Maintaining Independence:

Predicting and Preventing Residential Care Admission in Frail Older People Discharged from Hospital

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ABSTRACT

This thesis examines influences on outcomes for frail older people in the year following their discharge from a specialist subacute geriatric assessment unit. It is a mixed methodology study comprising four phases: an exploratory retrospective cohort study, a prospective cohort study in which outcomes for the cohort are examined both quantitatively and qualitatively to develop models to predict outcome, a validation cohort for these models and finally a pilot feasibility study for an intervention to support older people in the post-discharge period.

In the context of the growing ageing population, health and social care for older people is becoming a critical issue. It has been shown that older people would prefer to retain their independence and remain living in their own homes in their communities whenever possible. Those that remain in their own homes have better quality of life and lower rates of depression. The New Zealand government "Positive Ageing" strategy, and internationally the World Health Organisations "Active Ageing" policy framework support the goal of independent living for older people

Frailty is an evolving concept in the field of geriatric medicine. Frail older people are a group with reduced physical and mental health, cognitive and social reserves, in whom even a minor insult may trigger a catastrophic functional decline leading to outcomes such as institutionalisation and hospital admissions. Recognition of frailty is important, as a number of interventions have been shown to improve outcomes in frail people including comprehensive geriatric assessment.

My study group are frail older people in whom an acute illness has led to a loss of function requiring further hospital inpatient treatment and rehabilitation before they could be discharged. There is little existing evidence specifically regarding this group, either in terms of predicting outcomes, or interventions to support discharge and ongoing "ageing in place."

In the first phase of this study, I conducted a retrospective audit of outcomes in older people discharged from subacute geriatric care. The majority of older people were able to remain at home at one year. Predictors of residential care admission included age and function.

In the second phase I conducted a prospective cohort study using both quantitative and qualitative methods to examine predictors of outcome. Predictors of residential care admission included degree of frailty, dementia, self-rated quality of life and further hospital admissions. Telephone follow-up interviews were also conducted, and those who reported their health as deteriorating had a significantly increased likelihood of entering residential care. In contrast further hospital admissions were predicted by comorbidities.

Qualitative interviews were conducted with a group of older people who had entered residential care and a matched group who remained in their own homes. Key issues included burden on carers, attitudes of patients, carers and health professionals, and the impact of repeated hospital admissions.

In the validation cohort, I showed that the models I developed predicted outcomes with good sensitivity.

Finally, I aimed to develop an intervention based on earlier findings to support older people to remain in the community following discharge from hospital. Within the context of dynamically developing services for older people in Canterbury and New Zealand it was essential to work alongside these new developments. My intervention dovetailed with the newly evolving restorative home support system. I used regular telephone contact after discharge to identify those who reported their health as deteriorating. These people received a domiciliary visit, were discussed at a multidisciplinary team meeting and then had an individually tailored intervention. Regular telephone calls were acceptable to older people and their carers, and the majority reported a positive impact on their health. A number of feasibility issues, particularly in the interactions between my intervention and the community service were identified.

In summary, this study shows that it is possible to identify older people at high risk of adverse outcomes at the time of hospital discharge, and that routine measurement of frailty would be a useful addition to inpatient geriatric care. Regular telephone contact following discharge is acceptable to older people and carers and allows identification of those whose health is deteriorating earlier than they would otherwise present to primary or secondary care. Further development and testing of post-discharge supports is warranted.

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PUBLICATIONS

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TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

ABBREVIATIONS

ADL- Activities of Daily Living
AF- Atrial Fibrillation
AUC- area under curve
BH- Benjamini-Hochberg
BMI- Body Mass Index
CCF- Congestive Cardiac Failure
CDHB- Canterbury District Health Board
CGA- Comprehensive Geriatric Assessment
CI- Charlson Index
C(O)PD- Chronic (Obstructive) Pulmonary Disease
CRF- Chronic Renal Failure
CRP- C Reactive Protein
CVA- Cerebrovascular Accident/ Stroke
CXCL-10- pro-inflammatory cytokine
DM- Diabetes Mellitus
EFS- Edmonton Frail Scale
FI- Frailty Index
FIM- Functional Independence Measure
FR- Functional Reach
GDS- Geriatric Depression Score
GEM- Geriatric Evaluation and Management
GP- General Practitioner
HBSS- Home Based Support Services
HLC- Hospital Level Care
HOPS- Health of Older People Strategy
HTN- Hypertension
IADL- Instrumental Activities of Daily Living
ICF- International Classification of Functioning, Disability and Health
IHD- Ischaemic Heart Disease
IGF-1- Insulin-like Growth Factor 1
IL(6)- Interleukin (6)
LoC- Locus of Control
MDS-HC- Minimum Data Set for Home Care
MoH- Ministry of Health
NZ- New Zealand
OA- Osteoarthritis
OP- Osteoporotic fracture
OPHS- Older Person's Health Service
QOL- Quality of Life
RH- Rest Home
RHS- Restorative Home Support
RMO- Resident Medical Officer
ROC- Receiver Operated Characteristics
RR- Relative Risk
SAP- computerised patient records system
SR- Self-Rated
TUG - 3m Timed Up-and-Go
UI- Urinary Incontinence
WHO- World Health Organisation

1. CHAPTER ONE: INTRODUCTION: SETTING THE SCENE

The worldwide change in population demographics, with an ageing population, in particular an increase in the very old (>85 years), and rising prevalence of age-related disease and disability is a challenge receiving growing recognition in health and social services dealing with older people. Statistics New Zealand [1] recorded an increase in the 65+ age group by 26% in 2000-2010, with people over the age of 90 having the biggest growth in that.

In 2009 the World Health Organisation published its "Active Ageing" policy framework [2]. This defines active ageing as "the process of optimizing opportunities for health participation and security in order to enhance quality of life as people age." Determinants of active ageing include cultural differences, gender, health and social services, behavioural factors such as smoking and physical activity, genetic predisposition, psychological factors, and a person's physical, social and economic environment.

Within New Zealand, health and social care services for older people are provided through a range of services, underpinned by the Government "Positive Ageing Strategy", first published in 2001 [3],[4]. This strategy aims to "offer older people to continue to live safely in their community" through the development of health and disability services which are integrated and responsive to their needs. Accordingly, the NZ Ministry of Health (MoH) developed its Health of Older People Strategy (HOPS) in 2002 [5], outlining the steps required in the health sector to promote positive ageing. A range of key objectives were highlighted including:

- "Older people, their families and whanau are able to make well-informed choices about healthy living, health care and/ or disability support needs."

- "Policy and service planning will support quality health and disability support programmes integrated around the needs of older people."

- "Admission to general hospital services will be integrated with any community-based care and support that an older person requires" and in particular key step 7.1.1: "The MoH and DHBs will review services for older people to assess options for community-based care and disability support to avoid unnecessary hospitalisation or inappropriate long-term residential care."

- "Older people with high and complex health and disability support needs will have access to flexible, timely and co-ordinated services and living options that take account of family and whanau carer needs."

Key points within these objectives include:

- Develop the health care and home support workforce to focus on home-based rehabilitation (home support) services (key step 1.4, page 19)

- Develop an integrated continuum of care for older people (key step 2.1, page 20)

- Implementation plan and guidelines for comprehensive integrated assessment. Physical, mental, social, cultural and spiritual needs must be included, and whether functional limitations can be reversed by treatment and rehabilitation. (Key step 3.2, page 29)

- Specialist services must be provided with a continuum across assessment, treatment and rehabilitation in community, hospital and residential care settings. To achieve this identifying how specialist services will provide support for primary and community care services is key (key point 3.5.1, page 33).

- Comprehensive assessment before an older person moves between levels of care (key point 8.1, page 59)

Of particular relevance to this thesis, objective seven (HOPS, page 53-55) states that "admission to general hospital services will be integrated with any community-based care and support that an older person requires" including:

- Community-based care and disability support to avoid unnecessary hospitalisation or inappropriate long-term residential care admission.

- Proactive approaches to integrating hospital care with ongoing care: discharge planning, recovery and rehabilitation, preventing unnecessary admission to residential care with service targeting users at highest risk

- Implementing a discharge plan including providing appropriate information to primary and community health and disability support services to ensure a smooth transition between services.

This strategy was updated by the Ministry of Social Development in 2008 as the "Positive Ageing Strategy." [3] This strategy has a number of objectives, the two most

relevant to this thesis are goal 2: Health Goal (Objective 2.1-2.3), and goal 5: Ageing in the Community (objective 5.2-5.3)

- "Promotion of holistic-based wellness throughout the life cycle"

- "Develop options that allow integrated planning, funding and delivery of primary and secondary health services, residential care and community support services."

- Ensure the availability of multi-disciplinary comprehensive needs assessment for older people throughout New Zealand.

- Develop a wide range of services that facilitate ageing in the community

- Develop policy options that facilitate ageing in the community

At the start of this research in early 2007 CDHB had recently published a strategic planning document [6].. In the four years covered by this thesis, between 2006 and 2010 projected population growth predicted that the 65-69 year old group would increase by 14%, and the "oldest-old", >85 years, by 25% (CDHB OPHS "Directions 2006-2010", page 6). They predicted a corresponding large rise in the prevalence of age-related disease and disability, and increases in the demands on acute hospital care, specialist geriatric services and home-based support services. Relative to other areas of New Zealand, Canterbury has been spending more on residential care for older people than on home-based support services, which is not sustainable in the long-term, and is out of step with national strategies of "ageing in place." It is important to note, however, that it is extremely difficult to separate data on residential care costs from clinical data on residential care utilisation, as the former is related to individual eligibility for the nationally managed subsidy, with its associated asset-testing thresholds, which have themselves been the subject of significant change since 2005. In the previous period since 1990, this sector has been the focus of continuing change and review, as backgrounded by Ashton [7]. Suffice to say, at a policy level, reducing residential care costs and utilisation has been a significant driver of service development, regionally and nationally, for many years.

In addition to the "directions" document, CDHB also published in 2006 its Older Persons Health Strategy [8] This document outlines the challenges and proposed strategies for meeting those strategies across CDHB (not just within the Older Persons' Health

Service (OPHS). Challenges included the rising numbers and proportion of older people within Canterbury, and the discrepancy in funding and residential care use between Canterbury and other areas of New Zealand. Principles for the direction of services include ageing in place, building capacity within non-institutional services, and integrated planning and delivery (OPH Strategy page 8.).

These CDHB documents addressed the key target of "providing older people with community based services that allow them to maintain their independence for as long as possible, whilst acknowledging that older age often brings with it an increased need for support from a variety of health and related services." (CDHB OPH strategy, page 4)[8]. This document outlined the strategic direction for the service, and highlighted a number of key areas. Strengthening community services and improving discharge planning were two areas which were important in meeting the goal of supporting "ageing in place." Issues within these areas included changing models of rehabilitation so this can be provided in the community, ensuring timely delivery of community services to prevent hospital admission, and provision of effective discharge planning. Suggested methods to address these issues included introduction of the InterRAI (a tool to facilitate comprehensive geriatric assessment; more information on www.interrai.org), seven day per week community assessment service to provide a rapid response to acute illness and crises, and multidisciplinary team discharge planning and transfer of care.

In 2009 further developments in the CDHB OPHS took place, which are discussed in a paper by Stewart [9]. For older people with complex support needs, initiatives included the aim of supporting more people to avoid or delay entry into residential care. A key feature was ensuring availability and targeting of home support resources, with dynamically evolving community assessment resources and methods for assessing older people prior to residential care admission. Use of the Minimum Data Set for Home Care (MDS-HC) tool from the InterRAI suite and review by a geriatrician prior to residential care admission were the main assessment methods to achieve this goal.

The most significant development was introduction of restorative home support (RHS). This initially was a pilot study of 400 clients within Christchurch city. The model of RHS adopted followed from the New Zealand ASPIRE trial (Assessment of Services Promoting Independence and Recovery in Elders) [10], as one of the initiatives tested in this study, the Community FIRST arm, involved an RHS model. Although this did not reach statistical significance there was an encouraging trend towards a reduction in

residential care admission. The principle of the restorative approach involves working in collaboration with the older person to set goals for their care and the use of activities of daily living (ADLs) to meet these goals and support independence.

Key concepts of a restorative programme are:

- A holistic person-centred approach

- Promotion of wellness and active participation by the older person

- The process of goal setting is used, with a goal ladder leading to a distal goal which is targeted towards an important need of the older person, goal setting by the older person is facilitated by the home care provider, but allows clients to match their needs to the services planned.

- The older person is prescribed functional exercises to promote improvement in ADLs

- Support workers support the older person to maximise their independence, "doing with" rather than "doing to or for".

The TARGET goal facilitation tool (Towards Achieving Realistic Goals in Elders Tool) has been developed by Presbyterian Support and the University of Auckland [11] to provide a framework for restorative home support in New Zealand. The RHS model was introduced to a pilot area including six suburbs of Christchurch from mid 2009. As part of the introduction of the restorative intervention monthly multidisciplinary team meetings were introduced, for the purpose of staff training, and peer review during a period of changing service delivery in the community; these meetings included case managers, clinical assessors for the home care providers, physiotherapy and occupational therapy staff, as well as researchers and project managers.

