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Frailty And Its Association With Rehabilitation Outcomes: An Irish Prospective Cohort Study Of A Post-Acute Older Population

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FRAILTY AND ITS ASSOCIATION WITH REHABILITATION OUTCOMES: 
AN IRISH PROSPECTIVE COHORT STUDY OF A POST-ACUTE OLDER 
POPULATION

Mary Nolan B.Sc. (Physio)

A dissertation submitted in part fulfilment of the requirements for the degree of MSc. in 
Neurology and Gerontology

School of Physiotherapy, 
Faculty of Medicine and Health Sciences, 
Royal College of Surgeons in Ireland.

September 2014

Supervisor: Dr Frances Horgan
Declaration

I declare that this thesis, which is submitted to RCSI for examination in consideration of the award of a MSc. Neurology and Gerontology is my own personal effort. Where any of the content presented is the result of input or data from a related collaborative research programme this is duly acknowledged in the text such that it is possible to ascertain how much of the work is my own. I have not already obtained a degree in RCSI or elsewhere on the basis of this work. Furthermore, I took reasonable care to ensure that the work is original, and, to the best of my knowledge, does not breach copyright law, and has not been taken from other sources except where such work has been cited and acknowledged within the text.

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Date 1/09/2014
SUMMARY

Introduction

The projected increase in the older population over the coming decades will place a greater demand on health-care services. Frailty is highly prevalent in the hospitalised older adult. There is a lack of research examining the impact of frailty on determinants of physical function, quality-of-life and falls self-efficacy.

Aims and Objectives

The primary aim of this research was to evaluate the changes in physical function, quality-of-life and falls self-efficacy in frail older adults undergoing inpatient rehabilitation. A secondary aim was to examine the association between frailty and rehabilitation outcomes of physical function, quality-of-life, self-efficacy, time spent in therapy, length of stay and discharge destination.

Methods

A prospective cohort study design was employed using a sample of convenience. Forty-one subjects attending an inpatient post-acute rehabilitation unit were assessed on admission and at discharge. A range of physical determinants were used to assess function. They included the Clinical Frailty Scale (CFS), Grip-strength, Timed-Up-and-Go (TUG), ten meter walk test (10MWT), Elderly Mobility Scale (EMS), Tinetti Balance and Gait Assessment, Barthel
Index (BI). The EuroQol-5D Visual Analogue Scale (EQ-5D-VAS) was used to assess quality-of-life and the Falls Efficacy Scale (FES) as a measure of falls self-efficacy.

**Results**

The mean (±SD) age of the sample was 80.3(±7.1) years and the majority were female. Statistically significant changes from admission to discharge were found in the CFS (p≤0.001), grip-strength (p≤0.001), TUG (p≤0.001), 10MWT (p≤0.001), Tinetti (p≤0.001), BI (p≤0.001), EQ-5D-VAS (p≤0.001) and FES (p≤0.001). Moderate positive correlations were found between admission CFS and TUG (r=0.438, p<0.0004), gait-speed (r=0.408, p<0.009) at discharge. Moderate and strong negative correlations were found between admission CFS and Tinetti (r=−0.489, p<0.001) and EMS (r=−0.5, p<0.001) respectively. A moderate positive correlation was found between admission CFS and amount of time spent in therapy=0.364, p<0.019) and LOS (r=0.386, p<0.013). No relationship was found between the CFS and grip-strength, EQ-5D-VAS, FES or discharge destination. In multivariate regression analysis, admission CFS was a significant predictor of outcome in the EMS (beta=−0.304,p<0.037), TUG (beta=0.033,p<0.047), BI (beta=−0.32,p<0.05) and gait-speed (beta=0.327,p<0.045), but not for LOS or Tinetti, when the baseline confounders of age, gender, MMSE, social-connectedness and number of co-morbidities were controlled.

**Conclusions**

Frailty on admission was shown to have a modest relationship with many physical determinants of function, time spent in therapy and length of stay. It is evident that frailty
alone does not provide the clinician with a definitive clinical evaluation of an older person's potential outcome following rehabilitation.

**Implication of Findings**

This research provides the clinician with a better understanding of the relationship between frailty and specific functional outcomes of the older person. Policy makers are also more informed of the influence of frailty on health-service provision in the older adult undergoing post-acute rehabilitation.
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TILDA  The Irish Longitudinal Study of Ageing
UL  Upper limb
INTRODUCTION

Health-service provision is a becoming a priority as estimates project that the population aged over 65 will rise by 14% by 2021 (Kearney et al., 2011). The greatest increase will occur in the population aged over 80 years, with the number expected to double between 2011 and 2031 (TILDA 2011). Normal ageing is characterised by progressive changes which can lead to an increased susceptibility to disease (Lang et al., 2009). Frailty is a syndrome which is characterised by a diminished physiological response to stressors such as an acute illness or psychological distress (Fried et al., 2001). It is differentiated from, but strongly associated with ageing. The prevalence of frailty in hospitalised older adults has been reported to be as high as 94% (Dent et al., 2013). Its establishment as a predictor of those at risk of adverse outcomes in hospitalised older adults is growing (Singh et al., 2012). A greater understanding of the association of frailty with rehabilitation outcomes in the hospitalised older adult is a priority for the clinician. A better knowledge of the healthcare need and utilisation of services among the elderly in an Irish post-acute population is essential for policy planning (TILDA 2011).

Frailty is a pathway to disability however little is known about the impact of frailty on physical determinants in older adults undergoing post-acute rehabilitation. A growing body of evidence has established that frailty can predict adverse outcomes of dependency, mortality and risk of institutionalisation in hospitalised older adults (Singh et al., 2012). A small evidence-base for the effectiveness of multi-disciplinary interventions suggests that the process of frailty can be reversed (Theou et al., 2012, Cameron et al., 2013,Gill et al., 2002). This research has been undertaken in community-dwelling and residential-care settings with no interventional evidence pertaining to hospitalised older adults existing. This observational
study assessed frailty pre and post rehabilitation to examine if post-acute older adults can improve their frailty status. With the growing establishment of frailty for risk-stratification there is a need to assess the relationship of frailty and physical determinants in older adults undergoing rehabilitation.

Specialist inpatient geriatric rehabilitation, using a comprehensive geriatric assessment and multi-disciplinary interventions, has been proven to reduce physical dependency and institutionalisation (Ellis et al., 2011, Ellis and Langhorne et al., 2005). However its implementation in different healthcare settings varies significantly therefore making recommendations on its provision difficult (Ellis and Langhorne 2005). This study provided a detailed description of the provision of multi-disciplinary interventions and the amount of therapy-time participants underwent. The association of frailty with the amount of therapy-time was examined to gain a greater understanding of the relationship between frailty and multi-disciplinary processes.

The concept of frailty and its interaction with disability, co-morbidity and psychosocial functioning has been well established in community-based studies however its association in the hospital setting is poorly understood. Epidemiological evidence has determined that frailty is associated with elements of psycho-social functioning such as reduced quality-of-life, social participation and psychological distress (Rizzoli et al., 2013). Fear of falling is prevalent in hospitalised older adults and has been reported to be a predictor of poor functioning and reduced quality-of-life (Denkinger et al., 2010). Establishment of the association of frailty and the psycho-social elements of quality-of-life and fear of falling in the post-acute population is not clear. The aim of this study was to examine the association
between frailty, quality-of-life and fear of falling. This will enable a holistic understanding of the association of frailty and psycho-social domains of health and ageing in the older person undergoing inpatient rehabilitation.
CHAPTER 1 LITERATURE REVIEW

1.1 Frailty

1.1.1 Definition

Frailty is a commonly used term among the scientific and clinical fields of health and ageing. It is broadly accepted to be a multi-dimensional syndrome characterised by decreased physiological reserve and a diminished response to stressors (Rodriguez-Manas et al., 2013). Consequently, physiological homeostasis is compromised (Lang et al., 2009), and frail individuals become vulnerable to adverse events such as functional decline, falls, hospitalisation, institutionalisation and mortality (Macklai et al., 2013, Romero-Ortuno and Kenny 2012, Wang et al., 2013, Lang et al., 2009). The Irish Longitudinal Study of Ageing (TILDA) has reported the prevalence of frailty in Ireland to be nearly eight percent (Savva et al., 2013). Its prevalence has been shown to increase with age, however large epidemiological studies have demonstrated and age-independent association with frailty, suggesting that it is related to the biological ageing process rather than chronological age (Romero-Ortuno et al., 2011, Santos-Eggimann et al., 2009, Fried et al., 2001). Rockwood et al (2004) add that frailty is due to a complex interplay of factors such as gender, lifestyle, social-economic background, co-morbidities and affective cognitive or sensory impairments.

1.1.2 Frailty Models

The concept of frailty has been refined from a single disability-based model to include a more dynamic, integrative model inclusive of biomedical and psychosocial aspects (Lang et al., 2009, Rodriguez-Manus et al., 2013). The two main conceptual constructs of frailty are the
phenotype model (Fried et al., 2001) and the cumulative deficit model (Mitniski et al., 2001). Fried et al’s (2001) phenotype model describes frailty as a biological syndrome that results from an accumulation of deficits across physiological systems. The authors examined the domains of weight-loss, exhaustion, grip-strength, gait-speed and low physical activity, with the presence of two of these symptoms defining the "pre-frail" state, and three or more defining the "frail" state. Mitnitski et al's (2001) Frailty Index conceptualises frailty as a multi-dimensional risk state measured by the quantity of health problems rather than the nature. No gold standard definition of frailty exists however the Frailty Operative Definition-Consensus Project (2013) gained agreement between an expert panel for a conceptual framework of frailty to comprise certain domains of health including assessments of physical performance, in particular gait-speed and mobility, nutritional status, mental-health and cognition (Rodrigues-Manas et al., 2013).

1.1.3 The Frailty Cycle

Evidence suggests that transitioning between different levels of frailty is possible. Lang et al (2009), using the phenotype method, state that the "pre-frail" state is usually clinically silent, where an individual has enough physiological reserve to withstand a stressor such as illness, injury or psychological distress. The "frail" and "frail complication" states are characterised by a slow incomplete recovery due to insufficient reserves to withstand these stressors. This can lead to a high-risk of adverse outcomes such as mortality, disability and institutionalisation (Lang et al., 2009). Binder et al's (2002) randomised controlled trial (RCT) demonstrated improvements in physical function and self-reported functional abilities in participants with mild to moderate levels of frailty following an exercise intervention. Gill et al (2002) have shown in their large prospective sample of frail individuals, that
transitioning from a greater frailty to a lesser frailty is possible but is less frequent that a transition to worsening frailty. Evidence suggests that frailty is a dynamic process where recovery within frailty states is achievable.

1.2 Domains of Frailty

1.2.1 Frailty, Disability and Co-morbidity

The World Health Organisation's International Classification of Functioning and Disability describes disability as an encompassing term of problems experienced by individuals at the level of the body, the individual, and the individual in society. Frail older people demonstrate disability at each of these levels. Impairments include sarcopenia and muscle weakness. Activity limitations of walking and activities of daily living (ADL) are common (Fried et al., 2004, Rochat et al., 2010). Furthermore, up to 80% of frail older people have experienced restricted participation in life roles (Fairhall et al., 2011).

Many authors believe that disability is a consequence of frailty and not a causal factor (Fried et al 2001, Ferrer et al., 2013). Fried et al (2001) differentiated frailty from disability demonstrating that only 27% of the participants identified as being frail experienced difficulties in ADLs. In addition, frailty was present without co-morbidity or disability in 26.6% of frail participants. Recent research by Theou et al (2012) demonstrated that disability and co-morbidity are more frequent with increasing levels of frailty. This was particularly true for Instrumental ADLs (IADLs) and bathing as they are considered higher order self-care activities. Furthermore, Theou et al (2012) demonstrated in a large sample of 2,305 older persons, that 91.4% of frail participants had both disability and co-morbidity.
Frailty has been shown to be associated with co-morbidities particularly cerebrovascular, chronic kidney and cardiovascular disease (Chang et al., 2012). Frailty, disability and chronic diseases are considered separate concepts however they occur more frequently with higher frailty states.

1.2.2 Sarcopenia

Sarcopenia is viewed as a key element of the frailty process (Cruz-Jentoft et al., 2010, Ahmed et al., 2007, Fried et al., 2001, Topinkova 2008). The European Working-Group on Sarcopenia in Older People defined it as a syndrome characterised by progressive and generalised loss of skeletal muscle-mass and strength with a risk of adverse outcomes such as disability, poor quality-of-life and death (Cruz-Jentoft et al., 2010). Similar to frailty it is more prevalent with increasing age (Cruz-Jentoft et al., 2010). Poor mobility and lack of physical activity are major factors in the pathogenesis of sarcopenia with researchers stating its direct link to frailty markers of weakness, slow gait-speed and reduced grip-strength (Gill et al., 2002, Fried et al., 2001, Ahmed et al., 2007). Similar to frailty, sarcopenia has been shown to increase the risk of falls, fractures, hospitalisation, dependency, frailty and mortality (AbellanVanKan et al., 2009, Legrande et al., 2013).

1.2.3 Psychosocial Functioning

Psychosocial functioning encompasses characteristics such as mental-health functioning (depression, anxiety) and social engagement (isolation) (Schnittiger et al., 2013). It has been reported that as much as 90% of frail older people experience psychosocial dysfunction (Bielderman et al., 2013). There is evidence of a substantial interaction between frailty,
mental-health functioning, participation-restriction, health and mortality in the older population (Schnittiger et al., 2013, Boyd et al., 2009, Scheffer et al., 2008). However their direct relationship is poorly understood. In Ireland, 6% of older women and 7% of older men are socially isolated (TILDA 2011). TILDA studies have found that socially isolated older people are more likely to have poorer self-rated health and lower quality-of-life compared to their healthier counterparts.

Fear of falling, a psychological sequelae of falling, can be defined as a "low perceived self-efficacy at avoiding falls during essential, nonhazardous activities of daily living" (Tinetti et al., 1990). It has demonstrated strong associations with many negative outcomes including functional decline (Deshpande et al., 2008), worsening gait-speed (Denkinger et al., 2010) as well as longer length of stay (LOS) in hospitalised older adults (Bula et al., 2008). No evidence concerning the association between frailty and fear of falling in the hospitalised older adults exists.

Frailty encompasses many overlapping domains. However, there remains little evidence of the impact of frailty on these domains in the older adult undergoing post-acute rehabilitation. These interactions are important aspects to assess in the older population and enable the clinician to gain a greater understanding of the older person rehabilitation needs.

1.2.4 Frailty and Adverse Health Outcomes

Frailty has shown a strong predictive ability for adverse health outcomes in large cohort studies, demonstrating a higher risk of mortality, disability, institutionalisation and hospitalisation in frail persons. Large epidemiological cohort studies by Woods et al (2005)
and Bandeen-Roache et al (2006) confirm that mortality-risk is associated with frailty, independently of disability and chronic disease. Furthermore, Romero-Ortuno and Kenny (2012) demonstrated an age-independent association between higher frailty and higher mortality. Macklai et al (2013) found that frailty was independently associated with developing mobility, IADL and ADL disability over a two-year follow-up period. Additionally, they demonstrated in a pre-frail group, that the risk of functional decline and morbidity was still present but the magnitude of effect was slightly lower compared to the frail group. Single-markers of physical frailty (gait-speed and physical activity) have also shown a high predictive power for ADL disability (Vermeulen et al., 2011).

Wang et al's (2013) meta-analysis found that frailty was associated with a higher risk of hospitalisation and institutionalisation. Kiely et al (2009) found that the odds of emergency visits for frail older adults were higher compared to non-frail older adults. Wang et al (2013) add that for older adults over 80 years, frailty, disability and multiple co-morbidities are strongly associated with hospitalisation. Furthermore, Rockwood et al (2004) also demonstrated a higher risk of institutionalisation for mild (adjusted risk-ratio 2.54, 95% Confidence Interval (CI) 1.67-3.86), moderate and severely (risk-ratio 2.60, 1.36-4.96) frail older populations compared with non-frail individuals. This suggests that level of frailty and not only the presence or absence of frailty is associated with institutionalisation. Frailty has demonstrated predictive ability in terms of mortality, disability, institutionalisation and hospitalisation.
1.3 Frailty and Hospitalisation

1.3.1 Frailty in the Hospitalised Older Person

Hospital associated decline reduces an older persons physical function and quality-of-life, increases their risk of mortality and healthcare costs (Boyd et al., 2008, Landefeld et al., 1995, Helvik et al., 2013). It is the process of disability which is caused by the effects of an acute illness on a vulnerable older adult and also by the constraints of the hospital environment unrelated to the illness. Poor nutrition, prolonged immobilisation, sacropenia and poly-pharmacy are all factors leading to the loss of independence in hospitalised older adults (Boyd et al., 2005, Creditor 1993). The prevalence of frailty has been reported to be between 24-94% in hospitalised older adults (Dent et al., 2013). Similarly to hospital associated decline, frailty in the hospitalised older adult is associated with worsening patient outcome, including worsening mobility, functional decline and increasing mortality.

Frailty in the hospitalised older person has been found to be a significant predictor of mortality, dependency, LOS and institutionalisation. Singh et al's (2012) prospective study of 265 acute older inpatients found frailty, measured by the FI, was strongly associated with worsening patient outcome (p<0.001), was a predictor of poor functional gain (Barthel Index (BI)) (p<0.001) on discharge and mortality (p<0.001) at one year follow-up. Predictors of outcome such as age, co-morbidity and poly-pharmacy showed no significant association with outcomes. Evans et al's (2014) larger observational study supports this finding that frailty (FI-Comprehensive Geriatric Assessment), in patients admitted to an acute ward, was independently associated with a higher 30-day mortality rate, institutionalisation and longer LOS. Roberts et al (2012) observational study demonstrated that higher grip-strength was associated with reduced LOS among older patients in a community hospital rehabilitation
ward. In addition, Kerr et al (2006) found that an improvement of 1kg in grip-strength was associated with a 3% increase in the likelihood of discharge to usual residence after adjusting for age and gender in acute older inpatients (Hazard Ratio 1.03; 95% CI 1.00, 1.07; p=0.05). The growing body of evidence suggests that frailty significantly influences the outcomes of hospitalised older persons.

