.

For each increased level of frailty there is a corresponding increase in the percentage of people experiencing functional decline (frailty groups).

### Table 3.1 Baseline Characteristics of Study Participants

<table>
<thead>
<tr>
<th>Frailty Score</th>
<th>Number in group</th>
<th>Age (median and range)</th>
<th>Male (%)</th>
<th>Preferred language not English (%)</th>
<th>Home alone/home accompanied/residential care (%)</th>
<th>Charlson Score (mean) (p = .377)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>29</td>
<td>80 (66-96)</td>
<td>52</td>
<td>48</td>
<td>12 (37)</td>
<td>6 (33)</td>
</tr>
<tr>
<td>4-5</td>
<td>68</td>
<td>82 (66-97)</td>
<td>43</td>
<td>56</td>
<td>32 (47)</td>
<td>2 (3)</td>
</tr>
<tr>
<td>6-8</td>
<td>70</td>
<td>83 (66-97)</td>
<td>46</td>
<td>65</td>
<td>15 (21)</td>
<td>3 (4)</td>
</tr>
<tr>
<td>9</td>
<td>3</td>
<td>77 (65-80)</td>
<td>100</td>
<td>100</td>
<td>1 (33)</td>
<td>1 (33)</td>
</tr>
</tbody>
</table>

### Table 3.2 Results of univariate analysis of covariates

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Variable</th>
<th>Coefficient</th>
<th>95% CI</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional decline</td>
<td>Age</td>
<td>0.37</td>
<td>-0.13, 0.009</td>
<td>0.702</td>
</tr>
<tr>
<td></td>
<td>Gender</td>
<td>0.081</td>
<td>-0.080, 0.244</td>
<td>0.321</td>
</tr>
<tr>
<td></td>
<td>Usual residence</td>
<td>-0.06</td>
<td>-0.195, 0.070</td>
<td>0.355</td>
</tr>
<tr>
<td></td>
<td>Charlson score</td>
<td>0.015</td>
<td>-0.020, 0.0516</td>
<td>0.386</td>
</tr>
<tr>
<td></td>
<td>Preferred language</td>
<td>-0.00</td>
<td>-0.163, 0.161</td>
<td>0.988</td>
</tr>
<tr>
<td>Three month mortality</td>
<td>Age</td>
<td>0.001</td>
<td>0.005, 0.007</td>
<td>0.756</td>
</tr>
<tr>
<td></td>
<td>gender</td>
<td>-0.111</td>
<td>-0.204, 0.018</td>
<td>0.019</td>
</tr>
<tr>
<td></td>
<td>Usual residence</td>
<td>0.038</td>
<td>-0.080, 0.085</td>
<td>0.106</td>
</tr>
<tr>
<td></td>
<td>Charlson score</td>
<td>0.016</td>
<td>-0.006, 0.038</td>
<td>0.148</td>
</tr>
<tr>
<td></td>
<td>Preferred language</td>
<td>-0.047</td>
<td>-0.141, 0.015</td>
<td>0.316</td>
</tr>
</tbody>
</table>

### Table 3.3 Results of multivariate analysis looking at factors associated with frailty

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Model</th>
<th>Number in model</th>
<th>Coefficient</th>
<th>95% confidence interval</th>
<th>P value</th>
<th>OR</th>
<th>95% CI for OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional decline</td>
<td>Univariate</td>
<td>145</td>
<td>0.142</td>
<td>0.033, 0.252</td>
<td>0.011</td>
<td>1.8</td>
<td>1.13, 2.87</td>
</tr>
<tr>
<td></td>
<td>Model 1</td>
<td>145</td>
<td>0.144</td>
<td>0.035, 0.255</td>
<td>0.010</td>
<td>1.82</td>
<td>1.14, 2.91</td>
</tr>
<tr>
<td>Mortality and three months</td>
<td>Univariate</td>
<td>169</td>
<td>0.080</td>
<td>0.018, 0.143</td>
<td>0.012</td>
<td>2.5</td>
<td>1.19, 5.3</td>
</tr>
<tr>
<td></td>
<td>Model 2</td>
<td>169</td>
<td>0.079</td>
<td>0.017, 0.141</td>
<td>0.012</td>
<td>2.4</td>
<td>1.15, 4.97</td>
</tr>
<tr>
<td></td>
<td>Model 3</td>
<td>169</td>
<td>0.061</td>
<td>-0.003, 0.126</td>
<td>0.070</td>
<td>2.2</td>
<td>0.098, 4.67</td>
</tr>
<tr>
<td></td>
<td>Model 4</td>
<td>169</td>
<td>0.068</td>
<td>0.003, 0.133</td>
<td>0.04</td>
<td>2.3</td>
<td>1.15, 5.30</td>
</tr>
</tbody>
</table>

Model 1 variables: usual residence, excludes patients in residential care  
Model 2 variables: gender  
Model 3 variables: gender, Charlson co-morbidity score, usual residence  
Model 4 variables: usual residence
Figure 3.1  
Graph of mortality and Functional Decline versus Frailty

For each increased level of frailty there is a corresponding increase in the percentage of people experiencing functional decline (frailty score 1-3: 34 %, 4-5: 46 % and 6-8: 70 %). There was an overall trend for increasing mortality with increasing frailty (frailty score 1-3: 10 %, 4-5: 4 %, 6-8: 10 % and 9: 100 %).
Chapter 4  Do Health Assets have a Protective Effect for Hospitalised Frail Older Adults?

Corresponding Author:

Dr Kate Gregorevic, Department of Aged Care, Northern Hospital, 185 Cooper St Epping, Victoria, Australia

Phone: +61 3 84058000

Authors:

1. Dr Kate Gregorevic MBBS$^{1,2,4}$
2. Dr Nancye M. Peel PhD$^3$
3. Prof Wen Kwang Lim MBBS MD$^{2,4}$
4. A/Prof Ruth E Hubbard MBBS MD$^3$

1. Northern Hospital, Melbourne, Victoria Australia
2. University of Melbourne, Melbourne, Victoria, Australia
3. Centre for Research in Geriatric Medicine, The University of Queensland, Brisbane, QLD, Australia.
4. Melbourne Health, Melbourne, Victoria, Australia

This chapter is a lightly edited version of a publication in *QJM*. 2018 Nov 1;111(11) (see appendix 13)
4.1 Abstract

Background: Although increasing frailty is predictive of increased mortality and length of stay for hospitalised older adults, this approach ignores health assets that individuals can utilise to recover following hospital admission.

Aim: To examine whether health assets mitigate the effect of frailty on outcomes for older adults admitted to hospital

Design: 1418 patients aged ≥ 70 years admitted to 11 hospitals in Australia were evaluated at admission using the interRAI assessment system for Acute Care, which surveys a large number of domains, including cognition, communication, mood and behaviour, activities of daily living, continence, nutrition, skin condition, falls, and medical diagnosis.

Methods: The data set was interrogated for potential health assets and a multiple logistic regression adjusted for frailty index, age and gender as covariates was performed for the outcomes mortality, length of stay, readmission and new need for residential care.

Results: Inpatient mortality was 3% and 4.5% of patients died within 28 days of discharge. Median length of stay was 7 days (IQR 4-11). In multivariate analysis that includes frailty, being able to walk further (OR 0.08 (0.01-0.63)), ability to leave the house (OR 0.35 (0.17-0.74)) and living alone (OR 0.28 (0.10-0.79)) were protective against mortality. The presence of a support person was associated with a decreased length of stay (OR 0.14 (0.08-0.25)).

Conclusion: The inclusion of health assets in predictive models can improve prognostication and highlights potential interventions to improve outcomes for hospitalised older adults.
Introduction
Admission to hospital can be a life-changing event for older adults. Many will not return to the same level of health and function once discharged from hospital. An individual’s ability to recover from a physical insult will depend on their health status, which is the result of a complex interplay of medical, cognitive, nutritional, social and lifestyle factors.

Measurement of frailty at admission to hospital can be used to identify older adults at increased risk of mortality and long length of stay. For every increase in frailty by an increment of 0.1 on the frailty index, there is an increased risk of mortality with an OR of 1.05-2.01. However, inclusion of only risk factors to assess prognosis does not explain why some frail older adults have better physical and functional recovery following hospitalisation than others. In contrast to the ‘health deficits’ approach, salutogenesis theory focuses on individual and community capacity to improve health. Identification of health assets, which are resources that individuals or communities have at their disposal to protect against negative health outcomes and promote wellbeing, allows practical application of this theory.

The concept of health assets has primarily been developed in the community. Health assets have been identified across multiple domains including biological (eg. low cholesterol), functional (eg. ability to undertake community activities) and subjective (eg. a sense of wellbeing). In the community, health assets individually and
cumulatively are associated with longer survival and improved health status in models that include frailty.\textsuperscript{37}

There is increasing interest in identifying, early in the hospital stay, those patients who are likely to have adverse outcomes at discharge and therefore in need of specialised discharge planning. Timely identification of patients in need of resource intensive discharge planning has the potential to contain healthcare costs and to increase individual patient satisfaction.\textsuperscript{74,75} This study aimed to determine whether health assets could be identified in hospitalised patients that would mitigate the effect of frailty on adverse outcomes.

4.3 Methods

4.3.1 Study design, setting and participants

This was a secondary analysis of a prospective cohort of 1418 adults aged 70 and older from 11 acute care hospitals in Queensland and Victoria, Australia. Patients admitted to general medical, surgical and orthopaedic wards were included if they had an expected length of stay of at least 48 hours. Study recruitment has been previously described.\textsuperscript{72}

4.3.2 Measures

The interRAI assessment system for Acute Care (AC), specifically developed for use in the acute setting, was used for comprehensive geriatric assessment (CGA).\textsuperscript{76} The interRAI AC-CGA instrument, previously known as the interRAI AC, surveys a large number of domains, including cognition, communication, mood and behaviour, activities of daily living, continence, nutrition, skin condition, falls, and medical diagnosis. Trained nurse assessors completed the assessment using multiple sources of information, including patients, carers, medical and nursing staff and clinical records. This was collected at the time of admission and discharge. Patients were followed up by telephone and/or medical record review at 28 days post discharge from acute care to determine outcomes.
Health status: As a summative measure of health status, a Frailty Index (FI) (see supplementary data S1, appendix 13) was calculated for each patient using candidate variables derived from the interRAI AC and coded as deficits using a well-defined methodology. 

Health assets: The InterRAI data set was screened for potential health assets, which were chosen based on a systematic review and face validity. Variables were excluded if they were present in >99% of the patients or if they were used to construct the frailty index. The potential health assets included socio-demographics (English as primary language, being married, living with others, and having a support person positive towards discharge). In addition, premorbid activity (going out of the house and furthest distance walked at any one time) were also recorded for the 3 days prior to admission.

Outcomes: Inpatient mortality, mortality within 28 days post discharge from acute care, length of stay, new discharge to residential care and readmission within 28 days of discharge.

4.3.3 Analysis

Data was analysed using STATA version 14.1. Frequency distributions were used to describe population characteristics, reported as proportion of available data. Continuous variables were reported as means with standard deviation (SD) or medians with interquartile range (IQR), depending on distribution of the data. Univariate analysis was performed for each of the health assets against the outcomes of interest. A negative binomial regression was used for length of stay to account for right skew of the data. Health assets with a p value of <0.20 for association in the univariate analysis were included in logistic regression multivariate models for each adverse outcome. The level of statistical significance was set at <0.05 for the multivariate analysis. The FI (categorised at 0.1 increments), age and gender were included as covariates in multivariate models. The results for length of stay are reported as Incidence Rate Ratio (IRR). The results for all other outcomes are reported as Odds Ratios (OR) with 95% Confidence Interval (CI).
4.4 Ethics

Personal or proxy consent was obtained in writing by each participant prior to commencement of the studies. Ethical approval was granted from the human research and ethics committee of each participating hospital and University of Queensland medical research ethics committee.

4.5 Results

The study included 1418 patients with mean (SD) age of 81(7) years, 55 % of whom were female. The average length of stay was 9.6 days (SD10.3), with a median of 7 and IQR of 4-11 days; the 90th percentile was 21 days. Mean (SD) frailty index for the sample was 0.32 (0.14). Adverse outcomes at discharge included inpatient mortality (n=57, 4.0%); 132 (9.3%) had a prolonged length of stay (>21 days) in acute care. Of those discharged, 47 (3.5%) died within 28 days post discharge from acute care and 270 (20.8%) of patients were readmitted within 28 days. Table 4.1 shows the characteristics of the study population. There was <1% data missing on any of the selected health assets.

Supplementary Tables S2 and S3 (appendix 13) show the association of health assets with adverse outcomes in univariate analysis. Factors significantly associated with increased mortality as an inpatient and within 28 days of discharge from acute care included living arrangements (living with others/or in institutional care vs living alone), while being widowed/divorced/separated vs being currently married/with partner, and having greater level of premorbid activity (going out of the house and distance walked) significantly reduced risk of mortality. Living in institutional care vs living alone reduced the risk of readmission. Health assets significantly associated with increased length of stay included being never married vs being married/with partner, and not having a person supportive of discharge, factors which also increased the risk of being newly discharged to residential aged care. Living with others vs living alone and having a greater level of premorbid activity (going out of the house and distance walked) were associated with reduced length of stay and risk of being newly discharged to residential aged care.
Table 4.2 shows the multivariate analysis for health assets and adverse outcomes, including the Frailty Index as a co-variate and adjusting the model for age and gender. In multivariate analysis for inpatient mortality, patients who lived alone (compared to living with others) were less likely to die (OR 0.24 95%CI 0.08, 0.67). Compared to patients who walked < 5 metres in the 3 days prior to admission, those who walked over 50 metres had improved survival. For mortality within 28 days of discharge, living alone and increasing distances walked premorbidity were similarly protective. In addition, going out of the house in the 3 day premorbid period reduced the risk of mortality post discharge (OR: 0.35 95%CI 0.17, 0.74). Having a person supportive of discharge (OR: 0.63 (95% CI 0.56, 0.71), going out of the house in the 3 day premorbid period (OR: 0.90 (95% CI 0.81, 1.00) and not living alone were all associated with a decreased length of stay. Risk of being newly discharged to residential aged care was increased for patients who lived alone (OR: 1.85 (95% CI 1.07, 3.38) but reduced if the patient had a person supportive of discharge (OR: 0.14 (0.08, 0.25). No health assets were predictive of readmission.

Adding Frailty Index to the multivariate models, indicated that, for the adverse outcomes of inpatient mortality, new discharge to residential aged care, and longer length of stay, the addition of health assets to the models attenuated the effects of frailty, although higher levels of frailty remained an independent predictor for these outcomes.

4.6 Discussion
This study demonstrates that the outcomes related to poor health status can be offset by health assets. Previous studies have shown that frailty predicts mortality and increased length of stay, but examining frailty alone does not adequately explain why some frail older adults still recover well when admitted to hospital. These findings demonstrate that it is not possible to get a full understanding of health status without considering positive attributes in conjunction with deficits.

Inclusion of protective factors may help develop a predictive model for the hospital-associated mortality of frail older adults. Increased levels of social resources are
associated with lower mortality in the community setting. Although this could not be directly measured in this study, it is clinically sensible that those who were able to walk longer distances and leave the house would have improved access to community and decreased social vulnerability. The linear relationship between distance walked and mortality warrants further study as it provides older adults with a goal, which may be achievable and realistic.

Even when health assets were included in the predictive models, increasing frailty was still predictive of inpatient mortality, increased length of stay and a new need for residential care. The power of frailty as a predictor is as a multidimensional measure of health, covering medical, cognitive, functional and nutritional domains. Routine measurement of frailty at the time of admission to hospital provides a valid way to improve prognostication. Prognostication may then be further improved by considering the positive impact of health assets.

Some health assets have a more obvious mechanism of action than others. It is easily apparent that having a person supportive of discharge would be protective against a new need for institutional care. Other associations, like the ability to access the community and decreased 28 day mortality may be mediated by increased positive emotion due to decreased social isolation. Previous studies have identified that emotional support and subjective wellbeing are protective against mortality following hospital admission. A possible biological mechanism for this is an association with positive emotions and decreased inflammation.

This study highlights a difficulty in how we define health assets. The definition of health assets is that they are desirable in their own right and associated with positive health outcomes. Living alone highlights this challenge, as it may be an active choice, or it may have resulted through an adverse life event, like the death of a spouse. The effect of living alone on mortality is inconsistent in the literature with some community studies identifying an increased risk of mortality and others, particularly in older adults, a protective association. Other studies have also demonstrated that frail older adults who live alone have decreased inpatient
mortality.\textsuperscript{82} Living alone is linked with better functional status, which is protective against mortality,\textsuperscript{83} which may also explain why living alone was not associated with a new need for residential care. Although living alone can be a risk factor for loneliness, particularly for men,\textsuperscript{84} for others it may be a marker of resilience.

Using the outcome of interest to define whether a variable is a health asset also creates a difficulty as certain variables had differing effects on different outcomes. Living alone was associated with decreased mortality, but it was associated with an increased length of stay. The only variable that was protective for both length of stay and mortality was whether the patient had left the house prior to admission. This likely reflects that length of stay is not solely a product of the antecedent illness and frailty. Low socioeconomic status measured by income, low education, inadequate housing and social isolation also contribute.\textsuperscript{85,86} Social isolation has also been linked with increased mortality. It is likely that the ability to leave the house and access the community is a surrogate marker for social engagement.

The results of this study must be interpreted with caution. The data was collected in Australia, and although a range of hospitals were included across multiple states, factors specific to an individual country’s health system may limit generalisability. As this was a secondary analysis, we were limited to available data, so some health assets identified on systematic review such as subjective wellbeing and higher levels of education could not be examined.\textsuperscript{86}

Although many of the factors are likely to be associated with each other, raising concerns regarding confounding, like people who are able to walk farther being more likely to leave the house, these factors maintained individual predictive significance in a multivariate model.

As this study was a secondary analysis, we were limited in our outcomes to those that were available. Functional decline at discharge from hospital from premorbid is highly prevalent and may negatively impact quality of life. This is an important area for further research.
This study has certain strengths. The study population is a large cohort of patients recruited from secondary and tertiary hospitals. Data collection was comprehensive, with only 2% missing in the final analysis. Importantly, our model also included gender to account for the male-female health-survival paradox.

This study raises further questions regarding how to best define health assets. Health assets are associated with positive health, but should also be desirable in their own right so to consider health assets in a truly person-centred way, further qualitative research is needed to assess desirability of health assets to older adults themselves. Prospective studies should allow examination of a wider range of health assets, including social and economic measures. This would enable determination of whether health assets have a cumulative effect, as seen in the community setting.

4.7 Conclusions
Although this study further highlights that increasing frailty is a risk factor for inpatient mortality, this also demonstrates that health outcomes are a complex interplay between positive and negative factors. The inclusion of health assets in a model of health and illness augments our understanding of factors that lead to recovery. The ability to engage with the community and the maintenance of mobility may enhance survival for a hospitalised individual. Older adults have often developed great resilience over their life course. Encouraging people to identify and utilise their own resources is a more empowering approach to illness recovery. This approach highlights that older adults are not simply a sum of their losses, but individuals with a balance of risk factors and protective factors. As well as improving prognostication, identification of health assets could highlight new paths for interventions to help older adults survive and thrive following admission to hospital.
Acknowledgments

Conflicts of interest

The authors have no personal or professional conflicts of interest to declare.

This study was not sponsored
This study demonstrates that poor health status can be offset by the addition of health assets to the models. Attenuating the effects of mortality, increased length of stay, and a new need for residential care was increased for patients who lived alone (OR: 1.85 [95% CI 1.07, 3.38]) but reduced if the patient had a person supportive of discharge (OR: 0.35 [95% CI 0.17, 0.74]). Having a person supportive of discharge post discharge (OR: 0.24 [95% CI 0.08, 0.67]) was associated with a decreased risk of being newly discharged to residential care (OR: 0.08 [95% CI 0.01, 0.63]). Compared to patients who walked less than 5 metres, those who walked greater than 1000 metres were protective against mortality (OR: 0.20 [95% CI 0.04, 0.97]), and those who walked between 5 and 99 metres were 0.63 (0.56-0.71) times less likely to have been discharged to residential care.

### Table 4.1 Characteristics of Study Participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total n = 1418</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years) mean (SD)</td>
<td>81 (7)</td>
</tr>
<tr>
<td>Females n(%)</td>
<td>780 (55.0%)</td>
</tr>
<tr>
<td>Frailty Index mean (SD)</td>
<td>0.32 (0.14)</td>
</tr>
<tr>
<td>Language</td>
<td>English</td>
</tr>
<tr>
<td>Marital status</td>
<td>1267 (92.6%)</td>
</tr>
<tr>
<td>Other</td>
<td>147 (10.4%)</td>
</tr>
<tr>
<td>Live alone</td>
<td>192 (13.6%)</td>
</tr>
<tr>
<td>Lives with others in community</td>
<td>919 (65.0%)</td>
</tr>
<tr>
<td>Lives in institutional care including RACF</td>
<td>201 (14.2%)</td>
</tr>
<tr>
<td>Furthest distance walked at any one time in 3 day premorbid period (m)</td>
<td>494 (35.0%)</td>
</tr>
<tr>
<td>Has person supportive of discharge</td>
<td>919 (65.0%)</td>
</tr>
<tr>
<td>No</td>
<td>201 (14.4%)</td>
</tr>
<tr>
<td>Yes</td>
<td>263 (18.8%)</td>
</tr>
<tr>
<td>New discharge from acute care to RACF</td>
<td>383 (27.4%)</td>
</tr>
<tr>
<td>Death within 28 days discharge from acute careb</td>
<td>263 (18.8%)</td>
</tr>
<tr>
<td>Readmitted within 28 days discharge from acute carec</td>
<td>270 (19.8%)</td>
</tr>
</tbody>
</table>

aExcluding those in RACF (n = 173) prior to admission and deaths in hospital of those who weren’t admitted from RACF (n = 45).
bExcluding deaths in hospital (n = 57) and lost to follow-up (n = 16).
cExcluding deaths in hospital (n = 57) and within 28 days (n = 47) and lost to follow-up (n = 16).
RACF: residential aged care facility.

### Table 4.2 Multivariate Analysis of Health Assets and Adverse Outcomes

<table>
<thead>
<tr>
<th>Health assets</th>
<th>Outcomes</th>
<th>Inpatient mortality</th>
<th>Mortality at 28 days</th>
<th>Length of stay</th>
<th>New RACF discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>OR (95% CI)</td>
<td>OR (95% CI)</td>
<td>IRR (95% CI)</td>
<td>OR (95% CI)</td>
</tr>
<tr>
<td>Living arrangements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Live with others</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Live alone</td>
<td></td>
<td>0.24 (0.08-0.67)</td>
<td>0.28 (0.10-0.79)</td>
<td>1.19 (1.09-1.31)</td>
<td>1.85 (1.07-3.38)</td>
</tr>
<tr>
<td>Has support person</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Yes</td>
<td></td>
<td>0.63 (0.56-0.71)</td>
<td>1.04 (0.88-0.25)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Went out of house</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– Yes</td>
<td></td>
<td>1.08 (0.57-2.02)</td>
<td>0.35 (0.17-0.74)</td>
<td>0.90 (0.81-1.00)</td>
<td>0.63 (0.34-1.17)</td>
</tr>
<tr>
<td>Distance walked</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– &lt;5 metres</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– 5–99 metres</td>
<td></td>
<td>0.74 (0.37-1.47)</td>
<td>0.49 (0.24-1.00)</td>
<td>0.90 (0.77-1.05)</td>
<td>0.97 (0.43-2.19)</td>
</tr>
<tr>
<td>– 100 – 1000 metres</td>
<td></td>
<td>0.21 (0.06-0.74)</td>
<td>0.17 (0.05-0.58)</td>
<td>0.84 (0.71-1.00)</td>
<td>0.75 (0.27-2.13)</td>
</tr>
<tr>
<td>– &gt; 1000 metres</td>
<td></td>
<td>0.42 (0.17-1.04)</td>
<td>0.25 (0.09-0.66)</td>
<td>0.90 (0.77-1.05)</td>
<td>0.75 (0.30-1.86)</td>
</tr>
<tr>
<td>Covariates</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frailty index</td>
<td></td>
<td>1.72 (1.39-2.12)</td>
<td>1.24 (0.98-1.56)</td>
<td>1.19 (1.15-1.24)</td>
<td>1.28 (1.02-1.61)</td>
</tr>
</tbody>
</table>

Bold font indicates 95% CI does not cross 0.

All models adjusted for age and gender and Frailty Index.
OR, odds ratio; IRR, incident rate ratio; CI, confidence interval; RACF, residential aged care facility.
Chapter 5  Protocol for the Validation of the Health Assets Index in the Australian Inpatient Setting: A Multicentre Prospective Cohort Study

Authors

Corresponding author: Dr Kate Gregorevic

Kate.gregorovic@gmail.com

Department of Aged Care, Northern Health, 185 Cooper St, Epping, 3076

Phone: (03) 8405 8000 Fax: (03) 8405 8524

2. A/Prof Ruth E. Hubbard University of Queensland, Centre for Research in Geriatric Medicine, Brisbane, Australia

3. Dr Nancye M. Peel, The University of Queensland, Centre for Research in Geriatric Medicine, Brisbane Australia

4. A/Prof Wen Kwang Lim, Melbourne Health, Parkville, Australia

Keywords

• Frailty
• Frail older adult
• Inpatient
• Aged
• Health Assets

Word count: 2159

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5.1 Abstract

Introduction
It is well known that frail older adults are at increased risk for mortality and functional decline on admission to hospital. Systematic review demonstrates that health assets are associated with improved outcomes for hospitalised older adults. The health assets index (HAI) has been developed to measure health assets in the hospital setting. A protocol has been developed to determine the predictive validity of the HAI for frail older adults.

Methods and Analysis.
The HAI was developed based on a systematic review (chapter 2) and secondary analysis of the InterRAI-AC dataset (chapter 4). A pilot study was undertaken to refine the tool.

The validation study was a multi-centre prospective cohort. Participants were adults aged 70 and older with an unplanned admission to hospital. Frailty, illness severity and demographic data were also be recorded. The primary outcomes were mortality at 28 days post discharge and functional decline at the time of discharge from hospital. The primary hypothesis was that a higher score on the HAI would mitigate the effects of frailty for hospitalised older adults. The secondary outcomes were length of stay, readmission at 28 days and functional status at 28 days post discharge. The correlation between HAI and frailty was explored. A multivariate analysis was undertaken to determine the relationship between the HAI and the outcomes of interest.

Ethics and Dissemination
Ethical approval has been obtained from Austin Health Human High Risk Ethics Committee. The results will be disseminated in peer review journals and research conferences. This study will determine whether the HAI has predictive validity for mortality and functional decline for hospitalized, frail older adults.
Strengths and limitations of this study

- This is the first study to systematically measure health assets in the hospital setting.
- Attempts have been made to minimise the burden for unwell participants by including significant amounts of routine data to decrease barriers to participation.
- Despite completion of a systematic review, it is possible not all health assets have been identified.
- The health assets identified may not be applicable to other socio-cultural settings.
5.2 Introduction

The health assets index (HAI) (see Table 5.1) was created to capture the cumulative effect of health assets. The aim of this study is to determine whether the health assets index has predictive validity in the inpatient setting for older adults. It is proposed that the health assets index will improve prognostication when measured concurrently with frailty. Determination of health assets associated with improved outcomes may also lead to new strategies to improve survival and wellbeing following hospital admission.

Table 5.1 Health Assets Index

<table>
<thead>
<tr>
<th>Domain and Question number</th>
<th>Question</th>
<th>Proposed scoring system</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>At approximately what age did you start school?</td>
<td>To be determined depending on spread</td>
</tr>
<tr>
<td></td>
<td>At approximately what age did you finish school?</td>
<td></td>
</tr>
<tr>
<td><strong>Primary language</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>What is your primary language</td>
<td>Need to determine association</td>
</tr>
<tr>
<td><strong>Carer</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Do you have a carer or someone you can rely on to help with day-to-day activities?</td>
<td>0 no 1 yes</td>
</tr>
<tr>
<td>5</td>
<td>Do you have a support person who is positive towards discharge or maintaining residence in the community?</td>
<td>0 no 1 yes</td>
</tr>
<tr>
<td>6</td>
<td>Do you live alone or with others?</td>
<td>0 alone 1 with others</td>
</tr>
<tr>
<td><strong>GP</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Do you have a regular GP?</td>
<td>0 no 1 yes</td>
</tr>
<tr>
<td><strong>Financial</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Do you have private health insurance or other form of health services over such as Dept of Veterans’ Affairs Gold Card??</td>
<td>0 no 1 yes</td>
</tr>
<tr>
<td>9</td>
<td>Do you own their own home?</td>
<td>0 No 0.5 yes with mortgage 1 yes</td>
</tr>
<tr>
<td>Domain and Question number</td>
<td>Question</td>
<td>Proposed scoring system</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
|                           | How do you manage on the income you have available?                                                                                                                                                      | 0 It is difficult/impossible most of the time  
0.5 It is difficult some of the time  
1 It is mostly/always manageable                                                                 |
|                           | Number of children                                                                                                                                                                                      |                                                                                         |
| 10                        | How many children do you have?                                                                                                                                                                            | 0 zero  
0.5 for one to two  
1 for three or more                                                                                         |
|                           | Social engagement                                                                                                                                                                                       |                                                                                         |
| 11                        | Can you count on anyone to provide you with emotional support eg. talking over a problem, or helping with a decision?48                                                                              | 0 no  
1 yes                                                                                                                                  |
| 12                        | How many times a week do you see or talk to a family member or friend who does not live with you?                                                                                                       | 0 never  
0.5 less that once a week  
1 once a week or more                                                                 |
| 13                        | In the 3 days prior to the onset of the illness precipitating admission, number of days went out of the house or building in which he/she resides (no matter how short the period) | 0. No days out  
0.25 Did not go out in last 3 days, but usually goes out over a 3 day period  
0.5 1-2 days  
1 3 days                                                                 |
|                           | Psychosocial wellbeing                                                                                                                                                                                  |                                                                                         |
| 15                        | Do you have control over the important things in life?                                                                                                                                                   | 0 never  
0.5 sometimes  
1 mostly                                                                                                                     |
| 16                        | Overall how would you rate your quality of life?                                                                                                                                                         | 0 mostly bad  
0.5 sometimes good, sometimes bad  
1 mostly good                                                                                                                   |
| 17                        | In general would you say your health is:                                                                                                                                                                | 0 poor/fair  
1 good excellent                                                                                                                  |
5.3 Background

Health assets are protective factors that support health and wellbeing, rather than risk factors that are associated with disease. Health assets are a way to operationalise the concept of salutogenesis, which describes an approach focusing on factors that support well-being and health rather than factors that cause disease. This concept was initially developed in the community setting. In a systematic review, individual health assets have been demonstrated to decrease the risk of adverse outcomes including mortality, functional decline, for residential care, readmission and length of stay for older adults. Some examples of assets identified included higher level of educational attainment, social engagement, subjective wellbeing and financial resources.

It has been demonstrated that health deficits can be measured at the time of hospital admission by comprehensive geriatric assessment and used to construct a frailty index, which has a cumulative association with mortality and length of stay. The frailty index is a count of deficits across multiple domains including medical, functional, cognitive, psychological and nutritional. Each deficit is given equal weight and the score is derived by the numerator over the denominator.

Identifying only deficits does not explain why some frail older adults have a good outcome following hospital admission. In the community setting over a period of many years, a higher number of health protective factors decreased the risk of mortality and increased the likelihood of an improvement in health status for frail older adults. It is yet to be determined whether health assets have a cumulative effect in the hospital setting. As the risk for mortality and functional decline is relatively high, even a small impact could have a substantial effect at a societal level.

5.4 Development of the health assets index

To enable measurement of health assets, the Health Assets Index (HAI) (table 5.1) was created. Variables were included based on the systematic review, a secondary analysis of the InterRAI dataset and face validity.
Variables included met the following criteria:

1. Associated with positive health outcomes
2. Not included in the frailty index
3. Not present or absent in greater than 95% of patients
4. Variables can be binary, continuous or categorical.
5. As a group, the candidate assets must cover a range of domains, for example social, psychological and socio-economic
6. Assets must be age appropriate, for example being in paid employment is likely to have such low prevalence that it will not provide any meaningful discrimination in older adults

5.4.1 Scoring of HAI

The variables were assigned a score from 0 to 1.

- Binary variables will be scored as 0=asset not present 1=asset present
- Categorical variables will be scored according to a range i.e. activity level
- Continuous and ordinal variables will be transformed into categorical variables by examining spread and judgement, for example education may be divided as less than 12 years and more than 12 years.
- A higher score will correspond to a higher number of health assets

Objectives

- Determine the distribution of the HAI in hospitalised older adults
- Examine inter-rater reliability of the HAI
- Measure the presence of health assets in relation to the presence of frailty
- Determine whether a higher score on the HAI decreases the chance of mortality for hospitalised older adults
- Determine whether the health assets index decreases the change of hospital associated functional decline
- Determine impact of health assets on functional recovery and mortality at 12 months after follow-up

5.5 Primary Hypotheses

- The distribution of score on the health assets index will be related to the frailty score
- A higher score on the health assets index will mitigate the effect of frailty on hospitalised older adults and lead to decreased mortality and functional decline
5.6 Secondary hypothesis

- A higher score on the health assets index will mitigate the effect of frailty on hospitalised older adults and lead to decreased length of stay and readmission

5.7 Study design

The study protocol has been developed in accordance with the Transparent Reporting of a multivariable prediction model for Individual Prognosis Or Diagnosis (TRIPOD) checklist. The study is a prospective, observational, multicenter cohort study that will take place in the inpatient hospital setting.

5.8 Participants

5.8.1 Inclusion criteria:
Hospital inpatients who are aged 70 and above who have an unplanned admission.

5.8.2 Exclusion criteria:
Participants were excluded if they did not speak English or if they had cognitive impairment and no next of kin was available to consent for them.

5.9 Predictors

Predictors included in the study include age, gender, frailty (measured by frailty index) and modified early warning score to indicate illness severity. These will be measured at the time of admission to hospital from medical records, participants and next of kin.

5.10 Sample size

The interRAI dataset, which examined a comparable population, had a 28-day mortality of 7.5%. Functional decline in ADLs and iADLs was estimated at 35% based on prior studies in comparable populations. The confidence interval was set at 95% and the confidence level was set at 0.05. This gave the following size:

1. 30 day mortality – 134
2. Functional status for instrumental ADLs and DADLs 30 days after discharge – 350

To account for 10% loss to follow-up the

planned sample size is 385.

5.11 Consent
The researcher will speak to the clinical staff to determine whether there are any concerns regarding the patient’s cognition and capacity to consent. If any clinical staff raise concerns or if in the subjective judgment of the researcher there are concerns, consent will also be obtained from the next of kin or responsible person.