The group of older people who have had a recent hospital admission often represent a particularly vulnerable group who are at increased risk of loss of independence. Boyd et al [12] found that if older people failed to regain their previous level of function at the end of a hospital admission, they had a 41.3% chance of death, and 28.6% had not regained their pre-hospital function within 12 months. They call for longer periods of rehabilitation for older people after an acute illness and episode of functional decline. While the role of discharge planning and transfer of care has been raised both at a New Zealand national and local level, it remains an ongoing issue. In particular providing

services which bridge the gap between specialist inpatient services and community-based multidisciplinary teams and general practice (GP) care is an ongoing challenge. To address this issue CDHB developed the Community Optimisation, Recovery and Enablement (CORE) team in 2009. The focus of this project was reducing acute hospitalisations. One aim was to support older people on discharge from hospital: to offer outpatient rehabilitation through development of a goal-orientated plan, intensive outpatient rehabilitation for up to six weeks, and improvement of access to long-term disability support services, including the RHS model of care.

Older people in the community also have a wide range of health and social care related needs. These may be managed by GPs in primary care; community allied health professionals through the community therapy services, or through home based services including domestic assistance, personal care and district nursing. At the time of commencement of this thesis in 2006, post-discharge care was provided in an ad-hoc manner determined by the inpatient team, and most commonly comprised medical follow-up in primary care and needs-based domestic assistance and personal care. During the period in which this thesis is set, services for older people in Canterbury were undergoing a dynamic period of change, in particular with the introduction of the restorative home support pilot, the InterRAI, TARGET tool, and CORE teams.

This thesis is set in the gap between inpatient services and primary health care and community services, and examines firstly, what are the characteristics of the older people who utilise the health and social care services in the period after discharge from hospital? I then ask what factors influence outcomes for this frail group of people, from both a quantitative and qualitative perspective. Finally I aim to introduce a support intervention to bridge the gap between specialist inpatient treatment and rehabilitation, and the newly evolving multidisciplinary community-based team and home-based services in the setting of the introduction of restorative home support.

1.1 Study Setting and Terminology

This thesis is set both within a specific time period (2006-2009), and within the specialist services for older people, of a large New Zealand district health board (DHB). Inpatient services for older people vary widely in their composition and functioning throughout the world, so I will describe here the services in Christchurch at the time of

this research (2006-2010). Our service includes inpatient units for specialist older persons' healthcare assessment, treatment and rehabilitation; 66% of inpatients are referred following an acute medical or surgical admission and the remaining 34% directly from the community. Typically they will have multiple medical or post-surgical problems and will have experienced a loss of functional ability associated with their acute illness meaning they cannot manage in the community. Older people admitted directly from the community will typically have recognised geriatric syndromes such as falls, loss of mobility or confusion. Patients must usually be over 65 years of age (55 years for Maori or Pacific Islanders) and suffering from age-related illness or disability, with the potential for successful rehabilitation. Also within the service are inpatient consultation, day hospital, community assessment and rehabilitation teams (visiting and managing older people in their own homes) and outpatient clinics. There are also specialist stroke rehabilitation, orthogeriatric and psychogeriatric services, which were excluded from this thesis.

A study of the problems encountered by older people during their hospital stay has shown that many have ongoing medical problems requiring input from medical staff as well as their functional decline and rehabilitation needs [13]. A smaller number (about 30%) are admitted directly from home through their GP, usually with geriatric "syndromes" such as falls or confusion.

Long term residential care is another area where services differ markedly throughout the world in what is offered. In New Zealand there are four types of residential care. Rest home (RH) care is lower level care for older people whose function does not allow them to remain at home, for example if they are struggling with nutritional intake, preparing meals or domestic chores, but require only intermittent nursing input. Hospital level care (HLC) provides higher level of care with 24 hour nursing care available. D3 care is specialist dementia care, which is secure, but with only low level nursing care, while D6 care receive the most unwell clientele with both physical frailty and nursing needs as well as dementia related behaviours requiring secure care. Internationally and in the literature many terms are used, for example institutional care, institutionalization, residential care, nursing homes etc. In this thesis I will use the term residential care in a broad sense to cover all types of long-term residential care.

1.2   Thesis Outline

The aim of this PhD thesis is to examine the issues which promote independent living in frail older people who have undergone a recent subacute geriatric inpatient admission. The context of the thesis is a rapidly evolving set of services for older people in CDHB, particularly with the introduction of restorative home support and a community-based multidisciplinary team, however these initiatives have targeted community-dwelling older people, and there has been less work so far on the population of older people who have been hospitalised. Initially funding was received from the New Zealand Health Research Council, with the aims of exploring the outcomes for older people discharged from specialist geriatric care, and in particular the role of function as measured by the Functional Independence Measure (FIM) as well as other factors, such as dementia, which appeared to contribute to subsequent residential care admission both quantitatively and qualitatively. The project was then intended to use these data to design and evaluate an intervention to bridge the gap between hospital and community services and support "ageing in place." As the thesis has developed the aims have grown with it, and the revised aims will be presented at the start of each of the sections of the thesis.

The thesis begins with a review of the existing literature. First I describe the syndrome of frailty; an increasingly recognised condition within geriatric medicine, and is a diagnosis which would include the majority of my study populations. In the following sections I proceed to discuss the factors which support older people to remain living independently in the community and conversely predictors of adverse outcomes in particular residential care admission, further hospital admission or death in older people. I then describe previous trials of interventions to maintain independent living in frail older people.

Following this I move on to the investigative sections of my thesis. First, a retrospective cohort study of outcomes following an inpatient stay. Then, a more detailed quantitative prospective cohort study was completed, examining outcomes, in particular residential care admission in the year following discharge. The limitation of a study of this type is that some factors which are critical to older people and their carers may not be easily quantified. A qualitative study was therefore also undertaken to examine in more depth which factors were important in supporting independent living or leading to residential care admission in my cohort. Models were developed to predict adverse outcomes

following discharge. A further quantitative study was then completed to validate these models. I finally describe the development and piloting of an intervention intended to support older people in the period following discharge from hospital.

2. CHAPTER 2: LITERATURE REVIEW

Against the above framework of government and WHO priorities there have been many studies which have examined predictors of residential care admission, mortality and hospitalisation in different groups of older people and strategies to support people to remain in the community. "Ageing in Place" is a clear statement of the New Zealand position on ageing, that it is desirable for older people to remain within their own homes and communities. This thesis takes the viewpoint that a positive outcome for many older people in the community is for them to remain living independently in their own homes, "ageing in place" while recognising that for some residential care is an acceptable outcome for more frail or disabled people and that this may be a positive choice for some older people.

Papers in this literature review were identified through searches of Medline, using the search terms "frail elderly", "activities of daily living", "nursing homes", "institutionalization", "long-term care", "patient admission", and "patient discharge". Searches were limited to English language and aged 80 and over. "Frail elderly" was limited to prognosis and diagnosis. Following these searches the reference list of key articles were also manually searched. Key policy documents such as those mentioned in the introduction chapter were located on the New Zealand Ministry of Health and Ministry of Social Development websites, and on the Canterbury District Health Board website. Some papers, especially on methodological issues were provided by my supervisors and statistician. The original search was completed in January 2007, automatic weekly updates for the terms "frail elderly", "activities of daily living" and "nursing homes" all limited by aged 80 and over were then set-up.

This literature review first discusses an important concept prevalent within the population of interest, frailty. This is an important and developing concept in caring for older people. The difficulties faced by this population, the "frail elderly" are significant, and I will present literature illustrating the difficulties they face in day-to-day living and their risk of adverse outcomes. The impact of residential care admission on the lives of frail older people and their carers, and the decision making process about entering residential care will then be discussed. In the next sections of the review I will examine studies which have described the risk of adverse outcomes, that is residential care

admission, hospitalisation and mortality in different populations of elderly, in particular those who have undergone a hospital admission. Finally I will present a discussion of previous intervention studies in the frail elderly with the intention of reducing residential care admission. This review will identify gaps in our knowledge, to which the current project aims to contribute.

2.1 Frailty

2.1.1 What is frailty?

A comprehensive review of frailty and future directions for research are found in the conference proceedings published by Walston et al[14]. Interest in frailty as an entity began to develop in the 1980s and 90s, [15, 16] with increased recognition of a unifying diagnosis among the apparently different and non-specific presentations of illness in older adults. Initially it was defined in terms of chronic diseases, the "geriatric giants" or activities of daily living (ADL) disability. [16-18] However with increasing research in the area it became clear that frailty is a spectrum which is separate from, and may predate the overt development of illness or disability. This spectrum is defined as the loss of reserves in multiple systems, such that even an apparently minor insult can tip the balance into disease or disability.

There are currently two ways of thinking about frailty in older people. The first is a physiologically based definition which produces a physical phenotype of weight loss, self-reported exhaustion, decreased grip strength, slow walking speed and decreased physical activity. In the Cardiovascular Health Study [19] this phenotype defined a different group of patients from disability and comorbidity measures, although with considerable overlap (see Figure 1). The syndrome of frailty independently predicted falls, decreased mobility, development of ADL disability, hospitalisation and death.

Other authors have also found that the combination of weight loss and low activity were associated with poor subjective health, poor performance and mortality.[20] It has also been found that instrumental ADL disability is predicted by age, mobility, balance, grip strength, body mass index, physical activity, self-perceived health and fear of falling.[21] Furthermore, poor performance on an obstacle test, gait speed, hip abduction strength and the Romberg test predicted frailty on a physical performance scale which in turn predicted disability, loss of independence, and mortality.[22] Finally, slowed timed chair

stands, decreased arm-strength, decreased vision or hearing and a higher anxiety or depression score predicted development of the "geriatric giants" of falls, incontinence and ADL dependence.[23] From the perspective of weight loss, phenotypical frailty has been shown to be associated with poor nutritional intake.[24]

The second definition of frailty uses a more holistic approach incorporating not just physical measures but also considers psychosocial factors and vulnerability. In 1994 Rockwood et al[25] reached a dynamic model of frailty incorporating medical factors but also psychosocial factors such as self-rated health, social resources, economic factors and cognition. Others have found that impaired physical activity, malnutrition, depression and cognitive impairment predict the development of functional impairment.[26] Whitson et al[27] discuss the relationship of physiological (phenotypical) frailty with psychosocial frailty, illustrated in Figure 2. Patients may fall to the left of the line (be "frail") on the graph due to either physical frailty or a lack of psychosocial reserves or a combination of both. In a Chinese population [28] the relationship of social factors to a 62-item frailty index covering physical, psychological and cognitive health was examined. They found that adequacy of income, number and amount of contact with friends and neighbours and amount of exercise were associated with the frailty index. However as a cross-sectional study causality could not be established. In a New Zealand population Barrett et al[29] used a broad definition of frailty, "a complex or syndrome of underlying problems", taking into consideration 12 physical health diagnoses (eg cancer, coronary heart disease), seven mental health problems (such as feelings of worthlessness or loss of concentration) and a range of basic ADLs (such as taking short walk) and included in their study older people with six or more of these problems. From a population based survey of older people they defined 8.1% as being frail with the incidence increasing exponentially with age. Frailty was more prevalent in men, a difference which became more marked with age. Maori also had a higher incidence of frailty. Frailty was associated with housing situation (renting versus home ownership), housing standards such as cold, damp or lack of maintenance, mobility transport limitation and lack of social connections.[29]

Figure 1: Frailty, comorbidity and disability in the Cardiovascular Health Study

(from Fried et al 2001[19])

This figure illustrates the overlapping but distinct relationships between comorbidity, disability and frailty in a cohort of community dwelling older adults. It can be seen that many had two or more comorbidities, but only a smaller number fulfilled the criteria for frailty. In many frailty co-existed with comorbidity and/ or disability, but a smaller number met the criteria for frailty alone.
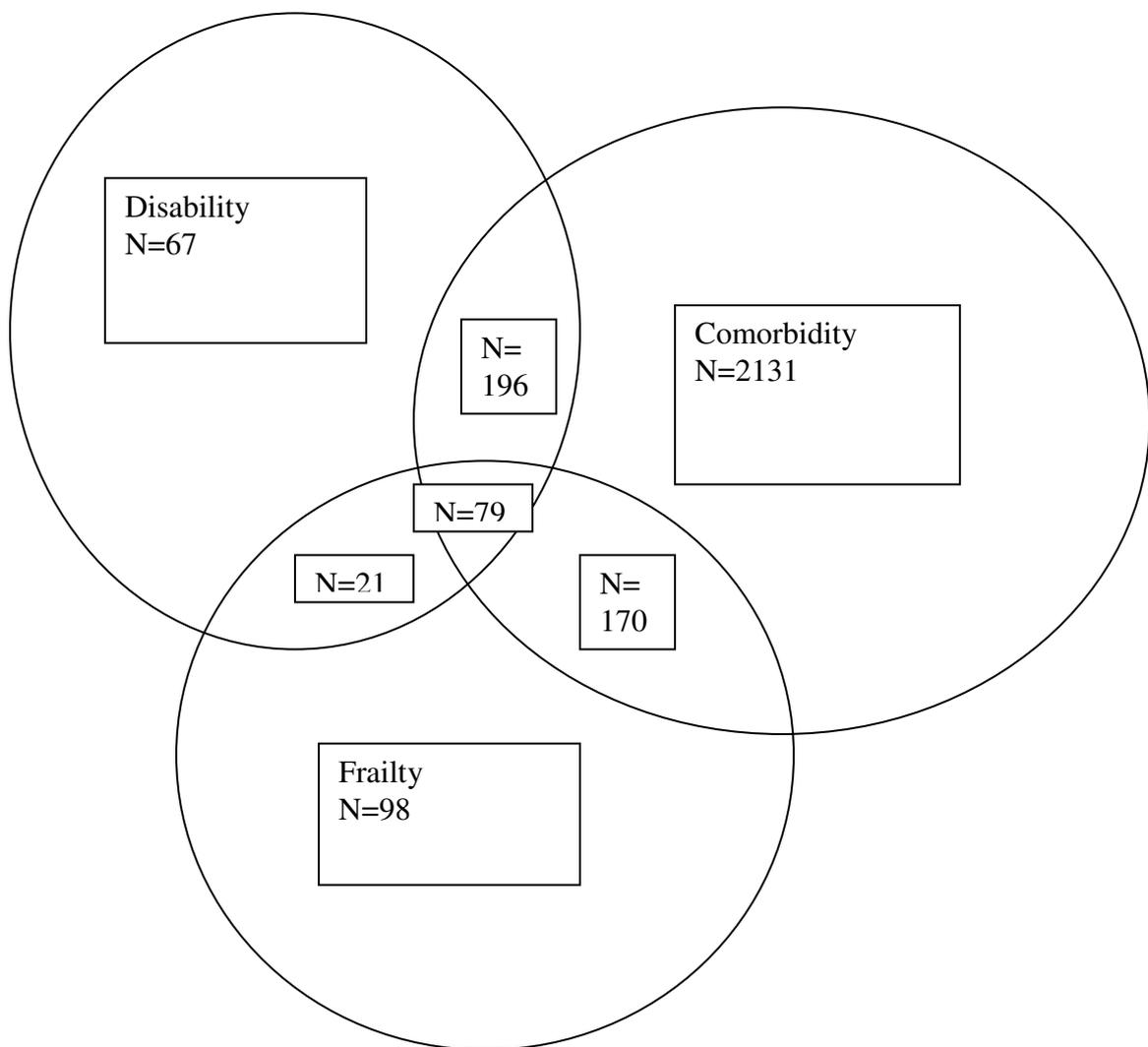
Figure 2: Relationship between physical and psychosocial frailty