The immediate influence of frailty on disability can last beyond hospital discharge and affect the functional dependency of older patients (Espinoza et al., 2005). Gill et al's (2010) ten-year prospective study examined the relationship between disability after hospitalisation or restricted activity, and frailty. They demonstrated that frailty accentuated worsening disability. The absolute risk of transitioning from no disability to mild disability within 1 month after hospitalisation for frail participants was 34.9% and only 4.9% for non-frail participants. Considering frailty's predictive ability and its influence on outcomes of the older person following a hospital admission it should be incorporated in the assessment of the hospitalised older patient.

It is evident that there is a lack of validated frailty measures in the older post-acute population. In this study, the Canadian Study of Health and Ageing Clinical Frailty Scale was used. Rockwood et al (2005) developed it as an easily applicable frailty tool based on a clinical evaluations in the domains of mobility, energy, physical activity and function. It has been shown to correlate highly with the FI (r=0.8, p<0.01). Its predictive validity for risk of institutionalisation and mortality has been proven in a 5-year prospective study in the elderly population (Rockwood et al., 2005).
There is a lack of evidence determining the influence of frailty on older adults undergoing post-acute rehabilitation. Frailty is known to be changeable over time (Hubbard et al., 2009, Gill et al., 2010). Interventions that slow the rate of functional decline in the frail population will ultimately impact on morbidity and mortality (Gill et al., 2004). Prevention and management of disability in hospitalised, ageing and frail person is an important focus of rehabilitation and should be considered a key-goal of intervention.

1.3.2 Interventions to Reduce Frailty

Evidence suggests that exercise can improve frailty levels and function in older adults. A systematic review of exercise interventions for the management of frailty, demonstrated that exercise had a positive impact on some physical determinants and on all functional outcomes (Theou et al., 2011). However the majority of these studies did not use a validated definition of frailty therefore it is questionable whether participants in the studies were frail. No RCTs concerning exercise and its ability to improve frailty has been conducted in the post-acute older population. Consequently it is difficult to extrapolate valid conclusions.

The majority of evidence concerning exercise and its ability to improve frailty has been conducted in the community-dwelling population (Theou et al., 2011). Gill et al (2002) conducted an RCT of a home-based programme designed to prevent functional decline in a high-risk group of physically frail elderly persons. Participants were divided into two subgroups, moderately or severely frail, using two objective measures, gait-speed and sit-to-stand ability. The moderately frail (one frailty-marker) intervention group had significantly lower disability scores at seven and twelve months compared to the control group. The
severely (two frailty-markers) frail intervention and control groups showed no significant differences in disability scores. Exercise can improve an older person’s function however frailty status can impact on a participant’s ability to improve following an intervention.

An inter-disciplinary approach to managing frailty in older adults appears to be important to effect change in frailty level. Cameron et al's (2013) RCT investigated the effectiveness of an individualised interdisciplinary approach to improving frailty status in 216 community-dwelling older adults. The intervention group consisted of an inter-disciplinary treatment programme intended to target domains of frailty including; an exercise component (ten physiotherapy sessions), dietician, psychologist or psychiatrist and activity groups aimed to encourage greater social engagement. Intention to treat analysis was performed and significant differences were noted in the intervention group in relation to frailty status with between group differences of 14.7% at 12 months (95%CI, 2.4%, 27%,p=0.02) and improvement in mobility disability (1.44, 95%CI, 0.08, 2.07;p<0.001) in the intervention group at twelve months. An inter-disciplinary approach targeting all domains of frailty, physical, psychosocial as well as nutritional support are all important aspects of intervention to improve frailty levels in community-dwelling older adults.

An observational study of older adults undergoing post-acute multi-disciplinary rehabilitation demonstrated that a significant improvement in frailty status can occur in hospitalised older adults (Coleman et al., 2012). Although the sample was small (n=36), a significant improvement was noted in frailty status (p< 0.0001) and in many aspects of physical function after a period of specialist geriatric inpatient rehabilitation.
Evidence for the effectiveness of exercise in improving frailty in the hospitalised older adult is lacking. Frailty status can influence a person’s ability to improve following an exercise intervention. A growing body of evidence suggests that individualised inter-disciplinary intervention with an exercise component can improve frailty and mobility related disability in community-dwelling older adults. However the influence of frailty on physical determinants in the hospitalised older adult remains unclear. In this research study, change in frailty level was observed to establish if a frail cohort of participants can transition to a lesser level of frailty. The relationship between frailty and physical determinants of function was examined to gain a greater understanding of its effect on the post-acute frail older adult.

1.4 Geriatric Rehabilitation Models

1.4.1 Specialist Geriatric Rehabilitation

Specialised inpatient geriatric treatment for older adults has demonstrated beneficial effects on functional status, LOS, prevention of institutionalisation, mortality and health-related quality-of-life (Van Crean et al., 2010, Bachmann et al., 2010, Ellis et al., 2011, Cohen et al., 2002). A diversity of models exist due to differing healthcare systems (Beland and Hollande, 2013). However, the most commonly recognised inpatient models of rehabilitation include geriatric evaluation and management units (GEM), Acute care for Elders (ACE) units and intermediate care rehabilitation models. Two systematic reviews have found that rehabilitation in these specialised, dedicated wards have increased the likelihood of functional improvement and lowered the need for institutional care (Bachmann et al., 2010, Van Crean et al., 2010)).
Van Craen et al (2010) and Ellis and Langhorne's (2005) systematic reviews identified common characteristics of a rehabilitation unit to include a specialised multi-disciplinary team (MDT), who hold regular meetings, and set MDT patient-centred goals and interventions based on a comprehensive geriatric assessment (CGA). A CGA has been defined as "a multi-dimensional inter-disciplinary diagnostic process used to determine the medical, psychological and functional capabilities of a frail elderly person to develop a co-ordinated and integrated plan for treatment and long term follow-up" (Ellis et al., 2011). It is recognised as an integral part of the process of rehabilitation delivery however its implementation is poorly described.

1.4.2 Comprehensive Geriatric Assessments

Evidence for the use of a CGA is well established as Ellis et al's (2011) systematic review demonstrated that hospitalised patients are likely to be alive and residing at home due to its implementation. Cohen et al's (2002) RCT investigated the effect of specialist geriatric rehabilitation with a CGA and MDT input delivered on a GEM unit compared to usual inpatient care. The intervention group received a CGA from all MDT members while the control group received usual inpatient care from all disciplines. A significant improvement in ADL performance (Katz Scale and Physical Performance Test) and health-related quality-of-life was found. However, MDT intervention was unspecified and lacked adequate description.
Similar to Cohen et al (2002), Landefeld et al (1995) demonstrated improved functional outcomes on a specialist geriatric ACE unit (n=615). All MDT members were involved in a CGA, patient-centred goal setting, daily MDT ward rounds and early discharge planning. However, specific recommendations for MDT intervention or exercise activity cannot be taken from these studies.

There is evidence that rehabilitation provided in an intermediate care setting is effective in reducing LOS and improving independence (Griffiths et al., 2000). Young et al (2002) conducted a multi-centre RCT of post-acute care in community hospitals compared to rehabilitation in large teaching hospitals. Community hospitals were mainly geriatric consultant-led units which provided a CGA including an MDT assessment and treatment, individualised care plans, therapy and close involvement of social service staff. Young et al (2002) demonstrated a statistically significant difference in the intermediate rehabilitation setting in terms of independence at six months post-discharge (mean difference=3.27, 95% CI=0.26-6.28; analysis of co-variance p=0.03). However within this multi-centre study the delivery of rehabilitation was heterogeneous and lacking adequate description therefore limiting its clinical applicability.

It is clear that better patient outcomes are due to a CGA and its implementation. However it lacks adequate description of its delivery and composition. Observational research by Jette et al (2005) examined the relationship between therapy intensity, functional outcomes and LOS in 4988 patients who underwent rehabilitation in post-acute care settings. They categorised total therapy intensity into 3 groups: less than 1 hour per day, 1-1.5 hours per day, and more than 1.5 hours per day. Higher therapy intensity was associated with a shorter LOS and
improvements in functional independence. Higher intensities of both physiotherapy and occupational therapy were associated with better outcomes in ADL domains. Kirk-Sanchez and Roach (2001) found similar results for an inpatient orthopaedic cohort, indicating that total hours of physiotherapy and occupational therapy predicted mobility at discharge from acute rehabilitation. This evidence suggests that the higher amount of therapy-time lead to better functional outcomes for patients undergoing rehabilitation. In this study, amount of time spent in therapy as differentiated to therapy intensity was observed. This may provide a more comprehensive description of the delivery of therapy.

It is clear that rehabilitation on a dedicated specialist geriatric ward with use of a CGA and an MDT approach can result in functional improvements, prevention of institutionalisation and an improvement in quality-of-life. The presented evidence highlights the heterogeneous way in which rehabilitation units are organised and implemented into practice thus making comparisons difficult.

1.5 Conclusion

Frailty is a multi-dimensional syndrome characterised by decreased physiological responses to stressors. It is highly prevalent in hospitalised older adults and leaves the frail patient at a high-risk of adverse outcomes including disability, falls, institutionalisation, longer LOS and mortality. In the literature, there is a lack of evidence examining the interaction of specific outcome measures with frailty. In this study, the Clinical Frailty Scale was used to assess frailty.
Transitioning between frail states is achievable but difficult to target due to its complex interactions in older adults. There is little evidence examining the interventions in the hospitalised older adult to reverse frailty. However it is recognised that MDT implementation of a CGA on a specialist geriatric rehabilitation unit is fundamental to successful rehabilitation. In this study, functional recovery was assessed utilising performance-based outcome measures to determine the effect of frailty on function following post-acute MDT rehabilitation.

The influence of frailty on physical determinants of function, quality-of-life and falls self-efficacy in the hospitalised older adult remains poorly understood. This study allowed an accurate description of the therapy received and gave the clinician a broad understanding of the influence of frailty on the post-acute frail older persons response to rehabilitation.

The aims of this study were firstly to evaluate the improvement in physical function, quality-of-life and falls self-efficacy and secondly to examine the association between an older persons level of frailty and their outcomes following post-acute rehabilitation.
CHAPTER 2 METHODOLOGY

2.1 Aims and Objectives

The primary aim of this research was to evaluate the changes in physical function, quality-of-life and falls self-efficacy in frail older adults undergoing inpatient rehabilitation. A secondary aim was to examine the association between frailty and participant's rehabilitation outcomes.

2.1.1 Objectives

1. To evaluate changes in frailty, functional mobility, balance, strength, functional dependence, quality-of-life and falls self-efficacy.

2. To examine the association between frailty on admission and rehabilitation outcomes (outlined in objective 1), discharge destination and length of stay.

3. To describe the content of physiotherapy and occupational therapy and examine the association between frailty on admission and the amount of time spent in therapy.

2.2 Design

This was a prospective cohort study design investigating changes in physical function, quality-of-life and self-efficacy. The study design was developed using the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) statement guidelines to ensure methodological validity (VanElm et al., 2008).
2.3 Subjects

2.3.1 Sample Selection

Participants were recruited from consecutive admissions to the 36-bed post-acute multi-disciplinary (MDT) rehabilitation unit in Cappagh Hospital. Recruitment took place over a 5 month period between mid-August 2013 and January 2014.

2.3.2 Inclusion and Exclusion Criteria

To be eligible for the study participants must have been patients admitted to the rehabilitation unit with a defined rehabilitation need.

Inclusion criteria:

Participants over the age of 65 years willing and able to give informed consent and who were mobile pre-admission to the acute hospital were included in the study.

Exclusion criteria:

- Patients who were unable to consent to study participation.
- Inability to mobilise pre-admission to the acute hospital.
- Acute amputees as they would be unable to complete some physical assessments
- Severe communication problems and/or inability to comply with simple instructions.

This criteria is similar to an observational study by Denkinger et al., (2010). A participant may be unable to comprehend the nature and scope of the study therefore informed consent cannot be obtained.
A power calculation was derived from previously published normative data for an inpatient rehabilitation population. A pre-test post-test study by Brooks et al (2006) examined changes in the Timed Up and Go (TUG) test in a geriatric inpatient population undergoing rehabilitation. A sample size of 41 subjects was required to have an 80% power to detect a difference in TUG of 3 seconds, assuming a standard deviation of 6.9 seconds and with an alpha of 5% (Brooks et al 2006).

2.4 Ethical Considerations

Application for Ethical approval was sought from Cappagh Hospitals Research Ethics Committee (Appendix 1). Recruitment commenced following approval by the ethics committee (Appendix 2). The data collected was stored under the Data Protection Act (2003) and the Data Guidance on Research in Health Sector (2007). To uphold participant confidentiality, each participant was given a unique code. This was then used as the only identifiable marker on all record sheets and electronic records. The principal investigator (PI) had access to a separate Excel file which linked the codes to the participants. Electronic records were stored on a secure encrypted memory stick and a password protected desktop computer in Cappagh Hospital. Paper records and the encrypted memory stick were stored in a locked cabinet on the ward in Cappagh Hospital. Data will be stored securely for five years.
2.5 Assessment Procedure

2.5.1 Informed Consent

The selection criterion was applied to all patients admitted to the rehabilitation unit. Eligible participants were invited to enrol in the study by the gatekeeper (Appendix 3) and were provided with an information leaflet (Appendix 4) describing the purpose, nature and risks of the study, and asked to sign a consent form (Appendix 5). Participants were made aware of their ethical right to withdraw from the study without giving reason or personal consequences. The patient was given a 24-hour period of time to allow comprehension of the information given. Once informed consent was gained by the gatekeeper, the participant's physiotherapist began data collection.

2.5.2 Pilot-study

A pilot-study was designed to identify appropriate assessment procedures, risks or confidentiality issues. Two patients were recruited and were assessed by the PI. Timing of the physiotherapy assessments took approximately 45 minutes depending on the participants physical and cognitive abilities.

2.5.3 Initial Assessment Administration

Participants completed their initial assessments (T1) as soon as they were admitted to the rehabilitation unit. Demographic and baseline information was obtained from the participant's medical chart by the PI. This information included age, gender, presenting complaint, number of co-morbidities, current medications and details of living situation and was recorded on the Data Collection Form (Appendix 6).
Physiotherapy assessments at T1 and discharge (T2) included the TUG, 10 meter-walk-test, grip-strength, the Tinetti Balance and Gait assessment and the Elderly Mobility Scale (EMS). Due to time and staffing resources, blinding of assessors was not possible and the assessments were carried out by the treating physiotherapist. To ensure the assessment process was standardised, the PI conducted education session and provided written instructions on the assessment procedures. These assessments took place in the physiotherapy gym. The EuroQol-5D was an additional self-reported quality-of-life measure also administered by the treating physiotherapist at T1. If the participant was unable to complete all assessments at T1 due to fatigue, they were completed the following day. The equipment used included a stopwatch, ruler, grip-strength dynamometer, cone, chair, plinth and a 10-metre walkway.

The Barthel Index (BI), Falls Efficacy Scale (FES) and the Mini-Mental State Examination (MMSE) are part of routine occupational therapy assessments. These assessments were conducted by the treating occupational therapist and scores passed to the study PI. The Lubben Social Network Scale and the short-form Geriatric Depression Scale (GDS) were self-reported measures administered by the PI and completed after initial physiotherapy assessments at T1. Frailty status was established by gaining multi-disciplinary (MDT) consensus at the weekly MDT meeting using the Clinical Frailty Scale (CFS) (Rockwood et al., 2005). This was collected within the first week of a participants admission when MDT members assessments were completed.
2.5.4 Description of Rehabilitation Service

Participants received rehabilitation from the MDT which consisted of geriatrician-led medical care, nursing care, physiotherapy, occupational therapy, medical social work, pharmaceutical, clinical nutrition, speech and language therapy and podiatric interventions as required. Patients were admitted to the rehabilitation unit in Cappagh from two acute teaching hospitals for post-acute MDT rehabilitation. Participants received routine physiotherapy care consisting of a comprehensive assessment of patients impairments, activity limitations and participation restrictions. Interventions included gait re-education, mobility and transfer practice, balance exercises, upper and lower limb strengthening programmes, functional strengthening exercise and class-based exercises. Comprehensive assessments, patient-centred goal-setting, multi-component interventions and discharge planning from the MDT were undertaken. Twice-weekly MDT meetings took place on the rehabilitation unit to discuss and direct patient rehabilitation appropriately. Volunteers also facilitated recreational activities for some participants.

2.5.5 Discharge Assessment Administration

Discharge outcome measure assessments were completed 24-48 hours prior to discharge from the rehabilitation unit. Colleagues and participants were blind to participant's previous results. Data regarding outcome measure assessments and rehabilitation interventions was collated by the PI at T2 using and existing computer system routinely imputed by physiotherapy and occupational therapy colleagues. This included, number of therapy sessions, time (minutes) spent in therapy and descriptions of therapy interventions. To minimise recall bias when collecting amount and content of therapy, colleagues were encouraged to enter data into the database as soon as possible. The number of referrals to other disciplines was also recorded.
for each participant. At T2 the PI gathered hospital outcomes including; length of stay, discharge destination, additional social support. This information was obtained from an existing database routinely collated by nursing and social-work colleagues.

2.6 Baseline Clinical Evaluations

2.6.1 Mini-Mental State Examination

The MMSE is a cognitive screening tool that comprises 30-items evaluating memory, orientation and arithmetic (Appendix 7). It was first described by Folstein et al (1975) and is commonly used in clinical practice to screen for dementia (Strauss et al., 2006). Foreman et al (1987) demonstrated that it had good internal consistency in a medical inpatient population (chronbach alpha of 0.96) with Espino et al (2004) demonstrating a lower chronbach alpha of 0.31 in community-dwelling subjects. Floor and ceiling effects have been demonstrated and its dependence on educational level may be responsible for varying reliability scores (Crum et al., 1993).

2.6.2 Short-form Geriatric Depression Scale

The Short-form GDS was used to measure the perception of mood and early signs of depression (Appendix 8). It comprises 15-items requiring dichotomous yes/no responses. Each item was scored by assigning one mark for each pre-determined answer. Scores between 0-5 indicates normal or no depression with scores greater than 5 indicating depression (Yessavage et al., 1983). The short-form version is designed for administration to the medically unwell older adult. Wacanta et al., (2006) reported excellent criterion validity in a cognitively mixed older person population.
2.6.3 **Lubben Social Network Scale**

The Lubben Social Network Scale–6 (LSNS-6) is a self-reported measure of social connectedness (Appendix 9). The total score is an equally weighted sum of 6 items categorised into family and friendship subscales. Scores range from 0 to 30 with a cut-off of 12 or less defining a participant as at risk of social isolation or socially isolated (Rubinstein et al., 1994; Lubben et al., 2006). The validity and reliability of the LSNS-6 has been proven in a community-dwelling elderly population (Lubben et al., 2006).