5.12 Study procedure
The participants will be approached by the researcher either on the acute ward or in the emergency department once they have been accepted for admission. The researcher will complete a frailty index and the health assets index based on information from the patient, carers and staff. The researchers will administer the HAI twice to a subset of patients to determine inter-rater reliability. The researcher will obtain information regarding illness severity from the medical records, which will be used to inform the MEWS. Age and demographic data will also be obtained from medical records. Demographic data will include gender, age, usual place of residence and previous home help services.

Participants will be asked for a contact phone number for follow-up. Participants who are able to consent for themselves will be asked to nominate whether they prefer to be contacted or for the researchers to contact a relative or carer. For participants who were not able to consent, where appropriate the person responsible will be contacted for follow-up at 30 days after discharge from the hospital.
5.12.1 Primary outcome measures

1. Mortality during inpatient admission which will be determined from hospital records
2. Mortality within 30 days of hospital discharge which will be determined from hospital records and the registry of births, deaths and marriages
3. Functional status at the time of hospital discharge measured by Katz activities of daily living which will be recorded from medical notes, or the need for subacute care or new admission to residential aged care.
4. Functional status at 30 days after hospital discharge which will be obtained by follow-up phone call or examination of medical records which will be measured by Katz activities of daily living and instrumental activities of daily living or new need for residential care.

5.12.2 Secondary outcome measures

1. Length of stay which will be determined from medical records
2. Readmission which will be determined from medical records and phone call

5.12.3 Data management

Each researcher will be responsible for entering de-identified data into a centralised, password-protected database on RedCap. RedCap is a secure web application for building and managing online surveys and databases, which enables data from all sites to be securely managed on a single database.

5.12.4 Statistical Analysis

Descriptive statistics will be used to examine baseline characteristics including MEWS, frailty index, age, gender and usual place of residence.

The distribution of the individual components will be examined in the population.
The distribution of the total score of the HAI will also be examined in the population.

Inter-rater reliability will be performed using Spearman’s correlation.

The association between HAI and outcomes was examined in a multivariate, regression model that included frailty, age, MEWS and gender. Participants who had a score of 0 for ADLs at the time of admission will not be included in the analysis for
functional decline due to a floor effect. A negative binomial regression will be used for length of stay to account for skew of data.

5.12.5 Ethics and dissemination
Ethical approval has been obtained from Austin Health high-risk ethics committee. Research governance has also been obtained for participating sites. The findings of this study will be presented at conferences and disseminated through publication in a peer-reviewed journal.

5.12.6 Patient Involvement
Patients were not involved in the development of the study. The results will be published in a peer-review journal, but there is no plan to specifically disseminate the findings to study participants.

5.13 Discussion
This is the first study the authors are aware of to measure health assets in hospitalised older adults in a systematic way. Health assets have been shown to play an important role in mitigating the effects of frailty for older adults in the community setting. The cumulative effect of this has not been explored systematically in the hospital setting.

Mortality and functional decline have been chosen as the outcomes of interest as hospital is a time of excess risk for these outcomes.\textsuperscript{39,91} The development of new disability is highly prevalent in hospitalised older adults, particularly for those who are frail.\textsuperscript{45} The prognosis for this is poor and of those who leave hospital with a new disability at one year 41% have died and only 30% have recovered to their previous functional state.\textsuperscript{2}

The ability of an individual to recover from an acute illness and to return to their home environment is dependent on factors additional to the acute illness. Individual resources, such as social supports\textsuperscript{79}, adequate financial resources\textsuperscript{92} and the ability to access and emotional support\textsuperscript{48} have been demonstrated to be protective. Social
vulnerability and socioeconomic factors are linked with frailty.\textsuperscript{73,93} This study will help clarify whether a higher level of health assets mitigate frailty associated outcomes or if their impact is primarily related to contribution to baseline frailty in this setting.

The secondary outcomes of increased length of stay and readmission have been chosen as in a systematic review health assets impacted these outcomes.

Health assets can be measured at any time during the hospital admission. Most of the health assets, such as those measuring education, family and financial resources will not alter depending on time of measurement. The frailty index has predictive validity whether it is measured at the time of admission or later in the hospital admission.\textsuperscript{14,71}

A limitation of the study is that not all patients admitted during the time period will be able to be approached. Increasing frailty is associated with increased length of stay.\textsuperscript{14,71} Length of stay is also impacted by the community resources available in individual health services which limits generalizability. Readmission is not associated with frailty status but is predicted by social vulnerability\textsuperscript{94}, so the HAI may be predictive for this outcome.

A strength of the methodology is the utilisation of significant amounts of routine data. This decreases the burden for participants in participating. The inclusion of participants with cognitive impairment by obtaining consent from a next of kin will also improve the generalisability.

Despite attempting to identify all health assets with a systematic review as well as interrogation of the InterRAI database,\textsuperscript{72} it is possible that not all health assets were identified. It also remains to be seen whether health assets are specific to a socio-cultural setting.
Health assets can lead to improved outcomes for hospitalised older adults. Validation of the HAI will enable better risk stratification. Understanding of factors that mitigate the effects of frailty could also lead to the development of interventions to facilitate recovery following admission to hospital.

**Contributorship**

All authors contributed significantly to the development of this manuscript.

- Dr Kate Gregorevic contributed to design of the protocol and preparation of the manuscript
- A/Prof Ruth Hubbard, Dr Nancye Peel and A/Prof Kwang Lim contributed to design of the protocol and revision of the manuscript
- All authors gave final approval to the manuscript

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**Competing Interests statement**

We have read and understood BMJ policy on declaration of interests and declare that we have no competing interests

**Patient and Public Involvement**

A pilot study of the HAI was undertaken as a substudy of the InterRAI acute care assessment. This pilot study determined that HAI was acceptable to participants.
Chapter 6  Health Assets and Frailty: Positive Psychosocial Resources and Health Status in Older Adult, a Prospective Cohort Study

6.1 Abstract

Background: Although frailty is predictive of poorer outcomes for hospitalised older adults, it does not account for all variation in outcomes. Health assets are protective factors associated with wellbeing that may moderate and mitigate frailty associated mortality and functional decline.

Objective: To determine whether frail older adults with a higher number of health assets have improved outcomes.

Design: Prospective cohort study.

Methods: Adults aged 70 and older with an unplanned admission to hospital were included. Recruitment took place on general medical, orthogeriatric and subacute wards of two hospitals in Australia. The Health Assets Index, frailty, functional status and covariates were measured at the time of recruitment. Outcomes were mortality at 30 days and functional decline at the time of discharge.

Results: There were 298 participants, with an average age of 84.7 and 66% were women. 80.1% were frail, with a frailty index of > 0.25, with a population mean FI of 0.38 (SD 0.12). The mean number of health assets was 10.86 (SD 2.87) with a minimum of 5.5 and a maximum of 15. 56.4% of participants had functional decline on discharge from hospital with 30 day mortality of 5.7%. There was an inverse relationship between frailty and health assets. In a multivariate analysis that accounted for interaction, for those who were not frail, a higher number of health assets was protective against mortality. This relationship was reversed at higher levels of frailty.

Conclusions: For robust older adults, health assets decrease the risk of mortality in the hospital setting.
Key Words:

- Frailty
- Health Assets
- Hospital Mortality

Key Phrases

- Although frailty is a risk factor for poor outcomes for older adults with unplanned admission to hospital, it does not account for all variation in outcomes.
- Health Assets are determining factors that predict health and recovery separately from conventional risk factors
- Health Assets mitigate the risk of mortality in the hospital setting in a model that accounts for frailty

6.2 Introduction

Unplanned admission to hospital for older adults frequently results in adverse outcomes: around 7.5% will be deceased within 28 days and 30-40% leave with functional decline which confers a poor long-term prognosis.

Although increasing frailty is predictive of adverse outcomes, measuring frailty alone does not fully explain trajectories of survival and recovery. Health assets are determining factors that predict health and recovery over and above conventional risk factors and are also desirable in their own right. In community studies, health assets can act individually and cumulatively to improve survival and health status. Although the protective effect of health assets in the community has been established, their impact in the hospital setting is less well characterised. Systematic reviews have demonstrated that individual health assets can improve outcomes, but many health assets have been examined only in isolation and not in a model with frailty.

A Health Assets Index (HAI) was developed to measure health assets in the acute health care setting. The aim of this study was to determine the validity of the HAI for the prediction of mortality and functional decline.
6.3 Methods

6.3.1 Setting and Sample
The study protocol has been previously published. In brief, study recruitment took place in general medical, orthogeriatric and subacute wards of two hospitals in Victoria and Queensland, Australia. Eligible participants were adults aged 70 and older who had an unplanned admission to hospital. Participants could be recruited at any time during hospital admission. Participants were excluded if they had cognitive impairment with no available next of kin, non-English speaking, severe psychiatric disturbance, too medically unwell or receiving terminal care.

Researchers screened for cognitive impairment by discussion with medical and nursing staff. Researchers also used clinical judgment when seeking consent, in case of new onset of delirium. If researchers or medical staff identified cognitive impairment, the next of kin was asked for formal consent. Participants deemed not able to consent were still asked about their willingness to participate to ensure they did not object to being involved.

6.3.2 Measures
The Health Assets Index (HAI) (supplementary table 7.1) was developed based on variables identified by systematic review and a secondary analysis of a large, Australian inpatient dataset. The following criteria were chosen for variables to be included in the HAI:

- Associated with positive health outcomes.
- Not included in the frailty index.
- Not present or absent in greater than 95% of patients.
- As a group, the candidate assets must cover a range of domains
- Assets must be age appropriate

The proposed scoring system was that each asset would be scored between 0-1 with a higher score corresponding to a higher number of health assets.
6.3.3 HAI and covariates
Measures were obtained using patient reported data, observation and medical records. At the time of recruitment, health assets were recorded on the HAI by trained assessors. Covariates measured included frailty, illness severity, sex and usual place of residence. Frailty was measured based on premorbid function at two weeks before admission using an FI (see supplementary data S1), which has been previously validated in the inpatient setting. Although the timing of recruitment from admission was variable, the FI has previously been used at different times during the admission and remains valid. Illness severity was measured with the Modified Early Warning System (MEWS), which uses routine observations at the time of admission.90

Katz Activities of daily living (ADLs)96 and Instrumental Activities of Daily Living (iADLs) at baseline were recorded with the same scoring used for men and women.

6.4 Primary Outcomes

6.4.1 Primary outcomes were:
1. Mortality at 30 days after discharge, which was identified on hospital records.
2. Functional decline at the time of discharge from hospital which was defined as a decreased score on ADLs compared to baseline or new discharge to residential aged care

6.4.2 Secondary Outcomes
1. Total length of stay including acute and subacute wards
2. Readmission within 30 days, identified on hospital record or phone call
3. Functional decline at 30 days post discharge home, which was defined as a decreased composite score for ADLs and IADLs at 30 days post discharge. Participants who were readmitted to hospital were excluded from this analysis as the interceding illness or injury that precipitated readmission would provide a confounder for functional decline.

Participants admitted from residential aged care were excluded from analyses of functional decline at 30 days post discharge as IADLs are not applicable to the
majority of this population in the Australian setting. Those discharged to a new residential aged care were assumed to have persistent functional decline.

Analysis
Frequency distributions were used to describe cohort characteristics, including each variable included in the HAI. Univariate analysis was performed for all of the health assets against the primary outcomes. Logistic regression was performed to determine the association between the HAI and prespecified outcomes. An adjusted logistic regression was performed for a model with the HAI and the FI, as well as the HAI, FI, MEWS, age and sex. An interaction term was then included in the model, allowing the effects of HAI and FI on mortality to vary given the value of the other.

6.4.3 Results
A total of 312 participants were screened, and 15 declined to participate. Of 298 participants recruited, the average age of 84.7 and 66% women (table 6.1). 43% lived alone, 46% lived with others and 11% lived at home. 27% were admitted to an orthogeriatric unit at the time of admission, 49% were admitted to a general medical unit and 27% were receiving subacute care. 80.1% had a frailty index of greater than 0.25, with a population mean score of 0.38 (SD 0.12) (table 6.2). The mean HAI score was 10.86 (SD 2.87) with a minimum of 5.5 and a maximum of 15. Table 6.2 describes the distribution of assets.

56.4% of participants had functional decline on discharge from hospital compared to baseline, and there was 5.7% 30 day mortality. The median length of stay was 19 days IQR (9,35). 8.1% were readmitted within 30 days. 213 (77.7%) returned to their previous residence and 49 (17.9%) were discharged to a new residential aged care facility. Of the 188 who returned home and were not readmitted within 30 days, 113 were able to be contacted and of those 34 (30.4%) had a persistent functional decline.

There was a significant inverse relationship between a higher number of health assets and frailty, OR 0.36(95%CI 0.19-0.68). In analysis examining only frailty or the
there was no significant association with length of stay, functional decline or readmission (Table 6.4). In the logistic regression model that accounted for interaction, there was a significant interaction between frailty and health assets for mortality, \( p=0.011 \) (95%CI 1.10-2.20). The pseudo-R2 score of 0.026, indicates that frailty accounted for very little variability. A marginal plot demonstrates that at the lowest levels of frailty, a higher number of health assets was protective against mortality, and at the highest levels of frailty, a higher number of health assets was associated with an increased risk of mortality (see figure 6.1).

### 6.5 Discussion

This study demonstrates a significant interaction between health assets and frailty and provides insights into both the development and management of frailty. In this study of older inpatients, a higher score on the HAI was associated with an improved baseline health status, as evidenced by the lower likelihood of frailty. The HAI alone was not predictive of mortality or functional decline, but in a model that accounted for the interaction with frailty it had differing effects for more robust compared to more frail older adults. These findings highlight that frailty is not just the product of biological factors, it is a complex interaction with social and psychological factors. It also underscores the ongoing importance of these factors in the hospital setting.

The concept of health assets was first developed and explored in the community setting in longitudinal studies.\(^5\)\(^6\) In a Beijing cohort, for older adults who had mild to moderate frailty, a higher number of protective factors decreased the risk of mortality and increased the likelihood of transition to a lower level of frailty.\(^37\) This has also been demonstrated in a subset of participants who were part of the Canadian Study of Health and Aging: adults aged 65 and older completed an index of self-rated health. For those who were fit, lower self-rated health was associated with an increased risk of death (\( \text{OR}=18 \), 95% CI 6.0-53.6).\(^97\)

In this study, the most frail participants had a higher risk of mortality if they had a higher level of health assets. It is not clear why the higher number of health assets would be associated with a higher mortality, but may relate to those who are more
frail being at increased risk for hospital admission,\(^8\) potentially with a condition that leads to functional decline but is not immediately life threatening. Those with a higher number of health assets may be better supported in the community, and only present to hospital with a more significant illness. Conversely it is also possible that this frail group are particularly dependent on their assets, such as carers and emotional support, and are at greater risk when they cannot access these.

The lack of a clear proportional relationship between health assets and mortality contrasts with other studies in the hospital setting.\(^77\) Although many studies have identified an association between individual assets and improved outcomes, most of these studies did not include a measure of frailty. Multiple studies investigated mortality and functional decline up to a year after discharge from hospital, and so it may be that health assets have more impact over the months following discharge.\(^98\) The lack of impact of protective factors for those who were already frail is consistent with findings in the community and indicates that once an individual is frail, there may be a critical loss of physiological reserve.\(^97\)

Although frailty is defined in physiological terms as a loss of homeostatic reserve and is characterized by a stochastic accumulation of subcellular deficits, the impact of psychosocial factors on biology needs to be considered as part of the pathogenesis. In particular, lower socioeconomic status can lead to biochemical indicators of stress, with raised levels of inflammatory cytokines,\(^99\) which is associated with accelerated biological aging and frailty.\(^16,100\)

This study also highlights one of the difficulties in measurement of health assets. When a biological measure, such as optimal creatinine, is identified, a laboratory cut off range is chosen by identifying a range that will cover most of the population. For items like social connection, it is not only the frequency, but also the quality of connections that impact health. It may be more appropriate to take a subjective and individualised approach to these items.
The study has certain strengths: very few patients refused participation, and due to the use of routine data, there was a high rate of follow-up for the primary outcomes. There were also important limitations: the relationship between frailty and health assets was only measured at one point in time, so causation cannot be inferred. It is possible that mortality was under-reported as hospital record data was used, along with phone calls to individuals who had returned home, although not all could be contacted. Due to limited numbers of research personnel, not all possible participants could be approached. The statistical model that utilised an interaction was not pre-specified, so this should be interpreted with caution. People who did not speak English were not included due to the lack of resources for interpreters, which limits generalizability in a multicultural setting. The follow-up was limited to a maximum of 30 days after hospital discharge, but it is possible that over a longer duration of time after discharge, health assets may have an impact on survival. Further qualitative research specific to older adults could help determine which factors this age group think are desirable and have an immediate impact on their own wellbeing.

6.6 Conclusion
The interaction between frailty and health assets highlights the complex interplay between social, psychological and biological factors, even in the hospital setting where someone has been removed from their usual environment. Although this study supports a role for measuring health assets to improve prognostication, it is not yet clear whether health assets are effective due to improved health literacy and behaviour change, or if there is also an underlying physiological effect. The interaction between health assets and frailty has intriguing implications for health at the broader population level to identify strategies improve long-term outcomes and immediate quality of life.
### Table 6.1  Baseline characteristics of Study Participants

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age Mean (SD) (293)</strong></td>
<td>84.6 (7.3)</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Female (%)</td>
<td>193 (66.0)</td>
</tr>
<tr>
<td>Male (%)</td>
<td>98 (44.0)</td>
</tr>
<tr>
<td><strong>Ward at time of recruitment (%)</strong></td>
<td></td>
</tr>
<tr>
<td>Orthogeriatrics</td>
<td>80 (27.0)</td>
</tr>
<tr>
<td>General medicine</td>
<td>146 (49.3)</td>
</tr>
<tr>
<td>Subacute</td>
<td>70 (23.7)</td>
</tr>
<tr>
<td><strong>Usual residence (%)</strong></td>
<td></td>
</tr>
<tr>
<td>Home alone</td>
<td>127 (43.1)</td>
</tr>
<tr>
<td>Home with others</td>
<td>137 (46.4)</td>
</tr>
<tr>
<td>Residential Care</td>
<td>31 (10.5)</td>
</tr>
<tr>
<td><strong>FI mean(SD); median (IQR)</strong></td>
<td>0.38 (0.12); 0.37 (0.29, 0.47)</td>
</tr>
<tr>
<td><strong>MEWS mean(SD); median (IQR)</strong></td>
<td>1.6 (1.20); 1 (1, 2)</td>
</tr>
<tr>
<td><strong>ADLs mean(SD); median (IQR)</strong></td>
<td>4.9 (1.6); 6 (4, 6)</td>
</tr>
<tr>
<td><strong>iADLs mean(SD); median (IQR)</strong></td>
<td>5.1 (2.89); 6 (2, 8)</td>
</tr>
</tbody>
</table>
Table 6.2  HAI characteristics (n (%)) unless otherwise specified

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years school mean (SD); median (IQR)</td>
<td>9.7(3.6); 10 (8,11)</td>
</tr>
<tr>
<td>Living arrangements</td>
<td></td>
</tr>
<tr>
<td>alone</td>
<td>122(41.5)</td>
</tr>
<tr>
<td>With others</td>
<td>142(48.3)</td>
</tr>
<tr>
<td>RACF</td>
<td>30(10.2)</td>
</tr>
<tr>
<td>Carer</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>94(32.0)</td>
</tr>
<tr>
<td>Yes</td>
<td>170(57.8)</td>
</tr>
<tr>
<td>RACF</td>
<td>30(10.2)</td>
</tr>
<tr>
<td>Person Supportive of discharge</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>71(24.8)</td>
</tr>
<tr>
<td>Yes</td>
<td>215(75.2)</td>
</tr>
<tr>
<td>GP</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>25(8.5)</td>
</tr>
<tr>
<td>Yes</td>
<td>268(91.5)</td>
</tr>
<tr>
<td>Private health/DVA</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>148(50.9)</td>
</tr>
<tr>
<td>Yes</td>
<td>143(49.1)</td>
</tr>
<tr>
<td>Do you own your home</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>80(27.4)</td>
</tr>
<tr>
<td>With mortgage</td>
<td>8(2.7)</td>
</tr>
<tr>
<td>Yes</td>
<td>204(69.9)</td>
</tr>
<tr>
<td>Are you able to manage on the income you have?</td>
<td></td>
</tr>
<tr>
<td>Difficult</td>
<td>16(5.5)</td>
</tr>
<tr>
<td>Sometimes difficult</td>
<td>43(14.7)</td>
</tr>
<tr>
<td>Mostly OK</td>
<td>233(79.8)</td>
</tr>
<tr>
<td>Number of children</td>
<td></td>
</tr>
<tr>
<td>none</td>
<td>34(11.6)</td>
</tr>
<tr>
<td>1-3</td>
<td>103(35.3)</td>
</tr>
<tr>
<td>3 or more</td>
<td>155(53.1)</td>
</tr>
<tr>
<td>Emotional support</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>56 (19.6)</td>
</tr>
<tr>
<td>Yes</td>
<td>230 (80.4)</td>
</tr>
<tr>
<td>Table 6.2 ctd</td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td></td>
</tr>
<tr>
<td><strong>How many times do you see/speak to someone you don’t live with</strong></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>11(3.8)</td>
</tr>
<tr>
<td>Less than once a week</td>
<td>26(9.0)</td>
</tr>
<tr>
<td>Once a week or more</td>
<td>253(87.2)</td>
</tr>
<tr>
<td><strong>Left the house in the three days before admission</strong></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>109(37.5)</td>
</tr>
<tr>
<td>Yes</td>
<td>182(62.5)</td>
</tr>
<tr>
<td><strong>Do you have control over your life</strong></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>36(12.5)</td>
</tr>
<tr>
<td>Sometimes</td>
<td>36(12.5)</td>
</tr>
<tr>
<td>Always</td>
<td>216(75.0)</td>
</tr>
<tr>
<td><strong>Quality of life</strong></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>40(13.9)</td>
</tr>
<tr>
<td>Sometimes good</td>
<td>53(18.4)</td>
</tr>
<tr>
<td>Mostly good</td>
<td>194(67.6)</td>
</tr>
<tr>
<td><strong>Self-rated health</strong></td>
<td></td>
</tr>
<tr>
<td>Poor/fair</td>
<td>124(42.7)</td>
</tr>
<tr>
<td>Good/excellent</td>
<td>166(58.3)</td>
</tr>
</tbody>
</table>
Table 6.3  Primary and Secondary Outcomes in Study Population. Values are numbers (percentages) unless otherwise stated.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 day mortality</td>
<td>No: 281(94.3)  Yes: 17(5.7)</td>
</tr>
<tr>
<td>ADL at discharge mean (SD) N=277</td>
<td>3.6(2.0)</td>
</tr>
<tr>
<td>Functional Decline(%)</td>
<td>No: 119(43.6)  Yes: 154 (56.4)</td>
</tr>
<tr>
<td>Length of stay mean (SD); median (IQR)</td>
<td>25.3(23.8); 19 (9,35)</td>
</tr>
<tr>
<td>ADL 30 days after discharge N=112</td>
<td>5.1(1.3) IQR(4,6)</td>
</tr>
<tr>
<td>iADL 30 days after discharge N=110</td>
<td>4.8(2.5) IQR(3,7)</td>
</tr>
<tr>
<td>Readmission 30 days</td>
<td>Yes: 235(91.9)  No: 33(8.1)</td>
</tr>
<tr>
<td>Functional decline at 30 days(%) in those who returned home</td>
<td>No: 32(71.2)  Yes: 79(28.8)</td>
</tr>
</tbody>
</table>
## Table 6.4  Multivariable Logistic Regression for Primary and Secondary Outcomes

<table>
<thead>
<tr>
<th></th>
<th>Mortality (OR, 95%CI)</th>
<th>Functional decline (OR 95%CI)</th>
<th>Length of stay (IRR,95%CI)</th>
<th>Readmission within 28 days (OR 95%CI)</th>
<th>Functional decline at 28 days (OR 95%CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HAI</strong></td>
<td>1.01(0.77,1.33)</td>
<td>0.93(0.82,1.06)</td>
<td>1.02(0.97,1.08)</td>
<td>0.043 (0.19,0.98)</td>
<td>0.76 (0.60, 0.96)</td>
</tr>
<tr>
<td><strong>FI</strong></td>
<td>1.45(0.97,2.19)</td>
<td>0.97(0.80,1.19)</td>
<td>0.97(0.89,1.06)</td>
<td>1.40(1.03-1.91)</td>
<td>1.50 (1.04, 2.26)</td>
</tr>
<tr>
<td><strong>Model 1: HAI with interaction FI</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HAI</strong></td>
<td>1.10(0.83,1.45)</td>
<td>0.92(0.81,1.06)</td>
<td>0.99(0.90,1.09)</td>
<td>0.97 (0.46, 2.06)</td>
<td>0.59 (0.18,1.4)</td>
</tr>
<tr>
<td><strong>FI</strong></td>
<td>1.61(1.01,2.60)</td>
<td>0.97(0.78,1.21)</td>
<td>1.02(0.96,1.08)</td>
<td>1.73 (.26, 11.32)</td>
<td>0.31(0.02,6.7)</td>
</tr>
<tr>
<td><strong>Model 2: HAI with interaction FI Age gender MEWS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HAI</strong></td>
<td>1.11(0.83,1.48)</td>
<td>0.93(0.81,1.06)</td>
<td>1.03(0.97,1.09)</td>
<td>0.78 (.35,1.70)</td>
<td>0.46(0.16,1.33)</td>
</tr>
<tr>
<td><strong>FI</strong></td>
<td>1.61(0.98,2.63)</td>
<td>1.03(0.82,1.30)</td>
<td>1.00(0.91,1.10)</td>
<td>1.10 (.15, 7.80)</td>
<td>0.36(0.20, 6.43)</td>
</tr>
</tbody>
</table>
Chapter 7  Discussion and Conclusions

7.1  Summary of PhD findings
The studies presented in this thesis support the primary hypothesis that health assets improve outcomes for frail older adults with unplanned admission to hospital. Although a higher number of health assets on the HAI validation study was not associated alone with mortality, there was a significant interaction with frailty and a differential effect on mortality for those who were more robust.

The CFS study is in keeping with previous studies that have demonstrated that it is feasible and valid to measure frailty in the inpatient setting. In the HAI validation study, a higher level of frailty measured on the frailty index did not correlate with an increased risk of mortality. Although this is likely due to methodological limitations, it does highlight that implementation of this tool needs to be carefully evaluated.

The interaction between assets and frailty demonstrates the complexity of health and the physiological impact of psychosocial factors on wellbeing and recovery. There is increasing understanding that these have a direct biological impact on health, as well as influencing health behaviours. Many health assets are created in the community and early in the life course. Developing a better understanding of these has potential to improve not only recovery in hospital, but health and longevity at the population level.

7.2  How should we measure frailty in the hospital inpatient setting?
There is increasing consensus that measuring frailty in the acute setting has predictive validity for mortality and length of stay.25 One of the barriers to routine implementation of frailty measurement has been the lack of agreement on the optimal measurement tool to use, but there is increasing evidence demonstrating the FI and the CFS are most appropriate,25 although both have advantages and limitations.

The FI and CFS have the advantage that they can be measured based on reported premorbid function.14,30,101 Importantly these can also be measured using routine
clinical data. A barrier to routine use of the FI in clinical settings is that without an electronic medical record with automated software, the time taken to complete this creates a barrier to use. A busy nurse or junior doctor may resent the time taken to fill out an additional form in an already full workday. Patients who are frail, as identified on the CFS, have been shown to have higher levels of mortality in multiple studies.\textsuperscript{30,31,65,67} The feasibility study reported in this thesis also shows that this measurement tool is acceptable and feasible to junior medical staff, as evidence by the high rates of completion.\textsuperscript{101} This shows that this tool not only has predictive validity, but is suitable for routine clinical use.

Even though the CFS is a simple tool to use, it still requires a small additional effort. For truly universal frailty measurement, it is critical to develop automated systems that use routine clinical data. The InterRAI–AC study demonstrates that a frailty index can be derived from a nursing assessment tool.\textsuperscript{72} Using ICD-10 codes that are associated with frailty has also been shown to be valid way to identify frail older adults at increased risk of mortality.\textsuperscript{102} This methodology relies on using data from past admissions, so is only suitable for those who have had a prior hospital admission.\textsuperscript{102}

Frailty does not begin when a patient enters the hospital. Most frail older adults are in the community doing their best to manage with the help of their primary care provider. Many have long-term relationships with their general practitioner (GP), who has knowledge of their medical conditions and functional status. In the UK data from Primary Care electronic medical records has been used to derive and electronic Frailty Index (eFI) that can be automatically populated from routine clinical data. This was validated against three outcomes: all-cause mortality; unplanned hospitalisation; and nursing home admission. The mean eFI score was 0.14 and increased with age. Around 50% of all people were frail, with 4% being severely frail.\textsuperscript{8} In this cohort, frailty was associated with an increased risk of mortality, unplanned hospital admission and admission to residential aged care with a dose-response relationship. The pseudo $R^2$ was low at 0.02, indicating that other sources of variability have an important impact.\textsuperscript{8} This study does not specifically examine
what happens to these patients when they are admitted to hospital, and a further study examining this question would confirm that this community data would aid prognostication in the hospital setting.

Using data that is collected in the community setting at the time of hospital admission removes the need for further data collection and analysis in the inpatient setting. One of the problems that currently threatens sustainability in the Australian healthcare setting is the difficulty communicating across hospital systems and primary care. Currently most patients receive primary care with a general practitioner who keeps their data on an individual practice server. This creates significant difficulties as previous medical history and current medications are frequently inaccessible outside routine working hours leading to duplication of testing and data collection and is a particular problem for patients who do are not able to provide a clinical history, such as older adults with dementia. In Australia, the My Health Record has been created as a way to remove this problem. It is feasible to create an eFI with routine data in the Australian setting and wide uptake of an electronic health record has the potential to improve identification and care for frail older adults.103

7.2.1 Limitations of frailty measurement
An issue with frailty measurement it that although it is predictive at the group level, discrimination at the individual level is low.25 In the HAI validation study, increasing frailty was not associated with increased mortality, and the pseudo-R2 score of 0.026, indicating that this accounted for very little variability. Overall, 74% of studies that examined the frailty index in the acute care setting found an association with increasing frailty and mortality.25 In the InterRAI-AC dataset of 1418 participants, for those with mild to moderate frailty the OR for increased mortality was 1.04(95%CI .31,1.76) indicating very little absoloute risk increase, with a CI that crosses 0. For those who were very frail with a score of 0.4 or above, the OR is 2.26(95%CI 1.58,2.94).4 This shows that it is only once people are severely frail; there is a significant increase in mortality. In the HAI validation study, there was a lower than expected mortality rate, as people who were expected to die were excluded. This
raises the prospect that the clinical measurement does not add additional prognostic information to clinical judgement.

The recent scoping review by Theou et al highlighted that it is critical for this field going forwards that there is agreement on the frailty measure being used. Different measures purporting to measure frailty can report vastly different prevalence of frailty within the same cohort. Similar to findings in a hospital cohort, a retrospective analysis of an Australian community cohort comparing four different measurement tools found that rates of frailty varied from 2% to 49.9% within the same cohort depending on the tool used. There have been similar findings in the hospital setting. It is critical that moving forward there is agreement on the definition and measure of frailty. As interest in frailty grows in specialties outside geriatric medicine, it is also important for non-geriatricians to have an understanding of what the characteristics are of a frailty measurement tool, to enable critical appraisal of the literature.

7.2.2 The Role of Frailty Measurement in Improvement of Hospital Systems

The creation of Safer Care Victoria was in response to the Targeting Zero report, which focused on the need to support the Victorian Hospital System to eliminate avoidable harm and strengthen quality of care. The trigger for this report was avoidable neonatal deaths at the Djerriwarrh Health Services. The concept of avoiding variation and providing standard care applies to all age groups. As frailty has an impact on outcomes, measuring this is an important way to look at standards of care across different hospital systems to ensure that frail older adults are receiving the safest care possible across different hospital systems. Although there has been extensive work on frailty measurement in the acute care setting, at this time, it is still unclear whether we should be basing individual management decisions on frailty.
7.2.3 Implementation of Frailty Measurement in the Acute Care Setting
The findings in the CFS study support the hypothesis that it is feasible and valid to measure frailty in the acute care setting. This is in the context of an increasing number of studies that demonstrate the predictive validity of the CFS and the FI in the inpatient setting.\textsuperscript{4,14,25} Although there are barriers to implementation, with increasing awareness of the value of objective measurement and technological advances these are surmountable. The question of how we can best utilise this information to improve patient care is likely to be answered once frailty measurement has been implemented in the clinical setting.

7.3 Frailty and Assets
The association of frailty and mortality highly supports that this is a true clinical measure of physiological ageing.\textsuperscript{9} Using the FI as a measure of health status has improved understanding of health transitions in older age,\textsuperscript{6} but it is an incomplete picture.

An early, influential article on frailty highlighted that frailty is a risk state for the development of disability and dependence, which is balanced by assets that help individuals to remain independent.\textsuperscript{105} Although assets are related to frailty, they act synergistically and should be considered as a separate entity. In a study of a cohort of older adults in Beijing, older adults who had mild to moderate frailty, but a higher number of health assets were more likely to transition to an improved health status and less likely to die than those without.\textsuperscript{37} Similarly to frailty, the association of assets and mortality is also highly suggestive of a biological mechanism of action, which is likely mediated through both lifestyle behaviours and decreased inflammation.

7.3.1 Is there a Bidirectional Relationship Between Frailty and Health Assets?
The strong association of a higher number of assets and decreased frailty identified in the HAI validation study further highlights the importance of measuring factors beyond those in the traditional biological risk model. As this is a single measure, the correlation cannot be interpreted as causation, but it adds further support to this theory in light of previously mentioned studies.

Some have postulated that positive factors, such as psychosocial resources may be moderators and mediators of frailty related outcomes. A moderator variable may change the strength and/or direction of the effect of a predictor (that is, frailty) on adverse outcomes, and is not necessarily causally related to the predictor and/or outcome. This contrasts with a mediator variable which is in the causal pathway between the predictor and the outcome. There is evidence that lifelong socioeconomic disadvantage negatively impact health status, with the poorest tertile in the UK having equivalent levels of frailty to the wealthiest who are ten years older. This would suggest that socioeconomic disadvantage is a mediator of frailty.

Around one third of older adults are likely to experience loneliness and 50% are at risk for social isolation. Social isolation has detrimental effects on health and is linked with mortality and morbidity. There is some evidence that social isolation may precede frailty, although this relationship was lost when education, household wealth, depressive symptoms, chronic physical illness and smoking status were included in the model. There is a plausible biological mechanism between social isolation and frailty as both are associated with increased levels of inflammation. As loneliness and social isolation also tend to be associated with physical inactivity and poor diet, which are in turn associated with frailty

It has also been demonstrated that acting to decrease social vulnerability may be a way to moderate frailty associated outcomes at the community level. This is demonstrated by a Europe wide study of older adults where frailty was measured using a frailty index and social vulnerability was measured using a separate index. This study covered 18,289 community-dwelling participants 50 years and older from a range of European Countries that were grouped by social model: Nordic
(Denmark, Netherlands, Sweden), Continental (France, Austria, Belgium, Germany) and Mediterranean (Greece, Italy, Spain). After controlling for age, sex, baseline disability and frailty level, mortality was highest for those with the highest level of social vulnerability, but this relationship was lost in the Nordic countries who provide the highest level of formal supports.50

The complex bidirectional interaction between frailty and social factors highlights that this area is still incompletely understood and has great potential for future interventions.