(from Whitson et al[27])

This figure illustrates the relationship between frailty and physical or psychosocial risk factors. Subjects who met the criteria for frailty fall to the left of the line, and it can be seen that either very poor physiological reserve, severely decreased psychosocial support, or a combination of both can lead to a subject falling to the left of the line, and hence meeting the diagnosis of frailty.
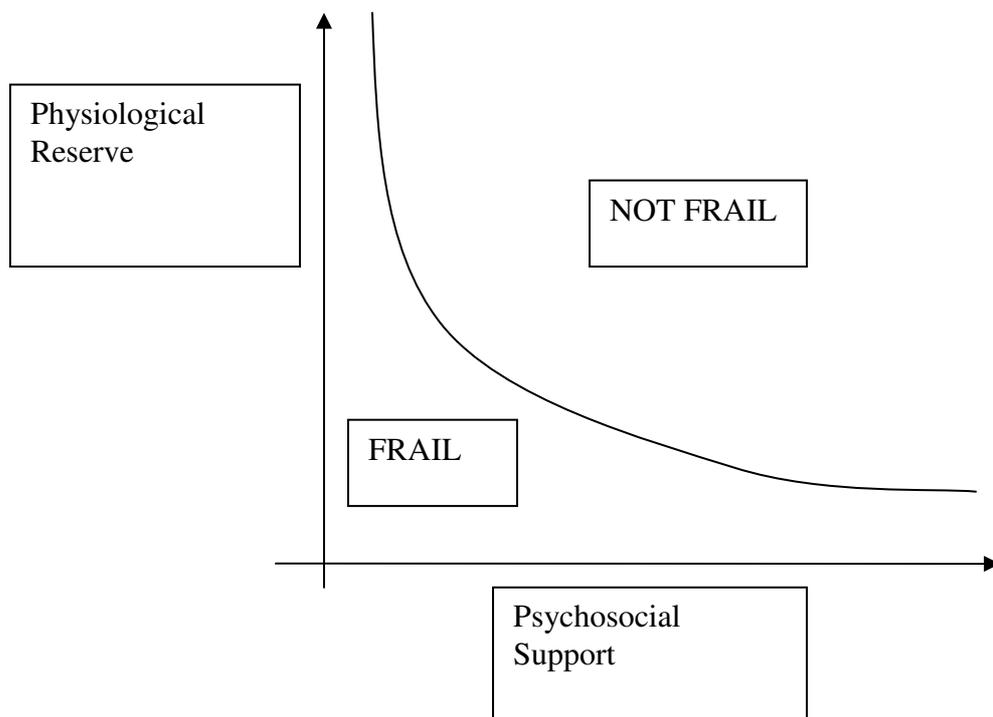
2.1.2 But is frailty not just the same as ageing?

It is clear that as we age the incidence of frailty increases. The frailty index of Rockwood et al [30, 31] has been shown to increase with increasing age with a characteristic accumulation in deficits. However this is not the only factor to be considered and it is clear that some people will reach a frail state in their 60s or 70s, while others remain robust and active into their 80s or beyond. [25] Schuurmans et al [32] have demonstrated that frailty is better than chronological age at predicting a decline in self-management ability.

2.1.3 What about disability?

Disability is defined in the International Classification of Functioning, Disability and Health (ICF) by the World Health Organisation [33]. Like frailty the definition covers both physical health as well as social aspects. It implies a state of limited participation. However this is distinct from frailty in a number of ways. First, disability may be caused by a single catastrophic event such as stroke or amputation rather than the accumulation of insults and deficits seen in frailty. Second, disability depends on the environment- a person may be disabled in one environment but fully capable with appropriate aids or modifications (for example modified vehicles). In addition frailty may be seen as a "preclinical" or "at-risk" syndrome which is present but may not manifest itself until an insult upsets the fragile balance caused by the loss of reserves.

2.1.4 And chronic disease?

In the study of Fried et al [19] a large number of patients had comorbidity, defined by two or more chronic diseases without meeting the criteria for frailty (see Figure 1). Chronic disease predisposes to frailty both directly with accumulated deficits and through other mechanisms such as decreased mobility and sarcopaenia. A number of the proposed biochemical markers for frailty may also be found in chronic diseases, for example raised inflammatory markers and cardiovascular disease. On the other hand, frailty predisposes to the development or manifestation of chronic disease through mechanisms such as malnutrition and decreased physical activity. Frailty has been shown to be a risk factor for the development of incident cardiovascular disease, and for mortality in

those with cardiovascular disease, while prevalent cardiovascular disease has been shown to be a risk factor for the development of frailty [34].

2.1.5 Predisposing factors for frailty

Life-course model

The life-course model for frailty[35] highlights predisposing factors which begin with early childhood development and growth patterns which influence muscle formation and the later development of sarcopaenia. Socioeconomic status in childhood[36] and motor and cognitive development also play a role.[37] Peak adult function is essential as this determines how much physiological reserve is available before age- or disease-related deterioration reaches a critical threshold. Lifelong habitual physical activity levels are a vital component of the frailty syndrome, and patterns of physical activity are often set in childhood or early adulthood. By middle age, predictors of frailty have been established in many cases, and the trajectory of decline determined [35]. These include smoking, excess alcohol intake, body mass index (either high or low),[37] and chronic diseases especially atherosclerosis and diabetes.[38] Using data from the Framingham heart study in 45-88 year olds, a composite deficit measure of 39 abnormal physical findings was shown to predict death and longevity.[39] In the mid-life group (age 50-54 years at baseline) diastolic blood pressure and blood glucose were also significant. Phenotypical frailty has been shown to be associated with lower muscle density, lower muscle mass and higher fat mass than found in age-matched non-frail subjects[40].

Biochemical, hormonal and inflammatory markers

A number of cross-sectional studies have looked at biochemical, hormonal and inflammatory markers for frailty. Raised IL-6, the pro-inflammatory cytokine CXCL-10 and CRP have been shown to be related to prevalent frailty and pre-frailty. [41-43] The presence of deficiencies in two or more anabolic hormones increased the risk of frailty in community dwelling older women. [44] Abnormal coagulation studies (factor VIII, fibrinogen and D-dimer) have also been demonstrated to be associated with frailty, [42] although the authors were unclear whether this was a direct effect or a response to inflammation. In another study raised IGF-1 and lower levels of Vitamin D were associated,[45] while Fried [46] found that white cell count and IGF-1 demonstrated a complex U-shaped curve with prevalent frailty. Metabolic changes including impaired

glucose tolerance and low cholesterol have been associated, although once BMI was included in the model this association weakened, and again there may be an effect of inflammation.[42] Mitochondrial enzymes, testosterone [47], cytokines, and vitamin deficits have been highlighted as important.[38] Low albumin is associated with increased mortality and increasing disability.[48] However with these cross-sectional studies it is difficult to establish cause-and –effect relationships, whether these markers predispose to frailty or develop in response to the syndrome.

Interacting factors and the cycle of decline

These physiological and biochemical markers often form a "vicious cycle" of deterioration, for example a patient who has low activity levels will go outside less and therefore develop low Vitamin D levels. This in turn has been shown to lead to muscle weakness and unsteady gait, hence further limiting mobility and predisposing to falls. With the low levels of vitamin D, osteoporosis is more common and hence a fall is more likely to result in a fracture with corresponding further loss in mobility and confidence.

The contribution of multiple physiological systems and the potential interactions to form a cycle of decline is illustrated by a recent study. Fried et al[49] performed a cross-sectional study in which 8 physiological measurements including anaemia, inflammation, growth factors like IGF-1, dihydroepiandrosterone (DHEA), HbA1c, micronutrients, adiposity, and fine motor speed were related to the presence of frailty. They found that there was an exponential relationship between the number of systems involved and the presence of frailty.

Physical activity and metabolism

Most authors highlight the key role of low physical activity levels in development of frailty. This has widespread effects on biochemical, hormonal and nutritional pathways with down-regulation of growth hormones, digestive enzymes, metabolic hormones and the cardiovascular system such as VO_2 max, leading to a cascade of chemoregulatory mechanisms.[50] VO_2 max and heart rate variability [51] have both been shown to predispose to the development of frailty. Down-regulation of the cardiovascular, metabolic and growth hormone systems lead to anorexia, sarcopaenia, muscle weakness and decreased exercise tolerance- the classical physical phenotype of frailty.

2.1.6 What is the significance of frailty?

As already discussed, the development of frailty puts older people at high-risk of decline in physical or mental health after apparently minor insults. This leads to hospital admission, residential care admission and excess mortality. Boyd et al [52] found that older people with pre-existing frailty defined by the criteria of Fried et al had an increased risk of developing dependence in ADLs, with a hazard ratio of 2.2, and that the risk of functional decline increased with the number of features of frailty an older person had. Pre-existing frailty has also been shown to be associated with the development of chronic diseases such as Alzheimers disease or cognitive impairment.[53] Covinsky et al[54] showed that frail older people had a steady decline in function in their last year of life, which was quite different to that seen in malignancy [55] or even single organ disease such as cardiac failure.[56] Lunney et al[57] showed that frail people in their last year of life were significantly more likely to experience ADL disability and have a steady trajectory of decline than those with malignancy, organ failure or sudden death. Dasgupta et al [58] found that increasing frailty increased the risk of complications and residential care admission after elective surgery. Hastings et al [59]found that ED attendances, hospitalisation, residential care and death in the first month after an index ED attendance were predicted by increasing scores on a measure of frailty (the accumulation of increasing numbers of deficits). In Australia the CHAMP study [60] showed an association between frailty and intrusive pain, which is particularly important as these elders have decreased reserves for coping with such distressing symptoms. There was also an association between pain, frailty and depressive symptomatology.

The diagnosis of frailty should move clinicians' thinking away from specific disease models to a more holistic and integrated approach. A number of interventions have been shown to be effective for frail older people including exercise regimes which have been shown to increase strength and promote muscle hypertrophy [61]; nutritional support especially during hospitalisation; review of medications and polypharmacy [62]; early comprehensive assessment which may identify undiagnosed or unstable medical conditions [13]; maximisation of function prior to a planned intervention such as surgery, assessment of social circumstances and multidisciplinary team intervention especially early mobilisation. In some circumstances it may also be appropriate to recognise patients on their final trajectory and move towards a more palliative approach.

2.1.7 Measurement of Frailty

So, I have discussed frailty as an important syndrome in the elderly, but how should a clinician go about making the diagnosis? There have been many approaches over the years. For those favouring the classical physical phenotype of frailty identification of the 5 key features is important. Typically this includes weight loss of >10% in the preceding year; a measure such as calf-circumference for sarcopaenia; decreased grip strength; decreased performance on a timed-walk test; patients' report of physical activity levels; and self-reported exhaustion [19]. This definition has been shown to predict disability [19, 63], falls [19], hospitalisation [63] and death [19, 63]. Another group simplified this definition further to weight loss, inability to rise from a chair without using the arms and reduced energy level and found that this predicted falls, development of disability, fractures and death as well as the 5-item scale [64].The addition of cognitive impairment to the original 5-item score increased the confidence to predict new IADL and ADL disability [63]. Studenski et al [65] have developed a 17-item clinical global impression of change in physical frailty score, which they have demonstrated is valid, reliable and feasible, but which has not yet been tested in a clinical situation regarding its ability to predict outcome.

However if we wish to consider frailty to include multiple risk factors in both physical and psychosocial functioning, which I favour, measures become more complex. The initial approach of a Canadian group was a cumulative deficit count of 70 items, [66] which was correlated with the phenotype definition, but had a better predictive value for 5-year survival. Another group developed a 48-item count [67] which predicted negative outcomes better than the phenotypic frailty definition. More recently the same Canadian group [68] describe the development of a frailty index (FI). They argue that to gain the maximum precision at least 30-40 variables are required. Their scale had 40 variables and was reproducible in a validation cohort. It was associated with mortality and showed a deficit accrual associated with age. This was also demonstrated in a multi-national study [69]. In a longitudinal study [70], subjects who remained alive at the end of the study had a significantly lower FI than those who had died, and the FI appeared to show a "threshold" effect with age at death being determined by the accrual of deficits, with death occurring at an approximate FI of 0.3 regardless of chronological age. The disadvantage of this approach is that the 40-, 48- or 70-item frailty indices are time-

consuming and unwieldy to use in clinical practice. Therefore a number of groups have developed more simplified scales.