2.7 **Outcome Measures**

2.7.1 **Canadian Study of Health and Ageing: Clinical Frailty Scale**

The CFS is a 9 point ordinal scale ranging from a level of 1 (very fit) to 9 (terminally ill) based on clinical opinion (Appendix 10). It has also shown high inter-rater reliability (intra-class correlation coefficient (ICC) 0.97, p<0.01) (Rockwood et al., 2005). It also correlates highly with the Frailty Index (r=0.8, p<0.01). In addition, Rockwood et al (2005) demonstrated that a one-category increment significantly increased the medium-term risk of death and entry into an institution when adjusted for age, sex and education.

2.7.2 **Grip-Strength**

Grip-strength was measured by a BASELINE Hand-Dynamometer. Tager et al (1998) and Bohannon (2008) have proven its validity and reliability in an older population. Grip-strength is associated with low physical performance in the very old (Legrand et al., 2013). Roberts et al (2012) demonstrated that a higher grip-strength was associated with reduced LOS among
older patients in a community rehabilitation hospital. Kerr et al (2006) demonstrated that an improvement in grip-strength was associated a greater likelihood of discharge to usual residence after adjusting for age and gender in acute older inpatients (HR 1.03; 95% CI 1.00, 1.07; p=0.05). The protocol used for administration is included in Appendix 11.

2.7.3 Timed-Up-and-Go

The TUG was the primary outcome measure in this study. It was developed by Podsiadlo et al (1991) and evaluates functional mobility by measuring the time taken to stand from a chair, walk 3 meters, turn around and return to the chair (Appendix 12). Brooks et al (2006) demonstrated that the TUG showed large responsiveness (standardised response mean=1.1) from admission to discharge in elderly inpatients undergoing rehabilitation. It has strong correlations with gait-speed (r=0.61) and the BI (Podsiadlo and Richardson 1991). Van Iersel et al (2008) also demonstrated that the TUG and gait-speed were the most sensitive to change in frail elderly inpatients. Savva et al., (2013) reported that the TUG is a sensitive and specific proxy for frailty in a large community-dwelling population.

2.7.4 Gait-Speed

Gait-speed was measured using the 10 meter walk test. It measures the time taken to walk 10 meters allowing for acceleration and deceleration (Appendix 13). Gait-speed is a useful screening tool for frailty in older adults (Kim et al., 2010). It has excellent test-retest and intra-rater reliability with ICC=0.87 to 0.88 (Collen et al., 1990). Studenski et al (2011) demonstrated that gait-speed is associated with mortality and dependency in older people. Its
responsiveness and clinical meaningful change estimates have been evaluated in an older population (Perera et al., 2006).

2.7.5 Elderly Mobility Scale

The EMS is a standardised validated scale for the assessment of mobility in frail elderly patients (Smith 1994). The scale assesses seven aspects of gait and ADL performance including gait speed, balance and bed mobility (Appendix 14). Excellent concurrent validity of the EMS and the BI (0.962) has been proven in hospitalised elderly patients (Smith 1994). Spilg et al (2001) demonstrated that the EMS is significantly more likely to detect mobility improvement than the BI.

2.7.6 Tinetti Balance and Gait Assessment

The Tinetti is a 16-item tool measuring older adults balance and gait abilities (Appendix 15). It has excellent inter (ICC=0.84) and intra-rater reliability (ICC 0.96) in an elderly population (Thomas et al., 2005, Sterke et al., 2010). This scale was chosen as it is suitable for orthogeriatric patients who may be under post-operative hip protocols.

2.7.7 Barthel Index

The BI is a 10-item scale assessing overall functional abilities in 10 ADLs (Mahony and Barthel, 1965) (Appendix 16). It has high inter-rater and intra-rater reliability (Wells et al., 2003). It is proven to be valid (DeMorton et al., 2008) and reliable (Sainsbury et al., 2005) in an older population.
2.7.8 *Euro-Qol-5D*

The EuroQol-5D is a self-reported measure of health-related quality-of-life, which contains ratings of perceived health-status with regards to mobility, self-care, usual activities, pain/discomfort and anxiety/depression (Anonymous 1990) (Appendix 17). These are ranked in order of nil, slight, moderate, severe or unable. A sixth question requires a person to score their perceived health-status on a visual analogue scale rated from 0-100. Validity and reliability have been proven in the older population (Haywood et al., 2005).

2.7.9 *Falls Efficacy Scale*

The FES was used to measure the level of concern/fear relating to falls (Tinetti et al., 1990). It comprises 10-items that relate to activities of daily living (Appendix 18). Powell and Myers (1995) demonstrated that it had excellent concurrent validity with the Activities specific Balance Confidence scale (r=0.84) in community-dwelling older adults. A large responsiveness between low and high mobility groups (effect size=1.2) was also shown. Adequate test-retest reliability (r=0.71) has also been shown (Tinetti et al., 1990).

2.8 *Statistical Analysis*

Statistical Package for the Social Sciences for statistical analysis version 21.0 was used to analyse the data. Data was examined for normality using normal probability plots and the Shapiro-Wilks test. Descriptive statistics were used to describe the baseline demographic and clinical evaluations of the group using parametric and non-parametric methods as appropriate. These were presented using tables and graphs. The significance of change in the outcome measures was calculated using the Wilcoxon Signed Rank Test for non-parametric
data. Change in grip-strength was evaluated using the paired t-test as it was parametric data. Changes in mobility and transfer status were evaluated using the McNemar test as they were recorded as dichotomous variables (dependent or independent).

The correlation between frailty at T1 and the measures for physical function, quality-of-life and falls self-efficacy were calculated using a Spearman rank-order correlation co-efficient test for non-parametric data. Cohen's (1988) guidelines on interpretation of the r value were used to examine the strength of the relationship with 0.1-0.29 indicating a low strength of correlation, 0.3-0.49 indicating a medium strength of correlation and 0.5-1.0 indicating a large strength of correlation. The percentage variance was calculated by squaring the r value and multiplying this by 100. This allowed estimation of the amount of variation in participant outcomes that could be attributed to the measure of frailty. Once a significant association was established subgroups of frailty level (mild, moderate and severe) were described using median scores as data was not normally distributed. Regression analysis was performed on the outcome variables ( ), while controlling for CFS on admission, to examine its predictive ability on LOS, therapy-time, BI and X at discharge. The results are presented in chapter three.
CHAPTER 3 RESULTS

3.0 Introduction

The primary aim of this research was to evaluate the changes in physical function, quality-of-life and falls self-efficacy in frail older adults undergoing inpatient rehabilitation. A secondary aim was to examine the association between frailty and participant's rehabilitation outcomes.

The objectives were:

1. To evaluate changes in frailty, functional mobility, balance, strength, functional dependence, quality-of-life and falls self-efficacy.

2. To examine the association between frailty on admission and rehabilitation outcomes (outlined in objective 1), discharge destination and length of stay.

3. To describe the content of physiotherapy and occupational therapy and examine the association between frailty on admission and the amount of time spent in therapy.

3.1 Participant Flow

Recruitment took place from mid-August 2013 to January 2014. Ninety-six patients were admitted to Cappagh Hospitals rehabilitation unit and screened for inclusion. Sixty-six were eligible for inclusion in the study with 51 consenting to participate. The final study sample was 41 participants. The flow of patients in the study is outlined in Figure 3.1.
The mean (±SD) age of the participants was 80.3 (±7.1) years with 63.4% (n=26) being female. Ninety-five percent (n=39) of participants were admitted from an acute hospital setting and 5% (n=2) from the geriatric outpatient clinic. The median (IQR) number of co-morbidities of the sample was 4 (2). The participants required a mean (±SD) of 10.7 (±3.6) medications and all had polypharmacy (taking >4 medications). Over half (53.7%, n=22) of the sample lived alone. Only two participants (4.9%) were independent with mobility. Baseline demographic data is presented in Table 3.1.
Table 3.1  Baseline Demographic Data (n=41)

<table>
<thead>
<tr>
<th>Baseline Characteristics</th>
<th>Mean (±SD)</th>
<th>% (n=number of participants)</th>
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</thead>
<tbody>
<tr>
<td>Age</td>
<td>80.3 (±7.1) years</td>
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</tr>
<tr>
<td>Gender</td>
<td></td>
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<tr>
<td>Female</td>
<td>63.4% (n=23)</td>
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<tr>
<td>Male</td>
<td>36.6% (n=18)</td>
<td></td>
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<tr>
<td>Presenting Condition</td>
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<tr>
<td>Falls and fracture</td>
<td>21.9% (n=9)</td>
<td></td>
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<tr>
<td>Falls</td>
<td>19.5% (n=8)</td>
<td></td>
</tr>
<tr>
<td>Cardiac Conditions</td>
<td>14.6% (n=6)</td>
<td></td>
</tr>
<tr>
<td>Respiratory tract infection</td>
<td>4.9% (n=2)</td>
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<tr>
<td>Venous leg ulceration</td>
<td>4.9% (n=2)</td>
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<tr>
<td>Spinal surgery</td>
<td>4.9% (n=2)</td>
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<tr>
<td>Acute neurological conditions</td>
<td>4.9% (n=2)</td>
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<tr>
<td>(subdural haematoma, MG)</td>
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<td></td>
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<tr>
<td>Other; Sepsis, gastrointestinal bleed</td>
<td>24.4% (n=10)</td>
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<tr>
<td>and surgery, septic and rheumatoid</td>
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<td></td>
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<tr>
<td>arthritis, hyponatraemia, malaise, UL</td>
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<tr>
<td>fracture</td>
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<tr>
<td>Mobility status</td>
<td></td>
<td></td>
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<tr>
<td>Independent with aid</td>
<td>4.9% (n=2)</td>
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<tr>
<td>Supervision</td>
<td>43.9% (n=18)</td>
<td></td>
</tr>
<tr>
<td>Assistance</td>
<td>48.8% (n=20)</td>
<td></td>
</tr>
<tr>
<td>Unable to mobilize</td>
<td>2.4% (n=1)</td>
<td></td>
</tr>
<tr>
<td>Transfer status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Independent with aid</td>
<td>2.4% (n=1)</td>
<td></td>
</tr>
<tr>
<td>Supervision</td>
<td>14.5% (n=17)</td>
<td></td>
</tr>
<tr>
<td>Assistance</td>
<td>56.1% (n=23)</td>
<td></td>
</tr>
<tr>
<td>History of falls</td>
<td>51.2% (n=21)</td>
<td></td>
</tr>
<tr>
<td>Number of co-morbidities</td>
<td>Median (IQR)</td>
<td>4 (2)</td>
</tr>
<tr>
<td>Number of medications</td>
<td>Mean (±SD)</td>
<td>10.7 (±3.6)</td>
</tr>
</tbody>
</table>

SD=standard deviation, IQR=inter-quartile range

Approximately forty percent (41.5%, n=17) were admitted having sustained a fall. Over half (n=9) of these falls resulted in a fracture including; hip (n= 5), pubic rami (n=2), femoral (n=1) and tibial (n=1). Of the other 8 participants who fell without sustaining a fracture, 4 had a diagnosis of Parkinson's disease. Cardiac conditions accounted for 14.6% (n=6) of the presenting conditions.
3.3 Clinical Profile on Admission

The majority (58.5%, n=24) of the sample were classified as "moderately frail" (CFS 6) with 24.4% (n=10) classified as "severely frail" (CFS 7) and 14.5% (n=6) as "mildly frail" (CFS 5) on admission (Rockwood et al., 2005). Only one person (2.4%) was classified as "vulnerable" (CFS 4). Frailty demonstrated a strong positive association with age (r=0.408, sig 0.008). The mean (±SD) Barthel Index score of 63.1(±16.3) indicated a moderate level of dependency (Shah et al., 1989). Only two participants (4.9%) were independent with mobility and one was classified as "mildly" frail (CFS 5) and one as "vulnerable" (CFS 4) on admission. All of the "severely" and "moderately" frail participants (n=34) required assistance or supervision to transfer and mobilise on admission. Seventeen percent (n=8) of the sample were considered socially isolated as indicated by a score of 12 or less on the Lubben Social Network Score (LSNS) (Lubben et al., 2006). The median (IQR) GDS score was 3 (3) with 14.6% (n=6) of the sample showing signs of depression. The median (IQR) MMSE score was 25 (7). The participants median (IQR) EQ-5D VAS (self-rated health status) was 60(25). A clinical profile of participants on admission is presented in Table 3.2.

Table 3.2 Clinical Profile on Admission (n=41)

<table>
<thead>
<tr>
<th>Baseline Clinical Evaluations</th>
<th>Median (IQR)</th>
<th>Mean (±SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFS</td>
<td>6 (1)</td>
<td>16.7 (±4.7)</td>
</tr>
<tr>
<td>MMSE</td>
<td>25 (7)</td>
<td></td>
</tr>
<tr>
<td>GDS</td>
<td>3 (3)</td>
<td></td>
</tr>
<tr>
<td>LSNS</td>
<td>63.1(±16.3)</td>
<td></td>
</tr>
<tr>
<td>Functional Dependence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barthel Index</td>
<td>60(25)</td>
<td></td>
</tr>
<tr>
<td>Measures of Participation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EQ-5D VAS</td>
<td>75(32)</td>
<td></td>
</tr>
</tbody>
</table>

MMSE=Mini-mental state examination, IQR=Interquartile range, SD=Standard Deviation, GDS=Geriatric depression score, LSNS=Lubben Social Network Score, CFS=Clinical Frailty Score, EQ-5D-VAS= EuroQol 5DVisual analogue scale, FES=Falls efficacy Scale
3.4 Multi-disciplinary Interventions

All participants were referred to, and received both, physiotherapy and occupational therapy assessments and treatments from Monday to Friday. Therapy intervention was individualised by the treating therapists. All participants received gait and balance re-education and lower limb exercises. Table 3.3 provides a description of the multi-component interventions provided by the physiotherapy and occupational therapy professions.

Table 3.3 Physiotherapy and Occupational Therapy Interventions

<table>
<thead>
<tr>
<th>Intervention</th>
<th>% (n=number of participants)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physiotherapy</strong></td>
<td></td>
</tr>
<tr>
<td>Gait re-education</td>
<td>100% (n=41)</td>
</tr>
<tr>
<td>Balance re-education</td>
<td>100% (n=41)</td>
</tr>
<tr>
<td>LL exercises</td>
<td>100% (n=41)</td>
</tr>
<tr>
<td>Aerobic training</td>
<td>95.1% (n=39)</td>
</tr>
<tr>
<td>UL exercise</td>
<td>65.9% (n=27)</td>
</tr>
<tr>
<td>Respiratory</td>
<td>23.4% (n=10)</td>
</tr>
<tr>
<td><strong>Occupational Therapy</strong></td>
<td></td>
</tr>
<tr>
<td>Graded ADL/PADL Practice</td>
<td>100% (n=41)</td>
</tr>
<tr>
<td>Seating/pressure Assessment &amp; Management</td>
<td>100% (n=41)</td>
</tr>
<tr>
<td>Falls prevention education</td>
<td>87.8% (n=36)</td>
</tr>
<tr>
<td>Home assessment</td>
<td>48.8% (n=36)</td>
</tr>
<tr>
<td><strong>Provided by both PT and OT</strong></td>
<td></td>
</tr>
<tr>
<td>Exercise provided in class setting: Balance (PT),</td>
<td>100% (n=41)</td>
</tr>
<tr>
<td>LL strengthening (PT), UL dexterity (OT)</td>
<td></td>
</tr>
<tr>
<td>Transfer training</td>
<td>100% (n=41)</td>
</tr>
</tbody>
</table>

LL = Lower limb, UL = Upper-limb, ADL = Activities of Daily Living, PADL = Personal Activities of Daily Living, PT = Physiotherapy, OT = Occupational Therapy

The mean (±SD) number of hours of therapy input was 23 (±10.7). The median (IQR) number of therapy sessions, including physiotherapy and occupational therapy, received by each patient was 28 (18). On average participants spent 49.3 minutes in one therapy session. In addition, 90.1% (n=37) were referred to the medical social worker, 78% (n=32) received dietician intervention, 49% (n=20) received podiatric treatment and 4.9% (n=4) received
speech and language therapy. The bar chart below presents the median number of minutes spent in therapy per frailty classification.

![Bar chart showing median minutes/session per frailty level]

**Figure 3.2 Frailty Level and Therapy-time per Session (n=40)**

### 3.5 Length of Stay and Discharge Destination

The median(IQR) LOS in the rehabilitation unit was 35 (29) days. Two participants were transferred to transitional care while awaiting long-term care. Of the participants discharged home (n=39), 46% (n=18) did not require any home-care support, 26% (n=10) required a new home-care package (HCP), 18% (n=7) required an increase in their HCP with 10% (n=4) remaining with their pre-admission HCP.
3.6 Changes in Frailty Level

At T2, 73.2% (n=30) of the participants had improved their frailty status from T1. Nearly one quarter (24.9 %, n=10) improved to either the "managing well" (CFS 3) or "vulnerable" classifications. Approximately twenty seven percent (n=11) of participants did not improve their frailty stage, with the majority of these participants (8/11) remaining in the "moderately frail" category. One participant remained in the "severely frail" classification and two remained in the "mildly frail" classification. None of the sample regressed in their frailty status. Figure 3.2 demonstrates the transitions between frailty levels.

![Changes in Frailty from Admission to Discharge](image)

**Figure 3.3** Changes in Frailty from Admission to Discharge (n=41)
3.6.1 Changes in Frailty and mobility/transfer status

Mobility and transfer status at T1 and T2 were dichotomised into dependent or independent. McNemar's tests showed a significant change in the proportion of participants who achieved independence in mobility and transfer abilities following rehabilitation (Mobility: Exact Sig. 2 tailed = 0.00, n = 41. Transfer: Exact Sig. 2 tailed = 0.00, n = 41). Two participants who were classified as "severely frail" (CFS 7) did not achieve independence with mobility or transfers at discharge. Two "moderately frail" (CFS 6) participants did not achieve independence with mobility at discharge with one of these participants remaining dependent for transfers also.
3.6.2  Changes in Rehabilitation Outcomes from T1 to T2

This study's primary outcome measure was the TUG. Participants median (IQR) score decreased from 42.5(34.5) seconds on admission to 20.1(20.4) seconds at discharge. There were significant change in all outcome measures; TUG, 10MWT, EMS, Tinetti Balance and Gait, BI, the EQ-5D-VAS and FES from T1 to T2. Details are presented in Table 3.4.