7.3.2 Frailty and Assets in the Hospital Context

The systematic review identified many factors that act as health assets, but there are few studies that have examined health assets in the context of frailty in the hospital setting. One study was conducted by Dent et al, which identified that people who were frail and who had a lower sense of control had an increased risk of mortality and new residential aged care. A lower sense of wellbeing also increased the risk for a new need for residential aged care,79 which may be an indirect indicator of functional decline.

Unlike in Dent et al’s study, the HAI validation study did not demonstrate an association between health assets and functional decline. The comparison of the studies needs to be made with caution as there was a different frailty identification tool measured, which is likely to diagnose differing rates of frailty.29 Dent’s study also took place in a geriatric evaluation and management unit, while most participants in the HAI validation study were in a general medical unit. A very high proportion of participants in the HAI validation study left hospital with a functional decline. This population may have been too frail to benefit from health assets.

There is some discrepancy in the relationship between frailty and health assets for mortality. The systematic review identified many factors that were associated with decreased mortality following hospital admission. In the secondary analysis of the InterRAI-AC study presented in chapter 4 individual health assets were associated
with improved outcomes for older adults, even if they were frail. The health assets identified that were associated with improved mortality were the ability to leave the house, distance walked and living alone. This contrasts with the HAI validation study, where a higher number of health assets was protective for the most robust but associated with increased mortality for the most frail.

Many of the assets may be more relevant for the community setting, like the ability to leave the house. This is likely to be highly relevant to post-hospital recovery, as those who can leave the house will have better access to community resources to facilitate recovery. Being able to walk further, accounting for the level of frailty, probably has a similar mechanism of action. Although mortality after discharge was measured in the HAI, it may be that the study was insufficiently powered for this association. These assets are potentially modifiable and present achievable strategies for older adults. Another reason that assets may have less impact on inpatient mortality is that by the time an individual is unwell enough to need hospital admission, the protective effects of the assets are minimal, and the impact only becomes relevant again for the survivors.

7.4 Health Assets and Hospital Associated Functional Decline
For most inpatients, the reasons for hospital admission do not start with the immediate antecedent event. The hospital admission is the result of the event and the individual’s level of reserve to cope with the physiological stress. For any individual, being involved as a pedestrian in a motor vehicle accident with a truck is likely to require admission to hospital (if they survive the impact), but for most fit younger adults, an upper respiratory tract infection is not likely to be a significant physical challenge. For a frail older adult who is operating at the limits of their homeostatic reserve, this seemingly minor illness can be enough for a decline in physical function. If an older adult can no longer perform their activities of daily living independently, often the only place where they can get urgent assistance is in an acute hospital. Hospital is a time of excess risk for older adults, and for the survivors, many will leave with a new disability. A study of 754 older adults in New
Haven Connecticut found that the hazard ratio for the development of new disability after hospital admission was 61.8 (95% CI 49.0-78.0).42

For those who survive hospital admission but who return home with a new disability, the prognosis is poor. In the HAI validation study, of those who returned home, rather than residential aged care and who were not readmitted, 30% had persistent disability, which was predominantly in iADLs. This finding is consistent with previous studies, which have shown similar rates of persistent disability.2 Persistent functional decline has a poor prognosis with 30% mortality and only a third returning to baseline function at one year.2

This PhD presents conflicting findings on the relationship between health assets and functional decline. In the systematic review a higher level of social engagement, sense of wellbeing, education and financial resources were linked with lower levels of functional decline after hospital discharge. In contrast in the HAI validation study, there was no relationship between health assets and functional decline. The rate of functional decline was higher in the HAI validation study than other studies, this may be due to the high prevalence of frailty, which is associated with an increased risk of functional decline.101

As functional decline has such significant implications for the individuals as a decline in ADL independence has been associated with lower life satisfaction.113 Functional decline also has important implications for hospital systems as it is associated with an increased length of stay.114 Most of the assets previously identified in systematic review are pre-existing and relatively fixed, but they point to potential areas for intervention. As an example, as education is protective, this highlights a need for clinicians to examine their own communication strategies with people who have a lower level of education to ensure people understand their own diagnoses and treatments.

This thesis highlights that there is a great need to do further research to identify older adults who need management of functional decline and to develop strategies
to help older adults do more than simply survive hospital but to recover to an individually acceptable level of function.

7.5  The Challenge of Implementing a Health Assets Approach in the Hospital Setting
The hospital environment creates potential barriers to the implementation of health assets. There are also challenges that are particularly relevant to older adults. A key aspect of salutogenesis is that the individual has a sense of coherence, which is “a generalized orientation toward the world which perceives it, on a continuum, as comprehensible, manageable, and meaningful”.115 When an individual faces a stressor they will:

- wish to, be motivated to, cope (meaningfulness)
- believe that the challenge is understood (comprehensibility)
- believe that resources to cope are available (manageability)

The hospital environment can be disempowering for older adults. Due to safety concerns, particularly falls, they are often beset with restrictions, such as whether they are allowed to walk independently. They are also limited in choices that many of us take for granted such as which foods to and the timing of these meals. The hospital day is organised around the routines needed for staff efficiency, such as when the doctor is available for ward rounds. This creates an environment that limits personal autonomy and could decrease an individual’s sense of coherence and their ability to use their own resources.

An additional challenge is that around 29-64% of older adults in hospital will have cognitive impairment, whether this is delirium or dementia.116,117 Although this was not examined in the HAI validation study it is highly likely many of the participants experienced cognitive impairment. The impact of health assets in people with cognitive impairment has not been well studied, but it is probable that cognitive impairment could lead to difficulties comprehending the situation that an individual finds themselves in.118 Key features of delirium are attentional deficits and
fluctuation throughout the day. Delirium may present an insurmountable barrier to the application of individual health assets to a significant subset of the population. One asset that could greatly benefit this group is to encourage carers and friends to advocate for the patient if they are not able to do so themselves.

The CFS study demonstrates that a barrier to comprehensibility in the Australian setting is that many older adults don’t speak English. To fully engage this group in their healthcare, hospitals need to explore systems to effectively engage with people from culturally and linguistically diverse backgrounds.

Even for those older adults who do not have cognitive impairment, staff use of medical jargon can provide a barrier to comprehensibility. The cohort of older adults in the HAI validation study had an average number of 9.5 years of education, which means that most did not finish high school. Assuming many then worked in manual occupations that did not depend on literacy, it is likely the low levels of literacy compared to university trained medical staff represents a significant barrier. This can potentially be overcome by asking patients to ‘teach-back’ to staff to ensure that staff have conveyed the diagnosis and treatment.

Another important factor that is essential to consider is the level of frailty. In the community setting, a higher level of protective factors was beneficial for those who had mild to moderate frailty, but not those who were severely frail. Only 19.0% of participants were not frail in the HAI validation study, so it may be that there had been a critical loss of physiological reserve that negated any positive influence from health assets.

While this thesis has focused on individual health assets, it is also important to consider the hospital environment. It may be that individual health assets have less impact on those who are already frail, and the hospital environment needs to be considered more closely. As an example a built hospital environment which encourages day-night differentiation and mobility may be a more effective way to
improve recovery for older adults. In addition, a hospital system that focuses on holistic care and functional recovery may be considered a community asset.

### 7.6 Health Assets: A Challenging Definition

Although Health Assets are desirable in their own right, they still need to be associated with positive outcomes. A factor that is associated with decreased mortality, and has immediate positive impact, such as meaningful social connection, can easily meet this definition. Having a partner may be desirable, but in the multivariate analysis undertaken in the study included in chapter 4, there was no impact on mortality, so in this group it is not a Health Asset.

It is also important that the outcome is biologically meaningful and important to the individual. In the Secondary Analysis presented in Chapter 4, living alone was associated with decreased mortality, but a greater risk of increased length of stay, so using the outcome as part of the definition of a health asset, it could be an asset or a deficit. Without formal study of patient’s values, it can be assumed that for most people survival is more important than a decreased length of stay. This highlights that going forward it is key to define biologically based outcomes that individual’s place value to use to identify health assets.

Another challenge in the identification and measurement of health assets relates to measuring quality and quantity. Social engagement provides an example of this, as an individual can have many contacts with other people but still experience loneliness, as this relates to the quality of social interactions rather than quantity. The HAI examined the frequency of social connections and whether the participants felt they had emotional support, but it is possible that this would be strengthened by further items to examine the quality of social relationships. This need to elucidate this further needs to be balanced with the need not to overburden people who are dealing with an unplanned hospital admission.

Similarly, a health asset must also be desirable in its’ own right. The secondary analysis in chapter 4 demonstrated that living alone is associated with improved
survival, and may even be associated with survival for older adults in the community,\textsuperscript{83} this does not mean that many people who are happily cohabitating would be advised to live alone. Instead it likely highlights the importance of supporting people to live in the setting of their own choosing.

7.6.1 Salutogenesis in the Community and Inpatient Setting
The HAI validation study adds further weight to the evidence that health assets are involved in the creation of health status. The creation of health is a complex interplay between biological and social factors. Human wellbeing is influenced not simply by a biological insult, such as an infection, but by influences both proximal and distant in the life course.\textsuperscript{98} This supports a model of health that examines an individual’s own resources and strengths, fully acknowledging the biological impact of psychological stressors.

The conflicting findings between the HA systematic review (chapter 2) and the HA secondary analysis (chapter 4) and the HAI validation (chapter 6) demonstrates that this is a complex area. It is possible that once an individual has reached a critical level of frailty, or illness, assets no longer have an impact on recovery. Nevertheless, the secondary analysis (chapter 4) in particular identifies that being able to walk and to access community resources is associated with better recovery after hospital. The likely explanation for the conflicting findings is both the frailty of the participants in the HAI validation study (chapter 6), and that hospital systems and processes do not encourage self-determination and a sense of coherence.

Hospital admission represents a sentinel life event, with a high probability of an adverse outcome for older adults. Each individual brings with them a lifetime of assets and deficits that have created their current baseline health status. Moving forward to best serve older adults with complex care needs it is essential to consider these factors and move away from a model that reduces individuals to a reductive list of diagnoses.\textsuperscript{121} This would move towards a model of care that utilises skill of geriatricians in comprehensive geriatric assessment. In most circumstances individual patients and hospital administrators share an aim for the patient to
recover quickly and return home. Engaging older adults in the creation of the hospital environment has the potential to create an environment that empowers people to play an active role in their own recovery, which is good for both patients and the sustainability of our health systems.

7.6.2 Engagement of Consumers in Research
To facilitate a sense of coherence for hospitalised older adults, it is key to recognise that this is a diverse group of people with their own needs and priorities. To take this work further and to identify practical applications of the theory of salutogenesis, it is essential to involve older adults directly in the design of this research. Just as it would not be considered acceptable for men to postulate what is a considered a health asset for women without consultation, or for a white person to make assertions about what is important for people of colour, it is important not to condescend to a group who are at risk of discrimination based on their age. By involving older adults in qualitative work, it may be possible to identify novel age and situation appropriate health assets.

7.6.3 Examining Assets and Gender
It is also essential to consider the role of gender in models of health. Women have a longer life expectancy than men in almost all countries, but with higher levels of disability and poor health. This disparity in life expectancy and poor health is partially biologically mediated as women tend to have a higher level of immune function and to be able to survive with a higher level of frailty. This has significant social implications as a larger proportion of the population reach older age, as currently in Australia 17% of men and 23% of women aged over 65 experience severe or profound core activity limitation.

A large proportion of increased mortality for men relates to risk taking behaviour and differing patterns of substance use, as evidenced by Russia, which has the highest difference in the world at almost 12 years due to gender-based patterns of alcohol and smoking. Even in this cohort, women had poorer health with higher levels of obesity, which is associated with higher levels of disability in women, but
not men. None of the studies identified in the systematic review, or in a systematic review of community based studies separated Health Assets by gender. This has important implications as assets may differ quite significantly, particularly for communities and individuals who follow rigid gender norms. As an example in societies where women are expected to provide the bulk of household labour, this expectation does not diminish with older age, so these women do not enjoy a retirement with increased leisure time. Similarly marriage has a greater health benefit for men compared to women. Although gender norms and expectations are changing, recent Australian data highlights that there is a lag in behavioural changes, with women still performing most childcare and unpaid household labour. Women also still experience income inequality, which translates to higher levels of poverty in older age. With these important biological and social differences, health assets may differ significantly when examined by gender and this would be important to include in future work.

7.6.4 Frailty measurement
This PhD has highlighted that it is valid and feasible to identify frailty in the hospital setting, and that the next challenge is implementation. An electronic medical record will help operationalise routine clinical data and improve feasibility of frailty measurement. As Australian Hospitals are moving towards electronic medical records, but without a standard approach to software choice, it is possible that different frailty measures will be chosen, meaning scores cannot be assessed across different health services.

It is key to work at level of Victorian Department of Health and Human Services to standardise the use of frailty measurement tools so measurement can provide the information needed to identify health systems and practices associated with better outcomes from a safety and cost perspective. Ideally, frailty measurement could be measured as part of routine primary care, with information sharing across primary and acute care. This will not only benefit those older adults with an unplanned admission to hospital, but general practitioners and other specialties, including
surgeons and oncologists, who are increasingly recognising the need for an individualised approach to risk assessment.

Once frailty measurement moves beyond research to be a routine clinical tool, it will be possible to refine its’ use to utilise the information to determine the best way to improve patient treatment and recovery.

7.7 Conclusion and Summary of Findings
The Hypotheses examined in the Thesis were:

1. It is feasible and valid to measure frailty in the inpatient setting using routine clinical data
2. Health Assets can be identified and measured in the inpatient setting
3. Health Assets mitigate outcomes for frail older adults with unplanned admission to hospital

The CFS study supports the hypothesis that it is feasible and valid to measure frailty in the inpatient setting using routine clinical data. This study demonstrates that this frailty screening tool maintains predictive validity when used by junior doctors without additional training, which makes it attractive for implementation. Nevertheless, there are limitations to this approach, which is that it puts an emphasis on physical function. The frailty index is based on a more holistic assessment and is more sensitive to capturing degrees of frailty but is difficult to implement without automated systems built into an electronic medical record. There is also a need to recognise that frailty state predates the acute illness and hospital admission, and to identify patients who leave hospital with a higher level of frailty than was present premorbid. Better integration and utilisation of data collected by general practitioners, would be an efficient way to identify frailty and would be likely to improve co-ordination of care following hospital admission.

Although the concept of health assets was developed in the community, this thesis demonstrates that relevant health assets can also be identified in the hospital setting. Many of the health assets identified on systematic review relate to experiences earlier in the life course, highlighting that there is an ongoing biological
relevance in older age for early life events. The HAI (chapter 6) identified that it was feasible to measure these prospectively and that the time taken was not too onerous for unwell older adults. This supports the importance of including psychosocial information as part of a presenting history for older adults. Although this study has demonstrated that it is feasible to measure these, further research is required to elucidate whether the impact of health assets is due to biological mechanisms or changes in health behaviour.

This thesis support the hypothesis that health assets can mitigate outcomes for frail older inpatients. Although multiple health assets have been identified in the systematic review (chapter 2), an important limitation is that there was only study that also measured frailty, and so it is possible that these factors were acting by increasing frailty. The secondary analysis of the InterRAI dataset (Chapter 4) highlights that that being able to walk further and to leave the house were associated with improved survival, which shows that there are possible interventions that relate to physical fitness and the ability to access the community that could help older adults. The HAI validation study (chapter 6) demonstrated the complex interplay between assets and frailty, and showed the assets may only protective against mortality for the least frail. This complex interplay may be caused by frail older adults having reached a critical loss of physiological reserve for the assets examined. It is also possible that these community assets have less impact in the hospital setting when an individual has been removed from their usual environment and supports. It may be that the hospital environment itself needs to be approached from a Salutogenic framework to improve outcomes for frail older adults.

Health assets appear to have a bidirectional relationship with frailty, but may also present potential interventions to improve outcomes for older adults. As frailty measurement becomes widely implemented in hospital systems, it is important to recognise that an individual’s health status is not just a result of deficits, but of assets as well, which may provide an important and empowering strategy to facilitate recovery.
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Appendix 1: Frailty Index

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Response/code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Cognitive Status</td>
<td>normal = 0, CIND=0.5, dementia = 1</td>
</tr>
<tr>
<td>2  Delirium</td>
<td>no = 0, yes = 1</td>
</tr>
<tr>
<td>3  Depression</td>
<td>no = 0, yes = 1</td>
</tr>
<tr>
<td>4  Anxiety</td>
<td>no = 0, yes = 1</td>
</tr>
<tr>
<td>5  Fatigue</td>
<td>no = 0, yes = 1</td>
</tr>
<tr>
<td>6  Emotional Other* (eg recent bereavement)</td>
<td>no = 0, yes = 1</td>
</tr>
<tr>
<td>7  Motivation</td>
<td>high = 0, low = 1</td>
</tr>
<tr>
<td>8  Speech</td>
<td>Not impaired = 0, impaired = 1</td>
</tr>
<tr>
<td>9  Hearing</td>
<td>Not impaired = 0, impaired = 1</td>
</tr>
<tr>
<td>10 Vision</td>
<td>Not impaired = 0, impaired = 1</td>
</tr>
<tr>
<td>11 Sleep</td>
<td>normal = 0, disrupted = 1</td>
</tr>
<tr>
<td>12 Daytime Drowsiness</td>
<td>no = 0, yes = 1</td>
</tr>
<tr>
<td>13 Transfer</td>
<td>independent = 0, assisted=0.5, dependent = 1</td>
</tr>
<tr>
<td>14 Walking</td>
<td>independent = 0, assisted=0.5, dependent = 1</td>
</tr>
<tr>
<td>15 Aid</td>
<td>independent = 0, assisted=0.5, dependent = 1</td>
</tr>
<tr>
<td>16 Falls</td>
<td>no = 0, yes = 1</td>
</tr>
<tr>
<td>17 Falls Number</td>
<td>no falls= 0, 1-3 falls=0.5, more than 3 falls = 1</td>
</tr>
<tr>
<td>18 Bowel</td>
<td>normal = 0, incontinence = 1</td>
</tr>
<tr>
<td>19 Bladder</td>
<td>normal = 0, incontinence/ catheter = 1</td>
</tr>
<tr>
<td>20 Weight</td>
<td>good = 0, obese/underweight = 1</td>
</tr>
<tr>
<td>21 Weight change</td>
<td>Loss/gain = 1</td>
</tr>
<tr>
<td>22 Appetite</td>
<td>normal = 0, poor = 1</td>
</tr>
<tr>
<td>23 Feeding</td>
<td>no = 0, yes = 1</td>
</tr>
<tr>
<td>24 Bathing</td>
<td>independent = 0, assisted=0.5, dependent = 1</td>
</tr>
<tr>
<td>25 Dressing</td>
<td>independent = 0, assisted=0.5, dependent = 1</td>
</tr>
<tr>
<td>26 Toileting</td>
<td>independent = 0, assisted=0.5, dependent = 1</td>
</tr>
<tr>
<td>27 Medication use</td>
<td>independent = 0, assisted=0.5, dependent = 1</td>
</tr>
<tr>
<td>28 Medical problems</td>
<td>Count of medical problems (begins with reason for referral)</td>
</tr>
<tr>
<td>29-49 Count of medications</td>
<td>If &lt; 7 = 0, from 8 to 12=0.5, 13 and more =1</td>
</tr>
</tbody>
</table>
Appendix 2: Clinical Frailty Scale

Clinical Frailty Scale*

1. Very Fit – People who are robust, active, energetic and motivated. These people commonly exercise regularly. They are among the fittest for their age.

2. Well – People who have no active disease symptoms but are less fit than category 1. Often, they exercise or are very active occasionally, e.g. seasonally.

3. Managing Well – People whose medical problems are well controlled, but are not regularly active beyond routine walking.

4. Vulnerable – While not dependent on others for daily help, often symptoms limit activities. A common complaint is being “slowed up”, and/or being tired during the day.

5. Mildly Frail – These people often have more evident slowing, and need help in high order IADLs (finances, transportation, heavy housework, medications). Typically, mild frailty progressively impairs shopping and walking outside alone, meal preparation and housework.

6. Moderately Frail – People need help with all outside activities and with keeping house. Inside, they often have problems with stairs and need help with bathing and might need minimal assistance (cuing, standby) with dressing.

7. Severely Frail – Completely dependent for personal care from whatever cause (physical or cognitive). Even so, they seem stable and not at high risk of dying (within ~ 6 months).

8. Very Severely Frail – Completely dependent, approaching the end of life. Typically, they could not recover even from a minor illness.

9. Terminally Ill – Approaching the end of life. This category applies to people with a life expectancy <6 months, who are not otherwise evidently frail.

Scoring frailty in people with dementia

The degree of frailty corresponds to the degree of dementia. Common symptoms in mild dementia include forgetting the details of a recent event, though still remembering the event itself, repeating the same question/story and social withdrawal.

In moderate dementia, recent memory is very impaired, even though they seemingly can remember their past life events well. They can do personal care with prompting.

In severe dementia, they cannot do personal care without help.


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**Appendix 3: Katz Activities of Daily Living and Lawson-Brody Instrumental Activities of Daily Living**

**Katz ADLs**

<table>
<thead>
<tr>
<th>Activities</th>
<th>Independence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Points (1 or 0)</td>
<td>(1 Point)</td>
</tr>
<tr>
<td></td>
<td>NO supervision, direction or personal assistance.</td>
</tr>
<tr>
<td><strong>BATHING</strong></td>
<td>1Bathes independently</td>
</tr>
<tr>
<td>Points:</td>
<td>0 Requires assistance or supervision</td>
</tr>
<tr>
<td><strong>DRESSING</strong></td>
<td>1Independent</td>
</tr>
<tr>
<td>Points:</td>
<td>0 assistance or supervision</td>
</tr>
<tr>
<td><strong>TOILETING</strong></td>
<td>1 independent</td>
</tr>
<tr>
<td>Points:</td>
<td>0 assistance or supervision</td>
</tr>
<tr>
<td><strong>TRANSFERRING</strong></td>
<td>1 independent transfer</td>
</tr>
<tr>
<td>Points:</td>
<td>0 requires assistance or supervision</td>
</tr>
<tr>
<td><strong>CONTINENCE</strong></td>
<td>1 continent</td>
</tr>
<tr>
<td>Points:</td>
<td>0 incontinent</td>
</tr>
<tr>
<td><strong>FEEDING</strong></td>
<td>1 eats independently</td>
</tr>
<tr>
<td>Points:</td>
<td>0 requires assistant or artificial feeding</td>
</tr>
</tbody>
</table>

Source: *try this: Best Practices in Nursing Care to Older Adults, The Hartford Institute for Geriatric Nursing, New York University, College of Nursing, www.hartfordign.org.*
### Lawson-Brody Instrumental Activities of Daily Living

<table>
<thead>
<tr>
<th>Item</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Telephone use</strong></td>
<td></td>
</tr>
<tr>
<td>Can your loved one use the telephone?</td>
<td>1. <strong>Can use telephone to make or receive calls</strong></td>
</tr>
<tr>
<td></td>
<td>0 <strong>Doesn’t use telephone</strong></td>
</tr>
<tr>
<td>(does not need to be asked if participant answers phone independently)</td>
<td></td>
</tr>
<tr>
<td><strong>Shopping</strong></td>
<td></td>
</tr>
<tr>
<td>Can you/ or (insert name) plan, prepare and cook a meal</td>
<td>1. <strong>Can shop independently</strong></td>
</tr>
<tr>
<td></td>
<td>0 <strong>Does not complete shopping</strong></td>
</tr>
<tr>
<td><strong>Food prep</strong></td>
<td></td>
</tr>
<tr>
<td>Can you/ or (insert name) plan, prepare and cook a meal</td>
<td>1. <strong>Yes</strong></td>
</tr>
<tr>
<td></td>
<td>0 <strong>No</strong></td>
</tr>
<tr>
<td><strong>Housework</strong></td>
<td></td>
</tr>
<tr>
<td>Do you/ (insert name) undertake any housework</td>
<td>1 <strong>Yes</strong></td>
</tr>
<tr>
<td></td>
<td>0 <strong>No</strong></td>
</tr>
<tr>
<td><strong>Laundry</strong></td>
<td></td>
</tr>
<tr>
<td>Do you/ (insert name) do any laundry or clothes washing</td>
<td>1 <strong>Yes</strong></td>
</tr>
<tr>
<td></td>
<td>0 <strong>No</strong></td>
</tr>
<tr>
<td><strong>Mode of transport</strong></td>
<td></td>
</tr>
<tr>
<td>Are you / (insert name) able to travel out of the house by car/taxi/public transport</td>
<td>1 <strong>Yes</strong></td>
</tr>
<tr>
<td></td>
<td>0 <strong>No</strong></td>
</tr>
</tbody>
</table>
by yourself?

<table>
<thead>
<tr>
<th>Question</th>
<th>1 Yes</th>
<th>0 No</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Do you take your own medications?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Are you able to manage your finances and day to day purchases?</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Appendix 4: Modified Early Warning Score

Modified Early Warning Score

<table>
<thead>
<tr>
<th></th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic Blood pressure</td>
<td>&lt;70</td>
<td>71–80</td>
<td>81–100</td>
<td>101–199</td>
<td>≥200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(mmHg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart rate (bpm)</td>
<td>&lt;40</td>
<td>41–50</td>
<td>51–100</td>
<td>101–110</td>
<td>111–129</td>
<td>≥130</td>
<td></td>
</tr>
<tr>
<td>Respiratory rate (bpm)</td>
<td>&lt;9</td>
<td>9–14</td>
<td>15–20</td>
<td>21–29</td>
<td>≥30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>&lt;35</td>
<td>35–38.4</td>
<td>≥38.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVPU score</td>
<td>Alert</td>
<td>Reacting to</td>
<td>Reacting to</td>
<td>Unresponsive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Voice</td>
<td>Pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 5


Introduction

Older adults are at particular risk of adverse outcomes when they are hospitalised, even for a seemingly minor illness. As well as the risk for mortality, many older adults will leave hospital with less independence in activities of daily living. Frailty is a loss of physiological reserve that leaves an older adult vulnerable to a significant deterioration in health status from even a minor insult. For hospitalised older adults, increasing frailty is associated with a higher risk for mortality and functional decline, as well as an increased length of stay. Frailty can be measured using a deficit index. This is informed by counting deficits across a range of domains including medical, functional, cognitive, psychological and nutritional. This has demonstrated prognostic validity in the inpatient setting.

Including only risk factors in models of health and wellbeing does not explain why some older adults recover well following hospitalisation. Health assets are determining factors that predict health and illness over and above conventional risk factors. The inclusion of health assets in the model of disease and wellness can elucidate why some older adults maintain or even improve their health status. Health assets are derived from the concept of ‘salutogenesis’, which focuses on the resources individuals utilise in a stressful situation to move towards health. Community studies have demonstrated that health assets can act as protective factors and mitigate the effect of frailty.

Based on the principles of the frailty index, a Health Assets Index (HAI) has been developed following a systematic review of health assets in hospitalised older adults. The purpose of this study is to validate the HAI, and to determine whether health assets can mitigate the effects of frailty on hospitalised older
adults. The primary outcomes of interest are mortality and functional decline at 30 days. The secondary outcomes are length of stay, inpatient mortality, inpatient functional decline and readmission at 30 days.

**Background**

Health assets are determining factors that predict health and illness over and above conventional risk factors. For a factor to be a health asset, it must not simply be the absence of a risk factor, such as being a non-smoker. Some health assets identified in the community setting are cardiorespiratory fitness, a stable marriage, positive emotions and social participation. Health assets have primarily been examined in the community setting. A systematic review was conducted to identify potential health assets in hospitalised older adults (currently under consideration for publication). This review has informed the development of the Health Assets Index (HAI) (see appendix 1).

**Systematic review methods:** MEDLINE, EMBASE, CINAHL and PsycINFO were searched to identify studies examining outcomes for hospitalised older adults. Included studies examined at least one potential individual health asset, which was a psychosocial characteristic or health characteristic.

As well as the obvious risk of mortality, older adults are at a high risk for functional decline when they are hospitalised. Older adults who are discharged from hospital with an increased level of dependence in activities of daily living have a poor prognosis at one year, with only 30% returning to their previous functional level. Older adults are also at increased risk for longer lengths of stay and readmission. As older adults make up a disproportionately large group of hospital inpatients, it is critical that this group are included in research studies.

Not all hospitalised older adults will have adverse outcomes after hospitalisation. The dominant approach has been to identify risk factors associated with adverse outcomes. Frailty, pre-existing dependence in activities
of daily living, malnutrition, depression and impaired cognition\textsuperscript{43} are well established as risk factors for poor recovery from acute hospitalisation.\textsuperscript{44} The frailty index is a count of deficits across medical, psychological, functional, cognitive and social domains that has demonstrated good predictive validity in this population.\textsuperscript{14} One of the study aims of the interRAI-AC is to see whether a frailty index can be derived from this tool. Community studies have demonstrated that health assets can mitigate the effects of frailty, \textsuperscript{37} but this has not been explored in hospitalised older adults.

Many potential health assets were identified in this systematic review (table 1). Health assets in older adults lead to a decrease in mortality, functional decline, readmission and new need for residential care. This review also highlighted the need for further research to examine the complex interplay between health status and psychological and social factors. As the absolute risk of mortality and functional decline is so high in hospitalised older adults, the positive impact of health assets has the potential to provide significant benefit.

The frailty index, which is derived from a comprehensive geriatric assessment at the time of hospital admission predicts mortality and functional decline\textsuperscript{14}. An index of social vulnerability can predict mortality in community dwelling older adults\textsuperscript{73}. These studies together demonstrate proof of concept that an asset index can be created, which may further help identify older adults who are likely to have better outcomes following hospitalisation.

In order to determine whether health assets have a significant impact on outcomes for hospitalised older adults, a clinical measurement tool needs to be developed. The proposed tool, the HAI, was developed based on the systematic review. The HAI is being developed as a tool with clinical utility to be used in conjunction with the frailty index improve clinical prognostication.
Table 2: Health Assets and associated findings

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Sense of Control</th>
<th>Sense of wellbeing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreased Functional Decline</td>
<td>Dent(^79)</td>
<td>Chaudhry(^{130})</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Li(^{92})</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chen(^{131})</td>
</tr>
<tr>
<td>Decreased Long-term mortality</td>
<td>Dent(^79)</td>
<td>Dent(^79)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Li(^{92})</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Berkman(^{132})</td>
</tr>
<tr>
<td>Less likely to need residential care</td>
<td>Smith(^{133})</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drame(^59)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Goodwin(^{58})</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Smith(^{133})</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Zureik(^{134})</td>
</tr>
<tr>
<td>Decreased Readmission</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Social engagement*: social activities, social support, large social network
Development of the Health Assets Index
The Health Assets Index (HAI) has been developed (see attached documentation) to enable measurement of health assets.

Variables were included based on the following criteria:

7. Variables identified on the systematic review, or variables with face validity
8. Be associated with positive health outcomes
9. Not included in the frailty index
10. Not be present or absent in greater than 95% of patients
11. Variables can be binary, continual or categorical.
12. As a group, the candidate assets must cover a range of domains, for example social, psychological and socio-economic
13. Assets must be age appropriate, for example being in paid employment is likely to have such low prevalence that it will not provide any meaningful discrimination in older adults

The variables will be assigned a score from 0 to 1.

- Binary variables will be scored as 0=asset not present 1=asset present
- Categorical variables will be scored according to a range i.e. activity level
- Continual and ordinal variables will be transformed into categorical variables by examining spread and judgement, for example education may be divided as less than 12 years and more than 12 years.

Adding the deficits and dividing by the total will give a score with a range from 0-1.

Pilot study
A pilot study was conducted from December 2015 to February 2016 at the Northern Hospital as a substudy of the Early needs assessment of adult patients in acute care: establishment of clinimetric properties of a screening tool (HREC/15/NH/27). An abbreviated version of the HAI, the Health Assets Questionnaire (appendix 1) was administered by a nurse researcher. Patients aged 70 years and older admitted to participating wards were included.
59 patients were included in the pilot study, with 52% women. The HAQ took 2-3 minutes to administer. No patients were distressed by the questions. Patients had difficulty interpreting the question regarding the number of years of education they had received, so this was not included when calculating a score. The score was calculated as a sum total of all questions.

A subset of the health assets index was examined, the health assets None of the items were present or absent in greater than 95% of patients. The theoretical score range was 0-9. The average score was 5.9(SD1.1), with a range from 3-8. The pilot study demonstrated that it is feasible to administer questions regarding health assets and that it is acceptable to patients.

The systematic review and the acceptability of the questionnaire support moving forward to validate the HAI.

Study Aims
To determine the predictive validity of the health assets index, to identify frail older adults who have decreased risk of mortality and functional decline.

Objectives

- Determine the distribution of the HAI in hospitalised older adults
- Examine inter-rater reliability of the HAI
- Measure the presence of health assets in relation to the presence of frailty
- Determine whether a higher score on the HAI decreases the chance of mortality for hospitalised older adults
- Determine whether the health assets index decreases the change of hospital associated functional decline
- Determine impact of health assets on functional recovery and mortality at 12 months after follow-up

Primary Hypothesis

- The distribution of score on the health assets index will be related to frailty score
- A higher score on the health assets index will mitigate the effect of frailty on hospitalised older adults and lead to decreased mortality and functional decline
Secondary hypothesis

- A higher score on the health assets index will mitigate the effect of frailty on hospitalised older adults and lead to decreased length of stay and readmission

Study Design

This will be a prospective cohort. The factors of interest will be measured at the time of recruitment, and outcomes will be assessed at the end of the period of hospitalisation.

Study setting and location

The study setting will be in a range of acute general medical, orthogeriatric and aged care wards and subacute wards.

Study population

Adults aged 70 and older who have an unplanned admission to hospital

Inclusion criteria

- Patient or surrogate agree to participate, complete and sign consent form

Exclusion criteria

- Patient is not able to consent and there is no surrogate decision maker available
- Patients who primarily speak a language other than English
Study outcomes

Primary

1. 30 day mortality
2. Decline in functional status, defined as a decrease score for Instrumental activities of daily living (IADLs) or Domestic activities of daily living (DADLs) compared to baseline, or a new need for residential care or admission to subacute care

Secondary

3. Length of stay
4. Readmission within 30 days
5. Functional status for DADLs at time of discharge from hospital
6. 12 month mortality
7. 12 month functional decline

Study procedures

Recruitment of patients

At the start of each day, the researcher will source the admissions from overnight for the participating wards. Throughout the day, the researcher will check for new admissions to each of the participating wards either through use of the hospital admissions software, or through some other prearranged method such as direct communication with ED/MAPU or bed management staff.