The Canadian group simplified their multifactorial measure into a 7-item global clinical assessment scale[71] based on physical activity levels, co-morbidities and ADLs. They found this scale predicted death and residential care admission [72]. The Vulnerable Elders survey [73] used a scoring system based on age, self-rated health, physical function and functional disability. They found that the most vulnerable third on this scale had an increased risk of death or functional decline, and that the addition of comorbidities to this scale did not significantly improve its predictive value. However both these scales lose the psychosocial aspects which are felt to be important in frailty.

More recently a variation on Fried's frailty score was proposed using weight loss, decreased grip strength, MMSE, TUG and FEV_1[74]. They found that this measure was correlated with both the original 5-item frailty score of Fried and Rockwood's deficit count. However it had better predictive validity at the severe end of the disability spectrum than Fried's score and was simpler to use than the complex deficit count.

Another such simplified score, the Edmonton Frail Scale (EFS) [75] is an 11 item scale which has been shown to be correlated with a geriatrician's comprehensive assessment, and the Barthel Index. It is shown in Table 1. I believe that this scale is a promising addition to geriatrician's assessment methods, as it makes a broad multifactorial assessment of frailty in older people without a complicated deficit count.

Table 1: The Edmonton Frail Scale
The tool shown in this table was devised by Rolfson et al[75] as a comprehensive assessment of frailty and was validated in a community-based sample.

	Domain	Question	0 points	1 point	2 points
1	Cognition	Clock drawing	No errors	Minor errors	Major errors
2	General Health	How many times have you been in hospital in the past year?	0	1-2	>2
3		Describe your health	Excellent	Good	Fair/ poor
4	Functional dependence	How many of these activities do you require help with? Meal preparation, shopping, transportation, telephone, housekeeping, laundry, managing money, taking medication	1-2	2-4	5-8
5	Social support	When you need help can you count on someone to meet your needs?	Always	Sometimes	Never
6	Medication	Do you take >5 meds?	No	Yes	
7		Do you ever forget to take your meds?	No	Yes	
8	Mood	Do you often feel sad or depressed?	No	Yes	
9	Continence	Do you have a problem with losing control of your urine?	No	Yes	
10	Functional performance	3m-Timed up-and-go	0-10s	11-20s	>20s
11	Nutrition	Have you lost any weight recently?	No	Yes	

Another scale is that of Ravaglia et al [76] which has 9 items and predicted fractures, hospitalisation, disability and mortality. Owens et al [62] propose a 7-item scale which they found predicts residential care admission, mortality and prolonged or expensive hospital stays. The same Canadian group [77] propose an 11-item scale with items identified from a standardised comprehensive geriatric assessment as having the highest hazard ratio for adverse outcomes. They then grouped patients into severe, moderate and mild frailty and found that these groupings predicted residential care admission and mortality. These scales are simpler to use in clinical practice and may help non-geriatricians to identify at risk groups in whom a more comprehensive evaluation should be considered.

2.1.8 Interventions in Frailty

There have been few interventions specifically targeting the syndrome of frailty in the elderly. One such study is underway- the Frailty Intervention Trial (FIT) [78]. This study will use the criteria of Fried et al, and specifically target each of the 5 areas with nutritional support for weight loss; assessment and treatment of depression for those with self-reported exhaustion; physiotherapy for weak grip strength, slowed walking speed or low physical activity levels; and a general health assessment with implementation of appropriate chronic disease management. Primary outcome will be changes in the frailty score, with secondary outcomes of hospitalisation, residential care admission, use of community and health services, falls, psychological status, quality of life, cost-effectiveness and mortality. The study is scheduled to complete in 2011.

Other studies have looked at the effect of interventions on secondary outcomes such as falls, energy or nutritional intake and weight. Exercise programmes have been shown to reduce falls [79, 80], improve muscle strength [81, 82], gait velocity [81, 82], level of physical activity [81], general mobility tasks [82] and confidence in mobility [82]. In the Canadian Study of Health and Aging [83] exercise was shown to reduce mortality and improve general health status, with the benefits most marked in those who were frailest at commencement of the trial. It was also shown to improve cognition.

Nutritional supplements in conjunction with exercise have improved weight and energy intake [81], while a combination of resistance exercise, functional exercise and nutritional supplements increased muscle strength and improved mobility [84]. There was a small effect in weight gain and reduction in mortality on meta-analysis [85].

2.1.9 Conclusion

I propose here a model for frailty, based on the existing literature, which incorporates predisposing factors such as early childhood development and peak adult performance plus biochemical and hormonal changes in the development of the physical phenotype of frailty. With the addition of psychosocial factors, this has the potential to form a cycle of deterioration. My model is illustrated in Figure 3.

Identification of frail patients is a key component of geriatric care, and allows for intervention such as exercise, nutritional support, management of unstable medical conditions, review of polypharmacy and arrangement of social supports.

My study group involves one particular subset of frail patients- those who have undergone specialist geriatric inpatient care. I will consider what happens to these patients after hospitalisation, and what intervention(s) may help to maintain their function in the longer term and prevent the spiral of functional decline and increasing dependency.

The following sections of this literature review examine what predicts adverse outcomes in this group, and previous interventions aimed at the frail elderly population to prevent outcomes including death, residential care admission, hospitalisation and functional decline. In particular I will examine the outcome of residential care admission, which is this study's primary outcome.

Figure 3: Potential Mechanisms of Frailty
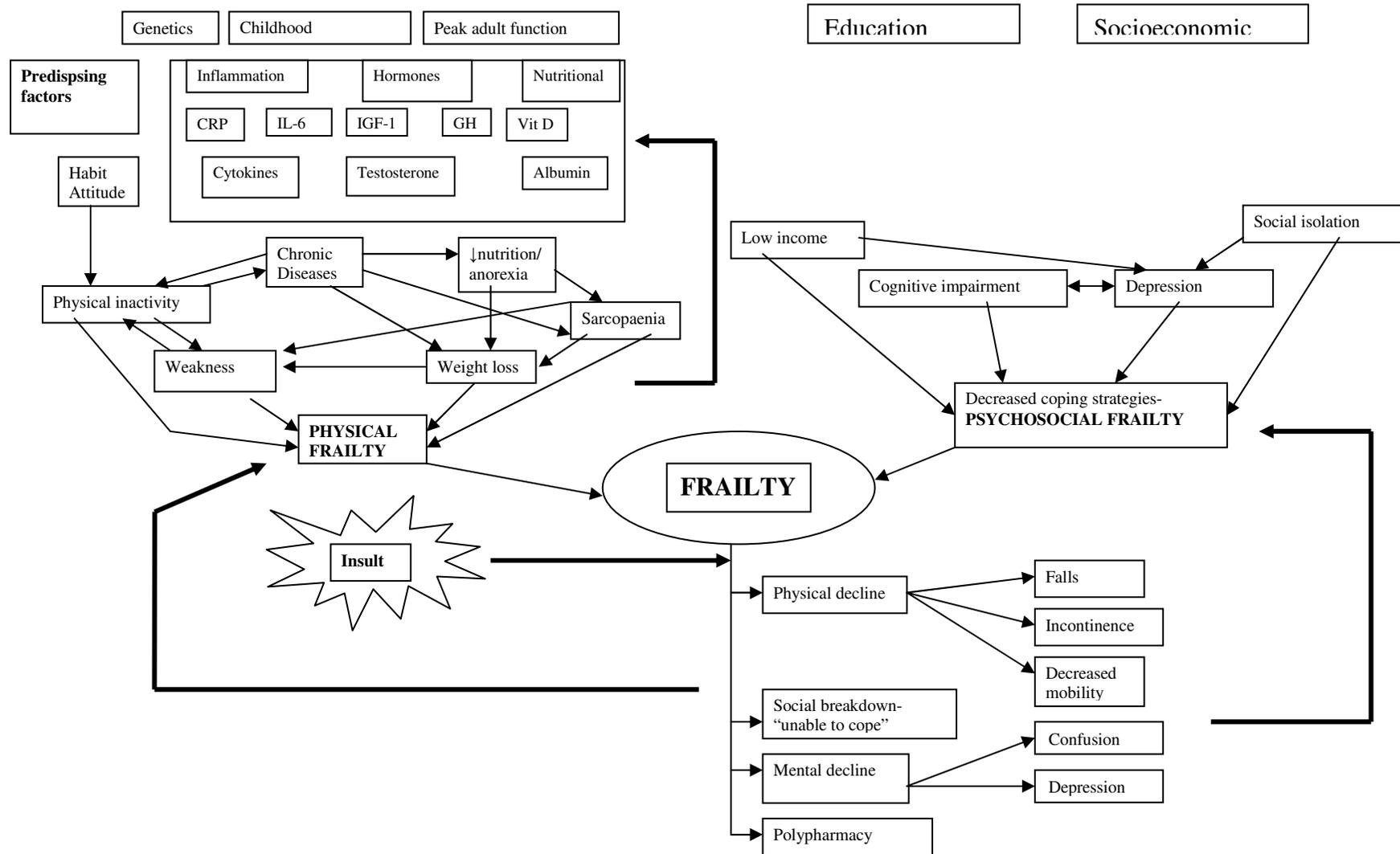
2.2 The transition to residential care

Moving to residential care is a significant moment in the lives of older people and their families and caregivers. For some older people with increasing frailty and functional dependency, after careful thought and consideration the move to residential care is entirely appropriate and can be made successfully. However for others moving to residential care can have an adverse impact on their health and wellbeing. The decision to move may take into consideration physical health, mental health, frailty, social circumstances and the opinion of a wide range of friends, family and health professionals. In turn, residential care has further impacts on physical health, mental health and the older person's social and community contacts. In this section I will discuss studies which have explored issues which affect older people around this time of transition. Proving cause and effect in this "vicious cycle" is difficult and most studies to date have been limited by a cross-sectional design.

Most older people would prefer to remain independent in their own homes for as long as possible [86]. It has been shown that even very frail older people may defy expectations of health professionals and remain at home, even when they were considered at an "unacceptable" level of risk at the time of discharge from hospital [87].

Studies have looked at the effect of residential care on older people. They have found that institutionalised older people have poorer quality of life and a greater sense of loneliness and social isolation than their community dwelling counterparts [88]. However they also showed that these factors were related to an older person's level of dependency, so it is impossible to determine whether an older person felt lonely and isolated first, then moved into care in response, or became increasingly dependant and moved to care first, then developed a sense of loneliness and social isolation as a result.

In 1998 a qualitative study investigated residents' experiences of nursing home life in Australia [89]. Key findings were the loss of autonomy and decision making about their living arrangements and day-to-day activities, having to live in close proximity with other residents who may have difficult behaviours and the loss of privacy, the relationships with staff and the lack of meaningful activities with the sense of "waiting to die". Overall residents experienced poor quality of life.

In the recent New Zealand based Older People Entering Residential Accommodation (OPERA) study [90] older people and their carers' experiences of the process of moving into care were examined. Most older people felt that they and their family had been involved in the decision. However from those that entered residential care, 53% felt that doctors had strongly influenced the decision. A striking finding of the study was older people's satisfaction with their decisions around residential care admission. There was a marked contrast between those who remained at home with 73% being happy to have remained at home, while in those who had moved 71% were unhappy with the decision.

There have also been a number of studies which have examined the relationship between residential care admission and depression. Depending on the scale used and the exact population up to 50% of older people in care have been found to have depression [91] [92]. This is 3-4 times the numbers of community dwelling elderly [93].

In an American study, older people who had, prior to their acute admission, been independent and non-disabled were admitted to nursing homes after discharge from acute care were studied. Gill et al [94] found that the majority of patients had ongoing disability, with about half (46.3%) being discharged home with new disability and a quarter (27.4%) remaining in residential care with ongoing disability. Only 32% returned home with their previous level of function. Examining a similar issue- the use of rest homes for care of older people during acute illness- a New Zealand study looked at a "dinner, bed and breakfast" scheme [95]. Older people were supposed to have minor, self-limiting illnesses and minor functional impairment, and were expected to return to their own homes within 3-5 days. However when the outcomes were analysed it was found that a large number of older people ended up remaining in residential care. One possible interpretation of these studies is that older people lost function in association with an acute illness, which without further rehabilitation was not regained in a residential care setting.

In an earlier American paper, Rossman [96] discusses her experiences of providing home care to geriatric patients as an alternative to admission to acute hospital services. She describes a number of patients who actually improved in their home environment, and that readmission rates had been reduced. She recognises a number of potential complications of inpatient care including increased rates of anxiety and depression, and the risk of nosocomial infections. Older patients living at home when asked about their attitude to returning to hospital, expressed negative emotions such as hopelessness and

fear; for example "It's better to die than keep going back and back to the hospital." Finally she found that home care was considerably cheaper than hospital care.

So, residential care admission is often regretted by older people, and is associated with poorer mental health in many. Older people feel that their decisions are strongly influenced by health professionals especially doctors, rather than their own free choice. Those who move to residential care during or immediately after an acute illness, even when this is intended as a temporary measure, may not regain their previous level of function without specific rehabilitation, and may be left with ongoing disability, and in many cases long-term residential care admission.