Table 3.4  Changes in Outcome Measures from T1 to T2 (n=41)

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
<th>Test Result</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median (IQR)</td>
<td>Median (IQR)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFS (1-7)</td>
<td>6 (1)</td>
<td>5 (2)</td>
<td>z = -5.06</td>
<td>p ≤ 0.001*</td>
</tr>
<tr>
<td>TUG (sec)</td>
<td>42.5(34.5)</td>
<td>20.1 (20.4)</td>
<td>z = -5.34</td>
<td>p ≤ 0.001*</td>
</tr>
<tr>
<td>10MWT (sec)</td>
<td>28.5 (16.5)</td>
<td>15.5 (13.8)</td>
<td>z = -5.19</td>
<td>p ≤ 0.001*</td>
</tr>
<tr>
<td>EMS (0-20)</td>
<td>13(5)</td>
<td>17 (4)</td>
<td>z = -5.38</td>
<td>p ≤ 0.001*</td>
</tr>
<tr>
<td>Tinetti (0-28)</td>
<td>17 (7)</td>
<td>24 (9)</td>
<td>z = -4.99</td>
<td>p ≤ 0.001*</td>
</tr>
<tr>
<td>BI (0-100)</td>
<td>65 (25)</td>
<td>90 (25)</td>
<td>z = -5.53</td>
<td>p ≤ 0.001*</td>
</tr>
<tr>
<td>EQ-5DVAS (0-100)</td>
<td>60 (25)</td>
<td>75 (20)</td>
<td>z = -4.20</td>
<td>p ≤ 0.001*</td>
</tr>
<tr>
<td>FES (0-100)</td>
<td>75 (34)</td>
<td>94 (17)</td>
<td>z = -4.60</td>
<td>p ≤ 0.001*</td>
</tr>
<tr>
<td>Grip-strength</td>
<td>Mean (±SD)</td>
<td>Mean (±SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right(kgs)</td>
<td>13.2 (±8.2)</td>
<td>14.3 (±8.1)</td>
<td>t = -2.06</td>
<td>p &lt; 0.0005*</td>
</tr>
<tr>
<td>Left(kgs)</td>
<td>13.9 (±7.8)</td>
<td>15.1 (±7.6)</td>
<td>t = -3.31</td>
<td>p &lt; 0.0005*</td>
</tr>
</tbody>
</table>

*Significant at p ≤ 0.05 level T1=Admission, T2=Discharge, IQR=Interquartile range, SD=standard deviation, TUG=Timed Up and Go, CFS=Clinical Frailty Scale, 10MWT=10-meter-walk-test, BI=Barthel Index, EQ-5D-VAS=EuroQoL Visual Analogue Scale, FES=Falls Efficacy Scale, kgs=kilograms.
3.7 Frailty and its Association with Rehabilitation Outcomes

Moderate and strong correlations existed between frailty level on admission and the TUG, 10MWT, Tinetti, EMS and BI scores. No relationship existed between frailty and grip-strength, EQ-5DVAS or FES scores. Below is a table summarising the significance and strength and variance of the relationship between the CFS and each rehabilitation outcome.

Table 3.5 Correlations between Frailty and Rehabilitation Outcome Measures

<table>
<thead>
<tr>
<th>FRAILTY T1 Outcome Measures at T2</th>
<th>Correlation Co-efficient</th>
<th>Sig</th>
<th>Variance</th>
<th>Intensity of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>TUG</td>
<td>0.438</td>
<td>0.0004**</td>
<td>19.2%</td>
<td>Moderate positive</td>
</tr>
<tr>
<td>10MWT</td>
<td>0.408</td>
<td>0.009**</td>
<td>16.6%</td>
<td>Moderate positive</td>
</tr>
<tr>
<td>EMS</td>
<td>-0.50</td>
<td>0.001**</td>
<td>25%</td>
<td>Strong negative</td>
</tr>
<tr>
<td>Tinetti</td>
<td>-0.489</td>
<td>0.001**</td>
<td>23.9%</td>
<td>Moderate negative</td>
</tr>
<tr>
<td>BI</td>
<td>-0.459</td>
<td>0.003**</td>
<td>21.1%</td>
<td>Moderate negative</td>
</tr>
<tr>
<td>Mobility Level</td>
<td>0.22</td>
<td>0.167</td>
<td>4.8%</td>
<td>Not significant</td>
</tr>
<tr>
<td>EQ-5D-VAS</td>
<td>0.039</td>
<td>0.811</td>
<td>0.2%</td>
<td>Not significant</td>
</tr>
<tr>
<td>FES</td>
<td>-0.265</td>
<td>0.102</td>
<td>7%</td>
<td>Not significant</td>
</tr>
<tr>
<td>Grip-strength</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>-0.122</td>
<td>0.447</td>
<td>19.9%</td>
<td>Not significant</td>
</tr>
<tr>
<td>Left</td>
<td>-0.236</td>
<td>0.137</td>
<td>1.9%</td>
<td>Not significant</td>
</tr>
</tbody>
</table>

**Correlation significant at 0.01 levels (2-tailed)

Both TUG and the 10 meter-walk test (10MWT) scores had moderate positive correlations with frailty level on admission. This indicated that participants who were less frail on admission completed the TUG and 10MWT more quickly than the participants who were
more frail. The line-graph (Figure 3.4) below portrays the results of both outcome measures classified into frailty levels.

![Graph showing median seconds for TUG and 10MWT across frailty levels]

**Figure 3.4 Frailty Versus TUG and 10MWT (n=40)**

In sub-group analysis for gait-speed, "severely" frail participants median score was 0.37 meters/second (m/s), "moderately" frail participants scored 0.77 m/s and "mildly" frail participants took 0.74 m/s at discharge. The differences in frailty levels on admission predicted 19.2% of the variance observed in TUG scores and 16.6% of the variance in gait-speed at discharge.
The graph below portrays the negative correlations between frailty level and the EMS and Tinetti scores respectively. Participants who were less frail had better functional mobility and balance than their more frail counterparts at discharge. Frailty accounted for 25% and 23.9% in the variance of discharge EMS and Tinetti scores respectively.

![Graph showing correlations between frailty level and EMS/Tinetti scores]

Figure 3.5   Frailty Versus EMS and Tinetti (n=40)

A moderate negative correlation was found between frailty status on admission and the BI score at discharge. This demonstrates that the less frail the participants were on admission the less physically dependent they were at discharge. "Severely" frail participants median BI
score at discharge was 42.5, the "moderately" frail category scored 67.5 and the "mildly" frail category scored 82.5 points. Frailty levels on admission accounted for the 21.1% variance in the BI scores at discharge. The barchart below portrays this relationship.

![Bar chart showing BI scores for different frailty levels.](image)

**Figure 3.6 Frailty Versus BI (n=40)**

### 3.7.1 Frailty and its Associations with Discharge Destination and LOS

A moderate positive correlation existed between frailty and LOS which indicated that the frailer participant on admission had a longer LOS. The "severely" frail participants’ median LOS was 54.5 days, "moderately" frail participants was 33 and the "mildly" frail was 35.5 days. No significant association was found between frailty level on admission and discharge destination.
Table 3.6  Correlations between Frailty and Discharge Destination and LOS

<table>
<thead>
<tr>
<th>FRAILTY T1</th>
<th>Outcome Measures at T2</th>
<th>Correlation Co-efficient</th>
<th>Sig</th>
<th>Variance</th>
<th>Intensity of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Discharge Destination</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Home /LTC)</td>
<td>0.151</td>
<td>0.344</td>
<td>2.3%</td>
<td>Not significant</td>
</tr>
<tr>
<td></td>
<td>LOS</td>
<td>0.386</td>
<td>p=0.013*</td>
<td>14.9%</td>
<td>Moderate positive</td>
</tr>
</tbody>
</table>

* Correlation significant at 0.05 levels (2-tailed)

3.8  Frailty and Amount of Therapy Received

Moderate positive associations existed between frailty on admission and the amount of time spent in physiotherapy and occupational therapy combined. This indicates that if a participant’s frailty level was high on admission they underwent more therapy. This may also be due to the association with longer LOS.

Table 3.7  Correlations between Frailty, Amount of Therapy and Therapy Sessions

<table>
<thead>
<tr>
<th>FRAILTY T1</th>
<th>Therapy-time</th>
<th>Correlation Co-efficient</th>
<th>Sig</th>
<th>Variance</th>
<th>Intensity of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Therapy time</td>
<td>0.364</td>
<td>0.019*</td>
<td>13.2%</td>
<td>Moderate positive</td>
</tr>
<tr>
<td></td>
<td>Therapy session</td>
<td>0.388</td>
<td>0.012*</td>
<td>15.1%</td>
<td>Moderate positive</td>
</tr>
</tbody>
</table>

* Correlation significant at the 0.05 level (2-tailed)
3.9 Multivariate Regression

Multivariate regression was used to assess the ability of the CFS on admission to predict rehabilitation outcomes after controlling for several baseline factors including age, gender, MMSE, social-connectedness and number of co-morbidities. Frailty remained a significant predictor of outcome in the EMS (beta=-0.304, p<0.037), TUG (beta=0.033, p<0.047), BI (beta=-0.32, p<0.05) and gait-speed (beta=0.327, p<0.045) when the baseline confounders were controlled. Frailty was not a significant predictor of LOS or Tinetti when controlled for the baseline confounders.

3.10 Summary of Results

These results demonstrated statistically significant improvements in functional mobility, balance, strength, functional dependence, quality-of-life and falls self-efficacy of frail older people undergoing rehabilitation. A high proportion of participants successfully transitioned to a lesser level of frailty following rehabilitation.

Frailty on admission has a moderate influence on functional mobility, balance, gait-speed and physical dependency at discharge. No relationship existed between frailty on admission and grip-strength, quality-of-life, falls self-efficacy or discharge destination. A moderate positive association existed between frailty level on admission and amount of therapy received as well as LOS. Regression analysis demonstrated that CFS on admission was a significant predictor of outcome in the EMS, BI, TUG and gait-speed when potential confounders were controlled. These results will be discussed in Chapter 4.
CHAPTER 4 DISCUSSION

4.1 Introduction

This study found significant changes in impairment, activity limitation and participation restriction in frail older adults undergoing inpatient rehabilitation. Admission frailty level, as measured by Rockwood et al's (2005) Clinical Frailty Scale, demonstrated a significant association with functional mobility, balance, gait-speed, functional dependence, amount of therapy received and LOS. Frailty level on admission did not demonstrate a relationship with mobility status, grip-strength, quality-of-life, falls self-efficacy or discharge destination.

4.2 Baseline Demographic Review

The baseline demographic and clinical evaluations of the study participants were comparable to related studies (Singh et al., 2012, Coleman et al., 2012, Haley et al., 2014). Similar to Haley et al (2014) and Coleman et al (2012), the mean (±SD) age of the sample was 80.3 (±7.1) years, with the majority being female. The median number of co-morbidities was four. There was a high level of poly-pharmacy (≥ 4 medications, 100%, n=41). Falls and fractures were the most common presenting condition which is comparable to Haley et al (2014). MMSE scores indicated impaired cognition while the GDS score of 3 indicated that the participants were not depressed. Similar to Coleman et al (2012) and Singh et al (2012), over half of the sample lived alone. A greater percentage (17%) of this sample were socially isolated compared to Irish population normative values of 6%-7% (TILDA 2011, Lubben et al., 2006).
The median(IQR) LOS was 35 (29) days. The National Clinical Care Program for the Older Person (HSE 2012) recommends a 6-week stay for post-acute rehabilitation of older persons. Similar lengths of stay have been reported. Elphick et al (2007) a reported a mean of 37 days. Landi et al (2002) reported a mean LOS of 45 days and Gosselin et al (2008) reported a higher mean of 58.6 days. LOS was substantially longer than that of Haley et al's (2014) median LOS of 19 days. This range may represent differences in hospital processes and health-service provisions.

The present study's sample was a heterogeneous group of frail older adults with an identified need for inpatient rehabilitation. Many had already suffered multi-system reductions in many domains associated with frailty including disability, co-morbid disease, falls and reduced cognition which in turn predisposes to adverse health outcomes.

4.3 Changes in Frailty

Evidence suggests that ability to recovery from frail states is substantially diminished by intervening hospitalisations. There is limited evidence characterising the change in frailty status of older adults in post-acute rehabilitation units (Gill et al., 2011). Clinically, the change in frailty status indicated that participants transitioned from being "moderately" frail (help with all outside activities, stairs and bathing and minimal assistance with dressing) to "mildly" frail (evident slowing and needing help in IADLs) at discharge (Rockwood et al., 2005). These results were similar to Coleman et al's (2012) small (n=36) observational study, which found a significant improvement in the CFS to the "mildly" frail category in a similar cohort of patients. None of the sample regressed in their frailty status further indicating a
positive view of post-acute rehabilitation even in the process of illness. However, twenty-seven percent of the sample did not improve their frailty status. The majority of these remained "moderately" and "severely" frail. This may reflect the process of incomplete recovery characterising frailty. Gill et al's (2002) RCT demonstrated that worse frailty states have a diminished ability to improve after an intervention. The profile of these patients who are recovering from an acute medical illness, may also be an influential factor on the ability to improve frailty status.

Frailty level was not associated with mobility or transfer status on discharge, with a high percentage of participants achieving independence in mobility (90.2%, n=38) and transfers (92.7%, n=39). The dichotomous use of mobility/transfer status may account for this non-significant finding as frailty was associated with other mobility-markers. Previous research has reported that functional decline is common among recently discharged older adults Boyd et al (2009) found that 30% of a frail sample did not achieve their baseline mobility and transfer status following a functional decline during hospitalisation. This study's findings demonstrate a positive view of post-acute rehabilitation showing that frail patients can become independent with mobility despite high levels of frailty.

4.4 Rehabilitation Outcomes

This sample of older adults could be further identified as being frail for many reasons including the presence of multi-morbidities, disability and increasing age (Fried et al., 2001). In addition, the sample demonstrated reductions in single-markers of frailty such as grip-strength, gait-speed and functional mobility on admission (Fried et al., 2001, Hubbard et al.,
There were significant improvements at the level of impairment, activity limitations and participation restrictions of the older adult, which were clinically meaningful. Although the design of the present study does not allow causation to be assumed, it is possible improvements were related to the effectiveness of the rehabilitation programme, as the majority received MDT rehabilitation targeting participants' functioning at all levels.

4.5 Measure of Impairment

4.5.1 Grip-strength

The change in grip-strength demonstrated statistical significance (p>0.001). However the mean discharge scores were significantly lower when compared to cross-sectional epidemiological data of community-dwelling older persons and inpatients undergoing rehabilitation (Desrosiers et al., 1995, Bohannon et al., 2007, Roberts et al., 2014). Roberts et al's (2014) mean(±SD) grip-strength values for female and males undergoing rehabilitation were 13.6 (±5) kilograms and 21.7 (±7.7) kilograms respectively. These values are higher than the current study's mean(±SD) values at discharge, indicating a more frail population. However grip-strength improved in this study with a mean change of 1.1 and 1.2 kilograms in right and left-hands respectively. Evidence from a prospective observational study demonstrated that a one kilogram increase in grip-strength was associated with a 3% increase in likelihood of discharge home (Kerr et al., 2006). These study findings are clinically important.

Frailty status did not demonstrate a relationship with discharge grip-strength scores. This is despite grip-strength being a significant single-marker of frailty, and a predictor of mobility.
impairment, falls and poor future health in the community-dwelling population (Roberts et al., 2014). However, the findings from Singh et al's (2012) prospective cohort study of 265 acutely hospitalised older adults demonstrated that frailty was not significantly associated with grip-strength. The participants in this study were recovering from an acute illness. This, along with very low admission grip-strength values and only 65.9% of participants undergoing upper-limb exercises, may account for this finding.

4.6 Activity Limitations

4.6.1 Timed-Up-and-Go

The participants' median TUG scores improved from 42.5 to 20.1 seconds. Brooks et al’s (2006) small (n=52) study demonstrated that the TUG is a valid and responsive measure in older persons undergoing inpatient rehabilitation. Their mean (±SD) difference in TUG scores on discharge was -7.7(±6.9) seconds. Coleman et al's (2012) observational study demonstrated a comparable magnitude of improvement in TUG scores over a 6-week period of rehabilitation from 59 to 40 seconds in a similar cohort of participants. The present study supports previous literature and indicates a clinically significant improvement.

Clinically, a TUG score of greater than thirty seconds indicates assistance is required for indoor and outdoor ambulation (Podsiadlo and Richardson 1991). In sub-group analysis, only the participants who were classified as "severely" frail on admission remained above 30 seconds at discharge. The remaining "vulnerable", "mildly" frail and "moderately" frail participants scored under this cut-off point indicating greater independence in functional mobility. The participants in the present study would also be classified as having a high falls-
risk, indicated by a score of greater than 14 seconds both on admission and discharge (Shumway-Cook et al., 2000). Only one participant classified as "vulnerable" on admission was under Shumway-Cook et al's (2000) 14 second cut-off for falls-risk. However evidence concerning the predictive ability of the TUG for falling is retrospective (Beauchet et al., 2011). This could be prone to bias and results must be interpreted with caution.

A strong correlation between frailty and TUG scores has been found in a large population-based study (N=1,814)(Savva et al., 2013). The authors found that the TUG is a sensitive and specific proxy for frailty but not reliable in identifying pre-frail individuals. Savva et al's (2013) evidence suggests that the TUG captures all age-related components of frailty but not other components such as weight-loss or exhaustion. A cut-off of 16 seconds indicated a high specificity for frailty with 98% of the non-frail population completing the TUG in less than 16 seconds. The present study found a moderate correlation between increasing frailty and TUG scores with frailty being a significant predictor of TUG at discharge. Applying Savva et al's (2013) cut-off threshold for frail persons, only one participant, classified as "vulnerable" on admission, scored under this threshold at discharge. The remainder of the sample were classified as "mild", "moderate" or "severely" frail.