Sample size required

3. 30 day mortality – 169
4. Functional status for instrumental ADLs and DADLs 30 days after discharge – 350
To account for 10% loss to follow-up planned sample size is 385.

Consent

The researcher will speak to the clinical staff regarding to determine whether there are any concerns regarding the patient’s cognition and capacity to consent. If the clinical staff raise concerns or if in the subjective judgment of the researcher there are concerns, consent will also be obtained from the next of kin or responsible person.

Study procedure
The patients will be approached by the researcher either on the acute ward or in the emergency department once they have been accepted for admission. The researcher will complete a frailty index and the health assets index based on information from the patient, carers and staff. The researchers will administer the HAI twice to a subset of patients to determine inter-rater reliability. The researcher will obtain information regarding illness severity from the medical records. Age and demographic data will be obtained from medical records. Demographic data will include gender, age, usual place of residence and previous home help services.

Patients will be asked for a contact phone number for follow-up. Patients who are able to consent for themselves will be asked to nominate whether they prefer to be contacted or for the researchers to contact a relative or carer. For patients who were not able to consent, the person responsible will be contacted for follow-up.

**Outcome measures**

1. Inpatient mortality – this will be obtained from hospital records
2. 30 day mortality – medical records will be checked prior to calling patients or their families.
3. DADLs at time of discharge will be obtained from medical records
4. IADLs and DADLs will be obtained by phone call to either the patient or their nominated representative or the person responsible.
5. Length of stay will be obtained from medical records
6. Unplanned readmission within 30 days will be obtained either from medical records or from phone follow-up

**Measurement tools**

The health assets index will be obtained at the time of admission to hospital.

A frailty index will be derived from information obtained by the patient and medical records at the time of admission to hospital. Frailty will be determined based on what the patient was like two weeks prior to admission. This tool has been validated in the acute,
inpatient setting. The tool takes approximately 25 minutes to complete using information from patient and informant history as well as medical records.\textsuperscript{14}

Illness severity will be measured using the Modified Early Warning System (MEWS). This gives a score based on observations which are collected at triage. It has been validated for this use in the acute medical setting. Although this was not developed specifically for older adults, the mean age of the validation cohort was 63, with a range from 16-100.\textsuperscript{90} This information will be obtained from medical records.

Functional decline will be measured using the Katz Index of Independence in Activities of Daily Living and the Lawton-Brody Instrumental Activities of Daily Living scale. This will be measured at the time of admission to hospital and at 30 days post discharge. A functional decline will be considered a decrease in ADL count or admission to subacute care or new admission to residential care.

Length of stay will be defined as length of stay in the acute hospital, which will be obtained from hospital records.

**Statistical considerations and data analysis**

**Sample size required**

1. 30 day mortality – 169
2. Functional status for instrumental ADLs and DADLs 30 days after discharge – 350

To account for 10% loss to follow-up planned sample size is 385.

**Statistical methods**

The distribution of HAI scores will be examined in the population.

Multivariate analysis will take place. HAI score, frailty index, MEWS, gender and age will be included in the model.
Ethical considerations

The study will be conducted in full conformance with principles of the “Declaration of Helsinki”, Good Clinical Practice (GCP) and within the laws and regulations of Australia.

As this study focuses primarily on older patients, it is highly likely that patient in the target population will have cognitive impairment. Where there is suspicion of cognitive impairment, consent will also be obtained from the next of kin (NOK). As a high proportion of older adults who are admitted to hospital will have delirium and/or dementia, it is an issue of social justice that this group must be included in research to improve care for older adults. Although inpatients are an inherently vulnerable group due to their dependence on medical care, their care will not differ in any way whether or not they choose to participate in the study. The health assets index has been developed to rely on information that is routinely obtained in clinical care, such as whether the patient has a carer, to minimise the burden of providing additional information.

The patients/NOK will be informed that consent is voluntary and may be withdrawn at any time.

The patients will be advised that this is a validation study, so will not benefit them, but will hopefully be of benefit to future patients.

The additional time taken to obtain the data should be around 20-30 minutes, so will pose an additional burden on the patient. To minimise this imposition to the patient, where possible, information will be obtained from medical records. In addition, if any of the patients find particular questions distressing, they are free not to answer.

All attempts have been made to rely primarily on routine clinical data, but as the patient or their person responsible will be asked questions of a personal nature, there is still a possibility of causing psychological distress. If this occurs counselling from an independent practitioner will be followed up. If the researchers identify any medical or other issues of concern this will be communicated to the treating medical team.
It is possible that there will be issues of concern identified at the time of the phone call follow-up. If there is a medical issue, the patient will be advised to present to their GP or the emergency department. If there are psychosocial issues or carer stress, a referral will be made to the Austin Aged Care Assessment Service.

The data forms will have the patient label and unique study identifier on them. This information will be de-identified and entered into a password specific database. Hard copies of data will be stored for up to 7 years in a locked cabinet and then disposed of securely in accordance with Austin hospital procedure. Secondary data analysis may take place during this period. Electronic data will be stored on a secure server and will be accessible by username and password by key members of the Northern Hospital research team only.

In any publication that arises from this project, all data will be de-identified. Therefore there will be no personally identifiable data used in the analysis, writing up or disseminating of the project findings.

**Outcomes and significance**

This is the first study the authors are aware of to measure health assets in hospitalised older adults in a systematised way. The addition of measurement of health assets could explain why some frail older adults can return to a good health status after illness and hospitalisation. Elucidation of the role of health assets in the hospital setting could improve risk stratification and


39. Covinsky KE, Pierluissi E, Johnston CB. Hospitalization-associated disability: "She was probably able to ambulate, but I'm not sure". *Jama*. 2011;306(16):1782-1793.


104. *Better Safer Care, Delivering a world-leading healthcare system*. Victoria, Australia: Department of Health and Human Services; October 2016.


Appendix 6: Feasibility of the Health Assets Questionnaire: A Pilot Study

A5.1 Background

Once the Health Assets Index (HAI) was developed a pilot study was undertaken to determine whether this was feasible and whether participants understood it. The health assets index was derived from the systematic review of the literature and identification of protective factors on the secondary analysis of the interRAI-AC study (chapter 4).

A5.2 Methods

The pilot study was conducted as a substudy of the Early needs assessment of adult patients in acute care: establishment of clinimetric properties of a screening tool (Purple box study) (lead investigator Prof. Len Gray). As some items on the HAI were already included in this study, an abbreviated version of the HAI, the health assets questionnaire (HAQ) was administered (Table 6.1). A separate consent was obtained for the substudy and patients were free to complete only the Purple Box study if they chose. This substudy took place at the Northern Hospital.

A5.2.1 Objectives:

- Determine the time taken to complete the HAQ
- Determine willingness of patients to answer the questions in the HAQ
- Determine patients’ understanding of the HAQ questions
- Examine spread of data to look for floor and ceiling effect
- Obtain data to perform a sample size calculation

A5.2.2 Case criteria
• Agree to participate, complete and sign consent form

• Aged 70+

• Admitted to acute care within the last 12 hours

A5.2.3 Outcomes

1. Determine the feasibility of the HAQ

2. Determine inter-rater reliability of the HAQ

3. Determine sample size required for predictive validation study

A5.2.4 Measurement

Measurement was undertaken by trained research nurses, who administered the nine additional questions on the HAQ.

Information collected for the Purple Box study will be used in the analysis.

A5.2.5 Analysis

• The average time taken to complete the questionnaire was obtained

• The percentage of patients who agreed to complete the questionnaire was obtained.

• The range of responses were looked at for each question to look for a floor and ceiling effect.
• A qualitative approach was taken to the answers given to the questions to determine whether they are interpreted by the patient in the way intended by the researchers.

• The data was used to determine a sample size in a prospective validation study of the HAQ.

No inferential analysis was undertaken as this is a feasibility study.

A5.3 Results

There were 59 participants with an average age of 81.6 (range 70-99). All participants approached agreed to participate in the pilot study. The HAQ took less than five minutes to complete. There were 23 women, 25 men and data was missing for 11. None of the Assets were present in more than 95% of the participants (see table A5). Participants were also asked how many years of schooling they had undertaken, but most answered with the age they had finished school, so this question was refined to ask participants their age when they had started and finished school. The researcher collecting data reported that participants understood all other questions.

A5.4 Discussion and Conclusions

This pilot study demonstrates that the time taken to complete the HAQ was acceptable and that the participants did not find the questions overly onerous or distressing. This pilot study did lead to a change in the way the question regarding education was asked.

<table>
<thead>
<tr>
<th>Table A5: The Health Assets Questionnaire</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Question</strong></td>
</tr>
<tr>
<td>------------------------------------------</td>
</tr>
<tr>
<td>Do you have a carer or someone you can rely on to help with day-to-day activities? N=58</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Do you have a regular GP? N=59</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Question</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Do you have private health insurance or other form of health services cover such as Department of Veterans’ Affairs Gold Card? N=57</td>
</tr>
<tr>
<td></td>
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<tr>
<td>How many children do you have? N=59</td>
</tr>
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<td></td>
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<td></td>
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<tr>
<td>Can you count on anyone to provide you with emotional support eg. talking over a problem, or helping with a decision? N=59</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Do you have control over the important things in life? N=59</td>
</tr>
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<td></td>
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<td></td>
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<tr>
<td>How many times a week do you see or talk to a family member or friend who does not live with you? N=59</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td>Overall how would you rate your quality of life? N=57</td>
</tr>
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<td></td>
</tr>
</tbody>
</table>
1. TITLE AND SUMMARY OF PROJECT

1. Title

What is the formal title of this research proposal?

*Early needs assessment of adult patients in acute care: establishment of clinimetric properties of a screening tool*

What is the short title / acronym of this research proposal (if applicable)?

2. Description of the project in plain language

Give a concise and simple description (not more than 400 words), in plain language, of the aims of this project, the proposal research design and the methods to be used to achieve those aims.

Background:
The team in the Centre for Research in Geriatric Medicine (CRGM), in conjunction with the interRAI research collaborative and partners has developed a functional and psychosocial screening tool for the nursing admission process. This tool has been designed to be administered at admission by general hospital nursing staff to enable the prompt identification of functional and psycho-social issues and geriatric syndromes and the risk of acquiring them in hospital for all adult patients.

Aims:
- To test the psychometric properties of the assessment tool in field tests in a variety of acute care settings

Research Methods
A series of studies will be undertaken to evaluate:
1. Face and content validity
2. Internal consistency of scalar measures and predictive validity of diagnostic and risk screeners
3. Inter-rater reliability

Study 1 will take place at Princess Alexandra Hospital (QLD) and Northern Hospital (Vic). Ten nurses at each site will be asked to complete 2 usual assessments and 2 assessments using the new screening tool (4 patients), at least one of whom is 70 years or older. Nurses will be asked to note the time taken for the assessments and will complete a form to evaluate the ease of use and content of the screener.

For study 2, 1200 cases using the acute care screener will be collected at 3 Australian health districts (Metro South and Darling Downs (Qld) and Northern (Vic)). Internal consistency of scalar measures (eg ADL, cognitive performance, communication) will be tested and predictive validity of diagnostic and risk screeners assessed by comparing with documented presence of geriatric syndromes and adverse outcomes in participant medical records reviewed at 28 days post discharge.

Study 3 will take place concurrently with Study 2. For 100 cases, assessments will be completed by 2 nurses to compare inter-rater reliability.

The instrument will be refined based on findings from the psychometric testing. Ultimately the instrument will be tested in large scale implementation trials which are beyond the scope of this study.
### 2. Principal researcher(s) / investigator(s)

<table>
<thead>
<tr>
<th>Principal researcher / investigator 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title:</strong></td>
</tr>
<tr>
<td><strong>Forename/Initials:</strong></td>
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<td><strong>Organisation:</strong></td>
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<td><strong>Phone (BH):</strong></td>
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<tr>
<td><strong>Phone (AH)*:</strong></td>
</tr>
<tr>
<td><strong>Mobile</strong>*:</td>
</tr>
<tr>
<td><strong>Pager</strong>*:</td>
</tr>
<tr>
<td><strong>Fax:</strong></td>
</tr>
</tbody>
</table>

Is this person the contact person for this application?  
☐ Yes  ☐ No

**Summary of qualifications and relevant expertise**

MB,BS, M.Med, PhD, FRACP, FACHSE, FAAG

Professor Len Gray is the principle investigator on this study and the director of the Centre for Research in Geriatric Medicine, The University of Queensland. He has extensive research experience in aged care policy, models of aged care service delivery, assessment and care planning systems, and in recent years, e-health and telemedicine strategies. He leads international development of the interRAI Acute Care system of assessment, and is the Australian coordinator for interRAI. He has an extensive list of publications within his field of research expertise, has had over 35 successful grant applications since 2002.

Please declare any general competing interests  
None

Name the site(s) for which this principal researcher / investigator is responsible.  
Queensland sites

Describe the role of the principal researcher / investigator in this project.  
Professor Gray, along with a team of national and international experts is responsible for instrument design and development. He is also responsible for project design and protocol development.

Is the principal researcher a student?  
☐ Yes  ☐ No

<table>
<thead>
<tr>
<th>Principal researcher / investigator 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title:</strong></td>
</tr>
<tr>
<td><strong>Forename/Initials:</strong></td>
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<td><strong>Postcode:</strong></td>
</tr>
<tr>
<td><strong>Country:</strong></td>
</tr>
</tbody>
</table>
Online Forms
Research Specific Elements

1. Explain/justify why results will not be reported to participants:
   - Original paper copies will be stored in a secure location, in a locked filing cabinet, for the specified duration.

2. Does the research involve limited disclosure to participants?
   - No

3. Inter

   - People in existing dependent or unequal relationships

   - People whose primary language is other than English (LOTE)

4. Inter

   - Common syndromes include depression, dementia, immobility, inability to self

5. Inter

   - Hospital stay. Common syndromes include depression, dementia, immobility, inability to self

6. PARTICIPANTS

   - Anticipated start date or date range:
   - Anticipated finish date:

   - Describe the role of the principal researcher / investigator in this project.
   - Is the principal researcher a student?
     - Yes  No

   - Principal researcher / investigator 1
     - Title: Forename/Initials: Surname:
     - Dr Nacey M Peel

   - Mailing Address:
     - Level 2, Building 33,
     - Princess Alexandra Hospital
     - Woolloongabba

   - Suburb/Town: Brisbane
   - State: QLD
   - Postcode: 4102
   - Country: Australia

   - Organisation: The University of Queensland
   - Department*: Centre for Research in Geriatric Medicine
   - Position: Senior Research Fellow
   - E-mail: n.peel@uq.edu.au
   - Phone (BH): (07) 3176 7402
   - Phone (AH)*:
   - Mobile*:
   - Pager*:

   - Fax: (07) 3176 6945

   - Summary of qualifications and relevant expertise
     - PhD (Population Health), Master of Public Health, Bachelor of Physiotherapy.
     - Dr Peel is a Senior Research Fellow in the Centre for Research in Geriatric Medicine, The University of Queensland. Her research expertise relates to the determinants of health and well-being of older people, geriatric assessment (including frailty) and indicators of quality of care for the frail aged across the continuum of care.

   - Is this person the contact person for this application?
     - Yes  No

   - Principal researcher / investigator 3
     - Title: Forename/Initials: Surname:
     - Dr Peel will contribute to study design, protocol development and the statistical analysis plan. She will assist

   - Fax: (07) 3176 6945

   - Summary of qualifications and relevant expertise
     - Dr Hubbard's relevant qualifications include Bachelor of Science; Bachelor of Medicine and Bachelor of

   - Position: Deputy Director
   - E-mail: r.hubbard1@uq.edu.au
   - Phone (BH): (07) 3176 5530
   - Phone (AH)*:
   - Mobile*:
   - Pager*:

   - Fax: (07) 3176 6945

   - Is this person the contact person for this application?
     - Yes  No

   - Summary of qualifications and relevant expertise
     - Has the research proposal, including design, methodology and evaluation undergone, or will it undergo, a peer

   - Organisation: The University of Queensland
   - Department*: Centre for Research in Geriatric Medicine
   - Position: Deputy Director

   - PI Professor Len Gray

   - Private Sector

   - Queensland sites

   - Funding: Commonwealth of Australia

   - Brief description of the study:
     - The aims and methods of the project will be fully explained to the patient

   - Fax: (07) 3176 6945

   - Is this person the contact person for this application?
     - Yes  No

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   - Is this person the contact person for this application?
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3. Associate Researcher(s) / investigator(s)

How many known associate researchers are there? (You will be asked to give contact details for these associate researchers / investigators)

0

Do you intend to employ other associate researchers / investigators?  
○ Yes  ○ No

4. Contact

Provide the following information for the person making this application to the HREC.
5. Other personnel relevant to the research project

5a. How many known other people will play a specified role in the conduct of this research project?
5

5b. Describe the role, and expertise where relevant (e.g. counsellor), of these other personnel.

Our research nurse (Bonnie Pimm) is the nurse trainer for this project. She will provide instrument training to the clinical nurses involved in collecting data for this project.

There will be a nominated project manager (Dr Yvonne Hornby-Turner) responsible for overall project management, as well as coordinators at each of the Hospital and Health Service Districts. The coordinators will be responsible for overseeing the implementation of the project within their Health District. Project coordinators will also be involved in regular meetings with the CRGM project team to discuss project protocol and development at the sites.

5c. Is it intended that other people, not yet known, will play a specified role in the conduct of this research project?

☐ Yes  ☐ No

6. Certification of researchers / investigators

6a. Are there any relevant certification, accreditation or credentialing requirements relevant to the conduct of this research?

☐ Yes  ☐ No
7. Training of researchers

7a. Do the researchers / investigators or others involved in any aspect of this research project require any additional training in order to undertake this research?

☐ Yes  ☐ No

What is this training?
The clinical nurses involved in data collection for this project will be trained on the use of the screening instrument, conducting medical record reviews and recording the data from the reviews.

How and by whom will the training be provided?
Our research nurse (Bonnie Pimm) is the nurse trainer for this project. She will provide up to 2 hours of training to the clinical nurses on the use of the screening instrument, conducting medical record reviews and recording the data from the reviews. A user manual and training strategy will be developed specifically for this purpose.

How will the outcome of the training be evaluated?
As part of the training, clinical nurses will conduct two practice screening assessments and record data from two medical record reviews for practice case examples. These will be evaluated by the nurse trainer.

3. RESOURCES

Project Funding / Support

1. Indicate how the project will be funded?

Type of funding.

[Please note that all fields in any selected funding detail column (with the exception of the code) will need to be completed.]

<table>
<thead>
<tr>
<th>Funding</th>
<th>Confirmed or Sought?</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Competitive Grant</td>
<td>☐ Confirmed</td>
</tr>
<tr>
<td>Internal Competitive Grant</td>
<td>☐ Confirmed</td>
</tr>
<tr>
<td>Sponsor</td>
<td>☐ Confirmed</td>
</tr>
<tr>
<td>By Researchers Department or Organisation</td>
<td>☐ Confirmed</td>
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<tr>
<td></td>
<td></td>
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<tr>
<td>Amount of funding 777,296</td>
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</tr>
</tbody>
</table>

1a. External Competitive Grant

Name of Grant / Sponsor: Aged Care Service Improvement and Healthy Ageing
Grant: Department of Social Services

Code (optional): Not applicable

Detail in kind support: The research proposed in this ethics application aligns with the scope of the grant.

Indicate the extent to which the scope of the grant and the scope of this HREC application are aligned: Not applicable

2. How will you manage a funding shortfall (if any)?

This project budget has been carefully calculated and no shortfall is expected.
3. Will the project be supported in other ways eg. in-kind support/equipment by an external party eg. sponsor?

- Yes
- No

4. Is this a study where capitation payments are to be made, and will participants be made aware of these payments to clinicians or researchers / investigators?

No capitation payments are to be made.

5. Describe any commercialisation or intellectual property implications of the funding/support arrangement.

The researchers at CRGM have a grant agreement in place with The Department of Social Services, who have funded this project, which states the following:
- CRGM owns the Intellectual Property Rights in Material created undertaking the Activity.
- The Agreement does not affect the ownership of Intellectual Property Rights in Existing Material.

6. Does the funding/support provider(s) have a financial interest in the outcome of the research?

- Yes
- No

7. Does any member of the research team have any affiliation with the provider(s) of funding/support, or a financial interest in the outcome of the research?

- Yes
- No

8. Does any other individual or organisation have an interest in the outcome of this research?

- Yes
- No

*Indicate the interested party and describe the interest:*
Hospital administrators at state, national and international level may well be interested in the development of an integrated assessment tool for adults admitted to acute care.

9. Are there any restrictions on the publication of results from this research?

- Yes
- No

4. PRIOR REVIEWS

**Ethical Review**

Some HRECs may require researchers to provide information additional to that contained in a NEAF proposal. For this reason, it is prudent to check whether the HRECs to whom you propose to submit this proposal require additional information.

**Duration and location**

1. In how many Australian sites, or site types, will the research be conducted?

6

2. In how many overseas sites, or site types, will the research be conducted?
3. Provide the following information for each site or site type (Australian and overseas, if applicable) at which the research is to be conducted

<table>
<thead>
<tr>
<th></th>
<th>Site / Site Type Name:</th>
<th>Site / Site Type Location:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Princess Alexandra Hospital</td>
<td>Woolloongabba, QLD, 4102</td>
</tr>
<tr>
<td>2</td>
<td>Warwick Hospital</td>
<td>Darling Downs, QLD, 4370</td>
</tr>
<tr>
<td>3</td>
<td>Dalby Hospital</td>
<td>Darling Downs, QLD, 4405</td>
</tr>
<tr>
<td>4</td>
<td>Kingaroy Hospital</td>
<td>Darling Downs, QLD, 4610</td>
</tr>
<tr>
<td>5</td>
<td>Stanthorpe Hospital</td>
<td>Darling Downs, QLD, 4380</td>
</tr>
<tr>
<td>6</td>
<td>Northern Hospital</td>
<td>Epping, Victoria</td>
</tr>
</tbody>
</table>

4. Provide the start and finish dates for the whole of the study including data analysis

Anticipated start date: 01/09/2015 (dd/mm/yyyy)
Anticipated finish date: 31/08/2017 (dd/mm/yyyy)

5. Are there any time-critical aspects of the research project of which an HREC should be aware?

Yes
No

Describe the time-critical aspects:
This project commenced on 1 September 2015 and is funded until 31 August 2017. We have a strict schedule to maintain to ensure this project is completed on time. Data collection at the hospital sites is scheduled to commence 1 September 2015 and be completed by 30 June 2016.

6. To how many Australian HREC(s) (representing site organisations or the researcher’s / investigator’s organisation) is it intended that this research proposal be submitted?

3

A list of NHMRC registered Human Research Ethics Committees (HRECs), along with their institutional affiliations and contact details is available on the NHMRC website at the following web address: http://www.nhmrc.gov.au/health_ethics/hrecs/overview.html#d.

7. HRECs

HREC 1
**Name of HREC:**
Metro South Health Service District Human Research Ethics Committee (EC00167)

**Provide the start and finish dates for the research for which this HREC is providing ethical review:**
Anticipated start date or date range: 01/08/2015 (dd/mm/yyyy)
Anticipated finish date or date range: 31/08/2017 (dd/mm/yyyy)

**For how many sites at which the research is to be conducted will this HREC provide ethical review?**
1

**Site 1**

**Name of Site:** Princess Alexandra Hospital

**Principal Researcher 1**

**Principal Researcher Name:**
Professor Leonard C Gray

---

**Name of HREC:**
Darling Downs Hospital and Health Service Human Research Ethics Committee (EC00182)

**Provide the start and finish dates for the research for which this HREC is providing ethical review:**
Anticipated start date or date range: 01/08/2015 (dd/mm/yyyy)
Anticipated finish date or date range: 31/08/2017 (dd/mm/yyyy)

**For how many sites at which the research is to be conducted will this HREC provide ethical review?**
4

**Site 1**

**Name of Site:** Warwick Hospital

**Principal Researcher 1**

**Principal Researcher Name:**
Professor Leonard C Gray

---

**Name of Site:** Dalby Hospital

**Principal Researcher 1**
Site 3

Name of Site: Kingaroy Hospital

Principal Researcher 1

Principal Researcher Name: Professor Leonard C Gray

Site 4

Name of Site: Stanthorpe Hospital

Principal Researcher 1

Principal Researcher Name: Professor Leonard C Gray

HREC 3

Name of HREC:
Northern Health Human Research Ethics Committee (EC00423)

Provide the start and finish dates for the research for which this HREC is providing ethical review:
Anticipated start date or date range: 01/08/2015 (dd/mm/yyyy)
Anticipated finish date or date range: 31/08/2017 (dd/mm/yyyy)

For how many sites at which the research is to be conducted will this HREC provide ethical review?
1

Site 1

Name of Site: Northern Hospital

Principal Researcher 1

Principal Researcher Name: Dr Kwang Lim
8. Have you previously submitted an application, whether in NEAF of otherwise, for ethical review of this research project to any other HRECs?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

9. HRECs

<table>
<thead>
<tr>
<th>Research conducted overseas</th>
</tr>
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<tbody>
<tr>
<td>Peer review</td>
</tr>
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</table>

11. Has the research proposal, including design, methodology and evaluation undergone, or will it undergo, a peer review process?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

Provide details of the review and the outcome. A copy of the letter / notification, where available, should be attached to this application.

The research proposal, including design and methodology has undergone peer review as part of the Aged Care Service Improvement and Health Ageing Grant approval. It has also been reviewed by two expert panels of CRGM team members, interRAI Fellows, consulting research investigators, working clinicians, nursing directors and site coordinators.

5. PROJECT

1. Type of Research

Tick as many of the following 'types of research' as apply to this project. Your answers will assist HRECs in considering your proposal. A tick in some of these boxes will generate additional questions relevant to your proposal (mainly because the National Statement requires additional ethical matters to be considered), which will appear in Section 9 of NEAF.

**The project involves:**

- [ ] Research using qualitative methods
- [x] Research using quantitative methods, population level data or databanks, e.g survey research, epidemiological research
- [ ] Clinical research
- [ ] Research involving the collection and / or use of human biospecimens
- [ ] Genetic testing/research
- [ ] A cellular therapy
- [x] Research on workplace practices or possibly impacting on workplace relationships
- [ ] Research conducted overseas involving participants
- [ ] Research involving ionising radiation
Does the research involve limited disclosure to participants?

- [ ] Yes
- [x] No

**Does the research involve:**

- [ ] Opt out approach
- [ ] Waiver
- [x] None of the above

**Research plan**

2. Describe the theoretical, empirical and/or conceptual basis, and background evidence, for the research proposal, eg. previous studies, anecdotal evidence, review of literature, prior observation, laboratory or animal studies.

Geriatric syndromes are common among older patients in acute care. Many of these syndromes are present prior to the current acute illness, others arise in concert with the illness, and yet others occur during the course of the hospital stay. Common syndromes include depression, dementia, immobility, inability to self-care and under-nutrition. Beyond the point of admission, critical events such as delirium, falls and pressure ulcer are common. Good nursing care is critical to providing optimal management of these problems, and to the prevention of them if they are not already present. The nurse admission assessment represents an ideal opportunity to identify the presence of these syndromes, and to identify patients who are at risk of subsequently developing them.

However, our analysis of current nurse administered assessment instruments indicates a patchwork of tools, some derived from single syndrome screeners, and others home grown with unknown reliability and validity. This patchwork results in duplication, poor compliance, and inability to migrate to a digital environment. In turn, this limits integration with other systems, and inability to communicate information to others within and outside the hospital.

A proportion of older patients will, in the course of their hospital stay, require comprehensive geriatric assessment (CGA). Such assessments may result in decisions to transfer the patient to an acute or post-acute specialist geriatric unit, or to a rehabilitation unit, or guide decisions around discharge planning or transfer to a long term care facility. This process requires a specialised multi-disciplinary team, which may not be part of the usual ward staffing. Early identification of such patients should provide more timely assessment and improve the efficiency of transitions to post-acute care and discharge from hospital.

We have, in conjunction with the interRAI collaborative and a panel nursing professionals and clinicians, created a provisional screening instrument that has been designed to act as an early warning and response system for all adult patients who are admitted to acute care. The screener has the following 3 main aims:

a. Determine the immediate nursing care plan (e.g., the person is incontinent)

b. Indicate risk of future adverse events or outcomes where the nursing process has an important preventive function (e.g., the person is at high risk of pressure injury)

c. Suggest the need to engage other specialist providers in the care delivery process (e.g., the person is at risk of requiring long term care at discharge)

We anticipate that an assessment using this provisional screening instrument can be completed in around 20 minutes and that the system itself will be able to integrate case findings and good aged care practice into the program of general care. The result will be a single system that supports a variety of clinical assessments in the most efficient manner possible.

This system, which will form part of a "mini-suite" of assessment systems developed by interRAI to support the care of older people across the continuum of hospital care, now requires real world testing to determine its psychometric properties, alignment with other systems and compatibility with overall medical record development.

3. State the aims of the research and the research question and/or hypotheses, where appropriate.

Aims:

- To test the psychometric properties of the screening assessment instrument in field tests in a variety of acute care settings
### Objectives:
- Put the system through formal field testing through the implementation of three studies:
  1. Face and content validity
  2. Internal consistency of scalar measures and predictive validity of diagnostic and risk screeners
  3. Inter-rater reliability of clinical observations

### 4. Has this project been undertaken previously?
- Yes
- No

### Benefits/Risks
In answering the following questions (Q 5 – 11) please ensure that you address all issues relevant to the type of participants that will be involved in your research project. Refer for guidance to relevant chapters of the National Statement.

### 5. Does the research involve a practice or intervention which is an alternative to a standard practice or intervention?
- Yes
- No

### 7. What expected benefits (if any) will this research have for the wider community?
This current proposal aims to test the psychometric properties of a screening assessment instrument designed to:
1. inform the immediate nursing care plan
2. indicate risk of future adverse events or outcomes where the nursing process has an important preventive function and
3. suggest the need to engage other specialist providers in the care delivery process.
Once tested and validated, we anticipate that this instrument will help improve the hospital care and management system by improving the efficiency of patient transitions to post-acute care and discharge from hospital and reduce patient length of stay, hospital readmissions and the need for long term residential care.
Furthermore, this system is designed to replace the patchwork of assessment instruments currently used, and in doing so will reduce the length of time it takes to complete the initial nurse admission (to around 20 minutes), freeing up more time for hands on patient care; allow the sharing of information between other hospital assessment systems, reducing the need to collect duplicate information by the different disciplines (clinicians, dietitians, physiotherapists etc.), and support the transition to a digital hospital environment.

### 8. What expected benefits (if any) will this research have for participants?
This current proposal is to test the psychometric properties of a screening instrument that is designed to enable the prompt identification and management of functional and psychosocial problems, including geriatric syndromes such as cognitive impairment, under-nutrition, falls and pressure injury as well as the risk of acquiring them in patients admitted to acute care. Once tested and validated, we anticipate that this instrument will improve the care of and outcomes for older adults both in hospital and beyond.

### 9. Are there any risks to participants as a result of participation in this research project?
- Yes
- No

### 10. Explain how the likely benefit of the research justifies the risks of harm or discomfort to participants.
We believe that there is negligible risk of harm or discomfort to participants.

### 11. Are there any other risks involved in this research? eg. to the research team, the organisation, others
- Yes
- No

### 12. Is it anticipated that the research will lead to commercial benefit for the investigator(s) and or the research sponsor
Online Forms

Provision of information to participants about the following topics should be considered as may be relevant to the research

**Research Specific Elements**

17. What mechanisms do the researchers / investigators intend to implement to monitor the conduct and progress of the research project?

All persons involved in data collection at each site will receive appropriate training, guidance and support in relation to the study protocol, correct procedures and conduct of the research project. Regular contact meetings will be held with each site to review conduct and the progression of the research project. Data integrity checks will be carried out by the data management team.

Progress according to agreed timelines will be monitored by the funding body who will be provided with regular reports. Risk management strategies will be implemented.

6. PARTICIPANTS

1. Research participants

The National Statement identifies the need to pay additional attention to ethical issues associated with research involving certain specific populations.

This question aims to assist you and the HREC to identify and address ethical issues that are likely to arise in your research, if its design will include one or more of these populations. Further, the National Statement recognizes the cultural diversity of Australia’s population and the importance of respect for that diversity in the recruitment and involvement of participants. Your answer to this question will guide you to additional questions (if any) relevant to the participants in your study.

Tick as many of the following 'types of research participants' who will be included because of the project design, or their inclusion is possible, given the diversity of Australia’s population. If none apply, please indicate this below.

If you select column (a) or (b), column (c) will not apply.

<table>
<thead>
<tr>
<th>The participants who may be involved in this research are:</th>
<th>a) Primary intent of research</th>
<th>b) Probable coincidental recruitment</th>
<th>c) Design specifically excludes</th>
</tr>
</thead>
<tbody>
<tr>
<td>People whose primary language is other than English (LOTE)</td>
<td>☐</td>
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<tr>
<td>Women who are pregnant and the human fetus</td>
<td>☐</td>
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<tr>
<td>Children and/or young people (ie. &lt;18 years)</td>
<td>☐</td>
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<tr>
<td>People in existing dependent or unequal relationships</td>
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Online Forms

Recruitment

Previous studies, anecdotal evidence, interest in the outcome of the research?

Monitoring

Participants' rights and responsibilities

Consent Form

Deemed reliable until analysis on the entire data set has been carried out and the results published. Therefore, password protected file to the project data manager. The electronic data files will be stored on the University of Computer file PI Assoc/Prof Ruth Hubard

All UR numbers will be deleted. The study ID number will remain, which will allow the research team to identify

If a participant or person on behalf of a participant chooses to withdraw from the research, are there specific

whether or not to participate in, the project.

If an appropriate party cannot be located within a reasonable timeframe to provide consent, the patient will be

If there is no relative or carer, the patient's statutory health attorney will be asked to provide informed consent on

This system, which will form part of a "mini screener.

This screening instrument is designed for the early identification of care needs in adults (defined as 18 years or

This screening instrument is designed to assess all persons entering acute care aged over 18 years of age (including

voluntary and refusal to participate in the research will not affect their treatment or care.

Internal consistency of scalar measures and predictive validity of diagnostic and risk screeners

Critical events such as delirium, falls and pressure ulcer are common.

Study 1 will take place at Princess Alexandra Hospital (QLD) and Northern Hospital (Vic). Ten nurses at each site

Will any of the information be used by the research team be in identified or re

Describe any commercialisation or intellectual property implications of the funding/support arrangement.

Describe what was used to recruit participants.

Anticipated finish date:

Expected number of participants in this group:

Group name for participants in this group:

Will consent for participation in this research be sought from all participants?

Describe the information that will be collected.

Opt out approach

I/we will provide appropriate supervision to the student to ensure that the project is undertaken in accordance

Serious or unexpected adverse effects on participants;

All information is truthful and as complete as possible.

Project Title (in full):

HREC to which this

Describe the role of the principal researcher / investigator in this project.