I have discussed the older people's and carers' experiences of the transition to residential care admission and the impact this can have on people and their families. But in these cross-sectional studies cause-and-effect of factors such as physical illness, frailty, cognitive impairment and depression have not been clearly established. So, the question of what factors influence residential care admission, and whether any of them are open to intervention remains. In particular, which factors influence a successful discharge from hospital, and what enables independence to be maintained in this group of people?

2.3 Predictors of Residential Care Admission

As discussed above residential care is associated with regrets by the older person and increased rates of depression. The WHO and NZ government promote "ageing in place." However despite this New Zealand rest homes and private hospitals are busy, taking many new admissions and demand is rising. In this section of the literature review I shall go on to examine the predictors of residential care admission.

2.3.1 Long-term outcomes post-hospitalisation

There have been few studies of the predictors of long-term outcomes and discharge stability (that is the ability to sustain living in the environment to which an older person was discharged, in particular their own home) following a period of hospitalisation. This study follows older people for a year following discharge from specialist geriatric care. A study in 1978 followed all those aged over 85 years for a year following discharge for all those discharged from hospital in the city of Saskatoon [97]. They found

that 73% were able to remain in their own homes after one year, and that those who had been discharged to a relative's home had a higher chance of entering institutional care. They did not examine what factors were predictive of outcome in their cohort.

There have been few previous studies examining predictors of longer term outcome following discharge. Of those which have been conducted most have demonstrated the importance of functional status, with poorer function being related to subsequent residential care [98][99][100][101]. In particular, a decline in function during hospitalisation predicted rehospitalisation, residential care and mortality in the subsequent 6 months [102]. The importance of cognition has also been demonstrated [98][103][99][101]. Social circumstances are also significant. In one study living alone predicted residential care [100], while Robertson and Rockwood[79] found that those discharged to a relative's home had a three-fold increased chance of entering residential care compared with those who returned to their own home. Financial resources in the form of a low pension [103] were also important. Finally co-morbidity was important in two studies [99][101]. In post-surgical patients biomarkers (albumin and haematocrit) were also important [101].

2.3.2 Immediate outcomes following hospitalisation

Discharge destination

There have been more studies looking at the immediate outcomes following hospitalisation and these are summarised in Table 2, in chronological order by date of publication. The studies were quite varied in the populations included, and the type of hospital from which subjects were being discharged. In summary, physical function [18,98,99,103-108], poor cognition [18,98,104,106,107,109], delirium[109], frailty[18], co-morbidity score[99], stroke or neurological conditions [18,98,109], falls [18,109], pressure areas [104], urinary incontinence [108] and family wishes or problems [98,104,110] were important. Protective factors included ability to perform IADLs and the presence of strong community support, either spouse or professional [111].

In particular, in studies of specialist geriatric care or rehabilitation similar to the service involved in this study, Elphick et al [105] studied nonagenarians and found that the Barthel Index was predictive of discharge destination. In general rehabilitation was successful, with 76% of those admitted from their own home able to return there, even in their very elderly population. Another study of frail elders [99] also found that inpatient management

was successful with 74% returning home immediately and a further 10% over the next 6 months. Hodkinson and Hodkinson [112] followed 2558 admissions to a geriatric unit. They found that younger age, having been active prior to admission, a higher mental test score, and having been admitted from normal housing increased the likelihood of discharge home. Dehydration and having had a previous admission were adverse factors in women.

Table 2: Outcomes following Hospitalisation

This table summarises the studies evaluating the outcome for older people after hospitalisation. Immediate and longer-term outcomes are considered. A variety of predictors of outcome have been evaluated. Abbreviations: FIM- Functional Independence Measure; IADL- Instrumental Activities of Daily Living; ADL- Activities of Daily Living; LEADS- The Leeds Elderly Assessment Dependency Screening Tool

Study	Date of publication	Participants	Outcome measure		Predictors					
					Function	Age	Cognition	Co-morbidity	Social	Carer
Robinson et al [101]	2009	Post-surgical patient	Discharge destination, 6-month mortality		Functional dependence (Katz score)		Impaired cognition (mini- cog)	Charlson Recent falls Anaemia Low albumin		
Elphick et al[105]	2007	Nonagenarians in rehab	Discharge destination		Barthel index					
Slade[104]	2006	Inpatients	Nursing home placement		LEADS scale		Communication difficulties	Pressure sore	Respite care on admission	Family wishes
Baztan[108]	2004	All admitted to a geriatric rehabilitation unit	Institutionalisation or death					Incontinence at discharge		
Campbell[106]	2004	Systematic review	Discharge destination		Functional status	Age	Cognitive score	Presenting illness		
Lichtenberg et al[99]	2003	Frail live alone elders	Relationship between personal competencies and living arrangements	Immediate v delayed discharge	FIM		Cognition (trend)	Charlson		

Table 2: Outcomes following hospitalisation (cont.)

Author	Year	Population	Outcome						
Alarcon[92]	1999	Patients admitted to acute geriatric ward, mean age 81.8y	Institutionalisation on dc	Functional disability					
Alarcon[92]	1999		Institutionalisation at 6 months			Mental state		Low pension	
Carlson[91]	1998	Acute geriatric inpatients	Readmission, institutionalisation, mortality	Decline in FIM					
Alarcon[103]	1999	Patients admitted to acute geriatric ward, mean age 81.8y	Institutionalisation on dc	Functional disability					
Alarcon[103]	1999		Institutionalisation at 6 months			Mental state		Low pension	
Carlson[102]	1998	Acute geriatric inpatients	Readmission, institutionalisation, mortality	Decline in FIM					
MacNeill[107]	1997	Inpatient medical rehabilitation	Discharge home v with supervision	Higher FIM score		Higher dementia rating scale			
Zureik[110]	1995	Aged 75+ admitted to acute medical care	Institutionalisation	ADL/ IADL	Age	Mental disability	Medical conditions	Living arrangement	Principal carers home
Winograd[113]	1988	Aged 65+ admitted to veterans hospital	Institutionalisation	Frail Severely impaired					
Narain [98]	1988	70+ admitted acutely to VA hospital	Nursing home discharge	Low function	Age	Low mental status	Admission diagnosis neurological or neoplastic	Living location	Type of carer
Narain [98]	1988		6 month nursing home admission	Low ADL level		Lower mental status	Admission diagnosis		

2.3.3 In community dwelling older people

In the previous sections I discussed studies of factors affecting outcomes in older people who have been recently discharged from hospital. In the next section I will discuss factors important in supporting older people living in their own homes in the community. These studies, in community dwelling older adults, are summarized in Table 3, again studies are presented chronologically. They are less relevant to this thesis, as they consider the outcomes for those older people remaining in their own homes, and moving directly from there to residential care, however I wish to consider them here to guide which factors I measure in my own study.

Individual risk factors

Age

Older age is a risk factor demonstrated in a large number of studies [114-129]. In the Longitudinal Study on Aging [128] 7% of those aged 70-74 years were institutionalized, while this was more than doubled in over 80 year olds, while in Hancock's study [120] those aged over 80 years had a relative risk of 3.09 times that of those aged 75 years. Wang et al [127] demonstrated a risk ratio of 1.14 per additional year of age over 50. In a large UK study [125] 29% of those aged over 80 at commencement were in care at the 10 year follow-up.

ADLs

Another major theme is disability in activities of daily living (ADLs) or instrumental ADLs (IADLs) [114, 118-121, 123, 124, 126, 128, 130-137] For example, in the Program of All-Inclusive Care for the Elderly (PACE) [123] there was a relative risk of 1.15 per IADL disability while in the Longitudinal Study on Aging[128] baseline severe ADL disability was associated with a 17-times greater risk of residential care admission at 6 years. In the same study deteriorating advanced ADLs from baseline to follow-up predicted nursing home admission [138]. Particular ADL/ IADL disabilities have been identified, including needing help with bathing [131] or personal care [136], help around the house [136] or help shopping [131]. Help with medication has also been highlighted [136].

Dementia

Dementia is also important, with several studies reporting cognitive impairment as a significant factor in long-term care [118, 120, 122, 126, 129, 131, 136, 139-142]. Bharucha [140] found that dementia had a population attributable risk of 25.8% towards long-term care admission.

Comorbidities

Both the number of, and type of co-morbidities have also been shown to be important. Mayo et al [116] found that the Charlson co-morbidity index (CI) and the presence of chronic diseases were significant. Grundy and Jitlal [125] found that the presence of a limiting long-term illness increased the risk, OR 9.0 for men and 9.15 for women. Murumatsu et al [143] reported that the absolute number of medical conditions was significant. Weissert et al [121] reported disease diagnoses, especially the combined diagnosis of any mental health problems were important, with these having a relative risk of 16.1 of entering long-term care. Diabetes[117, 122, 132, 144], urinary incontinence [120, 122, 145], bowel incontinence [117, 123], heart failure [144], stroke [122, 132, 144], visual impairment [117], walking difficulty [127], falls [136], respiratory disease [142], cancer, especially with associated pain [142], and depression [134, 144] are commonly mentioned conditions which predict residential care admission. Disease severity and worsening trajectory predicted nursing home admission or mortality [142]. Self-rated health is also important with patients reporting fair or poor self rated health having a risk ratio of 2.9 compared with those with excellent health [127].

Frailty

Frailty is also important, as discussed earlier in this thesis. Boyd et al [52] used the physiological definition of frailty. They found that 17% of frail women in their study entered residential care compared with 5% of non-frail.

Financial resources

Financial resources have been shown to be important. Poverty [121] or low household income[116] is one important factor. State commitment to health-and-community-based-services, income, health insurance, and home ownership are predictive of short-term nursing home use in the USA [143]. In the UK [120, 125] and Australia [127] being a home owner reduced the risk of nursing home admission. A low pension was significant in a French study [103].

Families and Carers

Family resources and structure are another significant factor. Being unmarried is a risk factor for residential care admission [115, 121, 132, 146], as is living alone [120, 126, 146, 147], and being childless [125, 126]. In one study childless elders who lived alone had an 18% increase in risk of residential care admission [126]. Jette et al [129] examined the role of formal and informal caregivers. They found that greater amounts of informal care were associated with decreased risk of nursing home placement, although this varied depending on the gender of the carer. Those with male caregivers were twice as likely to enter care as those with female caregivers. Female caregivers were more likely than male carers to offer personal care. The burden of care on the primary caregiver was also important with those whose carer reported burden being twice as likely to enter care. Those living with their primary carer were less likely to enter care. They also examined the role of formal care and found this actually increased the risk of nursing home placement, but they do not comment on whether those receiving more care were also more disabled. Tsuji et al [117] showed that caregiver stress and carers living separately were risk factors. The data on children are ambiguous. Two studies showed that living with a child increased the risk of long-term care placement [136, 141], another showed that a greater number of children was protective [146]. In contrast another showed having children increased the likelihood of receiving care [148]. Living with a spouse has been shown to reduce the risk of residential care admission by five times in a Japanese study [141], while an American study found that shared care between a spouse and a child, or children, reduced the risk by 9.3% [126]. The Japanese study showed that higher caregiver scores on a burden index were more likely to institutionalise. Family members influenced outcomes through shifting some of the decision-making power away from the service providers, hence helping older relatives to continue living in community. Freeman et al [118] examined the role of driving and found that having no drivers in the household increased the risk.

Social networks

Social networks [147], such as having talked on phone with friends or relatives, got together with friends or relatives, used a senior centre, been to church, movies, sports event or having volunteered, were protective of residential care.

Complex Interactions

OPERA study

In the NZ OPERA study[90] statistically the main predictors of residential care admission were loss of functional ability with instrumental ADLs, having a child living far away, and being at home alone for long periods of time. In addition qualitative interviews revealed the importance of coping (that is the way the person and/ or their carer managed the home situation); the adequacy and quality of support; decisions around safety and the final choice of an appropriate residence. In OPERA, coping was divided into "physical" issues such as declining mobility or dementia and "emotional" issues like loneliness and not wanting to be a bother. Many older people entered residential care precipitated by a major event such as an acute illness requiring hospital admission or the death of a spouse.

Complex models

Morris et al [136] propose a model to integrate criteria which predict residential care. Their scoring system includes 34 items, with up to five possible responses per item. From these responses they then placed older people into four categories: 36% of those in the high-risk group were institutionalized at 48 months, while <1% of those at very low risk had entered residential care. Factors included in their model were IADL and ADL participation; cognition; ability to climb stairs, leave the house, prepare meals and take out rubbish; age; health status (falls, cancer, mental health, arthritis, stroke), previous hospitalisations, previous residential care admission; gender; social support (marital status, dependence in decision making, children nearby and living with others); income; type of residence. Pivotal determinants of high risk status were age, impaired functional status and falls, mental health problems, stroke and cancer.

Weissert and Cready [121] also developed a model to determine risk for individual people. Age, marital status, poverty and dependency level were all strongly associated with residential care admission in this study, as were difficulties with toileting or feeding and mental health problems . Multiple risk factors increased the risk of nursing home placement. They propose a complex exponential equation to explain the contribution of various risk factors to residential care admission.

Likewise Shapiro and Tate [149] performed a forward stepwise fitting modelling process, using simple tree diagrams and probabilities derived from multivariate regression analysis. They emphasise the important of taking into consideration multiple interacting factors to identify older people at high risk of requiring residential care.

On a simpler level, as Rockwood et al [132], describe: "maintenance in the community is mediated by a complex interplay of biological, medical, social and psychological factors. The result is a balance of assets that maintain and deficits that threaten, continued residence in the community. When deficits outweigh assets, there is a breakdown in the capacity for the older person to live in the community, and institutionalisation results" (p.581).