Overall these results provide evidence for the improvement of functional mobility in frail older adults undergoing rehabilitation. It may be inferred that improvements in functional mobility may be due to all participants receiving mobility/transfer practice as well as functional activity practice throughout their rehabilitation period, however causation cannot be implied. It appears that "severely" frail participants entering rehabilitation may still be slower and thus dependent in their functional mobility at discharge. This may be due to the
insensitivity of the TUG score in relation to CFS construct of frailty, the heterogeneity of the population studied or the influence of an acute medical illness on a participants' recovery.

4.6.2 Gait-speed

The median improvement in gait-speed was 0.295 meters/second (m/s) representing a clinically-relevant change. Previous studies have shown that improvements as small as 0.1 m/s resulted in a substantial reduction in mortality and improvements in physical function (Hardy et al., 2007, Peterson et al., 2009). A systematic review by Perera et al (2006) found that a substantial clinically meaningful change in gait-speed was between 0.08 to 0.14 m/s in community-dwelling older adults. This present study demonstrates a substantial improvement. This may be due to all participants undergoing gait-rehabilitation and lower-limb exercises in addition to attending an exercise class, although the design of the study does not allow causative conclusions to be made.

The "mildly" and "moderately" frail participants' gait-speed was above the 0.7 m/s threshold, while "severely" frail participants had a significantly lower gait-speed of 0.37 m/s on discharge. Slow gait-speed of less than one m/s is a predictor of incident disability and mortality in the older population. It is also a proven predictor for mortality, disability, falls, hospitalisation and institutionalisation (AbellanVanKan et al., 2009). All participants in this study scored below this threshold at discharge and were therefore at a high risk for adverse outcomes.
Gait-speed thresholds have also been established for functional independence and successful community ambulation (AbellanVanKan et al., 2009, Palambaro et al., 2006). Cwikel et al (1995) found that a cut-off point of 0.5 m/s showed a faster walking speed in community dwelling subjects was associated with being socially active. Kressing et al (2001) used a cut-off point of 0.9 m/s and reported that slow walkers were less fearful of falling (FES) than fast walkers. However, the "mildly" and “moderately” frail participants entering rehabilitation are more likely to be socially active but may demonstrate a fear of falling when compared to their faster walking counterparts. The "severely" frail group may demonstrate severe functional dependence for mobility at discharge.

Castella et al (2013) identified a cut-off of 0.8 m/s for identifying frailty in a community-dwelling older population. Findings from this study are similar to Castella et al's (2013) finding, as all "mildly", "moderately" and "severely" frail participants would be classified as frail, while the one participant classified as "vulnerable" scored above this threshold. Frailty was a significant predictor of outcome in gait-speed when adjusted for age, gender, MMSE, social-connectedness and co-morbidities. Clinicians can expect frail participants to remain at risk for adverse health outcomes but can achieve clinically meaningful changes in gait-speed.

4.6.3 Tinetti

There were significant changes in participants balance scores indicating a change from a high falls risk on admission to a low falls-risk on discharge. Faber et al (2006) examined the detectable change in the Tinetti in older 245 independent and residential care participants and found that a clinically important change in scores was 5 points. Consequently the current
study’s change in median scores reflects a clinically relevant reduction in falls-risk. Similar to Coleman et al's (2012) observational study this study observed a significant improvement in frail participants balance scores.

Evidence concerning the influence of frailty on balance outcomes in the post-acute older population is lacking. This study demonstrates that admission frailty level is associated with discharge balance scores with frailer participants tending to have poorer balance. "Severely frail" participants' median score (18 points) on discharge indicated that participants remained at a high-risk of falling with both "mildly" and "moderately" frail participants. Clinicians can expect the frailer participant be at a higher-risk of falling. Overall the strength of the relationship between frailty and discharge balance scores was moderate thus indicating that other factors may influence discharge balance scores.

4.6.4 Elderly Mobility Scale

A median change of 4 points was found in the EMS over the rehabilitation period. This reflects a similar magnitude of improvement found by Haley et al (2014) in frail older adults undergoing sub-acute rehabilitation (median change 4). Smith et al (1994) examined its predictive ability demonstrating that a score of 9 points or less indicated participants were of a high dependency level. 10-14 points indicated that participants were borderline in terms of safe mobility and independence in ADLs and a score greater than 14 indicated a tendency to return home.
The EMS scores at discharge correlated strongly with frailty status on admission. Furthermore, frailty on admission predicted EMS outcome when adjusted for age, gender, MMSE, social-connectedness and co-morbidities. From these results, the clinician can expect the participant who was classified as "severely" frail on admission to possibly require assistance with mobility and ADLs as they scored 14 points. "Mildly" and "moderately" frail participants were in the higher functioning category and therefore are more likely return home.

4.6.5 **Barthel Index**

There were significant changes in the BI from a median(IQR) of 65(25) to 90(25) points at discharge. Clinically, this indicates that participants transitioned from a moderate dependency on admission to a mild dependency in ADL function (Shah et al., 1989). Granger et al (1987) reported that a score of 60-80 indicated that an individual could live alone but may need formal community services. Chen et al (2010) reported that a 10% improvement in BI scores was associated with functional recovery of older inpatients receiving geriatric rehabilitation. In the present study a higher recovery of 38.5% was found.

Frailty level demonstrated a moderate negative association with BI outcome. This suggests that the higher the participant’s frailty level on admission the lower their BI at discharge, with frailty remaining a significant predictor of BI outcome when adjusted for age, gender, MMSE, social-connectedness and co-morbidity. This study supports Singh et al's (2012) prospective cohort study of 265 hospitalised older adults which demonstrated that higher frailty predicted poor functional gain in the BI (p<0.001). Inferring the above results the
participants who were classified as "moderately" frail on admission may be able to live at home alone but need community support. "Mildly" frail may not need these community supports as they may only have mild disability on discharge as indicated by a score of 82.5 points. The participant classified as "severely" frail on admission is likely to have severe dependency as indicated by their low median score of 42.5. The association of frailty with the BI is poorly examined in the hospitalised older adult however these results support the evidence of a significant interaction between both domains.

### 4.7 Measures of Participation

#### 4.7.1 Quality-of-life

The present study supports that of Coleman et al (2012) previous research indicating significant improvements in self-rated health status of participants undergoing post-acute rehabilitation. Kind et al's (1998) observational study provided EQ-5D-VAS population-based normative values for quality-of-life, demonstrating community-dwelling older persons aged over 80 years scoring 75 (20). This indicated that the study sample had a normal quality-of-life rating.

Community-based research suggests that frailty is significantly associated with physical and cognitive health-related quality-of-life. Gobbens et al's (2012) longitudinal study of 484 community-dwelling older persons showed large associations between frailty and poor quality-of-life. Contrary to this frailty levels, in the present study did not have an association with quality-of-life outcomes. This difference may be due to a number of reasons. The insensitivity of the frailty scale and quality-of-life domain (self-rated health) examined may
lack specificity in this inpatient cohort. Furthermore, the domains of quality-of-life remain difficult to quantify thus making it difficult to capture in this heterogeneous inpatient population (Rizzoli et al 2013). Experiencing acute illness and disability may affect people differently with participants being at various stages of recovery, psychological adjustment and physical capability therefore causing heterogeneity among the sample and possibly this non-significant finding. However despite frailty being present, hospitalised older persons had a normal quality-of-life.

4.7.2 Falls self-efficacy

A significant improvement in falls self-efficacy was found with median(IQR) scores improving from 75(34) to 94(17) points. Tinetti et al's (1990) study of 74 community-dwelling older persons found a score of less than 80 indicated a fear of falling. Cummings et al (2000) demonstrated score of 75 or less was indicative of falling and reduced functional ability. FES scores suggest that participants had a fear of falling on admission and were at a higher falls-risk. At discharge the sample scored above these cut-offs indicating a clinically relevant change. Admission frailty levels in this study did not show an association with self-efficacy outcome. The ceiling-effect for the FES has been previously described in the literature and high admission and discharge scores in the present study may account for this non-significant relationship (Huang and Wang 2009). In addition, the CFS may not be a sensitive frailty construct to detect this domain of functioning. Using the CFS does not assist clinicians in determining a participant's falls self-efficacy on discharge from post-acute rehabilitation.
4.8 Frailty: Association with Therapy-time

Admission frailty level correlated moderately with the amount of therapy-time and the number of sessions over the period of rehabilitation. Evidence concerning the amount and frequency of therapy in this population is lacking with no evidence examining it relationship with frailty (Ellis and Langhorne 2005). In sub-group analysis, the "mildly" frail participant had a median of 22 sessions lasting for 47 minutes. The "moderately" frail participant received a higher time of 51.7 minutes and had 26.5 sessions of therapy. The "severely" frail participant had a tendency to receive more sessions (median=35) but of a shorter duration of 43.8 minutes. This may be indicative of the poor exercise capacity, exhaustion and diminished capacities experienced with greater frailty. The evidence presented provides a detailed description of the delivery of therapy for specific levels of frailty.

The amount of therapy received may have been influenced by extraneous variables including local hospital processes, resource limitations, recall biases or adverse events during rehabilitation. Colleagues were encouraged to complete therapy-time records promptly however recall bias may have been influential. Adverse events such as recurrent illness, falls or injury may have precluded engagement in rehabilitation. These events were not recorded in the present study but may have been influential factors.

This study provided a broad overview of the delivery of MDT rehabilitation to the frail older adult and thus addressed the identified gap in the literature. It also allows future comparison with other rehabilitation units to be made.
A moderate positive association was found between frailty on admission and LOS, indicating that more frail participants tended to stay longer. The median length of stay for the "mildly", "moderately" and "severely" frail participant was 35.5, 33 and 54.5 days. "Severely” frail participants LOS was longer than the recommended 42 days outlined in the National Clinical Care Programme for the Older Person (HSE 2012).

The study's findings are in keeping with the majority of previous research. Singh et al (2012) reported that frailty levels correlated significantly with LOS in an acute geriatric ward. Evan et al's (2014) larger prospective cohort study of 231 hospitalised older adults supports this finding. However, Haley et al (2014) did not demonstrate an association between frailty and LOS. When adjusted for age, gender, MMSE, co-morbidities and social-connectedness, frailty was not an independent predictor of LOS. This difference may be due to the varying provision of rehabilitation services and the many other confounding factors (delayed or self-discharge) influencing LOS.

Singh et al (2012) and Evans et al (2014) large prospective cohort studies have shown an association between frailty and discharge destination. However Haley et al (2014) and this study do not support this finding. The difference may be explained by the influence of other variables such as personal circumstances, social-support or the differing hospital processes. It may also be due to the present study's small sample size or the use of different frailty measures and their validity in predicting LOS and discharge destination. However it indicates
positive results for post-acute rehabilitation as despite frailty being present the majority of the participants (95.1%, n=39) returned home.

4.10 Clinical Utility

Overall the use of a frailty score to classify participants undergoing rehabilitation shows a moderate association with their outcomes in terms of functional mobility, walking speed, balance and dependency. It is interesting to note that frailty was only associated with measures of activity and not impairments or participation restrictions. This may be due to the construct of the CFS itself, as its definition includes mainly functional activity limitations. The use of a frailty measure appears to be somewhat helpful in assisting the clinician to understand a frail persons potential short-term activity outcomes.

The moderate relationship found between frailty, LOS and therapy-times makes clinical sense. The more frail participant is likely to have reduced capacity for exercise thus requiring a longer period of rehabilitation. However, a stronger relationship between frailty, dependency and LOS, at a longer follow-up, has been shown in acutely hospitalised older adults. Although this difference may be due to the frailty measures used, it remains difficult to disentangle the interaction between frailty, hospital processes and other extraneous factors. This conflicting evidence requires further investigation. A measure of frailty that is validated in the older post-acute rehabilitation population would enable clinicians and health-service planners to plan and deliver effective rehabilitation services. Validated research concerning the influence of frailty and healthcare needs of older people undergoing post-acute rehabilitation is essential for policy planning.
It is evident that the use of the CFS frailty measure alone is not sufficient to allow clinical decisions to be made. In clinical practice other predictors of outcome such as level of impairment, cognition and social-support have been established and proven useful predictors of patient outcome. However, it is clear that frailty measures in the post-acute setting warrants further investigation as clinically significant relationships were established. This study provides the clinician with a better understanding of a frail older person’s ability.
4.11 Limitations of the Study

- This was an uncontrolled study therefore the improvements shown cannot be solely attributed to the effects of rehabilitation. Natural recovery from an illness, optimisation of medications or simply time may have accounted for these improvements.

- This study was conducted in a single-centre. The resources available in this setting may not reflect those of other rehabilitation units. Therefore the results may not be applicable to other rehabilitation centres. In addition, the small sample-size further limits the generalisation of the study findings.

- Therapy-time but not intensity was examined in this study. Due to the design of the study it was not possible to conclude what intensity of therapy input is required to effect a change in frailty.

- Every effort was made to minimise rater and recall biases however they may have influenced the results. The assessors in this study were also the participants’ treating therapists. They were blinded to the participants' scores however they may have been able to recall these results. Therapy-time was also recorded by the treating therapists who were encouraged to record it as soon as possible to minimise recall bias.
4.12 Recommendations for Future Research

- Future research should include a larger multi-centre follow-up study in this frail cohort to determine if the improvements observed continue post-rehabilitation. It would also assist in determining the predictive ability of the CFS.

- Future research should encompass a frailty measure with other proven predictors of outcome in hospitalised older adults. It is evident that frailty status alone is unable to assist the clinician to do so.

- A proportion of patients admitted to the rehabilitation unit were ineligible to enter the study due to their cognitive ability therefore limiting them from completing assessments. Further research with this frail cognitively impaired cohort is warranted.

- A larger multi-centre follow-up study would allow for more robust frailty subgroup analysis. This would assist health-services to plan and deliver an effective rehabilitation service addressing the needs of specific frail subgroups. An economic-analysis including the cost-effectiveness of rehabilitation services would also assist the planning process.

- A large RCT would determine the intensity of therapy required to effect change in frailty status in this population. The RCT could use similar outcome measures to this study. Components of upper-limb and lower-limb strength as well as aerobic exercise could be included.
CONCLUSION

A greater focus on health-service provision for the older person is fast becoming a priority as Ireland's ageing population grows. The findings of this study provide an insight into the complex interaction between frailty and a hospitalised older person's outcomes following post-acute rehabilitation.

The majority of participants presented with a moderate level of frailty and functional decline following hospitalisation for an acute illness. Significant improvements in the physical and psychosocial domains of health were found. The more frail participants were more likely to have poorer physical outcomes in terms of functional mobility, balance and gait-speed compared with their less frail counterparts. When adjusted for confounders of age, gender, MMSE, social-connectedness and co-morbidities frailty on admission was predictive of aspects of functional mobility and ADL. More frail participants also tended to spend a greater cumulative time in therapy and have a longer LOS. No association between frailty and determinants of quality-of-life or falls self-efficacy was found.

The assessment of frailty level does not replace clinical judgement, nor does it allow a decision to be made regarding the provision of intervention. However it does provide the clinician with a better understanding of the relationship between frailty and the older persons physical outcomes, within the context of the specific service provision. While the limitations of the study in terms of design are acknowledged, this evidence provides a positive outlook for older patients undergoing rehabilitation as significant improvements in physical function, quality-of-life and self-efficacy were demonstrated despite frailty being present.
The use of a frailty measure and the comprehensive description of the multi-disciplinary interventions of older participants undergoing specialist geriatric rehabilitation, may help clinicians understand why interventions are effective and for whom they are most successful. Consequently planning for an effective rehabilitation service can be made. This study profiled one such rehabilitation unit and the influence of frailty on older persons’ rehabilitation outcomes in an Irish cohort. Further research investigating other aspects of health that may inform our decisions regarding provision of rehabilitation is warranted. This will enable targeted and effective planning for services in the post-acute frail population and thus facilitate successful ageing.

WORD COUNT  13,747
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1. Title of the Research Project:

Frailty and its Association with Rehabilitation Outcomes: An Irish prospective cohort study of a post-acute older population

1. Is this study a clinical trial of a medicine or a clinical investigation of a medical device? No

If No, please delete Box A and move to Box B. If yes, and your trial relates to medicinal products for human use, please do not use this application form. Please fill in the standard Department of Health and Children Application Form:

http://www.dohc.ie/issues/clinical_trials_2004/forms.doc
Box B:

Is Cappagh National Orthopaedic Hospital the only site in which it is proposed that this research will take place? Yes
Is this a multi-centre study? No

2. Principal Investigator: The person who takes primary responsibility for the conduct of the research.

For research involving patients, it is essential that a Cappagh National Orthopaedic Hospital Consultant be named as a co-investigator.

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<td>Mary Nolan</td>
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<td>Professor</td>
<td>MRCPI Consultant Geriatrician</td>
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3. Please indicate whether any payments, monetary or otherwise, are to be made to a person for conducting this research project or any part of the project.

No payments, monetary or otherwise are being made to a person for conducting this research. Future funding maybe sought from the chartered physiotherapists in neurology and gerontology clinical interest group of the Irish Society of Chartered Physiotherapists or the Health Research Board.
Do not leave any question unanswered. As far as possible, type an answer to each question and do not use ‘non-applicable’ or ‘as above.’

It is important that the language used in this application is clear and understandable to lay members. Do not use acronyms.

**DETAILS OF THE RESEARCH PROJECT**

4 (a) Has this or a similar application been previously submitted for review to this or any other Ethics Committee in Ireland or the EU and, if so, what was the outcome? No

4(b) Has similar research on this topic been done before in this country or elsewhere? Yes

5.

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6 (a) What is the principal research objective of the proposed study?

To evaluate rehabilitation outcomes of frail elderly patients attending a specialist inpatient geriatric rehabilitation unit. A secondary aim is to describe demographic and clinical evaluations on admission and determine if they are associated with patient outcomes

6 (b) What are the secondary research objectives?

1. To evaluate changes in physical function, quality of life and self-efficacy

2. To ascertain an association between frailty and rehabilitation outcomes (outlined in objective one), discharge destination and length of stay
Appendix 1 Ethics Application Form

3. To describe the content of therapy received and explore the relationship between the amount of therapy time and frailty status

6 (c) What is the scientific justification for this research?