Dr Peel is a Senior Research Fellow in the Centre for Research in Geriatric Medicine, The University of

Position:

Anticipated start date or date range:

Country:

State:

Mailing Address:

Suburb/Town:

Title:

Expected number of participants in this group:

Group name for participants in this group:

Will individual results be provided

Opt out approach

Confirm

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Group name for participants in this group: Adults 70 years or older
Expected number of participants in this group: 1000
Age range: 70+

Other relevant characteristics of this participant group:
In-patient in an acute care ward
Admitted to the ward within the last 12 hours
For Aboriginal or Torres Strait Island participants, the age range would include people aged 50+
Why are these characteristics relevant to the aims of the project?
The focus of this study is to test the psychometric properties of a screening instrument that is designed to enable
the prompt identification and management of complex problems and geriatric syndromes. It is therefore essential
that we over sample persons aged 70+ to allow us to determine whether the omnibus assessment system is
suitable for this age group.

Group 2

Group name for participants in this group: Adults <70
Expected number of participants in this group: 200 - 500
Age range: >18 - <70

Other relevant characteristics of this participant group:
In-patient in an acute care ward
Admitted to the ward within the last 12 hours
Aboriginal or Torres Strait Island participants, the age range would include people aged <50
Why are these characteristics relevant to the aims of the project?
We will include adult persons aged <70. This will allow us to identify how the instrument performs in this age
group who are likely to have less complex care needs.

Group 3

Group name for participants in this group: Nurse evaluators
Expected number of participants in this group: 20
Age range: >18 years

Other relevant characteristics of this participant group:
General ward nurses from a variety of acute care wards (medical, surgical, orthopaedic) to give feedback on
assessment tool for face and content validity.
Why are these characteristics relevant to the aims of the project?
The tool is designed to be used by general ward nurses.

Your response to question 1 at Section 6 - "Research Participants" indicates that the following participant groups are
excluded from your research. If this is not correct please return to question 1 at Section 6 to amend your answer.

- Children and/or young people (ie. <18 years)

5. Have any particular potential participants or groups of participants been excluded from this research? In answering
this question you need to consider if it would be unjust to exclude these potential participants.

This screening instrument is designed for the early identification of care needs in adults (defined as 18 years or
more) admitted to acute care.

Participant experience

6. Provide a concise detailed description, in not more than 200 words, in terms which are easily understood by the lay
reader of what the participation will involve.

For nurses involved in study 1, participation will involve completing 2 usual care admission assessments and two
assessments using the assessment screener, timing how long it takes to do each assessment and completing an
evaluation form. It is anticipated that the additional assessments will take 15-20 minutes each and the evaluation 5-
10 minutes each.

For study 2, all eligible patients admitted to acute care for treatment will be approached by a nurse assessor.
Patients or substitute decision makers will be asked to give written informed consent for participation, which will
include permission to access their medical record for information pertaining to this hospital episode of care.
informed consent to participate is given, the nurse assessor will meet with the participant to ask questions relating to their health and care needs. This should take about 5 to 10 minutes. Other information about the participant that forms part of the screening assessment will be gleaned from patient observation or medical file notes. Post discharge, a nurse who is part of the research team, will review medical file notes to collect data for validation of the screener. Study 3 will involve the participants being assessed on two separate occasions within a 2 hour time frame by 2 nurses, requiring the patient to experience 2 short interviews (5-10 minutes each).

**Relationship of researchers / investigators to participants**

7. Specify the nature of any existing relationship or one likely to rise during the research, between the potential participants and any member of the research team or an organisation involved in the research.

The nurse researcher who collects data on outcomes from medical file review is blinded to the results of assessment and is not involved in care of the patient. The completion of the assessment will run consecutively and separate to normal clinical practice.

9. Describe what steps, if any, will be taken to ensure that the relationship does not impair participants’ free and voluntary consent and participation in the project.

Potential participants will be advised during the information and consent process that their decision to participate or not participate will not, in any way, influence their hospital treatment or care. The written materials given to potential participants will emphasise the voluntary nature of their participation in the project and that any reluctance to participate will be honoured and will not affect their treatment or care. Potential participants will also be informed that they are free to withdraw from the project at any time and their decision to do so will not affect their treatment or care.

10. Describe what steps, if any, will be taken to ensure that decisions about participation in the research do not impair any existing or foreseeable future relationship between participants and researcher / investigator or organisations.

The identity of patients and non-participants will remain strictly private and confidential and only available to those directly involved in data collection.

11. Will the research impact upon, or change, an existing relationship between participants and researcher / investigator or organisations?

- Yes
- No

**Recruitment**

13. What processes will be used to identify potential participants?

At the beginning of a shift, the nurse assessor will access the electronic hospital record system in acute care to identify eligible participants.

14. Is it proposed to ‘screen’ or assess the suitability of the potential participants for the study?

- Yes
- No

*How will this be done?*

The nurse assessor will access the electronic records for patients which meet the inclusion criteria. If the patient is critically unwell the nurse will seek approval from the treating team prior to approaching the patient.

15. Describe how initial contact will be made with potential participants.

The nurse assessor will approach each individual patient/carer within 12 hours of admission to invite them to participate in the project. Patients who are critically unwell will not be approached without approval of the treating
16. Do you intend to include both males and females in this study?

☐ Yes  ☐ No

What is the expected ratio of males to females that will be recruited into this study and does this ratio accurately reflect the distribution of the disease, issue or condition within the general community?

It is expected that more females than males will be recruited into the study and the likely ratio of females to males will be 3:2. This reflects the longer longevity of females compared to males and the greater likelihood of a female being admitted to hospital than a male.

17. Is an advertisement, e-mail, website, letter or telephone call proposed as the form of initial contact with potential participants?

☐ Yes  ☐ No

18. If it became known that a person was recruited to, participated in, or was excluded from the research, would that knowledge expose the person to any disadvantage or risk?

☐ Yes  ☐ No

Consent process

19. Will consent for participation in this research be sought from all participants?

☐ Yes  ☐ No

Will there be participants who have capacity to give consent for themselves?

☐ Yes  ☐ No

What mechanisms/assessments/tools are to be used, if any, to determine each of these participant's capacity to decide whether or not to participate?

Initially, clinical staff will be asked to identify potential participants and make a clinical judgement about their capacity to understand the project and decide whether or not to participate. Depending on their current stage in the admission process they may also have been screened for cognitive impairment, in this instance the results from the screening will be consulted to make a decision about a patient's capacity.

Are any of the participants children or young people?

☐ Yes  ☐ No

Will there be participants who do not have capacity to give consent for themselves?

☐ Yes  ☐ No

Specify why these participants do not have capacity to give consent for themselves:

A number of the participants will have cognitive impairment or dementia while some may have fluctuating cognitive impairment due to delirium.

By whom will consent for these participants be given?

Where patients are unable to provide informed consent, consent will be sought from a relative or carer or statutory health attorney on their behalf.

On what basis is it believed that these people have legal authority to give consent for these participants?

As per standard hospital practice, the relative/carer accompanying the patient will be asked to provide consent on behalf of the patient, in cases where the patient is unable to do so. Prior to seeking consent from the relative/carer the research nurse will ensure that the person providing consent has legal authority to represent the patient as a secondary decision maker.

If there is no relative or carer, the patient's statutory health attorney will be asked to provide informed consent on behalf of the patient. Based on previous experience, this is likely to be required in only a very small minority of cases. If an appropriate party cannot be located within a reasonable timeframe to provide consent, the patient will be
excluded from the study. The following questions relate to participants who are able to provide consent and also to participants for whom consent may be provided by a person with legal authority to do so. When answering these questions you need to describe any differences in the processes followed, or the documentation used, for different groups of participants in your proposal, e.g. processes and documentation for users of facilities/services will differ from those for providers of those facilities/services. Where your proposal involves participants with an intellectual or mental impairment, or people in dependent relationships, additional questions about their consent appear at section 7 questions 19-20 and questions 15-18 respectively.

Describe the consent process, i.e. how participants or those deciding for them will be informed about, and choose whether or not to participate in, the project. The aims and methods of the project will be fully explained to the patient and/or relative or carer prior to their agreeing to participate in the project. This will be done verbally and via a printed Information Sheet. They will be informed that their participation is voluntary and they may withdraw at any time without prejudice. They will have the opportunity to ask questions about the project and have their questions answered before agreeing to participate. They will also be made fully aware that refusal to participate will not influence their level of care.

If a participant or person on behalf of a participant chooses not to participate, are there specific consequences of which they should be made aware, prior to making this decision? No Might individual participants be identifiable by other members of their group, and if so could this identification could expose them to risks? No

If a participant or person on behalf of a participant chooses to withdraw from the research, are there specific consequences of which they should be made aware, prior to giving consent? No

Specify the nature and value of any proposed incentive/payment (e.g. movie tickets, food vouchers) or reimbursement (e.g. travel expenses) participants. Not applicable

Explain why this offer will not impair the voluntary nature of the consent, whether by participants’ or persons deciding for their behalf. Not applicable

Do you propose to obtain consent from individual participants for your use of their stored data/samples for this research project?

☐ Yes  ☐ No

7. Participants Specific

8. CONFIDENTIALITY/PRIVACY

Answers to the questions in section 8.1 will establish whether an HREC will need to apply guidelines under federal or State/territory privacy legislation in reviewing your application. Answers to questions in the remaining parts of section 8 will show how confidentiality of participants is to be protected in your research.

1. Do privacy guidelines need to be applied in the ethical review of this proposal?

Indicate whether the source of the information about participants which will be used in this research project will involve:

☐ collection directly from the participant

☐ collection from another person about the participant

☐ use or disclosure of information by an agency, authority or organisation other than your organisation

☐ use of information which you or your organisation collected previously for a purpose other than this research project

Information which will be collected for this research project directly from the participant

Describe the information that will be collected directly from participants. Be specific where appropriate. Participants will be observed and asked questions by the nurse assessor who will complete the screening assessment.

This information can include the following:

Name

Basic demographic information (age, gender, ethnicity)
Information which will be collected for this research project from another person about the participant

Describe the information which will be collected from another person about participants. Be specific where appropriate. The information to be collected from the patient, outlined above, will be collected from the patient’s carer or relative if the participant is unable to provide it.

Will consent be sought from participants (or for participants from persons with legal authority) for the collection and use of information about them?

☐ Yes  ☐ No

Indicate the number of databases, from which you will be collecting information, held by any of these categories of agencies.

1a. Indicate the number and identity of agencies, authorities or organisations, which will be using or disclosing information, the names of the databases (where applicable), the data items and their degree of identifiability and, where applicable, the reasons for using identifiable or re-identifiable data.

<table>
<thead>
<tr>
<th>Agency Type</th>
<th>Database Count</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
<td>State/Territory</td>
<td>2</td>
</tr>
<tr>
<td>Private Sector</td>
<td>0</td>
</tr>
</tbody>
</table>

1
Name of agency / organisation: Queensland Health
Online Forms

Reporting individual results to participants and others

Publication of the results of this project?

2. Applicable, the reasons for using identifiable or re-

3. Relevant. Considering your proposal. A tick in some of these

4. Participants Specific

5. PROJECT

Aboriginal and/or Torres Strait Islander

6. Where it is stored securely for a period of 7 years before being disposed of. All data will be stored and disposed of

7. on a group level basis only, i.e. grouping by demographics such as age.

8. All UR numbers will be deleted. The study ID number will remain, which will allow the research team to identify

9. skin conditions

10. Locomotion/walking

11. Vision

12. Self

13. Might individual participants be identifiable by other members of their group, and if so could this identification could

14. If a participant or person on behalf of a participant chooses not to participate, are there specific consequences of

15. By whom will consent for these participants be given?

16. The nurse assessor will approach each individual patient/carer within 12 hours of admission to invite them to

17. The nurse assessor will access the electronic records for patients which meet the inclusion criteria.

18. Patients or substitute decision makers will be asked to give written informed consent for participation, which will

19. evaluation form. It is anticipated that the additional assessments will take 15

20. For nurses involved in study 1, participation will involve completing 2 usual care admission assessments and two

21. *People with cognitive impairment, an intellectual disability or a mental illness.

22. You have indicated that it is probable that

23. Some HRECs may require researchers to provide information additional to that

24. In how many Australian sites, or site types, will the research be conducted?

25. There will be a nominated project manager (Dr Yvonne Hornby

26. Our research nurse (Bonnie Pimm) is the nurse trainer for this project. She will provide up to 2 hours of training

27. The team in the Centre for Research in Geriatric Medicine (CRGM), in conjunction with the interRAI research

28. Supervisor(s) of student(s)

29. List ALL research personnel and others who, for the purposes of this research, will have authority to use or have

30. The information collected by the research team about participants will be in the following form(s).

31. Give reasons why it is necessary to collect information in individually identifiable or re-identifiable form.

32. It will be necessary to collect information in a potentially re-identifiable format so that researchers can link data

33. between the AC screening assessment and medical and administration records both at the time of assessment

34. and 28 day post-discharge follow up.

35. The information collected by the research team about participants will be in the following form(s).

36. Give reasons why it is necessary to collect information in individually identifiable or re-identifiable form.

37. It will be necessary to collect information in a potentially re-identifiable format so that the researchers can link data

38. between the AC screening assessment and medical and administration records both at the time of assessment

39. and 28 day post-discharge follow up.

1c. Will the information to be used in medical research?

1d. Does this application include an attachment relevant to state/territory privacy legislation?
1e. Is the information health information?

- Yes  - No

Using information from participants

2. Describe how information collected about participants will be used in this project.

All consenting cases will be assigned a unique study ID number. This will be an arbitrary number which will not include any characteristics of the person themselves. Nurses at each site will collect and match data based on a patients’ unique hospital reference (UR) number, study ID number and date of birth. Before the data is sent off site all UR numbers will be deleted. The study ID number will remain, which will allow the research team to identify cases anonymously for data analysis purposes, but will not allow researchers to re-identify the patient themselves. Date of birth will remain for use in analysis e.g. to categorise patients by age. Anonymised data will be analysed on a group level basis only i.e. grouping by demographics such as age.

3. Will any of the information be used by the research team be in identified or re-identifiable (coded) form?

- Yes  - No

Indicate whichever of the following applies to this project:

- Information collected, used in, or generated by, this project will not be used for any other purpose.
- Information collected, used in, or generated by, this project will/may be used for another purpose by the researcher for which ethical approval will be sought.
- Information collected, used in, or generated by, this project is intended to be used for establishing a database/data collection/register for future use by the researcher for which ethical approval will be sought.
- Information collected, used in, or generated by, this project will/may be made available to a third party for a subsequent use for which ethical approval will be sought.

4. List ALL research personnel and others who, for the purposes of this research, will have authority to use or have access to the information and describe the nature of the use or access. Examples of others are: student supervisors, research monitors, pharmaceutical company monitors.

The Research Coordinator will have access to identifiable data.
The following research personnel will have access to de-identified data only.
PI Professor Len Gray
PI Assoc/Prof Ruth Hubard
PI Dr Nancye Peel
AI Assoc/Prof Kwang Lim
Dr Yvonne Homby-Turner (project manager/data manager)
Professor Sanjoy Paul (senior statistician)
Mayukh Samanta (statistician)

Storage of information about participants during and after completion of the project

5. In what formats will the information be stored during and after the research project? (eg. paper copy, computer file on floppy disk or CD, audio tape, videotape, film)

- Paper copies
- Computer file

6. Specify the measures to be taken to ensure the security of information from misuse, loss, or unauthorised access while stored during and after the research project? (eg. will identifiers be removed and at what stage? Will the information be physically stored in a locked cabinet?)
Paper records will be stored in a secure location, in a locked filing cabinet, at each hospital site during the period of data collection. Once the project is complete, paper records will be de-identified, scanned and send by email in a password protected file to the project data manager. The electronic data files will be stored on the University of Queensland secure (password protected) hard drive which has restricted access to research team members only. The original de-identified paper records will then be sent by recorded delivery to the project manager in CRGM. The original paper copies will be stored in a secure location, in a locked filing cabinet, for the specified duration.

9. The information which will be stored at the completion of this project is of the following type(s). Tick more than one box if applicable.

- [ ] individually identifiable
- [ ] re-identifiable
- [x] non-identifiable

10. For how long will the information be stored after the completion of the project and why has this period been chosen?

Following the completion of the project paper copies are moved to a University of Queensland data storage facility where it is stored securely for a period of 7 years before being disposed of. All data will be stored and disposed of safely and securely in accordance with the University of Queensland guidelines.

11. What arrangements are in place with regard to the storage of the information collected for, used in, or generated by this project in the event that the principal researcher / investigator ceases to be engaged at the current organisation?

All PIs and the project manager will have access to the paper and electronic data files. In the event that the lead PI becomes no longer engaged with the department other PIs and the PM will still be able to access and manage the data files. A PI will then be nominated as the responsible person in charge of managing the data and ensuring it is disposed of within the specified time frame and in accordance with the University of Queensland guidelines.

Ownership of the information collected during the research project and resulting from the research project

13. Who is understood to own the information resulting from the research, eg. the final report or published form of the results?

The University of Queensland

14. Does the owner of the information or any other party have any right to impose limitations or conditions on the publication of the results of this project?

- [ ] Yes
- [ ] No

Disposal of the information

15. Will the information collected for, used in, or generated by this project be disposed of at some stage?

- [ ] Yes
- [ ] No

At what stage will the information be disposed?
All data will be disposed of after 7 years following completion of this project.

How will information, in all forms, be disposed?
Paper records will be shredded and electronic files deleted.

Reporting individual results to participants and others
16. Is it intended that results of the research that relate to a specific participant be reported to that participant?

- Yes □ No

**Explain/justify why results will not be reported to participants:**
This study is to test and validate a screening instrument. The immediate results this instrument produces will not be deemed reliable until analysis on the entire data set has been carried out and the results published. Therefore, informing the patients of the results is not recommended.

17. Is the research likely to produce information of personal significance to individual participants?

- Yes □ No

18. Will individual participant's results be recorded with their personal records?

- Yes □ No

19. Is it intended that results that relate to a specific participant be reported to anyone other than that participant?

- Yes □ No

20. Is the research likely to reveal a significant risk to the health or well being of persons other than the participant, eg family members, colleagues

- Yes □ No

21. Is there a risk that the dissemination of results could cause harm of any kind to individual participants - whether their physical, psychological, spiritual, emotional, social or financial well-being, or to their employability or professional relationships - or to their communities?

- Yes □ No

22. How is it intended to disseminate the results of the research? eg report, publication, thesis

Results of the research will be disseminated as publications in peer-reviewed journals and presentations at national and international conferences and meetings. Annual reports and final reports on the project will be available to the funding body (The Department of Social Services).

23. Will the confidentiality of participants and their data be protected in the dissemination of research results?

- Yes □ No

**Explain how confidentiality of participants and their data will be protected in the dissemination of research results:**
All disseminated results will contain analysis on groups of participants and will not provide any personally identifiable data.

9. PROJECT SPECIFIC

Your responses to question 5.1 "Type of Research" and question 6.1 "Research participants" indicate that the HREC will require additional information which is specific to your research project. The following table indicates the question sets relating to the project that you will need to complete. If this is not correct please return to question 5.1 and 6.1 at to amend your answer.
9.8 Research on workplace practices or possibly impacting on workplace relationships

You have indicated that the project involves research in the workplace

1. Indicate at whose workplace the research is to be conducted (tick more than open if applicable):
   - One or more of the investigator's
   - Any of the participants'

2. What is the relationship of the researcher / investigator to the workplace, eg. proprietor, student, consultant, employee? Past or present?

3. What is the status in the workplace of all of the proposed participants, eg. Employee, client, consultant?

4. What measures will be taken to minimise the risk to workplace relationships?

10. Declarations And Signatures

Applicant / Principal Researchers (including students where permitted)

<table>
<thead>
<tr>
<th>Project Title (in full):</th>
<th>Early needs assessment of adult patients in acute care: establishment of clinimetric properties of a screening tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>HREC to which this application is made:</td>
<td></td>
</tr>
<tr>
<td>HREC Reference number:</td>
<td>HREC/15/NH/27</td>
</tr>
</tbody>
</table>

I/we certify that:

- All information is truthful and as complete as possible.
- I/we have had access to and read the National Statement on Ethical Conduct in Research Involving Humans.
- The research will be conducted in accordance with the National Statement.
- The research will be conducted in accordance with the ethical and research arrangements of the organisations involved.
- I/we have consulted any relevant legislation and regulations, and the research will be conducted in accordance with these.
- I/we will immediately report to the HREC anything which might warrant review of the ethical approval of the proposal (NS 2.37), including:
  - serious or unexpected adverse effects on participants;
  - proposed changes in the protocol; and
  - unforeseen events that might affect continued ethical acceptability of the project.
- I/we will inform the HREC, giving reasons, if the research project is discontinued before the expected date of
I/we will not continue the research if ethical approval is withdrawn and will comply with any special conditions required by the HREC (NS. 2.45);
I/we will adhere to the conditions of approval stipulated by the HREC and will cooperate with HREC monitoring requirements. At a minimum annual progress reports and a final report will be provided to the HREC.

Applicant / Chief Researcher(s) / Principal Researcher(s)

Professor Leonard C Gray
The University of Queensland
Signature
Date

Professor Leonard C Gray
The University of Queensland
Signature
Date

Associate Professor Ruth E Hubbard
The University of Queensland
Signature
Date

Dr Nancye M Peel
The University of Queensland
Signature
Date

Dr Kwang Lim
Northern Health
Signature
Date

Associate Researchers

Supervisor(s) of student(s)

Project Title (in full): Early needs assessment of adult patients in acute care: establishment of clinimetric properties of a screening tool

HREC to which this application is made:

HREC Reference number: HREC/15/NH/27

I/we certify that:

I/we will provide appropriate supervision to the student to ensure that the project is undertaken in accordance with the undertakings above;
I/we will ensure that training is provided necessary to enable the project to be undertaken skilfully and ethically.

Heads of departments/schools/research organisation

Project Title (in full): Early needs assessment of adult patients in acute care: establishment of clinimetric properties of a screening tool
I/we certify that:

- I/we are familiar with this project and endorse its undertaking;
- the resources required to undertake this project are available;
- the researchers have the skill and expertise to undertake this project appropriately or will undergo appropriate training as specified in this application.

<table>
<thead>
<tr>
<th>Title</th>
<th>First Name</th>
<th>Surname</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Position</td>
<td>Organisation Name</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Signature</th>
<th>Date</th>
</tr>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

11. Attachments

List of Attachments

<table>
<thead>
<tr>
<th>Core Attachments</th>
<th>Attachments which may be required/appropriate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recruitment/invitation</td>
<td>Copy of advertisement, letter of invitation etc</td>
</tr>
<tr>
<td>Participant Information</td>
<td>Copy or script for participant</td>
</tr>
<tr>
<td>Consent Form</td>
<td>Copy or script for parent, legal guardian or person responsible as appropriate</td>
</tr>
<tr>
<td>Peer review</td>
<td>Copy for participant</td>
</tr>
<tr>
<td>HREC approvals</td>
<td>Copy of peer review report or grant submission outcome</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attachments specific to project or participant group</th>
<th>Attachments which may be required/appropriate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research conducted in the workplace or possibly</td>
<td>Evidence of support/permission from workplace where research will be conducted</td>
</tr>
<tr>
<td>possibly impacting on workplace relationships</td>
<td></td>
</tr>
</tbody>
</table>
Core Elements
Provision of information to participants about the following topics should be considered for all research projects.

<table>
<thead>
<tr>
<th>Core Elements</th>
<th>Issues to consider in participant information</th>
</tr>
</thead>
<tbody>
<tr>
<td>About the project</td>
<td>Full title and / or short title of the project</td>
</tr>
<tr>
<td></td>
<td>Plain language description of the project</td>
</tr>
<tr>
<td></td>
<td>Purpose / aim of the project and research methods as appropriate</td>
</tr>
<tr>
<td></td>
<td>Demands, risks, inconveniences, discomorts of participation in the project</td>
</tr>
<tr>
<td></td>
<td>Outcomes and benefits of the project</td>
</tr>
<tr>
<td></td>
<td>Project start, finish, duration</td>
</tr>
<tr>
<td>About the investigators / organisation</td>
<td>Researchers conducting the project (including whether student researchers are involved)</td>
</tr>
<tr>
<td></td>
<td>Organisations which are involved / responsible</td>
</tr>
<tr>
<td></td>
<td>Organisations which have given approvals</td>
</tr>
<tr>
<td></td>
<td>Relationship between researchers and participants and organisations</td>
</tr>
<tr>
<td>Participant description</td>
<td>How and why participants are chosen</td>
</tr>
<tr>
<td></td>
<td>How participants are recruited</td>
</tr>
<tr>
<td></td>
<td>How many participants are to be recruited</td>
</tr>
<tr>
<td>Participant experience</td>
<td>What will happen to the participant, what will they have to do, what will they experience?</td>
</tr>
<tr>
<td></td>
<td>Benefits to individual, community, and contribution to knowledge</td>
</tr>
<tr>
<td></td>
<td>Risks to individual, community</td>
</tr>
<tr>
<td></td>
<td>Consequences of participation</td>
</tr>
<tr>
<td>Participant options</td>
<td>Alternatives to participation</td>
</tr>
<tr>
<td></td>
<td>Whether participation may be for part of project or only for whole of project</td>
</tr>
<tr>
<td></td>
<td>Whether any of the following will be provided: counselling, post research follow-up, or post research access to services, equipment or goods</td>
</tr>
<tr>
<td>Participants rights and responsibilities</td>
<td>That participation is voluntary</td>
</tr>
<tr>
<td></td>
<td>That participants can withdraw, how to withdraw and what consequences may follow</td>
</tr>
<tr>
<td></td>
<td>Expectations on participants, consequences of non-compliance with the protocol</td>
</tr>
<tr>
<td></td>
<td>How to seek more information</td>
</tr>
<tr>
<td></td>
<td>How to raise a concern or make a complaint</td>
</tr>
<tr>
<td>Handling of information</td>
<td>How information will be accessed, collected, used, stored, and to whom data will be disclosed</td>
</tr>
<tr>
<td></td>
<td>Can participants withdraw their information, how, when</td>
</tr>
<tr>
<td></td>
<td>Confidentiality of information</td>
</tr>
<tr>
<td></td>
<td>Ownership of information</td>
</tr>
<tr>
<td></td>
<td>Subsequent use of information</td>
</tr>
<tr>
<td></td>
<td>Storage and disposal of information</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Unlawful conduct</th>
<th>Whether researcher has any obligations to report unlawful conduct of participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial issues</td>
<td>How the project is funded</td>
</tr>
<tr>
<td></td>
<td>Declaration of any duality of interests</td>
</tr>
<tr>
<td></td>
<td>Compensation entitlements</td>
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<td></td>
<td>Costs to participants</td>
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<tr>
<td></td>
<td>Payments, reimbursements to participants</td>
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<tr>
<td></td>
<td>Commercial application of results</td>
</tr>
<tr>
<td>Results</td>
<td>What will participants be told, when and by whom</td>
</tr>
<tr>
<td></td>
<td>Will individual results be provided</td>
</tr>
<tr>
<td></td>
<td>What are the consequences of being told or not being told the results of research</td>
</tr>
<tr>
<td></td>
<td>How will results be reported / published</td>
</tr>
<tr>
<td></td>
<td>Ownership of intellectual property and commercial benefits</td>
</tr>
<tr>
<td>Cessation</td>
<td>Circumstances under which the participation of an individual might cease</td>
</tr>
<tr>
<td></td>
<td>Circumstances under which the project might be terminated</td>
</tr>
</tbody>
</table>

**Research Specific Elements**

*Provision of information to participants about the following topics should be considered as may be relevant to the research project.*

<table>
<thead>
<tr>
<th>Specific to project or participant group</th>
<th>Additional issues to consider in participant information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research conducted in the workplace or possibly impacting on workplace relationships</td>
<td>Whether employee performance will be measured</td>
</tr>
<tr>
<td>Aboriginal and/or Torres Strait Islander peoples</td>
<td>Whether results (identified or aggregate) will be provided to employer</td>
</tr>
<tr>
<td></td>
<td>Describe consultation process to date and involvement of leaderswhether ATSI status will be recorded</td>
</tr>
</tbody>
</table>
Appendix 8: Austin High Risk Ethics Approval HREC/16/Austin/180

AUSTIN HEALTH HUMAN RESEARCH ETHICS COMMITTEE

ETHICAL APPROVAL FOR NEW STUDY

Professor David Story
Department of Anaesthesia
Austin Health

28 July 2016

Dear Professor Story

AU RED HREC Reference Number: HREC/16/Austin/180

Austin Health Project Number: ND 16/180

Project Title: The impact of health assets on outcomes for hospitalised older adults: Validation of a health assets index.

I am pleased to advise that the above project has received ethical approval from the Austin Health Human Research Ethics Committee (HREC). This HREC is organised and operates in accordance with the National Health and Medical Research Council’s (NHRC) National Statement on Ethical Conduct in Research Involving Humans (2007), and all subsequent updates, and in accordance with the Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95), the Health Privacy Principles described in the Health Records Act 2001 (Vic) and Section 95A of the Privacy Act 1988 (and subsequent Guidelines).

HREC Approval Date: 28/07/2016

Participating Sites:

Ethical approval for this project applies at the following sites:

<table>
<thead>
<tr>
<th>Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austin Health</td>
</tr>
<tr>
<td>Northern Health</td>
</tr>
<tr>
<td>Metro South Health - Princess Alexandra Hospital</td>
</tr>
</tbody>
</table>
Approved Documents:

The following documents have been reviewed and approved:

<table>
<thead>
<tr>
<th>Document</th>
<th>Version</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEAF (AU/1/B7C7216)</td>
<td></td>
<td>28/07/2016</td>
</tr>
<tr>
<td>VSM</td>
<td>2</td>
<td>04/05/2016</td>
</tr>
<tr>
<td>Protocol</td>
<td>3</td>
<td>27/07/2016</td>
</tr>
<tr>
<td>Master Participant Information and Consent Form</td>
<td></td>
<td>27/07/2016</td>
</tr>
<tr>
<td>Master Person Responsible Information and Consent Form</td>
<td>3</td>
<td>27/07/2016</td>
</tr>
<tr>
<td>Frailty Index</td>
<td>1</td>
<td>04/05/2016</td>
</tr>
<tr>
<td>Health Assets Index</td>
<td></td>
<td>04/05/2016</td>
</tr>
<tr>
<td>Katz ADLs</td>
<td>2</td>
<td>31/05/2016</td>
</tr>
</tbody>
</table>

Site Specific Assessment:

SSA Authorisation is required at all sites participating in the study. SSA must be authorised at a site before the research project can commence.

The completed Site-Specific Assessment Form and a copy of this ethics approval must be submitted to the Research Governance Office in order to obtain authorisation to commence your project. It is recommended that you check details of governance application submission requirements with each participating site.

Conditions of Ethics Approval:

- You are required to submit to the HREC:
  - An Annual Progress Report (that covers all sites listed on approval) for the duration of the project. This report is due on the anniversary of HREC approval. Continuation of ethics approval is contingent on submission of an annual report, due within one month of the approval anniversary. Failure to comply with this requirement may result in suspension of the project by the HREC.
  - A comprehensive Final Report upon completion of the project.
  - Submit to the reviewing HREC for approval any proposed amendments to the project including any proposed changes to the Protocol, Participant Information and Consent Form/s and the Investigator Brochure.
  - Notify the reviewing HREC of any adverse events that have a material impact on the conduct of the research in accordance with the NHMRC Position Statement: *Monitoring and reporting of safety for clinical trials involving therapeutic products May 2009*.
  - Notify the reviewing HREC of your inability to continue as Coordinating Principal Investigator.
  - Notify the reviewing HREC of the failure to commence the study within 12 months of the HREC approval date or if a decision is taken to end the study at any of the sites prior to the expected date of completion.
  - Notify the reviewing HREC of any matters which may impact the conduct of the project.
- **If your project involves radiation:**
  - It is your responsibility to ensure the research is added to the site Management Licence issued by Department of Human Services –
Radiation Safety Section prior to study commencement should it be required (check your Medical Physicist Report). The site RGO must be notified when the research has been added to the licence.

- You are legally obliged to conduct your research in accordance with the Australian Radiation Protection and Nuclear Safety Agency Code of Practice ‘Exposure of Humans to Ionizing Radiation for Research Purposes’ Radiation Protection series Publication No.8 (May 2005)(ARPANSA Code).

The HREC may conduct an audit of the project at any time.

Yours sincerely
Appendix 9: Participant Information Sheet/Consent Form – Person Responsible
1. Introduction
The participant is invited to take part in this research project: The impact of health assets on outcomes for hospitalised older adults: Development and validation of a health assets index. The aim of this project is to determine whether health assets, which are resources that individuals have which are associated with good health, can lead to better outcomes for hospitalised older adults. All patients aged 70 and over who are admitted to participating hospital wards are eligible to take part. If the participant is unable to provide consent for themselves an ‘authorised substitute decision maker’ is eligible on their behalf.

This Participant Information Sheet/Consent Form tells you about the research project. It explains the tests and research involved. Knowing what is involved will help you decide if you want the participant to take part in the research.

Please read this information carefully. Ask questions about anything that you don't understand or want to know more about. Before deciding whether or not the participant can take part, you might want to talk about it with a relative, friend or local doctor.

Participation in this research is voluntary. If you do not wish for the participant to take part, they do not have to. They will receive the best possible care whether or not they take part.

If you decide you want the participant to take part in the research project, you will be asked to sign the consent section. By signing it you are telling us that you:
• Understand what you have read
• Consent to the participant taking part in the research project
• Consent to the participant having the tests and research that are described
• Consent to the use of the participant’s personal and health information as described.

You will be given a copy of this Participant Information and Consent Form to keep.

2. What is the purpose of this research?
Some older adults recover better than others from a hospital admission. We know about some of the risk factors for a poor recovery, like being more frail. Even with these risks, some older adults will recover well from the illness and hospitalisation. This project seeks to examine factors that are associated with making a good recovery after being admitted to hospital. In order to do this, we have created a questionnaire that measures health assets (the HAI). Information from this questionnaire will be examined with outcomes, such as mortality, ability to carry out day-to-day tasks and length of stay to determine whether there is an association with health assets and improved outcomes.

The results of this research will be used by one of the researchers, Dr Kate Gregorevic, as part of her PhD.

This research has been initiated by Dr Kate Gregorevic.

3. What will participation involve?

Participation in this research will involve a researcher meeting with you and the participant for 20-30 minutes to ask a few questions while the participant is in hospital. The researcher will also record some information based on their observations and the information in their medical file. This research will NOT have an impact on the participant’s routine care.

After the participant is discharged a researcher will read their file and record some further information about them. For example, how long they stayed, and where they went after discharge. The researcher may contact you at approximately 30 days after discharge to answer some follow-up questions. These questions will be related to the ability to perform day-to-day activities, like shopping and household chores. You will be contacted by phone again 12 months after discharge and asked the same questions regarding day-to-day activities.