Table 3: Predictors of Residential Care in Community-dwelling Elders

This table summarises the studies examining predictors of residential care admission in community dwelling older people. Abbreviations: IADLs- instrumental activities of daily living; ADL- activities of daily living; MI- myocardial infarction; PD- Parkinsons disease; MSQ- mental state questionnaire

Author	Year of publication	Participants	Outcome	Function	Age	Gender	Comorbidity	Cognition	Social	
Payette [133]	2009	Patients receiving home help services 60-94y	Institutionalisation	Functional impairment			Weight loss, >5kg,			
Murumatsu [143]	2007	Community dwelling >72y	Nursing home admission	Care needs	Age	Gender,	Number of medical conditions	Self-rated health	Home ownership education, race Family resources	State commitment to Health & community based services
Andel [122]	2007	1943 aged >65y	Nursing home placement	Difficulty with IADLs	Older age		Incontinence, diabetes, stroke	Dementia		White race
Grundy and Jitlal [125]	2007	36650, aged 65y and over, community dwelling	Institutionalisation		Age	Female	Limiting long-term illness		Living alone, childless	Housing tenant
Harris [144]	2006	Community dwelling	Nursing home admission				Diabetes Cancer MI, arthritis Respiratory disease Stroke Heart failure	Depression		
Rockwood [139]	2006	2 community dwelling samples	Institutionalisation	Higher deficit count						
Freeman [118]	2006	Community	Nursing home admission	ADL disability	Older			Cognitive impairment	No drivers in household	

Table 3: Predictors of Residential Care in Community-dwelling Elders (cont)

St John [134]	2006	Community dwelling	Institutionalisation	ADLs , IADLs				Depression		
Friedman [123]	2005	4646 community patients eligible for nursing home care	Nursing home placement	IADL dependence	Age		Bowel incontinence		Prior nursing home residence	
Mayo [116]	2005	6465 Community dwellers aged >65y	Hospitalisation	Limitations climbing steps Limitations in moderate activities	Age	Male	Charlson index Number of drugs		Lower household income	
Mayo [116]			Institutionalisation	Limitation in moderate activities	Age		Chronic disease score		Education	
Bharucha [140]	2004	1681 community dwelling elders	Institutionalisation					Dementia		
Lakdawalla [146]	2003	Different cohorts of elderly people	Nursing home residence	More disability- the key component		Male gender			Unmarried Low income	Increased number of children protective
Arai et al [141]	2002	47 pairs of impaired elderly and caregiver	Institutionalisation					Dementia	Caregiver spouse protective	
Hancock [120]	2002	Cross-sectional community survey	Rest home admission	ADL restrictions	Age		Urinary incontinence	Cognitive impairment	Less than good self-rated health Higher use of health services	Living alone

Table 3: Predictors of Residential Care in Community-dwelling Elders (cont)

Wang et al [150]	2002	3654 community dwelling aged >49y	Institutionalisation	Walking difficulty	Age		Smoking		Poor self-rated health	Home ownership protective
Woo [119]	2000	Hong Kong Chinese aged >70y	Institutionalisation	ADL dependency	Age				Marital status	
Miller et al [124]	1999	Longitudinal study on aging	Institutionalisation Community-based move	ADL/ IADL disability	Age	Male		Cognitive impairment		
Thom [145]	1997	5986 members of a health maintenance organisation	Nursing home admission				Incontinence at baseline			
Rockwood [132]	1996	Institutional and community dwelling elders	Living in long term care facility	Functional impairment		female	Diabetes, stroke, PD	cognitive impairment	Unmarried,	absence of caregiver
Tsuji et al [117]	1995	Patients receiving homecare	Nursing home admission		Older age		Bowel incontinence Diabetes Visual disturbance		Carer stress/ time conflict	Carers living separately
Boaz and Muller [126]	1994	National long term care survey (4892 people)	Long term care						Childless Living alone	Living with adults other than spouse or children
Wolinsky et al [138]	1993	Longitudinal study on aging	Nursing home placement	Deterioration in advanced ADLs						
Steinbach [147]	1992	Longitudinal study on aging	Institutionalisation						Living arrangements	Visits with friends or relatives

Table 3: Predictors of Residential Care in Community-dwelling Elders (cont)

Miller 1991 [130]	1991	Longitudinal study on aging	Institutionalisation	>2 ADL limitations	Older age Older (>80y) women				Unmarried	
Woroby 1990 [114]	1990	2498 unmarried	Change in living circumstances	Bathe self Get out of chair Get to toilet						
Weissert [121]	1989	Community dwelling elders	Institutionalisation	Level of ADL dependency Toileting or feeding difficulty	Age		Disease diagnosis		Poverty Unmarried	Multiple risk factors most important
Morris [136]	1988	Development-general population Validation-vunerable elderly	Development of a model for institutionalisation	ADL restriction Help with personal care	Increased age (over 85y)	Female	Fall in last 3 months	Errors on MSQ	Help around the house	Help with medication
[136]	1988						Recent Hospitalisation		Living with a child Ever been nursing home resident	Unmarried

2.4 Predictors of Hospitalisation

In addition to residential care admission, readmission to hospital is potentially another adverse outcome for older people after discharge from hospital. Hospitalisation puts frail older people at risk of functional decline and loss of independent living skills. Iatrogenic illness is an important risk, and can have a significant impact on health, well-being and function. In addition, repeated hospital admissions are often viewed negatively by health professionals, where terms such as "failed discharge" and "acopia" remain in use. In a recent study of older people labelled as having "acopia" high levels of new, acute illness were found [151].

In a study of patients discharged from hospital, unplanned readmission in the first 30 days was predicted by poor overall condition, pressure areas, loss of ability to feed self, and prior hospitalisation in the preceding three months [152]. 14.2% of discharges in their population of over 75 year-olds were readmitted in the first month. Other studies have found that male gender, [153, 154] advanced age,[153] social isolation[155, 156] or difficult environment [156], low income [157], ADL disability [102] or declining ability [102], severity of clinical disease [98, 154, 156, 158], or comorbidity [153, 159], and cognitive impairment [156] or depression [154, 160] were predictive of hospital readmission.

2.5 Predictors of Mortality

Another outcome of interest in an elderly population is mortality, although in our experience this is a less relevant outcome for elderly patients, many of whom who fear functional decline, disability and dependence more than death [161]. Table 4 summarizes studies predicting mortality in the elderly.

2.5.1 Following hospitalisation

In the most relevant study to my population, Rozzini [162] reports the 12 month mortality for a group of patients who had undergone inpatient geriatric care for subacute conditions or rehabilitation. They found that the failure to improve function during rehabilitation predicted 12 month mortality. In a Spanish study [163] of post-acute geriatric care, 1-year mortality was predicted by male gender, age, pre-hospital functional status,

and decreased level of function at the time of their acute illness . Higher functional gain during their geriatric care admission predicted lower mortality.

There have been a number of studies of outcome in the period following an acute hospital admission. In one study [164] one year mortality was 19%, with predictors of mortality at one year being index of disability, neoplasm, cardiovascular disease and prescription drug use. A second study [103] found that function (measured by the Barthel index), pressure sores, malnutrition and polypharmacy predicted 6-month mortality.

Others found that individual risks [165] were admission with pneumonia or sepsis, IADL disability, nursing acuity, catheter, dementia, deconditioning and functional decline. Sleiman et al [166] showed that functional trajectory during the hospital stay (degree of new disability and whether pre-morbid function could be regained) predicted 3-month mortality.

Inouye et al [167] developed a functional axis in patients aged over 70 years admitted to general medicine. From a range of variables considered there were three which were found to be significant: any IADL impairment, MMSE<20 and GDS>7. The high risk group had 2 or 3 variables and a 2 year mortality of 60% compared with the low risk group who had no variables and 24% mortality.

Walter et al [168] developed a scoring system with male gender, ADL dependency, congestive cardiac failure, solitary cancer, metastatic cancer, high creatinine, and low albumin included. Risk increased with the number of points from 4% mortality with 1 or 2 points to 82% with 9 points.

Drame et al [169] also produced a risk index using a comprehensive geriatric assessment including age, ADL dependence, delirium, malnutrition and co-morbidity. They found that mortality risk increased with increasing scores. The strongest independent predictive factor was the Charlson index.

2.5.2 Community dwelling elderly

Studies of community dwelling elders have tended to include younger and fitter populations than those of hospitalised elders, with corresponding lower overall mortality rates. Important factors have included age[116, 130, 170-172], comorbidities[116, 170, 171, 173], and disease trajectory[142], ADL or IADL limitation[54, 130, 138, 142, 170, 174, 175], cognition[170, 173], frailty[176, 177], physical health status[63, 182], baseline physical activity[116,

[170, 178], social circumstances[179] and hospitalisation [128, 180]. Hospitalisation itself was more common in those with poorer function and those whose function had declined since baseline. Several studies have demonstrated a relationship between self-rated health and mortality [171, 180-183]. Bowling et al [172] found that social participation and life satisfaction predicted lower mortality, even when health status was controlled.

In summary, mortality in a frail elderly community dwelling population is predicted particularly by comorbidity, either as an overall measure such as the Charlson Index [164, 173], or individual diagnoses such as neoplasm [164, 168] or congestive cardiac failure [168]. The predictive power of function has been considered less than in studies of residential care, but ADL and IADL impairment have been shown to be predictive [130, 165, 167, 168, 174]. Cognition is another important factor [167, 173]. Self-rated health [171, 180-183] and life satisfaction[172] also predict mortality.

Table 4: Predictors of Mortality

This table summarises the literature on predictors of mortality in older people in a variety of settings. Abbreviations: ADL- activities of daily living; IADL- instrumental activities of daily living; CI- Charlson Index; GEM- geriatric evaluation and management; MMSE- mini-mental state examination; GDS- geriatric depression scale; CVD- cerebrovascular disease; LSOA longitudinal study on ageing

Study	Year of publication	Population	Outcome	Predictive factors				
				Age	Comorbidities	Cognition	Function/ frailty	Others
Buchman et al [177]	2009	832 older people	Annual mortality over 8 years				Increase in frailty score	
De Rooij [184]	2007	461 elderly (mean age 78.2y) hospitalized	3 month mortality		Co-morbidity Malignancy	Delirium	Pre-admission ADL restrictions	
Di Bari [173]	2006	Community dwelling >65y	Mortality at 10y		CI Geriatric index of comorbidity Chronic disease score		Function	
Iwata et al [185]	2006	403 oldest-old discharged from acute care hospital	1-year mortality		CI Polypharmacy Benzodiazepine use Pressure areas	Delerium		Low albumin, Low haemoglobin
Woods [176]	2005	65-79y women, frailty	Mortality				Baseline frailty	
Mayo et al [116]	2005	6465 community dwelling elders	Mortality	Age	CI Chronic disease score Pain		Limitation in moderate activities	
Walter et al [168]	2001	Older people acute hospital admission	1 year mortality		Serum creatinine Low serum albumin		ADL dependence	Male gender
Williams et al [165]	1999	GEM unit, veterans affairs hospital	1 year mortality		Pneumonia/ sepsis	Dementia	Deconditioning/ functional decline IADL score	Nursing acuity

Table 4: Predictors of mortality (cont.)

Inouye [167]	1998	Acute general medicine aged 70+	90 d & 2y mortality			MMSE<20 GDS>7	IADL impairment	
Simonsick [178]	1993	Community dwelling >65y	Mortality				Highly active had half to 2/3 lower mortality	
Wolinsky et al [138]	1993	LSOA	Mortality				Deteriorating basic ADLs	
Incalzi et al [164]	1992	>70y acute hospital care	1 year mortality		Neoplasia CVD polypharmacy		Low ADL score	
Miller et al 1991 [130]	1991	LSOA	Mortality at 2 years	Age			>2 ADL/ IADL limitations, 20% deceased at 2 years	Men
Lamont [186]	1983	205 patients age >75y acute admissions	Mortality			Abnormal mental status		Weak social support
Hodkinson [112]	1980	2558 patients on geriatric ward	Mortality for 200d	Age >80	Dehydration Constitutional upset		Inactive before admission	Previous admission

2.5.3 Summary of predictors of outcome

So, in summary there is extensive literature on adverse outcomes of residential care admission, hospitalisation and mortality in community dwelling elders, but relatively little on those who have undergone a previous hospitalisation. In particular the data on those discharged from specialist geriatric care are very limited. We know this group are a frail and at risk group, but what predicts their outcome after discharge? Geriatricians claim to improve function and increase independence, but what are the actual outcomes? Following acute hospitalisation, factors which affect outcome include function, cognition, comorbidities and living alone, but the evidence is limited, and mostly based on cross-sectional studies. Multiple interacting factors need to be considered when trying to predict who will be at risk of adverse outcomes.

In this thesis I consider the outcome of discharge stability and the ability to remain at home, or successful "ageing in place" as my primary outcome measure. Conversely, the negative outcome of residential care admission is recorded. I also collect data on subsequent hospitalisations and mortality. I will address factors which have been shown to be important in other studies of outcomes for older people following discharge from hospital, described in the earlier parts of my literature review, and build on my own data as it is collected to guide the development of subsequent sections of the study. In particular this will be a dynamic study, measuring older people's health status at the time of their discharge from hospital, then following their progress over the course a year.

In addition to identifying a group who are at high risk of adverse outcomes a geriatrician also needs to know which interventions may improve outcomes for their patients. Therefore, in the next section of this literature review I will discuss interventions which have been trialled to improve outcomes in the frail elderly.