There is a projected increase in the older population therefore placing a higher demand on healthcare services for the older population. Frailty is a syndrome that describes an older person with health problems who has lost functional abilities due to limited remaining reserves (Ahmed et al., 2007). Frail older people's needs are complex, with co-existent medical, functional, psychological and social demands (Rockwood and Hubbard, 2004). One of the key evidence-based features of specialist geriatric services is the comprehensive geriatric assessment. This an inter-disciplinary process assessing the complex dimensions of a frail older persons needs (Ellis et al., 2011). It has been widely reported in the literature that morbidity and mortality rates, cognitive and physical functioning improve significantly if patients undergo a comprehensive geriatric assessment. Under the National Clinical Care Programme for the Older Person (2012) designated rehabilitation pathways with comprehensive geriatric assessments have been established to ensure timely access of frail older people to these services. The purpose of this observational study is to evaluate measures of frailty, functioning, disability and participation to gain a greater understanding of patients response to specialist geriatric rehabilitation. This may allow resources to be directed to the services most appropriate for efficient management of the frail older person requiring rehabilitation.

7. Give a full summary of the purpose, design and methodology of the planned research, including explanation of the theoretical framework that informs it. Is should be clear exactly what will happen to the participant, how many times and in what order.

Purpose and Design

The main purpose of this observational study is to look at how beneficial rehabilitation is for an older person. It will assess outcomes of physical function, self-efficacy (how confident a person is carrying out daily activities) and quality of life at admission to Cappagh hospitals rehabilitation unit and at discharge. The amount and type of rehabilitation a person receives and their level of frailty will also be measured. This is to examine if there are associations
Appendix 1 Ethics Application Form

between these measures and the patients eventual outcome (physical abilities, quality of life, self-efficacy, discharge destination, length of stay).

Methodology

The following data forms part of a comprehensive geriatric assessment and will be obtained on admission only.

- Participant Demographics including age and gender.
- Medical status including: Presenting diagnosis, acute hospital length of stay, Charlson Co-morbidity Index, number of co-morbidities, number of medications
- Physical status: Pre-admission levels of function, mobility, transfers, activities of daily living and falls history
- Cognitive status: Mini-mental state exam
- Mental status: Geriatric depression scale
- Social support including the Lubben Social Network Index

Data collection will be assisted by the geriatric medical team, nursing, occupational therapy and physiotherapy colleagues. These measures are required to obtain a baseline assessment of the type of patients which are admitted for rehabilitation to Cappagh Hospital.

All patients admitted to Cappagh hospitals rehabilitation unit are automatically referred for rehabilitation. A heterogeneous sample of older frail adults over 65 years of age admitted following a period of hospitalisation is expected. On admission the patient will be screened using the following selection criteria.

- Inclusion criteria: All patients admitted for rehabilitation to the Cappagh hospitals rehabilitation unit. A broad inclusion criteria was chosen to enable generalisation of the conclusions to the entire population requiring post-acute inpatient rehabilitation.
- Exclusion criteria: Patients who do not consent to study participation, inability to mobilise pre-admission to the acute hospital, severe communication problems and inability to comply with simple instructions. This inclusion criteria is similar to a previous observational study by Denkinger et al., (2010). A participant may be unable
to comprehend the nature and scope of the study as outlined above therefore informed consent cannot be obtained and they will be excluded from the study.

Procedure

The assessments of physical function, self-efficacy and quality of life will take place in the physiotherapy gym.

Assessments of physical function include the Clinical Frailty Scale, the timed up and go, the 10 meter walk test, Tinetti Balance and Gait assessments, grip strength and the two minute walk test. Most of these measures form part of a routine physiotherapy assessment. The patient will be given two other self administered test including the Falls efficacy scale and the Euro-QoL5D, both internationally recognised and validated tools used to measure confidence in performing activities and quality of life.

Nursing colleagues will complete the Barthel index, a widely recognized measure of dependency. These tests will be administered at admission and discharge. A pilot study will take place to ensure the tests are appropriately timed and co-ordinated to minimise participant burden.

Type of therapy received is routinely collected by occupational therapy colleagues using a computer system. Physiotherapy colleagues will collate this same information from a physiotherapy database.

On discharge the principle investigator Mary Nolan, will obtain additional information regarding participants discharge destination, find out if the patient was re-admitted to an acute hospital within 28 days, calculate the patients total length of stay and total amount of therapy received in Cappagh hospital. Most of these assessment are routinely collated by nursing and medical colleagues.

Benefit of Research

All of the assessments described above form part of the comprehensive geriatric assessment which has now become the cornerstone of specialist geriatric medicine (Ellis et al., 2011). This research is aiming to establish the benefit of rehabilitation to the frail older person. Associations between patient characteristics, frailty and outcomes is also going to be
established. Approval, pending Ethical approval, to undertake the study has been obtained from Professor Dermot Power, consultant geriatrician and Ms. Jill Long, Cappagh hospital physiotherapy manager. Please see attached letters.

8(a) Does the design of the study allow a statistically significant conclusion to be reached? Yes

8(b) What method(s) of analysis will be used?

Descriptive data will be used to describe demographic and clinical characteristics of the group. The data will be examined for normality and appropriate parametric (means, standard deviations) and non-parametric (medians, interquartile ranges) statistical methods will be applied.

Change in rehabilitation outcome measures will be examined for normality. The paired t-test or the Wilcoxon Signed Rank test will be used depending on the distribution of the data.

Association between several variables can be investigated. Unlike an experimental study, a causal relationship between variables cannot be measured. Multiple regression analysis will be used to examine associations between admission variables and rehabilitation outcomes, frailty, length of stay and discharge destination. This will be calculated using Pearson test for parametric data and Spearmans rank correlation for non-parametric data. Potential confounders including age, gender, length of stay and cognition will be adjusted for. Missing data will be described and accounted for.

9. Please name the medical device that it is proposed to investigate in the course of the study? (ONLY RESPOND TO THIS QUESTION IF YOU RESPONDED TO BOX A, Question 1)

10(a) State all possible risks to be incurred by PARTICIPANTS in the proposed clinical trial or research study?

<table>
<thead>
<tr>
<th>Nature of Risk: (e.g bruising due to blood sample)</th>
<th>Probability of Risk: (e.g. Very High Risk)</th>
<th>Magnitude of Risk: (e.g. not serious)</th>
<th>Physical / Psychological/Psychosocial or other (e.g. physical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Very low risk</td>
<td>Serious</td>
<td>Physical</td>
</tr>
</tbody>
</table>

99
10(b) State all possible risks to be incurred by CONTROLS in the proposed clinical trial or research study?

There are no control subjects in this study.

11(a) Please list those procedures in the study to which SUBJECTS will be exposed indicating those which will be part of Normal care and those that will be Additional. (If your participants are staff members, normal is the normal working day, additional is your research i.e. questionnaires, interviews and focus groups.)

<table>
<thead>
<tr>
<th>Normal Care:</th>
<th>Additional Care:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physiotherapy Assessment of physical function on admission and discharge. Physiotherapy treatment interventions</td>
<td>Assessment of depression and assessment social integration</td>
</tr>
<tr>
<td>Occupational therapy assessment and treatment interventions</td>
<td>Assessment of exercise tolerance on admission and discharge</td>
</tr>
<tr>
<td>Nursing assessment: Dependency measurement (Barthel Index) on admission and discharge</td>
<td>Assessment of Quality of Life on admission and discharge</td>
</tr>
</tbody>
</table>

11(b) Please list those procedures in the study to which CONTROLS will be exposed indicating those which will be part of Normal care and those that will be Additional. There are no control subjects in this study.

12. Please indicate if any treatment is withheld as a result of taking part in the study.

No treatment is being withheld as a result of taking part in this study.

13(a) What is the potential for pain, discomfort, distress, inconvenience or change to lifestyle for RESEARCH PARTICIPANTS?

<table>
<thead>
<tr>
<th>Pain (e.g. skin biopsy, lumbar puncture):</th>
<th>Discomfort (e.g. while giving a blood sample):</th>
<th>Inconvenience (e.g. attending a clinic/filling in a questionnaire):</th>
<th>Change to lifestyle (e.g. results of genetic testing / risk of surgery impacting on participant lifestyle):</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is no potential for pain in this study</td>
<td>There is no potential for discomfort in this study</td>
<td>Two short measures of Quality of Life and self efficacy will be self-administered by the participant</td>
<td>No negative changes to lifestyle are anticipated.</td>
</tr>
</tbody>
</table>
13(b) What is the potential for pain, discomfort, distress, inconvenience or change to lifestyle for CONTROLS? There are no control subjects in this study.

14. (a) What is the potential for benefit for RESEARCH PARTICIPANTS who agree to take part in this research, if any?

This study is hoping to establish if the participants general strength, balance and ability to do everyday activities such as walking improves with rehabilitation during their stay in Cappagh Hospital. This study will not affect the care participants receive whilst and inpatient in Cappagh Hospital.

14(b) What is the potential for benefit for CONTROLS who agree to take part in this research, if any? There are no control subjects in this study.

15(a) How will the health of the participants be monitored both during and after the study?

The participants will be under Nursing and Medical care provided by Cappagh National Orthopaedic Hospital at all times during and after this study.

15(b) What criteria exist for withdrawing individual participants prematurely?

A participant may withdraw at any time without giving reason. If a subject decides not to participate, or withdraws, their rehabilitation will not be affected in anyway. This will be clearly stated to the patient.

15(c) What steps will be followed if participants decide to withdraw during the course of the study?

Participants who withdraw from the study will have all identifiable data destroyed. None of their data will be used in the final research project.

16. What criteria exist for stopping or prematurely ending the research study?

If the medical team feels it is necessary, they may stop a subjects participation in the study at any time without participant consent.
17. (a) What arrangements are in place for monitoring, recording and reporting and evaluating adverse events? Please state who has overall responsibility in this area and what protocols are in place to monitor any unforeseen events. (Please name the person with overall responsibility.)

The participant will be under the care of the medical, nursing and multi-disciplinary team at all times whilst and inpatient in Cappagh Hospital. Should an adverse event occur the relevant and appropriate medical, nursing and multi-disciplinary team members will be informed, incident report forms will be filled out and the relevant action taken. Standard protocols are already in place. It is the responsibility of the investigator, Mary Nolan, to report immediately in writing to the Research Ethics Committee.

17. (b) Will a data monitoring committee be convened? No

If Yes, please give details.

18. Does the Principal Investigator or any of the key investigators have any direct or indirect involvement in the outcome of the study that could in any way be regarded as a conflict of interest?

The principal investigator may also be at times the participants treating physiotherapist. This may introduce an element of bias in the results however this is unavoidable due to current staffing levels. Participation or non-participation will not affect the standard of care that the participant will receive. This is clearly stated in the participation information leaflet.

Details of Participants

19. How many Subjects and Controls are expected to participate at each named site?

<table>
<thead>
<tr>
<th>Principal Investigator:</th>
<th>Site:</th>
<th>Number of Subjects:</th>
<th>Number of Controls:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mary Nolan</td>
<td>Cappagh National Orthopaedic Hospital</td>
<td>41</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total: 41</td>
<td>Total: 0</td>
</tr>
</tbody>
</table>
20. (a) How will Subjects be identified, approached, recruited and selected?  (Please be clear on whether you are approaching subjects in person in a clinic / on a ward, or in writing via letter at home, and how you are identifying patients e.g. from clinic lists etc.  Also, be clear on how you are recruiting e.g. by poster, by website advertisement.)

<table>
<thead>
<tr>
<th>Identified</th>
<th>Approached</th>
<th>Selected</th>
<th>Recruited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consecutive sampling of all admissions to St. Marys Rehabilitation Unit</td>
<td>The Principal Investigator will present a Participant Information Leaflet and answer any questions a potential participant may have. The PI will be available for further questions after this point.</td>
<td>Inclusion Criteria: All patients admitted to St. Marys Rehabilitation Unit</td>
<td>A Participant Information leaflet and a signed Consent form will be obtained.</td>
</tr>
</tbody>
</table>
Appendix 1 Ethics Application Form

20 (b) How will Controls be identified, approached, and recruited and selected? There are no controls in this study.

21. What are the principal inclusion criteria? (Please be careful not to contradict your replies to Question 29)

|   | All admissions to St. Mary's Rehabilitation Unit ie. Frail older persons over 65 years of age |

22. What are the principal exclusion criteria? (Please be careful not to contradict your replies to Question 29)

|   | Patients who do not consent to study participation |
|   | Inability to mobilise pre-admission to the acute hospital |
|   | Severe communication problems |
|   | Inability to comply with simple instructions |

23. Will any of the participants be simultaneously involved in any other research investigation? No, not to my knowledge.

24. Will participants receive reimbursement of expenses (travel costs, loss of earnings) or any other incentive or benefits for taking part in this research? No, as there are no anticipated travel expenses.

25 (a) Will the participant’s family Doctor be notified of the proposed study? No

25(b) Does the Information Leaflet inform the participant that their GP will be contacted? No

25(c) Have you included a copy of the letter to the General Practitioner for review? No
PATIENT INFORMED CONSENT

26 (a) Will written informed consent be obtained?  Yes

26 (b) Have you enclosed a copy of the Consent Form for Review?  Yes

26 (c) Which named person(s) will be responsible for obtaining consent? (qualifications and experience)

<table>
<thead>
<tr>
<th>Name</th>
<th>Qualification</th>
<th>Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mary Nolan</td>
<td>BSc Hons Physiotherapy</td>
<td>8 years clinical experience</td>
</tr>
</tbody>
</table>

26 (c) Give details of how this will be done. (Be careful to ensure your replies are consistent with Questions 20 (a) and 20 (b))

On admission to St. Marys Rehabilitation in Cappagh Hospital, potential participants will be invited to participate in the study by the principle investigator, Mary Nolan. The selection criteria will be applied to all patients admitted to the rehabilitation unit. Eligible participants will be given a participant information leaflet and a consent form to obtain informed and written consent. The participant will be given sufficient time to make a decision without duress. The participant will be asked to sign a consent form. On informed signed consent, participants will be once again made aware of their legal and ethical rights to withdraw from the study without giving reasons and without personal consequences. Once informed consent is gained data collection may begin.

27 (a) Will the participants be provided with an Information Sheet and Consent Form?  Yes

27 (b) Will the controls be provided with an Information Sheet and Consent Form?

No, there are no controls in this study.
Appendix 1 Ethics Application Form

28. Will the participant be given as much time as they require in which to make a decision regarding participation in this research study? Yes

29(a) Are any of the following groups included:

<table>
<thead>
<tr>
<th>Group</th>
<th>Yes/No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pregnant Women</td>
<td>No</td>
</tr>
<tr>
<td>Women of Child bearing potential</td>
<td>No</td>
</tr>
<tr>
<td>Children or Minors (≤16 years)¹</td>
<td>No</td>
</tr>
<tr>
<td>Cognitively impaired persons²</td>
<td>Yes</td>
</tr>
<tr>
<td>Comatose patients</td>
<td>No</td>
</tr>
<tr>
<td>Elderly/aged persons (&gt; 65 years)</td>
<td>Yes</td>
</tr>
<tr>
<td>Hospital Employees³</td>
<td>No</td>
</tr>
<tr>
<td>Students in the Hospital e.g. NCHD students⁴</td>
<td>No</td>
</tr>
</tbody>
</table>

29 (b) If so, please justify outlining how the study is expected to benefit the individual who participates.

<table>
<thead>
<tr>
<th>Risk Group to be included in the study:</th>
<th>Benefit to individuals in that risk group:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitively impaired persons and Elderly/aged persons</td>
<td>This study will establish if a participant's strength, balance and ability to do everyday activities, quality of life and confidence improves with rehabilitation during their admission to Cappagh National Orthopaedic Hospital. Treatment interventions will aim to reduce participants' functional decline post acute hospitalisation and have a positive outcome in overall function and well-being of the cognitively impaired participants and the elderly participants.</td>
</tr>
</tbody>
</table>

¹ Parts 4 and 5 of Schedule 1 of the European Communities (Clinical Trials on Medicinal Products for Human Use) Regulations 2004 clearly outlines conditions and principles which apply in relation to treatment of Minors who are participants in medical research.

² Parts 4 and 5 of Schedule 1 of the European Communities (Clinical Trials on Medicinal Products for Human Use) Regulations 2004 clearly outlines conditions and principles which apply in relation to treatment of Incapacitated Adults who are participants in medical research.

³ Hospital staff are excluded from participating in Cappagh National Orthopaedic Hospital studies, where a supervisory or dependent relationship exists with the Principal Investigator or any of the co-investigators listed in response to Question 2.

⁴ Medical Students and NCHDs are excluded on ethical grounds from participating in Cappagh National Orthopaedic Hospital studies.
Appendix 1 Ethics Application Form

29 (c) State the manner in which consent will be obtained paying particular attention to the role of parents, legal representatives, witness etc

<table>
<thead>
<tr>
<th>Minors &amp; the role of parents /guardians:</th>
<th>Adults without capacity and the role of legal representatives:</th>
<th>Will the consent form include a witness signature?</th>
</tr>
</thead>
<tbody>
<tr>
<td>No minors will be included in this study</td>
<td>No adults without capacity will be included in this study</td>
<td>Yes, Mary Nolan, the principle investigators signature</td>
</tr>
</tbody>
</table>

30(a) Does the Research involve the COLLECTION of human biological material?  No

30(b) Does the Research involve the RETENTION of human biological material? No

30(c) Who is the custodian of this human biological material? There is no human biological material involved in this study

30 (d) Does a recognised protocol exist for the collection, storage, care and disposal of this material? No as there is no human biological material involved in this study

30 (e) Have you enclosed a separate Consent Form for the Retention of Human Tissue for review? No as there is no human biological material involved in this study

30 (f) Does your research involve GENETIC TESTING? No

30 (g) Have you enclosed a separate Consent Form for Genetic Testing for review? No as genetic testing is not involved in this research

30 (h) Are arrangements in place for destroying identifiable samples to prevent further analysis should consent be withdrawn at a later time? No as genetic testing is not involved in this research

30 (i) Are samples sent outside of Cappagh National Orthopaedic Hospital? No
31. What arrangements exist to ensure participants are informed of any new information that becomes available during the course of the study? (Particularly information that could impact on their initial consent.)

All results of assessments will be given and explained to the participants. As this is an observational study, it is not anticipated that new information that will impact on their initial consent will become available.

32 (a) How will the results of this study be reported and disseminated?

This research protocol forms part of a Masters Degree in Neurology and Gerontology and will be reported in a thesis by the principle investigator.

32 (b) Will results be made available to research participants? Yes

If so, how will this be done? It is part of routine physiotherapy practice to inform the client of their results.