4. Participation is voluntary

Participation in any research project is voluntary. If you do not wish to take part, you do not have to. We know that right now the participant probably feels unwell, and may not feel much like participating in this research. However, it is important that we can gain a better understanding of factors that can improve outcomes for people when they are sick in hospital. It is therefore important that we include people who are unwell. This process is very brief and will only require 20-30 minutes of conversation, at the most. The follow-up phone calls will only take approximately 5 minutes of your time.

Any information about the participant will be treated with great respect and privacy. If you decide that they can take part, but later change your mind, you are free to withdraw them from the project at any stage.

Furthermore, a decision not to participate will NOT affect your routine care in any way or any relationships with staff members at The Austin Hospital.

If you do decide to take part, you will be given this information sheet and asked to sign a consent form.
This research project has been designed to make sure the researchers interpret the results in a fair and appropriate way and avoids study doctors or participants jumping to conclusions.

There are no costs associated with participating in this research project, nor will you or the participant be paid.

This is a multi-site trial, meaning that patients will be recruited from multiple hospitals. Overall, around 350 people will be recruited. There are researchers working from a number of organisations including the University of Melbourne and the University of Queensland.  

5. Does the participant have to take part in this research project?  
Participation in any research project is voluntary. If you do not wish for the participant to take part, they do not have to. If you decide that they can take part and later change your mind, you are free to withdraw them from the project at any stage.

If you do decide that the participant can take part, you will be given this Participant Information and Consent Form to sign and you will be given a copy to keep.

Your decision whether the participant can or cannot take part, or take part and then be withdrawn, will not affect their routine treatment, relationship with those treating them or relationship with the Austin Hospital.

6. What are the alternatives to participation?  
The participant does not have to take part in this research project to receive treatment at this hospital. If the participant chooses not to take part, this will have no impact on care.

7. What are the possible benefits of taking part?  
Participation in the study will not result in any benefit to the patient in the short-term. It is, however, hoped that this study will assist us to improve future quality of care provided to people in hospital and hence, so there may be some longer-term benefit.

8. What are the possible risks and disadvantages of taking part?  
Participation in the trial will not alter medical treatment in any way. It may be inconvenient to spend some the time answering questions.

**Psychological Stress** – You may feel that some of the questions we ask are stressful or upsetting to either the patient or yourself. If you/the participant does not wish to answer a question it may be skipped or the questionnaire can be stopped immediately if the questioning becomes too much. If the participant becomes upset or distressed as a result of their participation in the research project, the research team will be able to arrange for counselling or other appropriate support. Any counselling or support will be provided by qualified staff who are not members of the research team. This counselling will be provided free of charge.

10. What if the participant is withdrawn from this research project?  
If you decide to withdraw the participant from this research project, please notify a member of the research team before withdrawal. If you do withdraw consent during the research project, the study doctor and relevant study staff will not collect additional personal information from the participant, although personal information already collected will be retained to ensure that the results of the research project can be measured properly and to comply with law. You should be aware that data collected up to the time the participant withdraws will form part of the research project results. If you do not want them to do this, you must tell them before the participant joins the research project.
11. What will happen to information about the participant?
By signing the consent form you consent to the study doctor and relevant research staff collecting and using personal information about the participant for the research project. Any information obtained in connection with this research project that can identify the participant will remain confidential. Each participant will be given a unique code and the data will be de-identified. All collected information will be stored securely. Potentially identifiable information will be kept until all data have been collected and linked. At this point identifiable data will be deleted and participants will be assigned a unique project ID code.

The results from this study may be disseminated through journal publications and conferences. However, none of this information will be personally identifiable.

Hard copies of data will be stored for up to 7 years and then disposed of securely in accordance with Austin Hospital strict procedure. Secondary data analysis may take place while data is in storage. This may include subgroup analysis and examination of specific factors such as frailty. Electronic data will be stored on a secure server and will be accessible by username and password by key members of the research team only.

Information about the participant may be obtained from their health records held at this and other health services, for the purpose of this research. By signing the consent form you agree to the research team accessing health records if they are relevant to participation in this research project.

Any information obtained for the purpose of this research project that can identify the participant will be treated as confidential and securely stored. It will be disclosed only with your permission, or as required by law.

11. Complaints and compensation
If the participant suffers any injuries or complications as a result of this research project, you should contact the study team as soon as possible and you will be assisted with arranging appropriate medical treatment. If the participant is eligible for Medicare, they can receive any medical treatment required to treat the injury or complication, free of charge, as a public patient in any Australian public hospital.

12. Who is organising and funding the research?
The project is being conducted by researchers from the Northern Hospital, Austin Hospital and the University of Queensland. Associate Professor Kwang Lim, Associate Professor Ruth Hubbard, Dr Nancye Peel and Prof David Story are the principal investigators. Dr Kate Gregorevic, Dr Christine Mandrawa and Dr Wei-Tong Lau are associate investigators. This research is being conducted as part of Dr Kate Gregorevic’s PhD. Dr Gregorevic receives PhD scholarships from the Australian Postgraduate Association and the Northern Hospital Foundation.

14. Who has reviewed the research project?
All research in Australia involving humans is reviewed by an independent group of people called a Human Research Ethics Committee (HREC). The ethical aspects of this research project have been approved by the HREC of Austin Health. This project will be carried out according to the National Statement on Ethical Conduct in Human Research (2007). This statement has been developed to protect the interests of people who agree to participate in human research studies.

14. Further information and who to contact
The person you may need to contact will depend on the nature of your query. If you want any further information concerning this project or if the participant has any medical problems which may be related to involvement in the project, you can contact the principal study doctor on 03 9496 2489 or any of the following people:

### Clinical contact person

<table>
<thead>
<tr>
<th>Name</th>
<th>Dr Kate Gregorevic</th>
</tr>
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<tbody>
<tr>
<td>Position</td>
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If you have any complaints about any aspect of the project, the way it is being conducted or any questions about being a research participant in general, then you may contact:

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<th>Name</th>
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### Reviewing HREC approving this research and HREC Executive Officer details

<table>
<thead>
<tr>
<th>Reviewing HREC name</th>
<th>Austin Health</th>
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<tbody>
<tr>
<td>HREC Executive Officer</td>
<td>[Name]</td>
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<td>Telephone</td>
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<td>Email</td>
<td>[HREC Executive Officer Email address]</td>
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### Local HREC Office contact (Single Site - Research Governance Officer)

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<td>Email</td>
<td>[Email address]</td>
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**Consent Form – Person Responsible**

**Title**

The impact of health assets on outcomes for hospitalised older adults: Validation of a health assets index.

**Short Title**

Validation of a health assets index for hospitalised older adults
Declaration by Person Responsible

I have read the Participant Information Sheet or someone has read it to me in a language that I understand.

I understand the purposes, procedures and risks of the research described in the project.

I have had an opportunity to ask questions and I am satisfied with the answers I have received.

I freely agree to the participant taking part in this research project as described and understand that I am free to withdraw them at any time during the project without affecting their future health care.

I understand that I will be given a signed copy of this document to keep.

Name of Participant (please print) ________________________________

Name of Person Responsible (please print) __________________________

Relationship of Person Responsible to Participant ____________________

Signature of Person Responsible __________________________ Date ______

Name of Witness* to Person Responsible's Signature (please print) __________

Signature __________________________ Date __________

* Witness is not to be the investigator, a member of the study team or their delegate. In the event that an interpreter is used, the interpreter may not act as a witness to the consent process. Witness must be 18 years or older.

Declaration by Study Doctor/Senior Researcher†

I have given a verbal explanation of the research project, its procedures and risks and I believe that the person responsible for the participant has understood that explanation.

Name of Study Doctor/Senior Researcher† (please print) _______________________

Signature __________________________ Date __________

† A senior member of the research team must provide the explanation of, and information concerning, the research project.

Note: All parties signing the consent section must date their own signature
Appendix 10: Participant Information Sheet/Consent Form – Adult Providing own consent
Participant Information Sheet/Consent Form  
Non-Interventional Study - Adult providing own consent  
[insert site name]

Title
The impact of health assets on outcomes for hospitalised older adults: Validation of a health assets index.

Short Title
Validation of a health assets index for hospitalised older adults

Protocol Number
HREC/16/Austin/180

Project Sponsor
Not applicable

Coordinating Principal Investigator/Principal Investigator
[insert name/s]

Associate Investigator(s)
[insert name/s]

Location
[insert site name]

1. Introduction
You are invited to take part in this research project: The impact of health assets on outcomes for hospitalised older adults: Development and validation of a health assets index. The aim of this project is to determine whether health assets, which are resources that individuals have associated with good health, can lead to better outcomes for hospitalised older adults. All patients aged 70 and over who are admitted to participating hospital wards are eligible to take part.

This Participant Information Sheet/Consent Form tells you about the research project. It explains the tests and research involved. Knowing what is involved will help you decide if you want to take part in the research.

Please read this information carefully. Ask questions about anything that you don’t understand or want to know more about. Before deciding whether or you want to take part, you might want to talk about it with a relative, friend or local doctor.

Participation in this research is voluntary. If you do not wish to take part, you do not have to. You will receive the best possible care whether or not they take part.

If you decide you want the participant to take part in the research project, you will be asked to sign the consent section. By signing it you are telling us that you:

• Understand what you have read
• Consent to taking part in the research project
• Consent to having the tests and research that are described
• Consent to the use of your personal and health information as described.

You will be given a copy of this Participant Information and Consent Form to keep.
2. What is the purpose of this research?

Some older adults recover better than others from a hospital admission. We know about some of the risk factors for a poor recovery, like being more frail. Even with these risks, some older adults will recover well from the illness and hospitalisation. This project seeks to examine factors that are associated with making a good recovery after being admitted to hospital. In order to do this, we have created a questionnaire that measures health assets (the HAI). Information from this questionnaire will be examined with outcomes, such as mortality, ability to carry out day-to-day tasks and length of stay to determine whether there is an association with health assets and improved outcomes.

The results of this research will be used by the study doctor Dr Kate Gregorevic as part of her PhD.

This research has been initiated by Dr Kate Gregorevic.

3. What will participation involve?

Participation in this research will involve a researcher meeting with you for 20-30 minutes to ask a few questions while you are in hospital. The researcher will also record some information based on their observations and the information in your medical file. This research will NOT have an impact on your routine care.

After you are discharged a researcher will read your file and record some further information. For example, how long you stayed, and where you went after discharge. The researcher may contact you by phone at approximately 30 days after discharge to answer some follow-up questions. If you would prefer, you can nominate someone to answer these questions over the phone on your behalf. These questions will be related to the ability to perform day-to-day activities, like shopping and household chores.

4. Participation is voluntary

Participation in any research project is voluntary. If you do not wish to take part, you do not have to. We know that right now you probably feel unwell, and may not feel much like participating in this research. However, it is important that we can gain a better understanding of factors that can improve outcomes for people when they are sick in hospital. It is therefore important that we include people who are unwell. This process is very brief and will only require 20-30 minutes of conversation, at the most.

Any information about you will be treated with great respect and privacy. If you decide to take part, but later change your mind, you are free to withdraw from the project at any stage.

Furthermore, a decision not to participate will NOT affect your routine care in any way or any relationships with staff members at [insert site name].

If you do decide to take part, you will be given this information sheet and asked to sign a consent form.

This research project has been designed to make sure the researchers interpret the results in a fair and appropriate way and avoids study doctors or participants jumping to conclusions.
There are no costs associated with participating in this research project, nor will you be paid.

This is a multi-site trial, meaning that patients will be recruited from multiple hospitals. Overall, around 380 people will be recruited. There are researchers working from a number of organisations including the University of Melbourne and the University of Queensland.

5. Do I have to take part in this research project?
Participation in any research project is voluntary. If you do not wish to take part, you do not have to. If you decide that to take part and later change your mind, you are free to withdraw from the project at any stage.

If you do decide to take part, you will be given this Participant Information and Consent Form to sign and you will be given a copy to keep. Whether you decide to take part of not, or take part and then be withdrawn, will not affect your routine treatment, relationship with the treating team or relationship with the Austin Hospital.

6. What are the alternatives to participation?
You do not have to take part in this research project to receive treatment at this hospital. If you choose not to take part, this will have no impact on care.

7. What are the possible benefits of taking part?
Participation in the study will not result in any benefit in the short-term. It is, however, hoped that this study will assist us to improve future quality of care provided to people in hospital and hence, so there may be some longer-term benefit.

8. What are the possible risks and disadvantages of taking part?
Participation in the trial will not alter medical treatment in any way. It may be inconvenient to spend some the time answering questions.

Psychological Stress – You may feel that some of the questions we ask are stressful or upsetting. If you do not wish to answer a question it may be skipped or the questionnaire can be stopped immediately if the questioning becomes too much. If the you become upset or distressed as a result of participation in the research project, the research team will be able to arrange for counselling or other appropriate support. Any counselling or support will be provided by qualified staff who are not members of the research team. This counselling will be provided free of charge.

9. What if I decide to withdraw from this research project?
If you decide to withdraw from this research project, please notify a member of the research team before withdrawal. If you do withdraw consent during the research project, the researchers and relevant study staff will not collect additional personal information from you, although personal information already collected will be retained to ensure that the results of the research project can be measured properly and to comply with law. You should be aware that data collected up to the time the participant withdraws will form part of the research project results. If you do not want them to do this, you must tell them before the participant joins the research project.

10. What will happen to information about you?
By signing the consent form you consent to the study doctor and relevant research staff collecting and using personal information about you for the research project. Any
information obtained in connection with this research project that can identify the participant will remain confidential. Each participant will be given a unique code and the data will be de-identified. All collected information will be stored securely. Potentially identifiable information will be kept until all data have been collected and linked. At this point identifiable data will be deleted and participants will be assigned a unique project ID code.

The results from this study may be disseminated through journal publications and conferences. However, none of this information will be personally identifiable.

Hard copies of data will be stored for up to 7 years and then disposed of securely in accordance with Austin Health strict procedure. Secondary data analysis may take place while data is in storage. This may include subgroup analysis and examination of specific factors such as frailty. Electronic data will be stored on a secure server and will be accessible by username and password by key members of the research team only.

Information about you may be obtained from their health records held at this and other health services, for the purpose of this research. By signing the consent form you agree to the research team accessing health records if they are relevant to participation in this research project.

Any information obtained for the purpose of this research project that can identify the participant will be treated as confidential and securely stored. It will be disclosed only with your permission, or as required by law.

11. Complaints and compensation
If you suffer any injuries or complications as a result of this research project, you should contact the study team as soon as possible and you will be assisted with arranging appropriate medical treatment. If you are eligible for Medicare, they can receive any medical treatment required to treat the injury or complication, free of charge, as a public patient in any Australian public hospital.

12. Who is organising and funding the research?
The project is being conducted by researchers from the Northern Hospital, Austin Health and the University of Queensland. Associate Professor Kwang Lim, Associate Professor Ruth Hubbard, Dr Nancye Peel and Prof David Story are the principal investigators. Dr Kate Gregorevic, Dr Christine Mandrawa and Dr Wei-Tong Lau are associate investigators. This research is being conducted as part of Dr Kate Gregorevic’s PhD. Dr Gregorevic receives PhD scholarships from the Australian Postgraduate Association and the Northern Hospital Foundation.

13. Who has reviewed the research project?
All research in Australia involving humans is reviewed by an independent group of people called a Human Research Ethics Committee (HREC). The ethical aspects of this research project have been approved by the HREC of Austin Health. This project will be carried out according to the National Statement on Ethical Conduct in Human Research (2007). This statement has been developed to protect the interests of people who agree to participate in human research studies.
14. Further information and who to contact
The person you may need to contact will depend on the nature of your query. If you want any further information concerning this project or if the participant has any medical problems which may be related to involvement in the project, you can contact the principal study doctor on 03 9496 2489 or any of the following people:

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If you have any complaints about any aspect of the project, the way it is being conducted or any questions about being a research participant in general, then you may contact:

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**Reviewing HREC approving this research and HREC Executive Officer details**

<table>
<thead>
<tr>
<th>Reviewing HREC name</th>
<th>Austin Health Human Research Ethics Committee</th>
<th>Austin Health Human Research Ethics Committee</th>
</tr>
</thead>
<tbody>
<tr>
<td>HREC Executive Officer</td>
<td>Dr Sianna Panagiotopoulos</td>
<td>Dr Sianna Panagiotopoulos</td>
</tr>
<tr>
<td>Telephone</td>
<td>03 9496 4090</td>
<td>03 9496 4090</td>
</tr>
<tr>
<td>Email</td>
<td><a href="mailto:ethics@austin.org.au">ethics@austin.org.au</a></td>
<td><a href="mailto:ethics@austin.org.au">ethics@austin.org.au</a></td>
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</tbody>
</table>
Consent Form - Adult providing own consent

Title
The impact of health assets on outcomes for hospitalised older adults: Validation of a health assets index.

Short Title
Validation of a health assets index for hospitalised older adults

Protocol Number
HREC/16/Austin/180

Project Sponsor
Not applicable

Coordinating Principal Investigator/Principal Investigator

Associate Investigator(s)

Location
[Location where the research will be conducted]

Declaration by Participant
I have read the Participant Information Sheet or someone has read it to me in a language that I understand.
I understand the purposes, procedures and risks of the research described in the project.
I have had an opportunity to ask questions and I am satisfied with the answers I have received.
I freely agree to participate in this research project as described and understand that I am free to withdraw at any time during the project without affecting my future health care.
I understand that I will be given a signed copy of this document to keep.

Name of Participant (please print) ____________________________________________
Signature __________________________ Date __________________________

Name of Witness* to Participant’s Signature (please print) ____________________________________________
Signature __________________________ Date __________________________

* Witness is not to be the investigator, a member of the study team or their delegate. In the event that an interpreter is used, the interpreter may not act as a witness to the consent process. Witness must be 18 years or older.

Declaration by Study Doctor/Senior Researcher†
I have given a verbal explanation of the research project, its procedures and risks and I believe that the participant has understood that explanation.

Name of Study Doctor/Senior Researcher† (please print) ____________________________________________
Signature __________________________ Date __________________________

† A senior member of the research team must provide the explanation of, and information concerning, the research project.

Note: All parties signing the consent section must date their own signature.
Form for Withdrawal of Participation - Adult providing own consent

It is recommended that this form NOT be included as part of the PICF itself, but that it be developed at the same time and made available to researchers for later use, if necessary.

Title [Project Title]
Short Title [Short Project Title]
Protocol Number [Protocol Number]
Project Sponsor [Project Sponsor in Australia]
Coordinating Principal Investigator/Principal Investigator [Coordinating Principal Investigator/Principal Investigator]
Associate Investigator(s) [Associate Investigator(s)]
Location (where CPI/PI will recruit) [Location where the research will be conducted]

Declaration by Participant

I wish to withdraw from participation in the above research project and understand that such withdrawal will not affect my routine treatment, my relationship with those treating me or my relationship with [Institution].

Name of Participant (please print) ____________________________________________
Signature ___________________________ Date _____________________

In the event that the participant’s decision to withdraw is communicated verbally, the Study Doctor/Senior Researcher will need to provide a description of the circumstances below.

Declaration by Study Doctor/Senior Researcher†

I have given a verbal explanation of the implications of withdrawal from the research project and I believe that the participant has understood that explanation.

Name of Study Doctor/Senior Researcher† (please print) ________________________________
Signature ___________________________ Date _____________________

† A senior member of the research team must provide the explanation of and information concerning withdrawal from the research project.

Note: All parties signing the consent section must date their own signature.
Appendix 11: Are Health Assets Associated with Improved Outcomes for Hospitalized Older Adults? A Systematic Review.
Review

Are health assets associated with improved outcomes for hospitalised older adults? A systematic review

Kate J. Gregorevic\textsuperscript{a, c, *}, Wen Kwang Lim\textsuperscript{a}, Nancye M. Peel\textsuperscript{b}, Ruth S. Martin\textsuperscript{a}, Ruth E. Hubbard\textsuperscript{b}

\textsuperscript{a} Northern Hospital, 185 Cooper St., Epping, Victoria 3076, Australia
\textsuperscript{b} Centre for Research in Geriatric Medicine, School of Medicine, The University of Queensland, Level 2, Building 33, Princess Alexandra Hospital, 199 Ipswich Road, Woolloongabba, Brisbane, Queensland 4102, Australia
\textsuperscript{c} NorthWest Academic Centre, Department of Medicine, University of Melbourne, 185 Cooper St., Epping, Victoria 3076, Australia

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Healthy aging

\textbf{ABSTRACT}

\textbf{Objective:} Health assets are protective factors that support health and wellbeing, rather than risk factors that are associated with disease. This concept was developed in the community setting. In hospitalised older adults, the dominant approach has been to identify risk factors, with little examination of health assets. The purpose of this systematic review was to determine whether, in hospitalised older people, individual health assets decrease the risk of post hospital mortality, functional decline, new need for residential care, readmission or longer length of stay.

\textbf{Methods:} MEDLINE, EMBASE, CINAHL and PsycINFO were searched to identify studies examining outcomes for hospitalised older adults. Included studies examined at least one potential individual health asset, which was a psychosocial characteristic or health characteristic. Study quality was assessed, and findings are narratively described.

\textbf{Results:} Nine prospective cohort and two retrospective cohort studies were identified. Subjective, functional and biological health assets were identified. Health assets were associated with decreased risk of post-hospital mortality, functional decline, new need for residential care and readmission.

\textbf{Conclusion:} The complex interplay between health status and psychological and social factors is incompletely understood. Health assets are associated with improved outcomes for hospitalised older adults. The small number of studies suitable for inclusion indicates the need for further research in this area.

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\textsuperscript{*} Corresponding author at: Department of Aged Care, Northern Hospital, 185 Cooper St., Epping, Victoria 3076, Australia.
\textsuperscript{1} The first author (KG) is supported by PhD scholarships from the Northern Hospital and the Australian Postgraduate Association through the University of Melbourne.

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0167-4843 © 2016 Elsevier Ireland Ltd. All rights reserved.
1. Background

Hospitalisation is a sentinel life event for many older adults. In addition to the risk of death, around 30–40% of older adults will leave hospital with a new, often persistent, disability leaving them reliant on family or needing formal care (Boyd et al., 2008; Covinsky, Pierluissi, & Johnston, 2011). Although disability can occur insidiously in community dwelling older people, the incidence of onset increases markedly with hospitalisation (Gill, Allore, Holford, & Guo, 2004). Older adults are also at increased risk for longer lengths of stay and readmission (Evans, Sayers, Mitnitski, & Rockwood, 2014).

Pre-existing dependence in activities of daily living, malnutrition, depression and impaired cognition (Vaccarino, Kasl, Abramson, & Krumholz, 2001) are well established as risk factors for poor recovery from unplanned hospitalisation (Thomas, Cooney, & Fried, 2013). A higher level of frailty is predictive of increased risk of mortality, functional decline and increased length of stay for hospitalised older adults (Evans et al., 2014; Gill, Allore, Gahbauer, & Murphy, 2010; Gill et al., 2004).

Only including factors with negative associations does not explain why some frail older adults recover well following hospitalisation. An individuals’ health status is also determined by resources they have at their disposal, which protect against negative health outcomes and promote wellness. ‘Salutogenesis’ describes an approach focusing on factors that support well-being and health rather than factors that cause disease (Lindstroem & Eriksson, 2013). Inclusion of health assets in a model of illness and health allows operationalisation of the concept of salutogenesis. Health assets are determining factors that predict health and illness over and above conventional risk factors (Asset Based, 2011). They can be biological, subjective or functional (Seligman et al., 2013). A biological asset is an objectively measured health characteristic, such as a favourable blood lipid profile. Subjective health assets include psychological state and positive emotions. A functional health asset relates to the ability to undertake community and social participation and includes physical function and adequate finances (Seligman et al., 2013). Health assets have primarily been examined in the community setting. Potential assets in this setting are cardiorespiratory fitness, a stable marriage, positive emotions and social participation (Seligman et al., 2013).

Community studies have demonstrated that positive health factors can mitigate the consequences of frailty i.e. individuals with comparable frailty status have reduced mortality if they have a higher number of assets (Wang et al., 2014). An asset model is more empowering to individuals, as it encourages resilience and empowers people to be active participants in their own wellbeing.

The purpose of this systematic review was to determine whether individual health assets also improve outcomes in the acute hospital setting. The outcomes examined were post-hospital mortality, functional decline in activities of daily living, new need for residential care, readmission and length of stay.

2. Methods

2.1. Search strategy

A search of MEDLINE, EMBASE, CINAHL and PsycINFO was conducted in February 2015. The MEDLINE search used a combination of Medical Subject Heading (MeSH) terms and keywords. Modified forms of the same terms were used for PsycINFO, EMBASE and CINAHL. Results were limited to articles published from 1990 onwards; English language, aged 65 and older and human subjects. Search terms were used to identify hospital inpatients, outcomes of interest, and studies looking at health determinants. These searches were then combined with the Boolean operator AND. A PubMed search was also conducted using keywords to identify any articles that had been published in the preceding two months and had not yet been assigned MeSH terms (see Appendix A for search strategies). The reference lists of included articles were also examined. The study protocol was registered with Prospero (http://www.crd.york.ac.uk/PROSPERO/, registration number: CRD42015019818).

2.2. Study selection

2.2.1. Inclusion criteria

Studies were included if the study population included adults aged 65 and older who had an unplanned hospitalisation. Health assets were only considered if they were examined independently. Studies where the health asset was identified in the community prior to admission were included. The domains included were biological, subjective and functional health assets. The outcomes examined were post hospital mortality, functional decline, new need for residential care, length of stay and readmission. Only articles which examined quantitatively an association between factor(s) of interest and adverse outcomes were included.

Studies were excluded if they looked at a specific patient population such as transplant recipients, patients undergoing a particular intervention, or stroke patients. Studies were excluded if the association was found with an established risk factor defined as poor baseline function, co-morbidity, depression, malnutrition and cognitive impairment. Environmental and hospitalisation care processes were not examined.

Study quality was evaluated using an adapted version of the epidemiological appraisal instrument by Genaidy et al. (2007) (see Appendix B) (KG reviewed all, KL and RM reviewed half each). The studies were characterised as low, medium or high methodological quality.

2.3. Data extraction

Each study was interrogated for general information, population characteristics, outcome of interest, method and timing of data collection. A list of health assets was generated from the included studies.

2.4. Data synthesis and analysis

The studies were grouped by type of health asset examined. Although two studies included the same cohort, both were included as they examined the outcome of different health related characteristics.

3. Results

3.1. Overview of included studies

Initial search, title and abstract review were performed by KG. Initial searches identified 3566 original articles. After review of
the title, 3303 were rejected. The abstracts of the remaining 231 were reviewed, following which 41 articles were retrieved for full text review. Of these, 10 articles met the final inclusion criteria (see Table 1). One additional article was identified after reviewing the references of articles that met the inclusion criteria, resulting in a total of 11 articles (Fig. 1). A narrative approach was taken to the data analysis, as, due to the heterogeneity of study methods and populations, a meta-analysis was not possible.

Articles were identified which found health assets that decreased post hospital mortality, functional decline, new need for residential care and readmission (see Table 1). No health assets were found to be associated with a shorter length of stay. The included studies were predominantly from English speaking countries. Two studies used data from the same cohort of patients based in New Haven, Connecticut (Berkman, Leo-Summers, & Horwitz, 1992; Wilcox, Kasl, & Berkman, 1994) (see Table 1).

<table>
<thead>
<tr>
<th>Study and Sample size</th>
<th>Quality</th>
<th>Location and setting for recruitment</th>
<th>Duration of Follow-up</th>
<th>Health Asset</th>
<th>Functional decline</th>
<th>Post hospital mortality</th>
<th>Discharge to RACF</th>
<th>Readmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berkman et al. (1992)</td>
<td>high</td>
<td>USA Community</td>
<td>6 months</td>
<td>Emotional support</td>
<td>OR of 2.9 (1.2, 6.9) Low vs. high</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chen et al. (2008)</td>
<td>high</td>
<td>Taiwan</td>
<td>6 months</td>
<td>Oral health</td>
<td>OR 1.17 (1.04, 1.31) Poor vs. good</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dent and Hoogendijk (2014)</td>
<td>moderate</td>
<td>Australia subacute ward of single Hospital</td>
<td>12 months</td>
<td>Sense of control</td>
<td>OR 2.26 (1.01,5.04) Low vs. high</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drame et al. (2011)</td>
<td>moderate</td>
<td>France Multi-centre trial in acute hospitals</td>
<td>Time of discharge</td>
<td>Sense of wellbeing Social engagement</td>
<td>Many children Low vs. high</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goodwin et al. (2011)</td>
<td>high</td>
<td>USA General medical service of two hospitals</td>
<td>90 days for ADLs 12 months mortality</td>
<td>Financial resources</td>
<td>OR 1.59 (1.07, 2.37) Low vs. high</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Li et al. (2005)</td>
<td>high</td>
<td>Spain Acute hospital wards of four hospitals</td>
<td>Median 6.5 months</td>
<td>Social engagement</td>
<td>OR 1.36 (1.00, 1.87) Low vs. high</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rodríguez-Artalejo et al. (2006)</td>
<td>high</td>
<td>Spain</td>
<td>Acute hospital wards of four hospitals</td>
<td>Social engagement</td>
<td>OR 1.36 (1.00, 1.87) Low vs. high</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smith and Stevens (2009)</td>
<td>high</td>
<td>USA Single hospital</td>
<td>Retrospective cohort</td>
<td>High education</td>
<td>OR 0.74 (0.65, 0.97) More vs. less</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wilcox et al. (1994)</td>
<td>high</td>
<td>USA Community</td>
<td>6 months</td>
<td>Social engagement</td>
<td>Positivity association (no OR published)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zureik et al. (1995)</td>
<td>moderate</td>
<td>France Two hospitals</td>
<td>Time of discharge</td>
<td>Carer</td>
<td>OR 2.9(1.9, 4.3) No carer vs. carer</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Berkman and Wilcox use data from the New Haven Connecticut cohort of the Established Populations for Epidemiologic Studies of the Ageing, RACF: residential aged care facility.**
4. Discussion

This review indicates that individual health assets are associated with improved outcomes of functional decline, mortality, new need for residential care and readmission in hospitalised older adults. Older adults are more likely to have positive outcomes after an inpatient episode if they have adequate social, psychological and financial resources. The small number of studies suitable for inclusion indicates the need for further research in this area. Many health assets included in this review were presented with the negative associations of their absence, which is reflective of the traditional focus on risk factors and ill health, rather than seeking factors that can lead to better health.

Although many of the studies were classified as being high quality, as the studies were all cohorts, definitive causation cannot be demonstrated. Many of the findings, such as the protective effect of a carer, education and social engagement were repeated in multiple studies, which adds further weight. For many health assets, randomised controlled trials are not possible. This highlights the need to perform further cohort studies to look for factors that confer protection while adequately controlling for risk factors.

Although some of the resources identified are not amenable to modification, such as education, presence of a carer and financial resources, a large number could lead to targeted interventions, such as social engagement, having a primary physician and improving psychological health. This informs theoretical

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**Fig. 1. Summary of literature search and selection.**
knowledge of factors that have a positive influence on health and highlights new directions to improve outcomes for this vulnerable patient group. In the community setting, frail patients who have a high degree of social vulnerability are protected from mortality if they live in countries with social models that provide a high level of formalised support (Wallace, Theou, Pena, Rockwood, & Andrew, 2015), further demonstrating practical applications.

A health asset is an enabling factor, empowering individuals to use their own resources and resources around them to improve their health outcomes (Asset Based, 2011). In this context, it is easily apparent how some assets, such as a higher level of educational attainment or the ability to pay for basic health and personal expenses are protective. The mechanistic link between a higher level of social engagement and a lower chance of post hospital mortality or functional decline is less easily apparent. Psychosocial stress is associated with increased inflammation, which may be the conduit for this association (MccDade, Hawkley, & Cacioppo, 2006). Dent and Hoogendijk (2014) found that psychosocial factors conferred protection against adverse outcomes for frail adults in a hospitalised cohort. In contrast, this was not found in a community cohort which also included frail older adults and examined mortality and functional decline (Hoogendijk et al., 2014). The study by Dent and Hoogendijk (2014) had a higher mortality rate compared to Hoogendijk et al., with 23% vs 6.8%. The participants had a far higher rate of frailty in the study by Dent and Hoogendijk (2014), at 57%, with only 16.8% of the patients in the study by Hoogendijk et al. being classified as frail, despite using the same method of measurement which could contribute to the different result. If the community cohort were followed for a longer time period, as mortality rates increase, an effect may be seen.

Oral health was associated with better functional outcomes in an analysis that accounted for social supports, cognition, but not nutritional status (Chen, Wang, & Huang, 2008). It is possible that oral health is a reflection of higher socio-economic status, but it may also indicate an ability and willingness of the individual to take care of their health. This is consistent with the finding that having a primary health care provider is a health asset (Smith & Stevens, 2009).

Although some studies found associations with gender, the findings were not consistently positive for one gender in particular to include this as a health asset. No biological health assets were identified in this review. Lower levels of interleukin – 6 (IL-6) and insulin-like growth factor – 1 (IGF-1) are associated with better functional outcomes in patients following unplanned hospitalisation when combined with another predictive model (de Saint-Hubert et al., 2011). As IL-6 and IGF-1 were not examined independently of the risk prediction model, this study was not included, but this does suggest that neuroendocrine reserve and diminished inflammation could be health assets. It is possible that biological health assets are not predictive in the acute setting due to the overriding impact of the antecedent illness.

The theory of salutogenesis was developed in the community setting with a focus on maintaining and improving wellness (Lindstrom & Eriksson, 2005). Health assets in the community may not provide benefit when someone is hospitalised. Conversely there may be factors, which only come into effect once someone is hospitalised. In the community setting environmental factors and community resources also affect health outcomes (Wang et al., 2014). It has been well described that in the hospital setting, admission to an Acute Care of the Elderly unit instead of a general medical unit improves the likelihood of a positive functional outcome (Baztan, Suarez-Garcia, Lopez-Arrieta, Rodriguez-Manas, & Rodriguez-Artalejo, 2009) so this could also be considered a health asset.

The quality of hospital processes, including in-hospital nutrition and mobility; also have positive impact on health status outcomes. Mobility in hospital is partly a result of the quality of hospital processes (Zisberg, Shadmi, Gur-Yaish, Tonikikh, & Sinoff, 2015). It may also represent a health asset, as in studies where the statistical model has controlled for illness severity, functional status, co-morbidity and cognition, higher levels of mobility were associated with better long-term functional status and mortality (Zisberg et al., 2015).

Limitations of the present study include the heterogeneity of measures used to identify similar variables, which precluded meta-analysis. Many of the studies also examined similar populations, with 3 studies looking at populations from the same small city in the USA. Berkman et al. (1992) and Wilcox et al. (1994) examined different outcomes for a very similar characteristic in the same population. Both studies were included as the outcome of interest for the characteristic was different. Nevertheless, the number of studies from a limited population raises concerns about generalisability. Loss to follow up was not reported in some studies nor was completeness of follow-up. Only one study set in a subacute care unit examined subjective health assets, so this finding may not be generalisable to all inpatients. The health assets identified by Smith and Stevens (2009) and Goodwin, Howrey, Zhang, and Hoogendijk (2011) need to be interpreted in the context of being retrospective studies based on large computerised data sets. Examining these assets in a prospective cohort would strengthen these findings. It is possible that confounding accounts for some of the effects of the health assets identified. As an example it is possible that the effect of higher financial resources is accounted for by increased level of education. However, even if independence of factors can be demonstrated statistically, this is a convention that is not well grounded in biological reality, and it is likely that two associated factors would still have an additive effect. This is something that could be explored in further research.