2.6 Interventions aimed at promoting independence in the frail elderly

2.6.1 Discharge Planning and Post-hospital Interventions

Discharge planning is a term which covers interventions aimed at supporting the period of time around the discharge from hospital. It is a term which covers a heterogeneous group of interventions, ranging from those aimed at shortening the length of stay in hospital or preventing readmissions, to maintenance or improvement in function and prevention of residential care admission. Interventions range from a brief, one off assessment or telephone call, to intensive discharge support by a multidisciplinary team. They generally begin while the patient is in hospital and continue through into the community, but have a short time period involved. In contrast post-hospital interventions may be initiated after discharge but some continue for longer time periods. A number of the reviews discussed below have addressed both discharge planning and post-hospital interventions while others have concentrated solely on discharge planning.

Reviews

The most recent publication in this area was a meta-review which covered 15 reviews and 265 original articles [187]. Interventions included screening patients with a high risk of post discharge problems; intensive in-hospital discharge preparation; discharge rounds; transitional and intermediate care units; written information leaflets; liaison nurses; discharge co-ordinators; clinical nurse specialists; home visits prior to discharge; preventive home visits post-discharge; post-hospital support programs; telephone follow-up; discharge planning protocols; ameliorated communication between hospital and primary care provider and others.

- Interventions that combined discharge planning and discharge support were the most effective.

- There was little evidence that discharge interventions have an impact on length of stay, except in specialist groups such as stroke or heart failure.

- There was no evidence of a reduction in mortality or morbidity.

- One review of discharge support studies showed improvement in functional status at three months, this included data from eight trials with frail elderly and two post-surgical trials. One study looked at stroke patients and showed more independence in personal ADLs. One study found that a discharge co-ordinator improved physical status. Four other reviews showed no benefit of discharge support on physical functioning.

- One trial of hospital-at-home led to more patients being at home at six weeks, but other trials had no effect.

- Residential care was not considered as an outcome measure.

The same group had earlier conducted a meta-analysis of telephone follow-up post-discharge [188]. They identified 33 studies, but only a small number of these were considered methodologically sound enough to be included in the meta-analysis. Again studies were heterogeneous, with regards to the number of calls, person making the call and timing of calls. There was no benefit demonstrated from a pooled analysis of all types of telephone follow-up.

Kim et al [189] reviewed studies of hospital based case-management. They found no benefit on length of stay or readmissions: 10/17 studies showed no benefit of post-discharge nursing care, 3 studies compared post-discharge care with residential care and showed benefit in quality of life and lower costs for those remaining at home.

In a comprehensive series of reviews and later updates of a variety of different methods of providing support during and after discharge, Parker et al [190-192] divided discharge planning into four types of intervention: discharge planning (conducted while the patient was in hospital and after discharge); discharge support (post-discharge); education; and comprehensive geriatric assessment (CGA).

CGA were interventions with multidimensional health assessment, rehabilitation and social care which took place both in hospital and/or in the home following discharge. Parker's group included geriatric evaluation and management units (GEM), geriatric consultation teams and outpatient evaluation and management teams. They included 15 trials, 7 of which reported on long-term care after discharge. Significant reductions in the number of patients in long-term care were found at follow-up. There was no significant difference in mortality although a trend to reduced mortality at 6 months. There was no significant difference in readmissions. Functional status was measured

using a variety of different scales and hence meta-analysis of results was difficult. Improvements in functional status at 3-6 month follow-up were reported in 3/15 studies. There were no significant changes in cognitive or mental functioning in the small number of trials which reported these outcomes.

Discharge planning interventions in the reviews included:

- Pre-discharge assessment of patient and carer

- Development of a patient specific discharge plan and co-ordination of that plan during inpatient stay and after discharge

- Maintenance of communication with inpatient multidisciplinary team

- Regular visits while an inpatient

- Pre-discharge home visit

- Telephone contact and availability during admission and after discharge

- Services provided by a co-ordinator (usually a specialist nurse)

They included six trials with 2735 patients, and found no significant differences between intervention and control groups in mortality. Inpatient length of stay was reduced, as were readmission rates in the first 6-12 weeks, although this did not reach significance. Residential care admission was not considered.

Discharge support interventions were very heterogeneous ranging from a one-off telephone call to intensive multidisciplinary interventions and home-based rehabilitation with 28 controlled trials included. Mortality was significantly reduced on meta-analysis. There was no reduction in hospital readmissions or duration of stay. Physical function was reported using a range of different measures, so was difficult to analyse, but suggested a trend towards improved physical function in the intervention groups. There was no difference in cognitive or mental function, although with the same limitations. In studies reporting residential care, three suggested a reduction in long-term care in the intervention group and three showed no difference.

Finally Parker et al examined the role of **educational strategies** aimed at improving the ability of patients to manage their own care. These most often involved medication management, but to be included in this report studies also had to include other aspects of self-care, and five studies involved complex educational packages and support. There

was no difference demonstrated in mortality. Hospital readmissions were reduced in most trials, with five trials being suitable for meta-analysis, which showed a significant reduction in readmission. These were however all trials involving cardiac patients rather than a general population, so it is difficult to interpret this finding.

Ali and Rasmussen [193] conducted a review of the effectiveness of managing the hospital/ community interface. They included 39 studies (9 reviews and 30 RCTs). Once again the studies were very heterogeneous in nature, and included falls prevention programmes, home visitation, home intervention and assistive technology, hospital-at-home, group visits, home-based services, risk-screening, assessment at emergency departments, case-finding, case-management, triage, early discharge planning, discharge arrangements, nurse-led units, and supported discharge.

The most relevant interventions considered for older people similar to those in my study were home visiting, discharge planning and discharge support. Home visiting interventions aimed either at the general elderly population or specifically at the frail elderly showed a reduction in mortality and admission to long-term care facilities, which was most marked in the frail group. Discharge planning showed a reduction in hospital length of stay and readmissions, but not mortality. Discharge support showed no effect on mortality, length of stay or hospital readmissions. There were a wide range of functional outcomes reported, but generally there was a trend to improvement in function.

Also in 2004 Shepperd et al [194] considered discharge planning arrangements which were conducted while the patient was in hospital. In general medical patients they found two studies which increased satisfaction, but there were no differences in mortality, hospital length of stay or the likelihood of being discharged home.

Richards and Coast [195] performed a systematic review of 15 trials, with heterogeneous interventions and patient groups. Overall they found no consistent benefits. In studies of inpatient GEM two out of four studies showed improvement in mortality and functional status. Outpatient GEM showed improvement in quality of life and ADLs but no benefit on mortality in three studies. Case management interventions were not convincing with two out of five studies showing a benefit in admission rates and inpatient length of stay, but no differences in mortality. Services combining needs assessment, discharge planning and a method for facilitating the implementation of

these plans were more effective. Again residential care admission was not considered as an outcome.

Hyde et al [196] examined the role of supported discharge after an acute medical admission, looking at nine studies. Again heterogeneity of interventions and methodological flaws in the studies made comparisons difficult. In particular they included discharge planning/ support and hospital-at-home (for example home intravenous antibiotics) in the same analysis, although these interventions generally target very different populations [197]. They found that supported discharge increased the proportion of those remaining at home at six to twelve months. There was no difference in mortality or hospitalization.

Bours et al [198] examined the role of aftercare following discharge. They included 17 studies in their analysis. Nursing interventions were evaluated and included hospital-based nursing in the post-discharge period, community-based nursing, liaison-nursing, health visitors and friendly visitors under the supervision of nurses. Their principal finding was that the studies had overall low methodological quality. In terms of patient outcomes they found that nursing intervention following discharge did not show any consistent benefit.

Clegg and Clegg [199] examined the role of nursing care after discharge. They included 17 studies with diverse interventions including telephone calls, mailing of appointments and reminders, lists of early warning signs, provision of patient and carer education, provision of services for example assessment, case management, skilled nursing, rehabilitation, counselling, respite, supports groups, medical out-of-hours back up and on-call help. They found that studies were generally of poor methodological quality with high risk that bias could have been introduced. Most showed no benefit, although in three studies in which home nursing intervention was compared with residential care there was some benefit on quality of life.

Randomised Controlled Trials

While meta-analysis is a useful tool, it has limitations. In particular when the interventions are very heterogeneous, as they are in the field of discharge planning, it can be difficult to generalize results, and I believe important positive findings may be overlooked. I will therefore proceed to consider the individual trials in this field, with the aim of highlighting features of successful discharge planning or support

interventions. Trials are summarised in Table 5 and Table 6 below, divided into those trials which had generally positive outcomes and those which were negative.

Positive Trials

In general the positive trials targeted their intervention to a higher risk age group, either the more elderly (>75y)[200-205], specifically the frail elderly[206-209], or those considered especially at risk on the basis of clinical or functional problems[209-218]. Their interventions were more intensive[206, 207, 210, 211, 214, 219-221], and crossed the hospital-home interface[202, 206-208, 210, 213, 215-218, 220, 222]. Many were multidisciplinary[203, 204, 206-211, 214, 216, 217, 220, 223]. One example was intensive case management [224], which increased the number remaining at home from 10/ 113 controls to 57/ 101 intervention subjects. Another study of post-hospital intensive case management found that there was a 53% reduction in hospital days with a corresponding cost saving. [221]

A recent Australian study[218] followed patients after an acute medical admission who were felt to be at high risk of subsequent readmission (aged >75y, multiple recent admissions, multiple comorbidities, living alone, lack of social support, poor self-rated health, functional impairment and history of depression). Their intervention included a personalised exercise regime which commenced while they were in hospital and continued as an outpatient for six months. In addition they were visited by a nurse while in hospital to undergo detailed discharge planning and then followed up in the community with monthly telephone calls by the same nurse. The intervention group had significantly fewer hospital readmissions, emergency GP attendances and improved quality of life.

Cohen et al [225] performed a trial in which they compared either inpatient geriatric care or usual inpatient care followed by either outpatient geriatric care or usual care. Inpatient geriatric care reduced functional decline at the time of discharge from hospital when compared with usual medical care. Those allocated to outpatient GEM had better mental health scores on the SF-36 at one year.

Negative Trials

In contrast the negative trials included those with a younger population (as young as 45 years in one study) [226, 227]. Interventions were inpatient only[228-230], brief interventions such as a telephone call or mailed information only[226, 227], or assessment with recommendations to the primary care provider[231]. In Rubin's study [220] all acutely

admitted patients over aged 70y were included with small numbers having ADL disability at baseline. This gave a positive result for reducing IADL disability but inadequate numbers for detecting a reduction in other outcomes such as residential care admissions.

In one interesting study following patients after inpatient treatment for chronic diseases or rehabilitation patients were grouped according to their level of disability at entry into the trial.[232] All intervention subjects, both mildly and severely disabled, received home nursing care. They found that in the mildly disabled group physical and mental function was increased and residential care admission decreased compared with controls. However in the severely disabled group home nursing actually increased the use of health-care services.

In one study the costs for a cohort of elderly patients were examined [233]. They found that an intervention consisting of the availability of outpatient follow-up, together with encouragement to use outpatients, medication education and involvement of the home care nurse reduced costs by 52% in the intervention group compared with 24% in the control group. This was associated with a decrease in the number of bed days in the intervention group. However there was no difference in the number of nursing home admissions.

One trial examined the use of a discharge checklist[234] for the patient to highlight their concerns regarding discharge to the inpatient team, however it is not clear how these concerns were addressed.

Another study examined the use of a pharmacy intervention [235] consisting of a discharge plan produced by the hospital pharmacist and a follow-up domiciliary visit by a community pharmacist. This intervention had no effect on hospital readmissions.

Another interesting approach was the trial by McInnes et al[236] in which GPs were invited to make a pre-discharge visit. They were able to visit the patient and speak to the inpatient team. This study showed that patients felt more prepared for discharge, but there was no difference in readmissions to hospital. Limitations were that only a half of patients randomised to receive a GP visit were actually visited.

Table 5: Positive RCTs

This table summarises randomised controlled trials which showed a benefit in outcome measures including mortality, hospital admissions, residential care admission and functional ability in older people

Authors	Year of publication	Patient Group	Intervention	Outcome
Trials demonstrating a reduction in residential care admission				
Steeman et al [213]	2006	Patients at risk of readmission or institutionalisation	Inpatient assessment within 72h of admission, evaluation of home circumstances, design and implementation of a care plan,	Reduced admission to nursing home at discharge, 15 and 90 days
Steeman et al [213]	2006			No difference in hospital readmission
Latour et al[237]	2006	Patients discharged from a general medical ward	Nurse-led home based case management	Delayed time to non-independent living
Nikolaus et al [206]	1999	Patients admitted acutely to geriatric ward	Comprehensive geriatric assessment plus post-discharge care by multidisciplinary team	Reduction in length of stay
Nikolaus et al [206]	1999			Reduction in immediate nursing home placement
Nikolaus et al[[206]	1999			Shorter nursing home stays
Nikolaus et al [206]	1999			No difference in survival, readmissions or number of nursing home admissions
Martin et al [211]	1994	Very frail elderly at risk of failing to manage at home	Nurse manager plus health assistants Visits up to 3 times daily for 6 weeks	Small numbers More patients at home at 1 year (less patients in residential care)
Martin et al [211]	1994			Less acute hospital days

Table 5: Positive RCTs (cont.)