### INDEMNITY

33. What arrangements have been made to provide indemnification and/or compensation in the event of a claim by, or on behalf of, a participant for negligent harm?

The Principal Investigator is an employee of Cappagh National Orthopaedic Hospital and is covered by the hospitals Clinical Indemnity scheme.

34. What arrangements have been made to provide indemnification and/or compensation in the event of a claim by, or on behalf of, a participant for non-negligent harm?

The Principal Investigator is an employee of Cappagh National Orthopaedic Hospital and is covered by the hospitals Clinical Indemnity scheme.

35 (a) Have all medical practitioners involved in this study current medical malpractice insurance? Yes

35 (b) Is each member of the investigative team insured? Yes
CONFIDENTIALITY

36 (a) Who is the custodian of the data generated?

The principal investigator, Mary Nolan, is the custodian of the data generated.

36 (b) Who has access to this data?

<table>
<thead>
<tr>
<th>No</th>
<th>Name</th>
<th>Hospital Employee?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mary Nolan</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>Professor Dermot Power</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>Jill Long</td>
<td>Yes</td>
</tr>
</tbody>
</table>

36 (c) Does the Information Leaflet inform participants who is going to have access to their data? Yes

36 (d) How is security of data maintained?

Data will be encrypted using a software package. Electronic data will be password protected (changed regularly) and will be stored in Cappagh Hospitals physiotherapy department. All written data will be stored in a locked cabinet with access restricted to the PI. To uphold participant confidentiality, number codes will be used to conceal personal details and will not be disclosed except to persons involved in the study.

37 (a) How will the data be stored AND for how long?

Electronic data will be password protected which will be changed regularly and will be stored in Cappagh Hospitals physiotherapy department. Data will be encrypted using software. All written data will be stored in a locked cabinet with access restricted to the PI. Coded data will be stored securely for five years

37 (b) How will the data be disposed of? Paper data will be shredded and electronic data destroyed
Appendix 1 Ethics Application Form

37 (c) Does the Information Leaflet inform participants how long data will be stored for, and how data will be destroyed:  Yes

38 (a) What action will be taken to ensure that the identity of each participant remains confidential?
To uphold participant confidentiality, number codes will be used to conceal personal details and will not be disclosed except to persons involved in the study.

38 (b) Would you class the data as anonymous, identifiable or coded?
The data will be coded

39 (a) Will the participant’s medical records be examined?  Yes
39 (b) Will any medical records be examined by research workers?  Yes

If Yes, please justify.
Current medical information is required on the participants admission to the Rehabilitation Unit. However this information is routinely collected on initial medical, nursing, physiotherapy and occupational therapy assessments.

39 (c) Does the Participant Information Leaflet inform participants that their medical records will be examined, and by whom?
Yes, they will be examined by the principal investigator Mary Nolan and the multi-disciplinary team

ETHICAL CONSIDERATIONS

40. Does the Chief Investigator consider that there are any specific ethical issues that this study might present and how would these be dealt with?  Please identify and evaluate.  No specific ethical issues are expected to present as this study's assessments form part of a comprehensive and evidence-based geriatric assessment and routine care in the Rehabilitation Unit of Cappagh National Orthopaedic Hospital.
Title of the Research Project:

Rehabilitation Outcomes and their Association with Frailty: An Irish prospective cohort study of a post-acute older population

PLEASE ENSURE THAT YOU COMPLETE THE CHECKLIST ON THE FRONT COVER OF THE APPLICATION FORM AND ENCLOSE ALL RELEVANT ADDITIONAL DOCUMENTS.

DECLARATION:

- I certify the information in this form is accurate to the best of my knowledge and belief and I understand my ethical and legal responsibilities as Chief Investigator of this study.

- I confirm that the protocol and research will comply with all relevant Irish legislative requirements and will be conducted in accordance with European Communities (Clinical Trials on Medicinal Products for Human Use) Regulations 2004 and will abide by the ethical principles outlined in the Declaration of Helsinki and Good Clinical Practice.

- If the study receives a favourable opinion I agree to supply Annual Progress Reports, a Final report, and to seek prior approval from the Ethics Committee of any proposed changes/amendments to this protocol.

- All relevant information about serious adverse reactions and new events likely to affect the safety of the subjects will be reported to the Ethics (Medical Research) Committee in accordance with the obligations outlined in the Commissions guideline document.

Name of Chief Investigator: ____________________________________

Signature of Chief Investigator: ____________________________________

Date: ____________________________________
25th October 2013

Ms. Mary Nolan,
Senior Physiotherapist,
C/o St. Mary’s Rehabilitation Unit,
Cappagh National Orthopaedic Hospital,
Finglas,
Dublin 11.

Re: Application for Ethical Approval

Dear Mary,

The Research Ethics Committee of Cappagh National Orthopaedic Hospital reviewed your application. It was the decision of the committee to fully approve your application entitled “Multidisciplinary interventions, rehabilitation outcomes and an economic evaluation: An observational study in a post-acute frail older population”.

The Research Ethics Committee requests that the committee be formally notified of the date of finalisation of the study and provided with a formal report as to the outcome and success of this trial.

Please also be aware that this committee can only grant ethical approval to research conducted at Cappagh National Orthopaedic Hospital. Research conducted at any other site will require approval of that site's local research ethics committee or equivalent.

Should you require any further information please do not hesitate to contact me.

Yours sincerely,

Gordon Dunne
Chief Executive Officer
Ph: 01 8140461
Email: aisling.tumstead@cappagh.ie
Appendix 3 Gatekeeper Consent Form

St. Marys Rehabilitation Unit
Cappagh National Orthopaedic Hospital
Finglas
Dublin 11

Research Ethics Committee
Cappagh National Orthopaedic Hospital
Finglas
Dublin 11

Title of Study: Multi-disciplinary interventions, rehabilitation outcomes and an economic evaluation: An observational study in a post-acute frail older population

Principle Investigator: Mary Nolan, Senior Physiotherapist, St. Marys Rehabilitation Unit, Cappagh National Orthopaedic Hospital. Tel: 01 814 0419

Research Supervisor: Dr. Frances Horgan, Royal College of Surgeons in Ireland Contact email fhorgan@rcsi.ie
5th July 2013

Gatekeeper Consent form

I accept responsibility for providing potential participants with the initial contact information, and will anonymise data if appropriate

Gatekkers Signature

[Signature]

Gatekkers name (Block Capitals) KATE O’MARA

Date: 05/07/2013
Participant Information Leaflet

Principal Investigator: Mary Nolan, Senior Physiotherapist, St. Marys Rehabilitation Unit, Cappagh National Orthopaedic Hospital. Tel: 01 814 0419

Research Supervisor: Dr. Frances Horgan, Royal College of Surgeons in Ireland. Contact email fhorgan@rcsi.ie Tel: 01 4022472

Title: Frailty and its Association with Rehabilitation Outcomes: An Irish prospective cohort study of a post-acute older population

You are invited to take part in this research study. This leaflet will tell you about the purpose, risks and benefits of this study. Please read it carefully before you sign it.

If there is anything you are not clear about, I will be happy to explain it to you. Please take as much time as you need to read it.

If you agree to take part we would like to ask you to sign an informed consent document. You should only consent when you feel that you understand what is being asked of you and you have had enough time to think about your decision. Your participation is entirely voluntary. If you initially decide to take part you can subsequently change your mind without difficulty.

PURPOSE: The purpose of this study is to look at how beneficial rehabilitation is for you physically and how it improves your confidence to do your everyday activities.

WHY HAVE I BEEN CHOSEN? You have been invited to take part as you were admitted to Cappagh rehabilitation unit to improve your function and ability to do tasks.

WHO IS ORGANISING THIS STUDY?

Mary Nolan, a senior physiotherapist in St. Marys Rehabilitation Unit in Cappagh Hospital, is carrying out this study. Her supervisor is Dr. Frances Horgan, Senior Lecturer in physiotherapy in the Royal College of Surgeons in Ireland. This study is part of a Masters Degree project.

HOW WILL IT BE CARRIED OUT?

On admission to St. Marys Rehabilitation in Cappagh Hospital, you will be invited to participate in the study by Ms. Nolan. If you decide not to take part in the study, it will not affect your care whilst in Cappagh Hospital.

WHAT WILL HAPPEN TO ME IN THE STUDY? As part of this study you will be asked some personal details and how you feel about your health, mood and confidence in carrying out certain tasks. Your medical chart will be looked at to gather details of your
medical background by the principle investigator Mary Nolan and the multidisciplinary team. This is part of a routine assessment.

Assessments of your balance, mobility, strength and exercise tolerance will be carried out. This session should take on average 45 minutes and if you become tired during the assessment you can take regular rests. You will receive regular physiotherapy whilst and inpatient in Cappagh Hospital. This will consist of walking practice, balance retraining and practice in general movement and transferring from bed to chair. You will also be given exercises to improve your strength in your arms and legs and your balance.

These assessments will be repeated before your discharge from Cappagh Hospital.

**CONFIDENTIALITY:** When you enter the study you will be assigned a unique number and from then only this number will be used to identify you on study paper or computer files. The code will be kept on one sheet in a locked cabinet that only the researchers will have access to. Your name will not be published and will not be disclosed to anyone else. Information will be kept for 5 years and then destroyed by shredding paper files. The computerised data on you will then be numbered only and will be kept for future reference.

**BENEFITS:** This study is hoping to establish if your general strength, balance and ability to do everyday activities such as walking improves with rehabilitation during your stay in Cappagh Hospital. This study will not affect the care you will receive whilst and inpatient in Cappagh.

**RISKS:** There is a very slight risk that you could lose your balance during the assessments. However this is very unlikely as you will be supervised very closely at all times by an experienced physiotherapist.

**EXCLUSION:** All patients can enter this study, once informed consent has been obtained.

**Alternative treatment:** This study will not interfere with the level of care you receive in Cappagh Hospital.

**Voluntary Participation:** You have volunteered to participate in this study. You may withdraw at any time. If you decide not to participate, or if you withdraw, your rehabilitation will not be affected.

**Stopping the study:** If the medical team looking after you feels it is necessary, they may stop your participation in the study at any time without your consent.

**Permission:** Ethical Approval for this project has been granted by Cappagh National Orthopaedic Hospitals Research Ethics Committee.

**Contact details:** Please ask if you do not understand or would like more information. Mary Nolan, Telephone 01 814 0419 email mary.nolan@cappagh.ie or Dr. Frances Horgan Telephone 01 402 2472 email fhorgan@rcsi.ie
Consen Form

Principal Investigator: Mary Nolan, Senior Physiotherapist, St. Marys Rehabilitation Unit, Cappagh National Orthopaedic Hospital. Tel: 01 814 0419

Research Supervisor: Dr. Frances Horgan, Royal College of Surgeons in Ireland Contact email fhorgan@rcsi.ie Tel: 01 402 2472

Title: Rehabilitation Outcomes and their association with Frailty: An Irish prospective cohort study of a post-acute older population

Please tick the appropriate answer

I confirm that I have read and understood the Patient Information Leaflet dated _________ attached and that I have had ample opportunity to ask questions all of which have been satisfactorily answered

Yes □ No □

I understand that my participation is entirely voluntary and that I may withdraw from the study at any time, without giving reason and that this decision will not affect my future treatment or medical care

Yes □ No □

I understand that my identity will remain confidential at all times

Yes □ No □

I have been given a copy of the Participant Information Sheet and Consent form for my records

Yes □ No □

Participant's Name: __________________________________________________________

Participant's Signature: _____________________________ Date: ______________

To be completed by the Principal Investigator

I, the undersigned have taken the time to fully explain the nature and purpose of this study to the above participant, in a manner that he/she can understand. I have explained that risks and the possible benefits involved and have invited him/her to ask questions on any aspect of the study that concerned them.

Researcher's Name: _____________________________

Researcher's Signature: _____________________________ Date: ______________
# Data Collection Form

**Principal investigator:** Miss Mary Nolan, Senior Physiotherapist Cappagh Hospital, Tel: 01 814 0419  **Supervisor:** Dr. Frances Horgan, Contact: fhorgan@rcsi.ie

<table>
<thead>
<tr>
<th>Study number</th>
<th>DOB (Age)</th>
<th>Gender</th>
<th>M □</th>
<th>F□</th>
</tr>
</thead>
</table>

**Presenting diagnosis**

**Past medical history**

**Medications**

**Falls history in past year (number)**

**Length of acute hospital stay (days)**

**Social Support (Please tick)**

<table>
<thead>
<tr>
<th>Lives alone □</th>
<th>Lives with family □</th>
<th>Specify: ____________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informal supports</td>
<td>Family/other Support □</td>
<td>Specify: ____________</td>
</tr>
</tbody>
</table>

**Clinical Evaluations** | **Admission**
--- | ---
Lubben Social Network Score | |
MMSE Score | |
Geriatric Depression Scale | |
### Outcome Measures

<table>
<thead>
<tr>
<th>Outcome Measures</th>
<th>Admission</th>
<th>Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Frailty Scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Euro QoL VAS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Falls Efficacy Scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barthel Index</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TUG (sec)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grip-Strength (kgs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tinetti Balance &amp; Gait</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10MWT (sec)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Mobility and Transfers

<table>
<thead>
<tr>
<th>Baseline self-report</th>
<th>Admission T1</th>
<th>Discharge T2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobility TFs</td>
<td>Mobility TFs</td>
<td>Mobility TFs</td>
</tr>
<tr>
<td>Indp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indp with aid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supervision with aid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supervision</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assistance with aid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assistance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
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</table>

### Therapy content

<table>
<thead>
<tr>
<th>Physiotherapy Type of Intervention (please tick)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerobic training</td>
<td></td>
</tr>
<tr>
<td>Gait re-education</td>
<td></td>
</tr>
<tr>
<td>Balance re-education</td>
<td></td>
</tr>
<tr>
<td>Transfer practice</td>
<td></td>
</tr>
<tr>
<td>Lower limb exercise</td>
<td></td>
</tr>
<tr>
<td>Upper limb exercise</td>
<td></td>
</tr>
<tr>
<td>Respiratory Physiotherapy</td>
<td></td>
</tr>
<tr>
<td>Class exercise (specify Balance/ strength)</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 6 Data Collection Form

<table>
<thead>
<tr>
<th>Occupational Therapy</th>
<th>Type of Intervention (please tick)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seating</td>
<td></td>
</tr>
<tr>
<td>Graded ADL/PADLs</td>
<td></td>
</tr>
<tr>
<td>Transfer practice</td>
<td></td>
</tr>
<tr>
<td>Cognitive rehabilitation</td>
<td></td>
</tr>
<tr>
<td>Client education</td>
<td></td>
</tr>
<tr>
<td>Home Assessments</td>
<td></td>
</tr>
<tr>
<td>UL dexterity class</td>
<td></td>
</tr>
</tbody>
</table>

Other disciplines referred: Speech and Language, Social Work, Dietician, Podiatrist, Other (Please Specify) ______________________________________________________________

<table>
<thead>
<tr>
<th>Therapy Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT</td>
</tr>
<tr>
<td>Total time T1 - T2 (minutes)</td>
</tr>
<tr>
<td>Total number of sessions T1 - T2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LOS and Discharge destination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of stay rehabilitation unit</td>
</tr>
</tbody>
</table>

Discharge destination

<table>
<thead>
<tr>
<th>Home no supports</th>
<th>Home Care Package</th>
<th>Home Help</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>New</td>
<td>Increase</td>
</tr>
<tr>
<td>Long Term Care</td>
<td>Readmission to acute hospital</td>
<td>Deceased</td>
</tr>
</tbody>
</table>

□
Mini-Mental State Examination (MMSE)

Patient's Name: ____________________________ Date: ____________

*Instructions: Score one point for each correct response within each question or activity.*

<table>
<thead>
<tr>
<th>Maximum Score</th>
<th>Patient's Score</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td></td>
<td>“What is the year? Season? Date? Day? Month?”</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>“Where are we now? State? County? Town/city? Hospital? Floor?”</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>The examiner names three unrelated objects clearly and slowly, then the instructor asks the patient to name all three of them. The patient’s response is used for scoring. The examiner repeats them until patient learns all of them, if possible.</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>“I would like you to count backward from 100 by sevens.” (93, 86, 79, 72, 65, …) Alternative: “Spell WORLD backwards.” (D-L-R-O-W)</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>“Earlier I told you the names of three things. Can you tell me what those were?”</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Show the patient two simple objects, such as a wristwatch and a pencil, and ask the patient to name them.</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>“Repeat the phrase: ‘No ifs, ands, or buts.’”</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>“Take the paper in your right hand, fold it in half, and put it on the floor.” (The examiner gives the patient a piece of blank paper.)</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>“Please read this and do what it says.” (Written instruction is “Close your eyes.”)</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>“Make up and write a sentence about anything.” (This sentence must contain a noun and a verb.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Please copy this picture.” (The examiner gives the patient a blank piece of paper and asks him/her to draw the symbol below. All 10 angles must be present and two must intersect.)</td>
</tr>
<tr>
<td>30</td>
<td>TOTAL</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 8 Geriatric Depression Scale Scoring

Geriatric Depression Scale (GDS) Short Form

Instructions: Circle the answer that best describes how you felt over the past week.

1. Are you basically satisfied with your life? Yes No
2. Have you dropped many of your activities and interests? Yes No
3. Do you feel that your life is empty? Yes No
4. Do you often get bored? Yes No
5. Are you in good spirits most of the time? Yes No
6. Are you afraid that something bad is going to happen to you? Yes No
7. Do you feel happy most of the time? Yes No
8. Do you often feel helpless? Yes No
9. Do you prefer to stay at home, rather than going out and doing things? Yes No
10. Do you feel that you have more problems with memory than most? Yes No
11. Do you think it is wonderful to be alive now? Yes No
12. Do you feel worthless the way you are now? Yes No
13. Do you feel full of energy? Yes No
14. Do you feel that your situation is hopeless? Yes No
15. Do you think that most people are better off than you? Yes No

Total Score _______________
Appendix 8 Geriatric Depression Scale Scoring

Geriatric Depression Scale (GDS) Scoring Instructions

Instructions: Circle Score 1 point for each bolded answer. A score of 5 or more suggest depression.