Although a systematic search strategy was used, it is possible that relevant articles were not identified. The identification of an article on hand search of the references indicates that this strategy was not fully sensitive. Some studies were lacking in details of measurement. Drame et al. (2011) identified that having a large number of children was protective against the need for residential care, but the number of children was not specified.

Our findings must be interpreted with caution due to the low number of studies identified for inclusion and the lack of duplication of findings for most health assets. There are many candidate health assets, which have been examined in younger hospitalised populations, but not in older people. Being married and being resident in the country of birth have both been identified as health assets in younger inpatient cohorts (Dimengo, 1996; van Oeffelen, Agymang, Strons, Bots, & Vaartjes, 2014) but these factors have not been examined in older cohorts. There are perceived difficulties in including older adults in research studies, such as a perception of older people as ‘vulnerable’. As this group make up a high proportion of hospitalised older adults, it is imperative to design inclusive studies (McMurdo et al., 2011).

Studies in younger adults tend to focus predominantly on mortality, rather than functional decline, which could be considered an outcome of almost equal importance by many older adults, due to the adverse prognostic implications (Boyd et al., 2008). There is increasing need across many health systems to try and improve care for older people, not only for the outcome of mortality, but for the outcomes of functional decline and readmission. Greater understanding of the role of health assets in the hospital setting could help individuals to play a greater role in their own recovery. It could also lead to improvements in hospital systems to facilitate the role of the individual as the driver.
of their own return to wellbeing. This could also promote more granular risk stratification and resource allocation as patients with fewer health assets may require increased assistance to ensure recovery following hospitalisation.

5. Conclusion

The complex interplay between health status and psychological and social factors is incompletely understood. A health asset allows an individual to better understand the situation they are in and to use their own resources and resources around them to improve their health outcomes. A hospital admission is a time of great risk to older people and so it is critical to identify health assets that can improve outcomes and promote patients as active agents of their wellbeing. Health assets in older adults are associated with a decrease in mortality, functional decline, readmission and new need for residential care. Some health assets identified in younger age groups have not been explored in older age groups. Identification of health assets will allow collection of this information in the clinical setting, which may facilitate better allocation of healthcare resources and better patient outcomes. This review has identified many targets for further research.

Conflict of interest

The authors have no conflicts of interest to declare.

Sources of funding

This work was supported by PhD scholarships from the Australian Postgraduate Association and the Northern Hospital to KG.

Appendix A.

Search strategies for MEDLINE, EMBASE, PsycINFO and CINAHL

- Literature search strategies for MEDLINE (web of science)
  1. MeSH heading: hospitalisation OR inpatients
  2. MeSH Heading: survivors OR Activities of Daily Living OR Recovery of Function OR treatment outcome OR Health status OR Nursing Homes
  3. MeSH heading: Social support OR Risk Factors OR Social Determinants of Health OR caregiver OR Topic: indicator* OR determinant* OR carer*
- #1 AND #2 AND #3
  Limits: English language AND aged and human

- Literature search strategies for EMBASE (1437)
  1. Hospital patient OR hospitalisation
  2. Daily life activity OR survival OR treatment outcome OR health status OR nursing home
  3. determinant or indicator).mp. [mp = title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword OR risk factor OR social support OR caregiver OR carer.mp
  #1 and #2 and #3
  limits: 1990-to present, age 65+, English language

- Literature search strategies for PsycINFO 21
  1. hospitalisation OR hospitalised patient
  2. Daily life activity OR survival OR treatment outcome OR ability level OR nursing home
  3. Social support OR risk factor OR caregiver OR carer.mp (determinant or indicator).mp. [mp = title, abstract, heading word, table of contents, key concepts, original title, tests & measures]

5. Conclusion

The complex interplay between health status and psychological and social factors is incompletely understood. A health asset allows an individual to better understand the situation they are in and to use their own resources and resources around them to improve their health outcomes. A hospital admission is a time of great risk to older people and so it is critical to identify health assets that can improve outcomes and promote patients as active agents of their wellbeing. Health assets in older adults are associated with a decrease in mortality, functional decline, readmission and new need for residential care. Some health assets identified in younger age groups have not been explored in older age groups. Identification of health assets will allow collection of this information in the clinical setting, which may facilitate better allocation of healthcare resources and better patient outcomes. This review has identified many targets for further research.

Appendix B.

Study Evaluation Tool by Genaidy et al Score <33 low quality, 33–35 moderate quality, >35 high quality

(sco

References


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Appendix 12: The Clinical Frailty Scale predicts functional decline and mortality when used by junior medical staff: a prospective cohort study for publication with revisions, BMC Geriatrics
The clinical frailty scale predicts functional decline and mortality when used by junior medical staff: a prospective cohort study

Kate J. Gregorevic¹²*, Ruth E. Hubbard³, Benny Katz⁴⁵⁶ and Wen K. Lim⁵⁷

Abstract

Background: Increasing frailty is associated with risk of mortality and functional decline in hospitalized older adults, but there is no consensus on the best screening method for use by non-geriatricians. The objective of this study is to determine whether the clinical frailty scale (CFS) can be used to identify patient baseline frailty status in the acute general medical setting when used by junior medical staff using information obtained on routine clinical assessment.

Methods: This was a prospective cohort study in an acute general medical unit. All patients aged 65 and over admitted to a general medical unit during August and September 2013 were eligible for the study. CFS score at baseline was documented by a member of the treating medical team. Demographic information and outcomes were obtained from medical records. The primary outcomes were functional decline and death within three months.

Results: Frailty was assessed in 95% of 179 eligible patients. 45% of patients experienced functional decline and 11% died within three months. 40% of patients were classified as vulnerable/mildly frail, and 41% were moderately to severely frail. When patients in residential care were excluded, increasing frailty was associated with functional decline (p = 0.011). Increasing frailty was associated with increasing mortality within three months (p = 0.012).

Conclusions: A high proportion of eligible patients had the frailty measure completed, demonstrating the acceptability of the CFS to clinicians. Despite lack of training for medical staff, increasing frailty was correlated with functional decline and mortality supporting the validity of the CFS as a frailty screening tool for clinicians.

Keywords: Aged, Frailty, Hospitalization, Survival, Frail elderly, Activities of daily living

Background

Frailty is a state of vulnerability to poor resolution of homoeostasis after a stressor event and is a consequence of loss of reserve across multiple physiological systems which occurs across a lifetime [1]. Frailty can be used to identify older adults who are at increased risk of mortality and functional decline when they are hospitalized [2], but there is no consensus on the most appropriate way for non-geriatricians to identify frailty at the time of hospital admission [3]. Traditionally subjective opinion has been used by non-geriatricians to identify frailty, but this correlates poorly with objective measures of frailty [4].

The frailty phenotype [5] and the frailty index [6] have both been validated against adverse outcomes in large community cohorts. Fried’s frailty phenotype requires measurement of gait speed [5], which is likely to be affected by an acute illness. Comprehensive geriatric assessment (CGA) is a multidimensional patient assessment examining medical, psychological, nutritional, cognitive and functional domains [7]. CGA can decrease mortality and length of stay for hospitalized older adults [7]. The frailty index based on a comprehensive geriatric assessment (FI-CGA) at the time of hospital admission predicts increased risk of mortality and need for residential care [3, 8], but requires geriatrician input. CGA is time and resource intensive and it is not
feasible to provide this for all patients who present to hospital at this time. Screening for frailty by non-geriatricians may identify patients most likely to benefit from a CGA [3]. It may also help non-geriatricians with prognostication.

The Clinical Frailty Scale (CFS) [9] was developed to enable frailty to be measured in the outpatient clinical setting [10]. It has demonstrated very good inter-rater reliability [10, 11]. When used by trained assessors it predicts short-term and long-term mortality in acutely hospitalized older adults [11–16] grouped as frail or not frail. A large retrospective cohort study demonstrated that increasing frailty on the CFS has a linear relationship with inpatient mortality and increased length of stay [17]. The CFS is an attractive tool as it can be completed based on routine clinical admission and there is no need for extra equipment, so there are minimal barriers to its implementation. Although other frailty measurement tools, such as the Reported Edmonton Frailty Scale (REFS) have been validated against the Geriatrician’s Clinical Impression of Frailty in the inpatient setting, the REFS has features which limit its’ use in patients who do not speak English, or who are hearing or vision impaired [18].

The objective of this study is to determine the predictive validity of the CFS when used by untrained junior medical staff in the acute general medical setting using only routine clinical information.

Methods

Subjects and setting

The study took place at St Vincent’s Hospital, a university associated tertiary hospital in inner-Melbourne, Australia. All patients admitted under a general medical unit during August and September 2013, who were aged 65 years or older were included. There were four general medical units consisting of one registrar and two interns, as well as admitting night and day registrars, meaning there were 14 possible candidates to complete the CFS. As the primary focus of the study was to assess utility of the clinical frailty scale, not the doctors, data collection was anonymous to protect staff privacy. Patients were excluded if they were transferred to a different specialty unit. Ethics approval was obtained from St Vincent’s hospital, Melbourne. As the project used data that was collected as part of routine medical care, the ethics committee determined that individual consent was not required.

Measures and data collection

Copies of the Clinical Frailty Scale (CFS) were placed in the work-rooms of the junior medical staff. These doctors were asked to record a CFS score based on the patient’s functional status prior to admission using only routine clinical assessment. The CFS could be completed at any time during the admission, so patients admitted after hours and on weekends were included. No specific training or incentives were provided. Inter-rater reliability was not measured as this has been demonstrated in prior studies [10, 11] and it was felt that it would apply additional stress to the junior doctors completing the CFS. Demographic data and baseline characteristics were obtained via electronic medical records and chart review (Table 1). Co-morbidities were measured using the Charlson comorbidity index with information from medical records [19, 20].

The two outcomes investigated were mortality and functional decline. Mortality was measured at three months. This was obtained from hospital records. Functional decline was measured at the time of discharge from the acute hospital. Functional decline was defined as the need for subacute care, determined by a trained nurse assessor and geriatrician, patient being assessed as below pre-morbid function for their activities of daily living or instrumental activities of daily living, or the need for increased services on discharge both of which were determined by allied health practitioners. Patients who died during the admission were excluded from the analysis of functional decline. The information for mortality and functional decline was obtained from hospital records and chart review.

Analysis

Patients were divided into four groups based on their frailty scores. Patients who were scored at 1-3 on the CFS were defined as not frail (group 1), patients who were scored at 4-5 (group 2) as vulnerable/mildly frail, patients who scored 7-8 (group 3) as moderately to severely frail and patients who scored 9 were terminally ill but not otherwise frail (Group 4). All statistical analysis was performed using Stata version 12.1. The level of statistical significance was set at 0.05. Baseline characteristics between the groups were compared using the chi squared statistic, where applicable (see Table 1). Univariate analysis was performed for all variables (Table 2). Multivariate analysis was performed using two models. All variables which had a P value of less than 0.1 were included in the multivariate analysis. Usual residence was also included in a model for functional decline due to theoretical concern regarding confounding.

Results

Baseline characteristics

179 eligible patients were admitted during the time period of the study. Average age was 82.0. Frailty scores were obtained for 95 % of patients. 40 % of patients were vulnerable/mildly frail, and 41 % were moderately to severely frail. Only 17 % were not frail (Table 1). There were no significant differences in age, gender or co-
morbidity score across the groups. Patients who were more frail were less likely to live home alone ($p < 0.01$). Patients who were moderately to severely frail were most likely to live in residential care ($P < 0.01$). There were no other significant differences in baseline characteristics when grouped by frailty score (Table 3).

## Outcomes

Overall mortality at three months was 11%. At the time of discharge from the acute hospital, 45% of patients experienced functional decline. Mean length of stay was 6.7 days, which was not significantly different across frailty groups.

When people who lived in residential care were excluded, in univariate analysis patients who were more frail were also more likely to experience functional decline (OR 1.8, 95%CI 1.13,2.87) (Fig. 1). No other variable was associated with functional decline in univariate analysis. In the multivariate model with usual residence, the association between frailty and functional decline remained significant.

In univariate analysis increasing frailty was associated with increased risk for mortality (OR 2.5, 95% CI 1.19,5.3) (Table 2). Gender was included in the multivariate model, the OR for this model was 2.4 (95% CI 1.15,4.97).

### Discussion

This study demonstrates the feasibility of using the Clinical Frailty Scale in the acute general medical setting. The CFS correlates with the important outcomes of death and functional decline. This is the first study the authors are aware of, where no training was provided to junior doctors in order to examine how the CFS functions in a real world setting. This study also shows that this scale is highly acceptable to medical staff as there was a 95% completion rate. It was completed with information obtained on routine assessment at the time of admission, so the additional workload for junior medical staff was minimal. The combination of acceptability and prognostic guidance supports the role of the CFS as a tool to identify patients most suitable for comprehensive geriatric assessment.

Screening for frailty may act to decrease age related discrimination by identifying robust elderly patients. Screening can also identify the most frail and trigger discussions regarding limitations of treatment.

Other studies have looked at the CFS as a predictor of mortality in the acute hospital setting [11–13, 15, 17]. This study also examines functional outcomes. Failure to return to pre-morbid functional status predicts mortality [2] and institutionalization [21]. Patients who are at high risk for functional decline are also at high risk for mortality [2].

There was no association found between length of stay and frailty score, which is not consistent with other studies [15, 17]. This may be due to the high prevalence of frailty, meaning that discrimination was lost, as other studies that have examined this association have had lower proportions of frail patients [3]. In the studies by Wallis et al. [17] and Evans et al. [3] it is not clear whether length of stay included subacute care, which was not included in our study.

There is a positive relationship between the degree of frailty and the risk of mortality and functional decline when frailty is measured by FI-CGA [3]. This has also been demonstrated with the CFS in other studies [15].

Consistent with previous findings, female gender conferred protection against mortality [22].

Wallis et al. conducted a retrospective study to determine the association of the CFS with patient characteristics and

### Table 1 Baseline characteristics of study participants

<table>
<thead>
<tr>
<th>Frailty Score</th>
<th>Number in group</th>
<th>Age (median and range)</th>
<th>Male (%)</th>
<th>Preferred language not English (%)</th>
<th>Home alone/home accompanied/residential care (%)</th>
<th>Charlson Score (mean)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>29</td>
<td>80 (66-96)</td>
<td>52</td>
<td>48</td>
<td>12 (37)</td>
<td>6.4</td>
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<tr>
<td>4-5</td>
<td>68</td>
<td>82 (66-97)</td>
<td>43</td>
<td>56</td>
<td>32 (47)</td>
<td>6.4</td>
</tr>
<tr>
<td>6-8</td>
<td>70</td>
<td>83 (66-97)</td>
<td>46</td>
<td>65</td>
<td>15 (21)</td>
<td>6.8</td>
</tr>
<tr>
<td>9</td>
<td>3</td>
<td>77 (65-80)</td>
<td>100</td>
<td>100</td>
<td>1 (33)</td>
<td>6.3</td>
</tr>
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</table>

### Table 2 Results of univariate analysis

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Variable</th>
<th>Coefficient</th>
<th>95% CI</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional decline (exclude all patients in residential care)</td>
<td>Age</td>
<td>0.37</td>
<td>-0.013,0.009</td>
<td>0.702</td>
</tr>
<tr>
<td></td>
<td>Gender</td>
<td>0.081</td>
<td>-0.080,0.244</td>
<td>0.321</td>
</tr>
<tr>
<td></td>
<td>Usual residence</td>
<td>-0.06</td>
<td>-0.195,0.070</td>
<td>0.355</td>
</tr>
<tr>
<td></td>
<td>Charlson score</td>
<td>0.015</td>
<td>-0.020,0.0516</td>
<td>0.386</td>
</tr>
<tr>
<td></td>
<td>Preferred language</td>
<td>-0.00</td>
<td>-0.163,0.161</td>
<td>0.988</td>
</tr>
<tr>
<td>Three month mortality</td>
<td>Age</td>
<td>0.001</td>
<td>0.005,0.007</td>
<td>0.756</td>
</tr>
<tr>
<td></td>
<td>Gender</td>
<td>-0.111</td>
<td>-0.204,-0.018</td>
<td>0.019</td>
</tr>
<tr>
<td></td>
<td>Usual residence</td>
<td>0.038</td>
<td>-0.008,0.085</td>
<td>0.106</td>
</tr>
<tr>
<td></td>
<td>Charlson score</td>
<td>0.016</td>
<td>-0.006,0.038</td>
<td>0.148</td>
</tr>
<tr>
<td></td>
<td>Preferred language</td>
<td>-0.047</td>
<td>-0.141,0.015</td>
<td>0.316</td>
</tr>
</tbody>
</table>
outcomes. The CFS was completed for all patients aged 75 or older as part of routine care by junior medical or nursing staff, who were provided with training at induction. Despite the lack of training provided for the junior medical staff in our study, the OR for inpatient mortality was 1.6, 95 % CI 1.48, 1.74, which was comparable to the three month mortality rate in our study of 1.82, 95 % CI 1.14, 2.91. Similar to our findings, Wallis et al. [17] demonstrated that the least frail patients had slightly higher mortality than the moderately frail patients. This may be due to patients who are more robust only needing to be hospitalized for more a more severe interceding illness. In a similar population to ours, Basic and Shanley [15] also found a higher risk of mortality with increasing frailty identified on the CFS.

The study has certain strengths. A high proportion of eligible patients were included. Since individual consent/assent was not required and the CFS could be completed at any time during the hospital stay there were no barriers to recruitment of patients with communication, language or cognitive difficulties or those admitted outside routine working hours. This increases the generalisability of our findings to patients who have barriers to communication.

We also acknowledge methodological weaknesses. This is a single centre study, and so the results may not be applicable to other sites.

The measure of functional decline was indirect, as it was the need for subacute care, the need for increased services

<table>
<thead>
<tr>
<th>Table 3 Results of multivariate analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>Functional decline</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Mortality and three months</td>
</tr>
<tr>
<td></td>
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<td></td>
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</tbody>
</table>

Model 1 variables: usual residence, excludes patients in residential care
Model 2 variables: gender
Model 3 variables: gender, Charlson co-morbidity score, usual residence
Model 4 variables: usual residence

Fig. 1 For each increased level of frailty there is a corresponding increase in the percentage of people experiencing functional decline (frailty score 1-3: 34 %, 4-5: 46 % and 6-8: 70 %). There was an overall trend for increasing mortality with increasing frailty (frailty score 1-3: 10 %, 4-5: 4 %, 6-8: 10 % and 9: 100 %)
On discharge or the opinion of an allied health team member that the patient was below pre-morbid function. As we relied on routine clinical data, there was no direct measurement tool available. Although this is not a validated measure, the proportion of patients who experienced functional decline was similar to other studies in similar settings [2, 23]. Other studies have used a count of activities of daily living and instrumental activities of daily living as a marker of functional decline [24], and this is similar to the assessment performed by physiotherapists and occupational therapists. A new need for residential care has also been used as a marker of functional decline [25]. In this hospital setting it is rare for a patient to be newly discharged to residential care without being admitted to subacute care, so this was deemed a more appropriate measure.

Patients who were from residential care were excluded from the analysis of functional decline, as some of the criteria used to define functional decline were not applicable to this group. The measure used may have lacked sufficient sensitivity to detect functional decline in those who already had low baseline function, for example people receiving full time care from family members. These limitations could be overcome by conducting further research with an objective measure of function at the time of hospitalization and the time of discharge.

We were unable to include some potential confounders in the multivariate analysis. Only information that was routinely collected for patients as part of standard medical, allied health and nursing care was available, so we were unable to obtain a measure of nutrition, cognition or delirium.

As this study was conducted in a real world setting, we were unable to obtain inter-rater reliability. The CFS has previously been demonstrated to have high inter-rater reliability [11, 26].

A general limitation of frailty measurement in the acute setting, it that it is possible that the level of frailty is over-stated due to the effect of the antecedent illness. Many patients experience functional decline prior to hospital admission [27], which will lead to a higher frailty score. If the antecedent insult (such as infection, new drug) causes a functional decline resulting in a higher frailty score this still may represent a bad prognostic factor. The only way to examine this would be to look at prospective cohorts recruited in the community.

**Conclusions**

It is increasingly recognised that frailty rather than chronological age predicts adverse outcomes in hospitalized older adults. Identification of frailty in the acute setting within time and resource limitations is a major challenge. The CFS is quick and easy to use, and acceptable to busy junior clinicians. This trial demonstrates the feasibility of using the CFS in the acute setting. Incorporating this into routine care has the potential to improve the recognition and measurement of frailty. Future research should investigate how the CFS correlates with more precise measures of frailty, particularly the frailty index derived from comprehensive geriatric assessment and if multifaceted interventions including management of cognition, nutrition and social factors can improve outcomes for patients with different levels of frailty.

**Abbreviations**

CFS, clinical frailty scale; CGA, comprehensive geriatric assessment; FI-CGA, frailty index based on a comprehensive geriatric assessment.

**Funding**

There are no sources of funding to report.

**Availability of data and materials**

Data supporting findings in the study can be requested from corresponding author.

**Authors’ contributions**

KG: Study design, data collection, statistical analysis, interpretation of results, development of discussion, preparation of the manuscript. RH: Editorial input for manuscript. BK: Guidance with study design, editorial input for manuscript. KL: Guidance with study design and statistical analysis, editorial input for manuscript. All authors have read and approved the final version of the manuscript.

**Competing interests**

The authors declare that they have no competing interests.

**Consent for publication**

Not applicable.

**Ethics approval and consent to participate**

The protocol for the study has been approved by St Vincent’s Hospital (Melbourne) Research Governance Unit as a quality assurance project. As the study used data that was collected as part of routine medical care, the ethics committee determined that individual consent was not required. Patient data has been de-identified to preserve privacy.

**Author details**

1. Department of Aged Care, Northern Hospital, 185 Cooper St, Epping, Vic 3076, Australia.
2. North West Academic Centre, University of Melbourne, Melbourne, Australia.
3. Geriatric Medicine Deputy Director, Centre for Research in Geriatric Medicine, The University of Queensland, Brisbane, Australia.
4. Geriatric Medicine, St Vincent’s Hospital, Melbourne, Australia.
5. University of Melbourne, Melbourne, Australia.
6. La Trobe University, Melbourne, Australia.
7. North Western Hospital, Epping, Australia.

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**References**

Appendix 13: Are Health Assets Associated with Improved Outcomes for Hospitalized Older Adults? A Systematic Review QJM
Do health assets have a protective effect for hospitalized frail older adults?

K.J. Gregorevic¹,²,³, N.M. Peel⁴, W.K. Lim²,³ and R.E. Hubbard⁴

From the ¹Department of Aged Care, Northern Health, 185 Cooper St Epping, Victoria, Australia, ²Department of Medicine, University of Melbourne, Grattan St, Parkville, Victoria, Australia, ³Department of Aged Care, Melbourne Health, Grattan St, Parkville, Victoria, Australia and ⁴Centre for Research in Geriatric Medicine, The University of Queensland, Brisbane, Queensland, Australia

Address correspondence to Dr K.J. Gregorevic, Department of Aged Care, Northern Hospital, 185 Cooper St Epping, Victoria, Australia. email: katherine.gregorevic@mh.org.au

Summary

Background: Although increasing frailty is predictive of increased mortality and length of stay for hospitalized older adults, this approach ignores health assets that individuals can utilize to recover following hospital admission.

Aim: To examine whether health assets mitigate the effect of frailty on outcomes for older adults admitted to hospital.

Design: Patients of 1418 aged ≥70 years admitted to 11 hospitals in Australia were evaluated at admission using the interRAI assessment system for Acute Care, which surveys a large number of domains, including cognition, communication, mood and behaviour, activities of daily living, continence, nutrition, skin condition, falls and medical diagnosis.

Methods: The data set was interrogated for potential health assets and a multiple logistic regression adjusted for frailty index, age and gender as covariates was performed for the outcomes mortality, length of stay, re-admission and new need for residential care.

Results: Inpatient mortality was 3% and 4.5% of patients died within 28 days of discharge. Median length of stay was 7 days (IQR 4–11). In multivariate analysis that includes frailty, being able to walk further [OR 0.08 (0.01–0.63)], ability to leave the house [OR 0.35 (0.17–0.74)] and living alone [OR 0.28 (0.10–0.79)] were protective against mortality. The presence of a support person was associated with a decreased length of stay [OR 0.14 (0.08–0.25)].

Conclusion: The inclusion of health assets in predictive models can improve prognostication and highlights potential interventions to improve outcomes for hospitalized older adults.

Introduction

Admission to hospital can be a life-changing event for older adults. Many will not return to the same level of health and function once discharged from hospital.¹,² An individual’s ability to recover from a physical insult will depend on their health status, which is the result of a complex interplay of medical, cognitive, nutritional, social and lifestyle factors.

Measurement of frailty at admission to hospital can be used to identify older adults at increased risk of mortality and long length of stay. For every increase in frailty by an increment of 0.1 on the frailty index, there is an increased risk of mortality with an OR of 1.05–2.01.³–⁵ However, inclusion of only risk factors to assess prognosis does not explain why some frail older adults have better physical and functional recovery following hospitalization than others. In contrast to the ‘health deficits’ approach,
salutogenesis theory focuses on individual and community capacity to improve health.\(^4\) Identification of health assets, which are resources that individuals or communities have at their disposal to protect against negative health outcomes and promote wellbeing,\(^2\) allows practical application of this theory.

The concept of health assets has primarily been developed in the community. Health assets have been identified across multiple domains including biological (e.g. low cholesterol), functional (e.g. ability to undertake community activities) and subjective (e.g. a sense of wellbeing).\(^6\) In the community, health assets individually and cumulatively are associated with longer survival and improved health status in models that include frailty.\(^7\)

There is increasing interest in identifying, early in the hospital stay, those patients who are likely to have adverse outcomes at discharge and therefore in need of specialized discharge planning. Timely identification of patients in need of resource intensive discharge planning has the potential to contain healthcare costs and to increase individual patient satisfaction.\(^8,11\) This study aimed to determine whether health assets could be identified in hospitalized patients that would mitigate the effect of frailty on adverse outcomes.

**Materials and methods**

**Study design, setting and participants**

This was a secondary analysis of a prospective cohort of 1418 adults aged 70 and older from 11 acute care hospitals in Queensland and Victoria, Australia. Patients admitted to general medical, surgical and orthopaedic wards were included if they had an expected length of stay of at least 48 h. Study recruitment has been previously described.\(^4\)

**Measures**

The interRAI assessment system for Acute Care (AC), specifically developed for use in the acute setting, was used for comprehensive geriatric assessment (CGA).\(^12\) The interRAI AC-CGA instrument, previously known as the interRAI AC, surveys a large number of domains, including cognition, communication, mood and behaviour, activities of daily living, continence, nutrition, skin condition, falls and medical diagnosis. Trained nurse assessors completed the assessment using multiple sources of information, including patients, carers, medical and nursing staff and clinical records. This was collected at the time of admission and discharge. Patients were followed up by telephone and/or medical record review at 28 days post discharge from acute care to determine outcomes.

Health status: As a summative measure of health status, a Frailty Index (FI) (Supplementary Material S1) was calculated for each patient using candidate variables derived from the interRAI AC and coded as deficits using a well defined methodology.\(^4\)

Health assets: The interRAI data set was screened for potential health assets, which were chosen based on a systematic review\(^13\) and face validity. Variables were excluded if they were present in >99% of the patients or if they were used to construct the frailty index. The potential health assets included sociodemographics (English as primary language, being married, living with others,\(^14\) and having a support person positive towards discharge). In addition, premorbid activity (going out of the house and furthest distance walked at any one time) were also recorded for the 3 days prior to admission.

Outcomes: Inpatient mortality, mortality within 28 days post discharge from acute care, length of stay, new discharge to residential care and re-admission within 28 days of discharge.

**Analysis**

Data was analysed using STATA version 14.1. Frequency distributions were used to describe population characteristics, reported as proportion of available data. Continuous variables were reported as means with standard deviation (SD) or medians with interquartile range (IQR), depending on distribution of the data. Univariate analysis was performed for each of the health assets against the outcomes of interest. A negative binomial regression was used for length of stay to account for right skew of the data. Health assets with a P values of <0.20 for association in the univariate analysis were included in logistic regression multivariate models for each adverse outcome. The level of statistical significance was set at <0.05 for the multivariate analysis. The FI (categorized at 0.1 increments), age and gender were included as covariates in multivariate models. The results for length of stay are reported as Incidence Rate Ratio (IRR). The results for all other outcomes are reported as Odds Ratios (OR) with 95% Confidence Interval (CI).

**Ethics**

Personal or proxy consent was obtained in writing by each participant prior to commencement of the studies. Ethical approval was granted from the human research and ethics committee of each participating hospital and University of Queensland medical research ethics committee.

**Results**

The study included 1418 patients with mean (SD) age of 81.7 years, 55% of whom were female. The average length of stay was 9.6 days (SD10.3), with a median of 7 and IQR of 4–11 days; the 90th percentile was 21 days. Mean (SD) frailty index for the sample was 0.32 (0.14). Adverse outcomes at discharge included inpatient mortality (n = 57, 4.0%); 132 (9.3%) had a prolonged length of stay (>21 days) in acute care. Of those discharged, 47 (3.5%) died within 28 days post discharge from acute care and 270 (20.8%) of patients were readmitted within 28 days. Table 1 shows the characteristics of the study population. There was <1% data missing on any of the selected health assets.

**Supplementary Tables S2 and S3** show the association of health assets with adverse outcomes in univariate analysis. Factors significantly associated with increased mortality as an inpatient and within 28 days of discharge from acute care included living arrangements (living with others/or in institutional care vs. living alone), while being widowed/divorced/separated vs. being currently married/partner and having greater level of premorbid activity (going out of the house and distance walked) significantly reduced risk of mortality. Living in institutional care vs. living alone reduced the risk of readmission. Health assets significantly associated with increased length of stay included being never married vs. being married/with partner, and not having a person supportive of discharge, factors which also increased the risk of being newly discharged to residential aged care. Living with others vs. living alone, and having a greater level of premorbid activity (going out of the house and distance walked) were associated with reduced length of stay and risk of being newly discharged to residential aged care.

Table 2 shows the multivariate analysis for health assets and adverse outcomes, including the Frailty Index as a covariate and adjusting the model for age and gender. In multivariate analysis for inpatient mortality, patients who lived
Table 1. Characteristics of study population

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total n = 1418</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years) mean (SD)</td>
<td>81 (7)</td>
</tr>
<tr>
<td>Females n(%)</td>
<td>780 (55.0%)</td>
</tr>
<tr>
<td>Frailty Index mean (SD)</td>
<td>0.32 (0.14)</td>
</tr>
<tr>
<td>Language</td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>1267 (89.6%)</td>
</tr>
<tr>
<td>Other</td>
<td>147 (10.4%)</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
</tr>
<tr>
<td>Married / Partner</td>
<td>593 (42.2%)</td>
</tr>
<tr>
<td>Never married</td>
<td>99 (7.0%)</td>
</tr>
<tr>
<td>Widowed / Separated / Divorced</td>
<td>713 (50.7%)</td>
</tr>
<tr>
<td>Living arrangement</td>
<td></td>
</tr>
<tr>
<td>Lives alone</td>
<td>497 (35.0%)</td>
</tr>
<tr>
<td>Lives with others in community</td>
<td>719 (50.7%)</td>
</tr>
<tr>
<td>Lives in institutional care including RACF</td>
<td>201 (14.3%)</td>
</tr>
<tr>
<td>Health assets</td>
<td></td>
</tr>
<tr>
<td>Went out of house in 3 day pre-morbid period</td>
<td>No 494 (35.0%)</td>
</tr>
<tr>
<td></td>
<td>Yes 919 (65.0%)</td>
</tr>
<tr>
<td>Furthest distance walked at any one time in 3 day premorbid period (m)</td>
<td>&lt;5 m 201 (14.4%)</td>
</tr>
<tr>
<td></td>
<td>5–49 m 351 (25.1%)</td>
</tr>
<tr>
<td></td>
<td>50–99 m 200 (14.3%)</td>
</tr>
<tr>
<td></td>
<td>100 &lt; 1000 m 263 (18.8%)</td>
</tr>
<tr>
<td></td>
<td>≥ 1000 m 383 (27.4%)</td>
</tr>
<tr>
<td>Has person supportive of discharge</td>
<td>No 192 (13.6%)</td>
</tr>
<tr>
<td></td>
<td>Yes 1014 (72.1%)</td>
</tr>
<tr>
<td>Outcomes</td>
<td>Lives in institutional care including RACF 201 (14.3%)</td>
</tr>
<tr>
<td>Length of stay in acute care greater than 21 days (90th percentile)</td>
<td>132 (9.3%)</td>
</tr>
<tr>
<td>Inpatient mortality</td>
<td>57 (4.0%)</td>
</tr>
<tr>
<td>New discharge from acute care to RACF(^a)</td>
<td>66 (5.5%)</td>
</tr>
<tr>
<td>Death within 28 days discharge from acute care(^b)</td>
<td>47 (3.5%)</td>
</tr>
<tr>
<td>Readmitted within 28 days discharge from acute care(^c)</td>
<td>270 (20.8%)</td>
</tr>
</tbody>
</table>

\(^a\)Excluding those in RACF (n = 173) prior to admission and deaths in hospital of those who weren’t admitted from RACF (n = 45).

\(^b\)Excluding deaths in hospital (n = 57) and lost to follow-up (n = 16).

\(^c\)Excluding deaths in hospital (n = 57) and within 28 days (n = 47) and lost to follow-up (n = 16).

RACF: residential aged care facility.

Discussion

This study demonstrates that poor health status can be offset by health assets. Previous studies have shown that frailty predicts mortality and increased length of stay, but examining frailty alone does not adequately explain why some frail older adults still recover well when admitted to hospital. These findings demonstrate that it is not possible to get a full understanding of health status without considering positive attributes in conjunction with deficits.

Inclusion of protective factors may help develop a predictive model for the hospital-associated mortality of frail older adults. Increased levels of social resources are associated with lower mortality in the community setting. Although this could not be directly measured in this study, it is clinically sensible that those who were able to walk longer distances and leave the house would have improved access to community and decreased social vulnerability. The linear relationship between distance walked and mortality has significant practical implications as it provides older adults with a goal, which may be achievable and realistic.

Even when health assets were included in the predictive models, increasing frailty was still predictive of inpatient mortality, increased length of stay and a new need for residential care. The power of frailty as a predictor is as a multidimensional measure of health, covering medical, cognitive, functional and nutritional domains. Routine measurement of frailty at the time of admission to hospital provides a valid way to improve prognostication. Prognostication may then be further improved by considering the positive impact of health assets.

Some health assets have a more obvious mechanism of action than others. It is easily apparent that having a person alone (compared to living with others) were less likely to die (OR 0.24 95%CI 0.08, 0.67). Compared to patients who walked < 5 metres in the 3 days prior to admission, those who walked over 50 m had improved survival. For mortality within 28 days of discharge, living alone and increasing distances walked pre-mobidly were similarly protective. In addition, going out of the house in the 3 day premorbid period reduced the risk of mortality post discharge (OR: 0.35 95%CI 0.17, 0.74). Having a person supportive of discharge (OR: 0.63 (95% CI 0.56, 0.71)), going out of the house in the 3 day premorbid period (OR: 0.90 (95% CI 0.81, 1.00)) and not living alone were all associated with a decreased length of stay. Risk of being newly discharged to residential aged care was increased for patients who lived alone (OR: 1.85 (95% CI 1.07, 3.38)) but reduced if the patient had a person supportive of discharge (OR: 0.14 (0.08, 0.25)). No health assets were predictive of readmission.

Adding Frailty Index to the multivariate models, indicated that, for the adverse outcomes of inpatient mortality, new discharge to residential aged care and longer length of stay, the addition of health assets to the models attenuated the effects of frailty, although higher levels of frailty remained an independent predictor for these outcomes.
supportive of discharge would be protective against a new need for institutional care. Other associations, like the ability to access the community and decreased 28 day mortality may be mediated by increased positive emotion due to decreased social isolation. Previous studies have identified that emotional support and subjective wellbeing are protective against mortality following hospital admission.\(^6,17\) A possible biological mechanism for this is an association with positive emotions and decreased inflammation.\(^18\)

This study highlights a difficulty in how we define health assets. The definition of health assets is that they are desirable in their own right and associated with positive health outcomes. Living alone highlights this challenge, as it may be an active choice, or it may have resulted through an adverse life event, like the death of a spouse. The effect of living alone on mortality is inconsistent in the literature with some community studies identifying an increased risk of mortality\(^14\) and others, particularly in older adults, a protective association.\(^19\) Other studies have also demonstrated that frail older adults who live alone have decreased inpatient mortality.\(^20\) Living alone is linked with better functional status, which is protective against mortality,\(^21\) which may also explain why living alone was not associated with a new need for residential care. Although living alone can be a risk factor for loneliness, particularly for men,\(^22\) for others it may be a marker of re-silience.

Using the outcome of interest to define whether a variable is a health asset also creates a difficulty as certain variables had differing effects on different outcomes. Living alone was associated with decreased mortality, but it was associated with an increased length of stay. The only variable that was protective for both length of stay and mortality was whether the patient had left the house prior to admission. This likely reflects that length of stay is not solely a product of the antecedent illness and frailty. Low socioeconomic status measured by income, low education, inadequate housing and social isolation also contribute.\(^23,24\) Social isolation has also been linked with increased mortality. It is likely that the ability to leave the house and access the community is a surrogate marker for social engagement.

The results of this study must be interpreted with caution. The data was collected in Australia, and although a range of hospitals were included across multiple states, factors specific to an individual country’s health system may limit generalizability. As this was a secondary analysis, we were limited to available data, so some health assets identified on systematic review such as subjective wellbeing and higher levels of education could not be examined.\(^24\)

Although many of the factors are likely to be associated with each other, raising concerns regarding confounding, like people who are able to walk farther being more likely to leave the house, these factors maintained individual predictive significance in a multivariate model.

As this study was a secondary analysis, we were limited in our outcomes to those that were available. Functional decline at discharge from hospital from premorbid is highly prevalent and may negatively impact quality of life. This is an important area for further research.

This study has certain strengths. The study population is a large cohort of patients recruited from secondary and tertiary hospitals. Data collection was comprehensive, with only 2% missing in the final analysis.\(^15\) Importantly, our model also included gender to account for the male-female health-survival paradox.\(^25\)

This study raises further questions regarding how to best define health assets. Health assets are associated with positive health, but should also be desirable in their own right\(^7\) so to consider health assets in a truly person-centered way, further qualitative research is needed to assess desirability of health assets to older adults themselves. Prospective studies should allow examination of a wider range of health assets, including social and economic measures. This would enable determination of whether health assets have a cumulative effect, as seen in the community setting.\(^8\)

### Table 2. Multivariate analysis of health assets and adverse outcomes\(^a\)

<table>
<thead>
<tr>
<th>Health assets</th>
<th>Outcomes</th>
<th>Inpatient mortality OR (95% CI)</th>
<th>Mortality at 28 days OR (95% CI)</th>
<th>Length of stay IRR (95% CI)</th>
<th>New RACF discharge OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Living arrangements</td>
<td></td>
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<tr>
<td>– Live with others</td>
<td>––</td>
<td>––</td>
<td>––</td>
<td>––</td>
<td></td>
</tr>
<tr>
<td>– Live alone</td>
<td>0.24 (0.08–0.67)</td>
<td>0.28 (0.10–0.79)</td>
<td>1.19 (1.09–1.31)</td>
<td>1.85 (1.07–3.38)</td>
<td></td>
</tr>
<tr>
<td>Has support person</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– No</td>
<td>––</td>
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<td></td>
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<tr>
<td>– Yes</td>
<td>0.63 (0.56–0.71)</td>
<td>0.14 (0.08–0.25)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Went out of house</td>
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<td></td>
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<tr>
<td>– No</td>
<td>––</td>
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<td></td>
</tr>
<tr>
<td>– Yes</td>
<td>1.08 (0.57–2.02)</td>
<td>0.35 (0.17–0.74)</td>
<td>0.90 (0.81–1.00)</td>
<td>0.63 (0.34–1.17)</td>
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<tr>
<td>Distance walked</td>
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<td></td>
</tr>
<tr>
<td>&lt;5 metres</td>
<td>––</td>
<td>––</td>
<td>––</td>
<td>––</td>
<td></td>
</tr>
<tr>
<td>5–49 metres</td>
<td>0.74 (0.37–1.47)</td>
<td>0.49 (0.24–1.00)</td>
<td>0.90 (0.77–1.05)</td>
<td>0.97 (0.43–2.19)</td>
<td></td>
</tr>
<tr>
<td>50–99 metres</td>
<td>0.21 (0.06–0.74)</td>
<td>0.17 (0.05–0.58)</td>
<td>0.84 (0.71–1.00)</td>
<td>0.75 (0.27–2.13)</td>
<td></td>
</tr>
<tr>
<td>100–&lt;1000 metres</td>
<td>0.42 (0.17–1.04)</td>
<td>0.25 (0.09–0.66)</td>
<td>0.90 (0.77–1.05)</td>
<td>0.75 (0.30–1.86)</td>
<td></td>
</tr>
<tr>
<td>≥ 1000 metres</td>
<td>0.20 (0.04–0.97)</td>
<td>0.08 (0.01–0.63)</td>
<td>0.94 (0.79–1.11)</td>
<td>0.37 (0.09–1.52)</td>
<td></td>
</tr>
<tr>
<td>Covariates</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frailty index</td>
<td>1.72 (1.39–2.12)</td>
<td>1.24 (0.98–1.56)</td>
<td>1.19 (1.15–1.24)</td>
<td>1.28 (1.02–1.61)</td>
<td></td>
</tr>
</tbody>
</table>

Bold font indicates 95% CI does not cross 0.

\(^a\)All models adjusted for age and gender and Frailty Index.

OR, odds ratio; IRR, incident rate ratio; CI, confidence interval; RACF, residential aged care facility.
Conclusions

Although this study further highlights that increasing frailty is a risk factor for inpatient mortality, this also demonstrates that health outcomes are a complex interplay between positive and negative factors. The inclusion of health assets in a model of health and illness augments our understanding of factors that lead to recovery. The ability to engage with the community and the maintenance of mobility enhance survival for a hospitalized individual. Older adults have often developed great resilience over their life course. Encouraging people to identify and utilize their own resources is a more empowering approach to illness recovery. This approach highlights that older adults are not simply a sum of their losses, but individuals with a balance of risk factors and protective factors. As well as improving prognostication, identification of health assets could highlight new paths for interventions to help older adults survive and thrive following admission to hospital.

Supplementary material

Supplementary material is available at QMED online.

Conflict of interest: None declared.

References

Supplementary Data

The Frailty Index was calculated from 39 variables listed in Table S1 below; 37 of these translated directly into 37 potential deficits with 15 potential deficits allocated for number of comorbidities and 4 for medication categories


Table S1: Variables included in the Frailty Index

<table>
<thead>
<tr>
<th>Domain</th>
<th>Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognition</td>
<td>Cognitive skills for daily decision making</td>
</tr>
<tr>
<td></td>
<td>Short term memory</td>
</tr>
<tr>
<td></td>
<td>Procedural memory</td>
</tr>
<tr>
<td></td>
<td>Situational memory</td>
</tr>
<tr>
<td></td>
<td>Easily distracted</td>
</tr>
<tr>
<td></td>
<td>Disorganised speech</td>
</tr>
<tr>
<td></td>
<td>Mental function varies over the course of the day</td>
</tr>
<tr>
<td></td>
<td>Acute change in mental status</td>
</tr>
<tr>
<td>Communication and Sensorium</td>
<td>Making self understood</td>
</tr>
<tr>
<td></td>
<td>Ability to understand others</td>
</tr>
<tr>
<td></td>
<td>Hearing</td>
</tr>
<tr>
<td></td>
<td>Vision</td>
</tr>
<tr>
<td>Mood and Behaviour</td>
<td>Self reported little interest in things</td>
</tr>
<tr>
<td></td>
<td>Self reported anxiety</td>
</tr>
<tr>
<td></td>
<td>Self reported depression</td>
</tr>
<tr>
<td></td>
<td>Presence of disruptive behaviours</td>
</tr>
<tr>
<td>ADLs</td>
<td>Personal hygiene</td>
</tr>
<tr>
<td></td>
<td>Walking</td>
</tr>
<tr>
<td></td>
<td>Toilet transfers</td>
</tr>
<tr>
<td></td>
<td>Toilet use</td>
</tr>
<tr>
<td></td>
<td>Bed mobility</td>
</tr>
<tr>
<td></td>
<td>Eating</td>
</tr>
<tr>
<td></td>
<td>Mode of locomotion</td>
</tr>
<tr>
<td>Continence</td>
<td>Bladder continence</td>
</tr>
<tr>
<td></td>
<td>Bowel continence</td>
</tr>
<tr>
<td>Health conditions</td>
<td>Number of comorbidities</td>
</tr>
<tr>
<td></td>
<td>History of falls</td>
</tr>
<tr>
<td></td>
<td>Difficulty moving to standing</td>
</tr>
<tr>
<td></td>
<td>Difficulty turning around</td>
</tr>
<tr>
<td></td>
<td>Dyspnoea</td>
</tr>
<tr>
<td></td>
<td>Fatigue</td>
</tr>
<tr>
<td>Pain</td>
<td>Pain frequency</td>
</tr>
<tr>
<td></td>
<td>Pain intensity</td>
</tr>
<tr>
<td></td>
<td>Pain consistency</td>
</tr>
<tr>
<td>Nutrition</td>
<td>BMI category</td>
</tr>
<tr>
<td></td>
<td>Unintended weight loss</td>
</tr>
<tr>
<td></td>
<td>Mode of nutritional intake</td>
</tr>
<tr>
<td>Skin integrity</td>
<td>Presence of pressure injury</td>
</tr>
<tr>
<td>Medications</td>
<td>Polypharmacy categories</td>
</tr>
</tbody>
</table>
### Supplemental data: Table S2: Univariate analysis of Health Assets and Outcomes

<table>
<thead>
<tr>
<th>Health Asset</th>
<th>Inpatient Mortality</th>
<th>Died within 28 Days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No (n=1360)</td>
<td>Yes (n=57)</td>
</tr>
<tr>
<td>Age (mean and range)</td>
<td>81.0 (69-102)</td>
<td>81.9 (70-97)</td>
</tr>
<tr>
<td>Frailty Index (mean and range)</td>
<td>0.32 (0.02-0.72)</td>
<td>0.47 (0.04-0.76)</td>
</tr>
<tr>
<td>Marital status</td>
<td>593 (42.2)</td>
<td>47 (3.5)</td>
</tr>
<tr>
<td>- Married/partner</td>
<td>0.65(0.23,1.9)</td>
<td>0.38(0.21,0.66)</td>
</tr>
<tr>
<td>- Widowed/separated/divorced</td>
<td>1</td>
<td>0.4(0.24,0.84)</td>
</tr>
<tr>
<td>- Never married</td>
<td>557 (41.0)</td>
<td>36 (6.3)</td>
</tr>
<tr>
<td>Living arrangements</td>
<td>497 (35.1)</td>
<td>5 (8.8)</td>
</tr>
<tr>
<td>- Live alone</td>
<td>54 (8.9)</td>
<td>6 (10.7)</td>
</tr>
<tr>
<td>- Live with others</td>
<td>398 (29.2)</td>
<td>68 (11.5)</td>
</tr>
<tr>
<td>- Live in institution</td>
<td>188 (13.8)</td>
<td>13 (22.8)</td>
</tr>
<tr>
<td>Primary language</td>
<td>1217 (89.6)</td>
<td>50 (89.3)</td>
</tr>
<tr>
<td>- English</td>
<td>141 (10.4)</td>
<td>6 (10.7)</td>
</tr>
<tr>
<td>- Other</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Went out of the house in the 3 days before admission</td>
<td>494 (35.0)</td>
<td>25 (44.6)</td>
</tr>
<tr>
<td>- Yes</td>
<td>36 (6.3)</td>
<td>6 (10.7)</td>
</tr>
<tr>
<td>- No</td>
<td>463 (34.1)</td>
<td>31 (55.4)</td>
</tr>
<tr>
<td>Longest distance walked in 3 days before admission</td>
<td>192 (14.4)</td>
<td>19 (34.5)</td>
</tr>
<tr>
<td>- 5-49 metres</td>
<td>182 (13.6)</td>
<td>19 (34.5)</td>
</tr>
<tr>
<td>- 50-99 metres</td>
<td>330 (24.6)</td>
<td>21 (38.2)</td>
</tr>
<tr>
<td>- 100-&lt;1000 metres</td>
<td>197 (14.7)</td>
<td>3 (5.5)</td>
</tr>
<tr>
<td>- ≥ 1000 metres</td>
<td>373 (27.8)</td>
<td>10 (18.2)</td>
</tr>
<tr>
<td>Has a support person positive towards discharge</td>
<td>192 (14.4)</td>
<td>19 (34.5)</td>
</tr>
<tr>
<td>- No</td>
<td>183 (13.6)</td>
<td>9 (15.8)</td>
</tr>
<tr>
<td>- Yes</td>
<td>979 (72.5)</td>
<td>35 (61.4)</td>
</tr>
<tr>
<td>- Living in institution</td>
<td>188 (13.9)</td>
<td>13 (22.8)</td>
</tr>
</tbody>
</table>
## Table S3: Univariate analysis of Health Assets and Outcomes

<table>
<thead>
<tr>
<th>Health Asset</th>
<th>Readmission within 28 days</th>
<th>Length of stay</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=1028 (96.5)</td>
<td>n=270 (3.5)</td>
</tr>
<tr>
<td><strong>Age (mean and range)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>81.0 (69-102)</td>
<td>80.7(70-96)</td>
<td>0.99(0.974,1.0)</td>
</tr>
<tr>
<td><strong>Frailty Index (mean and range)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.31(0.017-0.72)</td>
<td>0.32(0.05-0.71)</td>
<td>1.11(0.97,1.18)</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married/partner = 593 (42.2)</td>
<td>410 (40.3)</td>
<td>9.2 (1-79)</td>
</tr>
<tr>
<td>Widowed/separated/divorced = 713 (50.7)</td>
<td>535 (52.6)</td>
<td>9.8 (1-99)</td>
</tr>
<tr>
<td>Never married = 99 (7.0)</td>
<td>72 (7.1)</td>
<td>11.7 (1-93)</td>
</tr>
<tr>
<td><strong>Frailty Index</strong></td>
<td>0.98(0.74,1.3)</td>
<td>11.0 (1-75)</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td>1.00 (1)</td>
<td>9.0 (1-99)</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td>0.91 (0.51,1.55)</td>
<td>8.5 (2-62)</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td>1.11 (1.06-1.16)</td>
<td>0.77 (0.68,0.88)</td>
</tr>
<tr>
<td><strong>Living arrangements</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Live alone = 497 (35.1)</td>
<td>503 (49.0)</td>
<td>11.0 (1-75)</td>
</tr>
<tr>
<td>Live with others = 719 (50.7)</td>
<td>377 (36.7)</td>
<td>9.0 (1-99)</td>
</tr>
<tr>
<td>Live in institution = 201 (14.2)</td>
<td>107 (114.3)</td>
<td>8.5 (2-62)</td>
</tr>
<tr>
<td><strong>Living arrangements</strong></td>
<td>0.98 (0.74,1.3)</td>
<td>0.82 (0.75,0.90)</td>
</tr>
<tr>
<td><strong>Living arrangements</strong></td>
<td>1.00 (1)</td>
<td>1.19 (1.06-1.22)</td>
</tr>
<tr>
<td><strong>Primary language</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>918 (89.6)</td>
<td>9.7 (1-99)</td>
</tr>
<tr>
<td>Other</td>
<td>244 (90.4)</td>
<td>8.6 (1-86)</td>
</tr>
<tr>
<td><strong>Primary language</strong></td>
<td>0.91 (0.58,1.4)</td>
<td>0.895 (0.78,1.03)</td>
</tr>
<tr>
<td><strong>Primary language</strong></td>
<td>0.98 (0.74,1.3)</td>
<td>0.82 (0.75,0.89)</td>
</tr>
<tr>
<td><strong>Primary language</strong></td>
<td>1.00 (1)</td>
<td>1.19 (1.06-1.22)</td>
</tr>
<tr>
<td><strong>Primary language</strong></td>
<td>1.00 (1)</td>
<td>1.19 (1.06-1.22)</td>
</tr>
<tr>
<td><strong>Went out of the house in the 3 days before admission</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes = 919 (65.0)</td>
<td>690 (67.2)</td>
<td>8.9 (1-99)</td>
</tr>
<tr>
<td>No = 494 (35.0)</td>
<td>336 (32.8)</td>
<td>10.9 (1-75)</td>
</tr>
<tr>
<td><strong>Went out of the house in the 3 days before admission</strong></td>
<td>0.94 (0.71,1.23)</td>
<td>0.82 (0.75,0.89)</td>
</tr>
<tr>
<td><strong>Went out of the house in the 3 days before admission</strong></td>
<td>1.00 (1)</td>
<td>1.19 (1.06-1.22)</td>
</tr>
<tr>
<td><strong>Went out of the house in the 3 days before admission</strong></td>
<td>1.00 (1)</td>
<td>1.19 (1.06-1.22)</td>
</tr>
<tr>
<td><strong>Longest distance walked in 3 days before admission</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 5 metres = 201 (14.4)</td>
<td>128 (12.7)</td>
<td>11.0 (1-99)</td>
</tr>
<tr>
<td>5-49 metres = 351 (25.1)</td>
<td>239 (23.6)</td>
<td>10.7 (1-97)</td>
</tr>
<tr>
<td>50-99 metres = 200 (14.3)</td>
<td>153 (15.1)</td>
<td>9.2 (2-62)</td>
</tr>
<tr>
<td>100-&lt;1000 metres = 383 (27.4)</td>
<td>281 (27.7)</td>
<td>9.2 (1-79)</td>
</tr>
<tr>
<td>≥ 1000 metres = 263 (18.8)</td>
<td>212 (20.9)</td>
<td>8.4 (1-9)</td>
</tr>
<tr>
<td><strong>Longest distance walked in 3 days before admission</strong></td>
<td>0.92 (0.55,1.51)</td>
<td>0.76 (0.65,0.88)</td>
</tr>
<tr>
<td><strong>Longest distance walked in 3 days before admission</strong></td>
<td>1.00 (1)</td>
<td>1.19 (1.06-1.22)</td>
</tr>
<tr>
<td>Has a support person positive towards discharge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No = 192 (13.6)</td>
<td>141 (13.8)</td>
<td>4.0 (8.5)</td>
</tr>
<tr>
<td>Yes = 1014 (72.1)</td>
<td>733 (71.8)</td>
<td>27 (57.4)</td>
</tr>
<tr>
<td>Living in institution = 201 (14.3)</td>
<td>147 (4.4)</td>
<td>16 (34.0)</td>
</tr>
<tr>
<td><strong>Has a support person positive towards discharge</strong></td>
<td>1.23 (0.82,1.85)</td>
<td>1.19 (1.15,1.22)</td>
</tr>
<tr>
<td><strong>Has a support person positive towards discharge</strong></td>
<td>0.64 (0.36,1.49)</td>
<td>0.57 (0.47,0.65)</td>
</tr>
<tr>
<td><strong>Has a support person positive towards discharge</strong></td>
<td>1.00 (1)</td>
<td>1.19 (1.15,1.22)</td>
</tr>
</tbody>
</table>
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Appendix 15: Validation of the health assets index in the Australian inpatient setting: a multicentre prospective cohort protocol study, BMJ Open
Validation of the health assets index in the Australian inpatient setting: a multicentre prospective cohort protocol study

Katherine Gregorevic, 1 Ruth E Hubbard, 2 Nancye May Peel, 2 Wen Kwang Lim 3

ABSTRACT

Introduction It is well known that frail older adults are at increased risk for mortality and functional decline on admission to hospital. Systematic review demonstrates that health assets are associated with improved outcomes for hospitalised older adults. The health assets index (HAI) has been developed to measure health assets in the hospital setting. A protocol has been developed to determine the predictive validity of the HAI for frail older adults.

Methods and analysis The HAI was developed based on a systematic review and secondary analysis of the interRAI-Acute Care (interRAI-AC) dataset. A pilot study was undertaken to refine the tool. The validation study will be a multicentre prospective cohort. Participants will be adults aged 70 years and older with an unplanned admission to hospital. Frailty, illness severity and demographic data will also be recorded. The primary outcomes are mortality at 28 days postdischarge and functional decline at the time of discharge from hospital. The primary hypothesis is that a higher score on the HAI will mitigate the effects of frailty for hospitalised older adults. The secondary outcomes to be recorded are length of stay, readmission at 28 days and functional status at 28 days postdischarge. The correlation between HAI and frailty will be explored. A multivariate analysis will be undertaken to determine the relationship between the HAI and the outcomes of interest.

Ethics and dissemination Ethical approval has been obtained from Austin Health Human High Risk Ethics Committee. The results will be disseminated in peer-reviewed journals and research conferences. This study will determine whether the HAI has predictive validity for mortality and functional decline for hospitalised, frail older adults.

INTRODUCTION

The health assets index (HAI) (see table 1) was created to capture the cumulative effect of health assets. The aim of this study is to determine whether the HAI has predictive validity in the inpatient setting for older adults. It is proposed that the HAI will improve prognostication when measured concurrently with frailty. Determination of health assets associated with improved outcomes may also lead to new strategies to improve survival and well-being following hospital admission.

BACKGROUND

Health assets are protective factors that support health and well-being, rather than risk factors that are associated with disease. 1 Health assets are a way to operationalise the concept of salutogenesis, which describes an approach focusing on factors that support well-being and health rather than factors that cause disease. 2 This concept was initially developed in the community setting. In a systematic review, individual health assets have been demonstrated to decrease the risk of adverse outcomes including mortality, functional decline, for residential care, readmission and length of stay for older adults. 3 Some examples of assets identified included higher level of educational attainment, social engagement, subjective well-being and financial resources. 4

It has been demonstrated that health deficits can be measured at the time of hospital admission by comprehensive geriatric assessment and used to construct a frailty index, which has a cumulative association with mortality and length of stay. 3–5 The frailty
## Table 1  Health assets index

<table>
<thead>
<tr>
<th>Domain and question number</th>
<th>Question</th>
<th>Proposed scoring system</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>At approximately what age did you start school?</td>
<td>To be determined depending on spread.</td>
</tr>
<tr>
<td>2</td>
<td>At approximately what age did you finish school?</td>
<td></td>
</tr>
<tr>
<td><strong>Primary language</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>What is your primary language?</td>
<td>Need to determine association.</td>
</tr>
<tr>
<td><strong>Carer</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Do you have a carer or someone you can rely on to help with day-to-day activities?</td>
<td>0: no.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1: yes.</td>
</tr>
<tr>
<td>5</td>
<td>Do you have a support person who is positive towards discharge or maintaining residence in the community?</td>
<td>0: no.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1: yes.</td>
</tr>
<tr>
<td>6</td>
<td>Do you live alone or with others?</td>
<td>0: alone.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1: with others.</td>
</tr>
<tr>
<td><strong>GP</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Do you have a regular GP?</td>
<td>0: no.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1: yes.</td>
</tr>
<tr>
<td><strong>Financial</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Do you have private health insurance or other form of health services over such as Department of Veterans' Affairs Gold Card?</td>
<td>0: no.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1: yes.</td>
</tr>
<tr>
<td>9</td>
<td>Do you own their own home?</td>
<td>0: no.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5: yes with mortgage.</td>
</tr>
<tr>
<td></td>
<td>How do you manage on the income you have available?</td>
<td>1: yes.</td>
</tr>
<tr>
<td><strong>Number of children</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>How many children do you have?</td>
<td>0: zero.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5: for one to two.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1: for three or more.</td>
</tr>
<tr>
<td><strong>Social engagement</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Can you count on anyone to provide you with emotional support, for example, talking over a problem, or helping with a decision?</td>
<td>0: no.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1: yes.</td>
</tr>
<tr>
<td>12</td>
<td>How many times a week do you see or talk to a family member or friend who does not live with you?</td>
<td>0: never.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5: less that once a week.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1: once a week or more.</td>
</tr>
<tr>
<td>13</td>
<td>In the 3 days prior to the onset of the illness precipitating admission, number of days went out of the house or building in which he or she resides (no matter how short the period).</td>
<td>0: no days out.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.25: did not go out in last 3 days but usually goes out over a 3-day period.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5: 1–2 days.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1: 3 days.</td>
</tr>
<tr>
<td><strong>Psychosocial well-being</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Do you have control over the important things in life?</td>
<td>0: never.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5: sometimes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1: mostly.</td>
</tr>
<tr>
<td>16</td>
<td>Overall how would you rate your quality of life?</td>
<td>0: mostly bad.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5: sometimes good, sometimes bad.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1: mostly good.</td>
</tr>
<tr>
<td>17</td>
<td>In general would you say your health is:</td>
<td>0: poor/fair</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1: good excellent</td>
</tr>
</tbody>
</table>
index is a count of deficits across multiple domains including medical, functional, cognitive, psychological and nutritional. Each deficit is given equal weight, and the score is derived by the numerator over the denominator.\footnote{3}

Identifying only deficits does not explain why some frail older adults have a good outcome following hospital admission. In the community setting over a period of many years, a higher number of health protective factors decreased the risk of mortality and increased the likelihood of an improvement in health status for frail older adults.\footnote{4} It is yet to be determined whether health assets have a cumulative effect in the hospital setting. As the risk for mortality and functional decline is relatively high,\footnote{4, 8, 9} even a small impact could have a substantial effect at a societal level.

**Development of the HAI**
To enable measurement of health assets, the HAI was created. Variables were included based on the systematic review, a secondary analysis of the interRAI dataset\footnote{3} and face validity (see table 1).

Variables included will meet the following criteria:
1. Associated with positive health outcomes.
2. Not included in the frailty index.
3. Not present or absent in greater than 95% of patients.
4. Variables can be binary, continuous or categorical.
5. As a group, the candidate assets must cover a range of domains, for example, social, psychological and socio-economic.
6. Assets must be age appropriate, for example, being in paid employment is likely to have such low prevalence that it will not provide any meaningful discrimination in older adults.

**Scoring of HAI**
The variables will be assigned a score from 0 to 1.

- Binary variables will be scored as 0=asset not present and 1=asset present.
- Categorical variables will be scored according to a range, that is, activity level.
- Continuous and ordinal variables will be transformed into categorical variables by examining spread and judgement; for example, education may be divided as less than 12 years and more than 12 years.
- A higher score will correspond to a higher number of health assets.

**OBJECTIVES**

- Determine impact of health assets on functional recovery and mortality at 12 months after follow-up.

**Primary hypothesis**

- The distribution of score on the HAI index will be related to the frailty score.
- A higher score on the HAI will mitigate the effect of frailty on hospitalised older adults and lead to decreased mortality and functional decline.

**Secondary hypothesis**

- A higher score on the HAI will mitigate the effect of frailty on hospitalised older adults and lead to decreased length of stay and readmission.

**Study design**
The study protocol has been developed in accordance with the Transparent Reporting of a multivariable prediction model for Individual Prognosis Or Diagnosis (TRIPOD) checklist.\footnote{10} The study is a prospective, observational, multicentre cohort study that will take place in the inpatient hospital setting.

**Participants**

**Inclusion criteria**
Hospital inpatients who are aged 70 years and above who have an unplanned admission.

**Exclusion criteria**
Participants were excluded if they did not speak English or if they had cognitive impairment and no next of kin was available to consent for them.

**Predictors**
Predictors included in the study include age, gender, frailty (measured by frailty index)\footnote{3} and modified early warning score\footnote{9} to indicate illness severity. These will be measured at the time of admission to hospital from medical records, participants and next of kin.

**Sample size**
The interRAI dataset, which examined a comparable population, had a 28-day mortality of 7.5%.\footnote{5} Functional decline in Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (iADLs) was estimated at 35% based on prior studies in comparable populations.\footnote{8, 12} The CI was set at 95%, and the confidence level was set at 0.05. This gave the following size:

1. Thirty-day mortality: 134.
2. Functional status for instrumental ADLs and DADLs 30 days after discharge: 350.
3. To account for 10% loss to follow-up, the planned sample size is 385.

**Consent**
The researcher will speak to the clinical staff to determine whether there are any concerns regarding the patient’s cognition and capacity to consent. If any clinical staff raise concerns or if in the subjective judgement of
the researcher there are concerns, consent will also be obtained from the next of kin or responsible person.

Study procedure
The participants will be approached by the researcher either on the acute ward or in the emergency department once they have been accepted for admission. The researcher will complete a frailty index and the HAI based on information from the patient, carers and staff. The researchers will administer the HAI twice to a subset of patients to determine inter-rater reliability. The researcher will obtain information regarding illness severity from the medical records, which will be used to inform the Modified Early Warning Score (MEWS). Age and demographic data will also be obtained from medical records. Demographic data will include gender, age, usual place of residence and previous home help services.

Participants will be asked for a contact phone number for follow-up. Participants who are able to consent for themselves will be asked to nominate whether they prefer to be contacted or for the researchers to contact a relative or carer. For participants who were not able to consent, where appropriate, the person responsible will be contacted for follow-up at 30 days after discharge from the hospital.

Primary outcome measures
1. Mortality during inpatient admission, which will be determined from hospital records.
2. Mortality within 30 days of hospital discharge, which will be determined from hospital records and the registry of births, deaths and marriages.
3. Functional status at the time of hospital discharge measured by Katz activities of daily living, which will be recorded from medical notes, or the need for subacute care or new admission to residential aged care.
4. Functional status at 30 days after hospital discharge that will be obtained by follow-up phone call or examination of medical records, which will be measured by Katz activities of daily living and instrumental activities of daily living or new need for residential care.

Secondary outcome measures
1. Length of stay, which will be determined from medical records.
2. Readmission, which will be determined from medical records and phone call.

Data management
Each researcher will be responsible for entering deidentified data into a centralised, password-protected database on RedCap. RedCap is a secure web application for building and managing online surveys and databases, which enables data from all sites to be securely managed on a single database.

Statistical analysis
Descriptive statistics will be used to examine baseline characteristics including MEWS, frailty index, age, gender and usual place of residence. The distribution of the individual components will be examined in the population. The distribution of the total score of the HAI will also be examined in the population. Interv-rater reliability will be performed using Spearman’s correlation.

The HAI will be examined in a multivariate, regression model that will include frailty, age, MEWS and gender. Participants who had a score of 0 for ADLs at the time of admission will not be included in the analysis for functional decline due to a floor effect. A negative binomial regression will be used for length of stay to account for skew of data.

ETHICS AND DISSEMINATION
Research governance has also been obtained for participating sites. The findings of this study will be presented at conferences and disseminated through publication in a peer-reviewed journal.

A pilot study of the HAI was undertaken as a substudy of the interRAI acute care assessment. This pilot study determined that HAI was acceptable to participants.

PATIENT INVOLVEMENT
Patients were not involved in the development of the study. The results will be published in a peer-reviewed journal, but there is no plan to specifically disseminate the findings to study participants.

DISCUSSION
This is the first study the authors are aware of to measure health assets in hospitalised older adults in a systematic way. Health assets have been shown to play an important role in mitigating the effects of frailty for older adults in the community setting. The cumulative effect of this has not been explored systematically in the hospital setting. Mortality and functional decline have been chosen as the outcomes of interest as hospital is a time of excess risk for these outcomes. The development of new disability is highly prevalent in hospitalised older adults, particularly for those who are frail. The prognosis for this is poor, and of those who leave hospital with a new disability at 1 year, 41% have died and only 30% have recovered to their previous functional state.

The ability of an individual to recover from an acute illness and to return to their home environment is dependent on factors additional to the acute illness. Individual resources, such as social supports, adequate financial resources and the ability to access and emotional support, have been demonstrated to be protective. Social vulnerability and socioeconomic factors are linked with frailty. This study will help clarify whether a higher
level of health assets mitigate frailty associated outcomes or if their impact is primarily related to contribution to baseline frailty in this setting.

The secondary outcomes of increased length of stay and readmission have been chosen as in a systematic review health assets impacted these outcomes.

Health assets can be measured at any time during the hospital admission. Most of the health assets, such as those measuring education, family and financial resources, will not alter depending on time of measurement. The frailty index has predictive validity whether it is measured at the time of admission or later in the hospital admission. 4,19

A limitation of the study is that not all patients admitted during the time period will be able to be approached. Increasing frailty is associated with increased length of stay.4,19 Length of stay is also impacted by the community resources available in individual health services, which limits generalisability. Readmission is not associated with frailty status but is predicted by social vulnerability,20 so the HAI may be predictive for this outcome.

A strength of the methodology is the utilisation of significant amounts of routine data. This decreases the burden for participants in participating. The inclusion of participants with cognitive impairment by obtaining consent from a next of kin will also improve the generalisability.

Despite attempting to identify all health assets with a systematic review as well as interrogation of the interRAI database,9 it is possible that not all health assets were identified. It also remains to be seen whether health assets are specific to a sociocultural setting.

Health assets can lead to improved outcomes for hospitalised older adults. Validation of the HAI will enable better risk stratification. Understanding of factors that mitigate the effects of frailty could also lead to the development of interventions to facilitate recovery following hospital admission.

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Competing interests None declared.

Patient consent Not required.

Ethics approval Ethical approval has been obtained from Austin Health high-risk ethics committee.

Provenance and peer review Not commissioned; externally peer reviewed.

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REFERENCES

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