1. Are you basically satisfied with your life? 
   - Yes  
   - No
2. Have you dropped many of your activities and interests? 
   - Yes  
   - No
3. Do you feel that your life is empty? 
   - Yes  
   - No
4. Do you often get bored? 
   - Yes  
   - No
5. Are you in good spirits most of the time? 
   - Yes  
   - No
6. Are you afraid that something bad is going to happen to you? 
   - Yes  
   - No
7. Do you feel happy most of the time? 
   - Yes  
   - No
8. Do you often feel helpless? 
   - Yes  
   - No
9. Do you prefer to stay at home, rather than going out and doing things? 
   - Yes  
   - No
10. Do you feel that you have more problems with memory than most? 
    - Yes  
    - No
11. Do you think it is wonderful to be alive now? 
    - Yes  
    - No
12. Do you feel worthless the way you are now? 
    - Yes  
    - No
13. Do you feel full of energy? 
    - Yes  
    - No
14. Do you feel that your situation is hopeless? 
    - Yes  
    - No
15. Do you think that most people are better off than you? 
    - Yes  
    - No

A score of ≥ 5 suggests depression  
Total Score ____________________

Ref. Yes average: the use of Rating Depression Series in the Elderly, in Poon (ed.): Clinical Memory Assessment of Older Adults, American Psychological Association, 1986
CIRCLE the most applicable answer for you

**FAMILY:** Considering the people to whom you are related by birth, marriage, adoption, etc…

| 1. How many relatives do you see or hear from at least once a month? |
|---------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 0                         | 1               | 2               | 3 or 4          | 5-8             | 9 or more        |

| 2. How many relatives do you feel at ease with that you can talk about private matters? |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 0                               | 1               | 2               | 3 or 4          | 5-8             | 9 or more        |

| 3. How many relatives do you feel close to such that you could call on them for help? |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 0                               | 1               | 2               | 3 or 4          | 5-8             | 9 or more        |

**FRIENDSHIPS:** Considering all of your friends including those who live in your neighbourhood

| 4. How many of your friends do you see or hear from at least once a month? |
|---------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 0                         | 1               | 2               | 3 or 4          | 5-8             | 9 or more        |

| 5. How many friends do you feel at ease with that you can talk about private matters? |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 0                               | 1               | 2               | 3 or 4          | 5-8             | 9 or more        |

| 6. How many friends do you feel close to such that you could call on them for help? |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 0                               | 1               | 2               | 3 or 4          | 5-8             | 9 or more        |
Appendix 9 Lubben Social Network Scale

SCORING SHEET
LSNS-6 total score is an equally weighted sum of these six items. Scores range from 0 to 30

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0 points</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1 points</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2 points</td>
<td></td>
</tr>
<tr>
<td>3-4</td>
<td>3 points</td>
<td></td>
</tr>
<tr>
<td>5-8</td>
<td>4 points</td>
<td></td>
</tr>
<tr>
<td>9 or more</td>
<td>5 points</td>
<td></td>
</tr>
</tbody>
</table>

**FAMILY:** Considering the people to whom you are related by birth, marriage, adoption, etc…

1. How many relatives do you see or hear from at least once a month?
2. How many relatives do you feel at ease with that you can talk about private matters?
3. How many relatives do you feel close to such that you could call on them for help?

   Family sub-score /15

**FRIENDSHIPS:** Considering all of your friends including those who live in your neighbourhood

4. How many of your friends do you see or hear from at least once a month?
5. How many friends do you feel at ease with that you can talk about private matters?
6. How many friends do you feel close to such that you could call on them for help?

   Friend sub-score /15

**Total Score** /30
## Clinical Frailty Scale

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Very Fit</td>
<td>People who are robust, active, energetic and motivated. These people commonly exercise regularly. They are among the fittest for their age.</td>
</tr>
<tr>
<td>2 Well</td>
<td>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.</td>
</tr>
<tr>
<td>3 Managing Well</td>
<td>People whose medical problems are well controlled, but are not regularly active beyond routine walking.</td>
</tr>
<tr>
<td>4 Vulnerable</td>
<td>While not dependent on others for daily help, often symptoms limit activities. A common complaint is being &quot;slowed up&quot;, and/or being tired during the day.</td>
</tr>
<tr>
<td>5 Mildly Frail</td>
<td>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.</td>
</tr>
<tr>
<td>6 Moderately Frail</td>
<td>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.</td>
</tr>
<tr>
<td>7 Severely Frail</td>
<td>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).</td>
</tr>
<tr>
<td>8 Very Severely Frail</td>
<td>Completely dependent, approaching the end of life. Typically, they could not recover even from a minor illness.</td>
</tr>
<tr>
<td>9 Terminally Ill</td>
<td>Approaching the end of life. This category applies to people with a life expectancy &lt;6 months, who are not otherwise evidently frail.</td>
</tr>
</tbody>
</table>

### 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.
Appendix 11 Grip Strength Standardised Instructions

**Grip-strength**

**Instructions to subject:** Hold your elbow at 90 degrees, squeeze the dynamometer as hard as you can, relax your grip and repeat two more times

**Instructions to rater:** Ensure the subject’s elbow is held at 90 degrees and the arm is not resting on the table. Calculate the average of the three scores.

Averaging three attempts is the most reliable measurement method (Matiowetz et al., 1984).

**Date __________________**

<table>
<thead>
<tr>
<th></th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Kgs

Physiotherapist Signature ___________________________

(PRINT NAME) ___________________________
Appendix 12 Timed Up and Go Standardised Instructions

Timed Up and Go

Instructions to therapist:
The person may wear their usual footwear and can use any assistive device they normally use.

1. Have the person sit in the chair with their back to the chair and their arms resting on the arm rests.

2. Ask the person to stand up from a standard chair and walk a distance of 10 ft. (3m).

3. Have the person turn around, walk back to the chair and sit down again.

Timing begins when the person starts to rise from the chair and ends when he or she returns to the chair and sits down.

The person should be given 1 practice trial and then 3 actual trial. The times from the three actual trials are averaged.

Instructions to the patient:
“When I say ‘go’ I want you to stand up and walk to the line, turn and then walk back to the chair and sit down again. Walk at your normal pace.”

Date ______________

<table>
<thead>
<tr>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

sec sec sec sec

Physiotherapist Signature ______________________

(PRINT NAME) ______________________
Appendix 13 Ten Meter Walk Test Standardised Instructions

**Timed 10-Meter Walk Test**
General Information: individual walks without assistance 14 meters and the time is measured for the intermediate 10 meters. Allow 2 meters each end for acceleration and deceleration

- assistive devices can be used but should be kept consistent and documented from test to test
- if physical assistance is required to walk, this should not be performed
- can be performed at preferred walking speed or fastest speed possible
- documentation should include the speed tested (preferred vs. fast)
- collect three trials and calculate the average of the three trials

**Patient Instructions (derived from reference articles):**
Normal comfortable speed: “I will say ready, set, go. When I say go, walk at your normal comfortable speed until I say stop”
Maximum speed trials: “I will say ready, set, go. When I say go, walk as fast as you safely can until I say stop”

**Admission (T1) Date ______________

<table>
<thead>
<tr>
<th></th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>sec</td>
<td>sec</td>
<td>sec</td>
<td></td>
<td>sec</td>
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</tbody>
</table>

Physiotherapist Signature _______________________
(PRINT NAME) _______________________

128
### Elderly Mobility Scale

<table>
<thead>
<tr>
<th>Item</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lying to sitting</strong></td>
<td></td>
</tr>
<tr>
<td>2 Independent</td>
<td></td>
</tr>
<tr>
<td>1 Needs help of 1 person</td>
<td></td>
</tr>
<tr>
<td>0 Needs help of 2+ people</td>
<td></td>
</tr>
<tr>
<td><strong>Sitting to lying</strong></td>
<td></td>
</tr>
<tr>
<td>2 Independent</td>
<td></td>
</tr>
<tr>
<td>1 Needs help of 1 person</td>
<td></td>
</tr>
<tr>
<td>0 Needs help of 2+ people</td>
<td></td>
</tr>
<tr>
<td><strong>Sit to stand</strong></td>
<td></td>
</tr>
<tr>
<td>3 Independent in under 3 seconds</td>
<td></td>
</tr>
<tr>
<td>2 Independent in over 3 seconds</td>
<td></td>
</tr>
<tr>
<td>1 Needs help of 1 person (verbal or physical)</td>
<td></td>
</tr>
<tr>
<td>0 Needs help of 2+ people</td>
<td></td>
</tr>
<tr>
<td><strong>Standing</strong></td>
<td></td>
</tr>
<tr>
<td>3 Stands without support &amp; reaches within arms length</td>
<td></td>
</tr>
<tr>
<td>2 Stands without support but needs help to reach</td>
<td></td>
</tr>
<tr>
<td>1 Stands, but requires support</td>
<td></td>
</tr>
<tr>
<td>0 Stands, only with physical support (1 person)</td>
<td></td>
</tr>
<tr>
<td>Support = <em>uses upper limbs to steady self</em></td>
<td></td>
</tr>
<tr>
<td><strong>Gait</strong></td>
<td></td>
</tr>
<tr>
<td>3 Independent (incl. use of sticks)</td>
<td></td>
</tr>
<tr>
<td>2 Independent with frame</td>
<td></td>
</tr>
<tr>
<td>1 Mobile with walking aid but erratic/unsafe turning</td>
<td></td>
</tr>
<tr>
<td>0 Requires physical assistance or constant supervision</td>
<td></td>
</tr>
<tr>
<td><strong>Timed walk</strong></td>
<td></td>
</tr>
<tr>
<td>3 Under 15 seconds</td>
<td></td>
</tr>
<tr>
<td>2 16-30 seconds</td>
<td></td>
</tr>
<tr>
<td>1 over 30 seconds</td>
<td></td>
</tr>
<tr>
<td><strong>Functional Reach</strong></td>
<td></td>
</tr>
<tr>
<td>4 Over 20cm</td>
<td></td>
</tr>
<tr>
<td>2 10-20cm</td>
<td></td>
</tr>
<tr>
<td>0 Under 10cm or unable</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Interpretation of scores**

- **14 – 20** Manoeuvres alone and safely. Independent in basic ADLs. These patients are generally safe to go home but may need home help.
- **10 – 13** Borderline in terms of safe mobility and independence in ADLs. These patients will require some help with mobility manoeuvres.
- **< 10** Dependent in mobility manoeuvres and requiring help with basic ADLs (transfers, toileting, dressing etc.). May require home care package/long term care depending on patients’ wishes and circumstances.
### Tinetti Balance and Gait Assessment

<table>
<thead>
<tr>
<th>Balance Assessment</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Patient seated on a hard, armless chair</em></td>
<td></td>
</tr>
</tbody>
</table>

#### Sitting Balance
- 0 = Leans or slides in the chair
- 1 = Steady, safe

#### Rises from chair
- 0 = Unable without help
- 1 = Able, uses arms to help
- 2 = Able to rise, 1 attempt

#### Attempts to rise
- 0 = Unable without help
- 1 = Able, requires > 1 attempt
- 2 = Able to rise, 1 attempt

#### Immediate standing balance (first 5 seconds)
- 0 = Unsteady (staggers, moves feet, marked trunk sway)
- 1 = Steady, but uses walker or other support
- 2 = Steady without walker or other support

#### Standing balance
- 0 = Unsteady
- 1 = Steady but wide stance (medial heels > 4” apart) uses cane or other support
- 2 = Narrow stance without support

#### Nudged
*Subject at maximum stance position, (feet as close together as possible)*
- Examiner pushes lightly on subjects sternum with palm of hand 3 times
- 0 = Begins to fall
- 1 = Staggers, grabs but catches self
- 2 = Steady

#### Eyes Closed
*At maximum stance position*
- 0 = Unsteady
- 1 = Steady

#### Turning 360 degrees
- 0 = Discontinuous steps
- 1 = Continuous steps

#### Turning 360 degrees
- 0 = Unsteady, grabs, staggers
- 1 = Safe, smooth motion

#### Sitting down
- 0 = Unsafe, misjudged distance, falls into chair
- 1 = Uses arms or not a smooth motion
- 2 = Safe, smooth motion

<table>
<thead>
<tr>
<th>Balance Score</th>
<th>/ 16</th>
</tr>
</thead>
</table>

**Therapist name** *if signature not legible please print name*
### Gait Assessment

**Initial instructions:** subject stands with examiner. Walks down hallway or across room, first at usual pace, then back at rapid but safe pace (using usual walking aids).

#### Date

<table>
<thead>
<tr>
<th><strong>Initiation of gait</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Immediately after told to “go”</em></td>
<td></td>
</tr>
<tr>
<td>0 = Any hesitancy or multiple attempts to start</td>
<td></td>
</tr>
<tr>
<td>1 = No hesitancy</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Step length and height (right foot swing)</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = Does not pass left stance foot with step</td>
<td></td>
</tr>
<tr>
<td>1 = Passes left stance foot</td>
<td></td>
</tr>
<tr>
<td>0 = Right foot does not clear floor completely with step</td>
<td></td>
</tr>
<tr>
<td>1 = Right foot completely clears floor</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Step length and height (left foot swing)</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = Does not pass right stance foot with step</td>
<td></td>
</tr>
<tr>
<td>1 = Passes right stance foot</td>
<td></td>
</tr>
<tr>
<td>0 = Left foot does not clear floor completely with step</td>
<td></td>
</tr>
<tr>
<td>1 = Left foot completely clears floor</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Step symmetry</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = Right and left step length not equal (estimate)</td>
<td></td>
</tr>
<tr>
<td>1 = Steps appear continuous</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Path</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Excursion – observe over 10 feet distance</em></td>
<td></td>
</tr>
<tr>
<td>0 = Marked deviation</td>
<td></td>
</tr>
<tr>
<td>1 = Mild / moderate deviation or uses walking aid</td>
<td></td>
</tr>
<tr>
<td>2 = Straight without walking aid</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Trunk</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = Marked sway or uses walking aid</td>
<td></td>
</tr>
<tr>
<td>1 = No sway but flexion at knees or back or spreads arms out for stability while walking</td>
<td></td>
</tr>
<tr>
<td>2 = No sway, flexion, use of arms or walking aid</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Walking stance</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = Heels apart wide base</td>
<td></td>
</tr>
<tr>
<td>1 = Heels almost touching whilst walking</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Mobility Score</strong></th>
<th>/ 12</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Score (Balance plus mobility)</strong></td>
<td>/ 28</td>
</tr>
</tbody>
</table>

**Therapist name** if signature not legible please print name

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Risk indicators: ≤ 18 indicates high falls risk, 19 – 23 moderate falls risk, ≥ 24 low falls risk
Barthel Index Scoring

**FEEDING**
0 = Unable
5 = needs help cutting, spreading butter etc or requires a modified diet
10 = Independent

**BATHING**
0 = Dependent
5 = Independent (or in shower)

**GROOMING**
0 = needs help with personal care
5 = Independent face/hair teeth shaving implements provided

**DRESSING**
0 = dependent
5 = Needs help but can do about half unaided
10 = Independent (including buttoned, zips, laces etc.)

**BOWELS**
0 = Incontinent
5 = Occasional accident
10 = Continent

**BLADDER**
0 = Incontinent or catheterised
5 = occasional accident (1 per 24 hrs)
Appendix 16 Barthel Index

10 = Continent over 7 days

**TOLET USE**
0 = Dependent
5 = Needs some help
10 = Independent (on and off, dressing, wiping)

**TRANSFERS (BED TO CHAIR AND BACK)**
0 = unable
5 = Major help from 1 or 2 assistants
10 = Minor help (verbal or physical)
15 = independent (may use aids)

**MOBILITY (ON LEVEL SURFACES)**
0 = immobile or <50 yards
5 = wheelchair dependent, including corners > 50 yards
10 = walks with help of one person (verbal or physical) > 50 yards
15 = independent (but may use aid) >50 yards

**STAIRS**
0 = unable
5 = needs help (verbal, physical, carrying aid)
10 = independent

| **Total Score (0-100)** |
Appendix 17 Euro-Quality-of-Life 5D

Under each heading, please tick the ONE box that best describes your health TODAY

**MOBILITY**
I have no problems in walking about
I have slight problems in walking about
I have moderate problems in walking about
I have severe problems in walking about
I am unable to walk about

**SELF-CARE**
I have no problems washing or dressing myself
I have slight problems washing or dressing myself
I have moderate problems washing or dressing myself
I have severe problems washing or dressing myself
I am unable to wash or dress myself

**USUAL ACTIVITIES** *(e.g. work, study, housework, family or leisure activities)*
I have no problems doing my usual activities
I have slight problems doing my usual activities
I have moderate problems doing my usual activities
I have severe problems doing my usual activities
I am unable to do my usual activities

**PAIN / DISCOMFORT**
I have no pain or discomfort
I have slight pain or discomfort
I have moderate pain or discomfort
I have severe pain or discomfort
I have extreme pain or discomfort

**ANXIETY / DEPRESSION**
I am not anxious or depressed
I am slightly anxious or depressed
I am moderately anxious or depressed
I am severely anxious or depressed
I am extremely anxious or depressed
Appendix 17 Euro-Quality-of-Life 5D

☐ We would like to know how good or bad your health is TODAY.

This scale is numbered from 0 to 100.
100 means the best health you can imagine. 0 means the worst health you can imagine.
Mark an X on the scale to indicate how your health is TODAY.
Now, please write the number you marked on the scale in the box below.

YOUR HEALTH TODAY =
Falls Efficacy Scale

On a scale from 1 to 10, with 1 being not confident at all and 10 being very confident, how confident are you that you do the following activities without falling?

<table>
<thead>
<tr>
<th>Activity</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Take a bath or shower</td>
<td></td>
</tr>
<tr>
<td>Reach into cabinets or closets</td>
<td></td>
</tr>
<tr>
<td>Walk around the house</td>
<td></td>
</tr>
<tr>
<td>Prepare meals not requiring carrying heavy or hot objects</td>
<td></td>
</tr>
<tr>
<td>Get in and out of bed</td>
<td></td>
</tr>
<tr>
<td>Answer the door or telephone</td>
<td></td>
</tr>
<tr>
<td>Get in and out of a chair</td>
<td></td>
</tr>
<tr>
<td>Getting dressed and undressed</td>
<td></td>
</tr>
<tr>
<td>Personal grooming (i.e. washing your face)</td>
<td></td>
</tr>
<tr>
<td>Getting on and off of the toilet</td>
<td></td>
</tr>
<tr>
<td><strong>Total Score</strong></td>
<td></td>
</tr>
</tbody>
</table>