Hansen et al[200, 201]	1994	All patients aged >75y discharged from hospital	District nurse visit on day of discharge GP visit 2 weeks after discharge	Less patients admitted to nursing home in first year
Hansen et al [201200]	1994			No significant difference in mortality
Hansen et al [201200]	1994			No significant difference in hospital readmissions
Evans et al[215]	1993	High risk patients	Discharge planning by social worker commenced on day 3 of admission	Fewer days in nursing home
Evans et al [215]	1993			Increased likelihood of return home
Evans et al [215]	1993			Decreased unplanned readmissions and fewer inpatient days
Evans et al [215]	1993			Reduced costs
Melin et al [210]	1992	Frail elderly at risk of institutionalisation	Physician-led primary home care service, 24h availability	Less institutionalisation
Melin et al [210]	1992			Improvement in medical condition
Melin et al [210]	1992			Improvement in ADLs
Nielsen et al[238]	1972	Patients aged >60y, not requiring skilled nursing care	Home aide service	Fewer days in residential care
Nielsen et al [238]	1972			No significant differences in mortality
Nielsen et al [238]	1972			No significant differences in hospitalization

Table 5: Positive RCTs (cont.)

Trials demonstrating other benefits				
Young et al[209]	2005	Frail older people admitted for >7 days to a geriatric ward with recognised geriatric syndromes	Multidisciplinary team working through primary care trusts	Non-inferiority trial- no difference shown between intermediate care and hospital inpatient care
Preen et al[222]	2005	Patients with chronic cardio-pulmonary diagnoses admitted to general medical wards	Individual discharge care plan Agreed goals GP consultation within 7 days	Better health service access Improved confidence with discharge process Only 1 week follow-up
Cunliffe et al[223]	2004	Aged >65y, acute medical and surgical wards	Multidisciplinary home rehabilitation	Reduced length of stay Improved functional status at 3 and 12 months No difference in mortality or institutionalisation
Cucinotta et al[219]	2004	Frail elderly, cared for by family with cognitive and functional impairments	Specialized home care attendant 4-10 hours per day	Lower mortality at 6 months Lower hospitalization at 6 months Lower drop-outs at 6 months
Anttila et al[233]	2000	Aged >75y living alone	Encouraged to visit outpatients whenever necessary Medication education Involvement of home care nurses	Reduced number of hospital days Decreased total cost
Naylor et al[216, 217]	1999/1994	Patients aged >65y medical and surgical at high risk of poor outcome	Hospital visits every 48h to plan discharge Home visit within 48h and after 7-10 days Weekly telephone contact Nurse on call 7 days per week	Decreased readmissions in first 2 weeks, decreased multiple admissions, fewer hospital days in first 6 weeks, longer time to first readmission (very small numbers)
Naylor et al [239216]	1991/1994			Reduction in costs by 50%

Table 5: Positive RCTs (cont)

Naylor et al[239]	1999	Cardiology and cardiac surgery patients	As above	Fewer readmissions and shorter total inpatient time
Hansen et al [208]	1995	Post subacute geriatric care	Geriatric team visits at 1,3,8 & 16 weeks post-dc	Reduction in hospital admissions
Hansen et al [208]	1995			New problems identified in 88%
Hansen et al [208]	1995			No difference in institutionalisation or mortality (underpowered)
Styrborn[204]	1995	Patients aged >75y admitted acutely to hospital	Early discharge planning by geriatric team of geriatricians and district nurse	Reduced "bed-blocking"
Styrborn [204]	1995			Reduced expenditure
Landefeld et al[229]	1995	Patients aged 70+y	Daily MDT rounds, Discharge planning, medical care review, no post-discharge follow-up	Better activities of daily living s at discharge especially in those more disabled at admission
Landefeld et al [229]	1995			Fewer discharged to residential care
Landefeld et al [229]	1995			No difference in mortality
Landefeld et al [229]	1995			No difference in institutionalisation at 3 months
Landefeld et al [229]	1995			No difference in hospital readmission at 3 months
Haddock[203]	1994	64 elderly patients	Collaboration between nursing and social worker	Shorter length of stay
Haddock [203]	1994			Fewer readmissions
Haddock [203]	1994			Higher rate of services in place
Rubin et al [220, 240]	1993/ 1992	Post-acute hospital care (aged >70y)	Outpatient CGA	Improved instrumental activities of daily livings
Rubin et al [220240]	1993/1992			Reduced hospitalisation

Table 5: Positive RCTs (cont.)

Oktay and Volland[214]	1990	Patients aged >65y with high care needs discharged to informal carer	Nurse and social work visitor at least once a month, but up to 3 times daily	Fewer hospital days
Oktay and Volland [214]	1990			No difference in caregiver stress or patient functioning
Oktay and Volland [214]	1990			Possibly delayed time to death
Oktay and Volland [214]	1990			Lower inpatient costs
Weinberger et al[212]	1988	Patients discharged from hospital, stratified according to risk of readmission	Close monitoring by outpatient nurses, appointment reminders and rescheduling of missed visits	High risk group had shorter, less intensive hospital readmissions
Townsend et al[205]	1988	Patients aged >75y	Community support scheme using care attendants up to 12h per week for 2 weeks	Reduced admissions, and less multiple admissions, less days in hospital
Kennedy et al[202]	1987	Patients aged >75y	Geriatric nurse specialist assessed during inpatient stay, formulated needs assessment and discharge plans, made follow-up visit	Shorter length of stay
Kennedy et al [202]	1987			Longer period before readmission
Kennedy et al [202]]	1987			Majority of both group remained at home

Table 6: Randomised controlled trials demonstrating no benefits in outcome measures
This table summarises randomised controlled trials aimed at improving outcomes including mortality, hospital admission, residential care admission and functional ability in older people, but which did not show any effect.

Author	Year of publication	Patient group	Intervention	Outcome
Hammar et al[241]	2007	Patients aged >65y	Standardising practices and making written agreements between hospital and home care and within home care services; identification of a working pair within a multidisciplinary team (doctor/ nurse/ aid); planning and integrating services with other informal care; participation in hospital discharge;	No differences in hospital readmissions
Hammar et al [241]	2007			No difference in mortality
Hammar et al [241]	2007			No difference in activities of daily living
Kircher et al[228]	2007	Frail elderly	Inpatient GEM consultation team	No significant differences in readmissions
Grimmer et al[234]	2006	Patients aged >60y, acute admission with new diagnosis	Patients provided with discharge checklist, and asked to highlight specific concerns to hospital team Before and after design	Increased readmission in intervention group
Grimmer et al [234]	2006			Higher satisfaction with discharge process
Brand et al[242]	2004	Patients aged >65y with history of readmissions or multiple co-morbidities	Pre-discharge assessment by nurse practitioner Follow-up 2 weeks post-discharge Development & reinforcement of an action plan Liaison with GP and consultant Scheduling and reminder of clinic appointments	No difference in hospital readmissions No difference in emergency attendance Small numbers changing residence (3 v 2)
Nazareth et al[235]	2001	Patients aged >75y from acute and long-stay wards	Pharmacy discharge plan by hospital pharmacist, domiciliary follow-up visit by community pharmacists	No difference in hospital readmissions
Nazareth et al [235]	2001			More likely to have discharge planning recommendation implemented
McInnes et al[236]	1999	Patients aged >60y	Pre-discharge visit by General Practitioner	No difference in length of stay

Table 6: Randomised controlled trials demonstrating no benefits in outcome measures (cont)

McInnes et al [236]	1999			No difference in readmission rates or time to readmission
McInnes et al [236]]	1999			Intervention group felt better prepared for discharge
Rosswurm and Lanham[243]	1998	Patients aged >65y	Nurse and social worker teams Formal discharge planning tool	No difference in hospitalization
Rosswurm and Lanham [243]	1998			No significant differences in nursing home admissions
Siu et al[231]	1996	Patients aged >65y with unstable medical problems, recent functional limitation, or geriatric clinical problems admitted acutely	Nurse practitioner who examined prior to discharge, then visited in first 3 days after discharge Discussed by multidisciplinary team then recommendations made to primary care provider	No differences between groups in survival, hospital readmission, or nursing home placement at 60 days
Landefeld et al[229]	1995	Patients aged 70+y	Daily multidisciplinary rounds, Discharge planning, medical care review, no post-discharge follow-up	Better activities of daily living at discharge especially in those more disabled at admission
Landefeld et al [229]	1995			Fewer discharged to residential care
Landefeld et al [229]	1995			No difference in mortality
Landefeld et al [229]	1995			No difference in institutionalisation at 3 months No difference in hospital readmission at 3 months
Dunn et al[244]	1994	Patients discharged from geriatric wards	Single visit by health visitor 72h post-discharge	No significant differences in number or length of unplanned readmissions
Dunn et al [244]	1994			No difference in emergency visits
Dunn et al [244]	1994			No difference in physician visits
Fitzgerald et al[227]	1994	Patients aged >45y	Mailed educational information, Phone call in first 5 days	No significant differences in readmission
Williams et al[245]	1992	Patients aged >75y recently discharged from hospital	Timetabled visiting by health visitor, who performed a wide variety of tasks	No difference in outcomes
Smith et al[226]	1988	Patients discharged from General Medical Service. Mean age 52y	Nurse telephone call within 1 week of discharge Mailing of information Reminders of appointments	No difference in readmissions
Corley Saltz et al[230]	1988	Patients aged >75y discharged from acute care hospital	Inpatient Geriatric Consultation team	No difference in placement at discharge or 6 months No difference in mortality at 6 months

Qualitative, Descriptive and non-randomised trials

Other researchers have reported descriptive studies of discharge planning. Kravitz et al[246] describe an intervention in patients at high risk of functional decline or increased mortality who were discharged from acute hospital care. Inclusion criteria included aged >80 years, unstable medical conditions, requiring assistance to ambulate and laboratory abnormalities. Patients were visited by a geriatric nurse practitioner who made their initial assessment during the inpatient stay, then followed the patient with a community visit 48-72 hours after discharge. Patients were presented to a multi-disciplinary team meeting, held twice weekly, which included the nurse practitioner, a geriatrician, physiotherapist and social worker. Acute problems were referred to the primary care physician. Findings were that the nurse practitioner identified new or worsening concerns in 99% of patients, ranging from medicolegal issues (for example the absence of power of attorney), patient education on medication or follow-up, medication adverse effects, laboratory abnormalities and home safety. A mean of 3.4 recommendations were made per patient.

Mamon et al[247] implemented a discharge planning protocol consisting of 4 phases: 1) patient assessment, 2) development of a discharge plan, 3) provision of services including patient/family education and service referrals and 4) follow-up/ evaluation. They identified that unmet needs were common in their patient population with 33% of patients reporting one or more unmet need at two weeks following discharge. Having a formal discharge planner reduced these unmet needs.

Styrborn et al[248] reported the outcome of geriatric discharge planning. They found that nursing interventions were frequent, and that one-third of patients expressed some worries especially medical concerns. Medical and functional status remained the same or improved during the follow-up period.

Dansky et al[249] reported the outcomes for those receiving home health services, and found that those who received skilled nursing services were less likely to report health problems or complications.

In the study by Rosswurm and Lanham [243] pain and activity limitation were the main problems experienced by elderly patients after discharge, being experienced by 40% and 33% respectively. Functionally dependant patients only received referral for home help about 50% of the time, and the need for this could be identified through the discharge

planning process. Rehospitalisation was more likely with greater functional dependence and occurred in both their intervention and control groups.

Yau et al [250] describe a case-management approach in Hong Kong. Their intervention involved an initial assessment by a geriatrician, followed by intervention by nurse case managers. Common phone calls to case managers included medical advice (10.5%), feeling unwell (10%), pain (8.7%), need for resources (8.7%). Interventions included identification of problems (29%), education (27%), and support of caregivers (13%). Interviews with nurse case managers highlighted the need to target at-risk patients, cultivate a relationship, formulate a management plan, emphasize early detection and prompt intervention, match needs to the right service, make sense of the complex service environment, take care of the caregiver and monitor progress

Wright et al [251] report on a pilot study of case-management in at-risk older patients. A hospital based multidisciplinary team developed a care plan for the patient which was then implemented by a nurse case manager on discharge. A high proportion, 70%, of patients felt that program had improved their health, made it easier for them to get healthcare services, and provided them with a better understanding of their disease. In a before and after comparison there were reduced hospital admissions and costs.

Van Walraven et al [252] performed a retrospective study of all patients discharged from an acute admission. They found that those followed up by their inpatient physician had a reduction in death or readmission.

Mistiaen et al [253] performed a postal survey of patients recently discharged from hospital. They found that 80% mentioned a need for information (for example information on recovery time, signs of recovery, how much to rest, how active to be, medications, home nursing, when to call a doctor), 77% needed help with housework, 74% needed help with mobility, 53% needed help with personal care and 90% had one or more physical complaint. About a fifth (22%) had unmet needs with physical complaints and a quarter (26%) with household activities.

In a similar qualitative study Jones et al[254] found that 60% assessed as needing help with personal care or housekeeping, a large proportion of which was given by relatives. Use of help was related to limitations in basic ADLs. Many patients were unaware of available services, and did not feel that managing at home had been discussed with them in hospital.

Donnelly and Dempster [255] investigated patient satisfaction regarding an intensive "home from hospital" scheme which provided 6 weeks input following discharge. Patients and professionals involved in the survey felt the service was beneficial. Patients on the scheme tended to improve function during the trial period, although without a control group the significance of this is unclear.

In a more specific survey patient recollection of discharge instructions was investigated [256]. Less than half the patients surveyed could recall their discharge instructions.

The views of carers, both paid and unpaid, have also been investigated. In a study of home-care workers[257] adequate information about the patient's illness, information abut their functional ability and cognition, timely information about discharge and good co-operation between hospital and home care workers was highlighted as being important. Grimmer et al [258] investigated the experiences of unpaid caregivers. They found that carers felt uninvolved in discharge planning process and that they reported not being given information (for example on medications or lifting and handling). They did not feel that their own physical and emotional health had been considered. Stresses developed in many of the patient-carer relationships, and morale (both patient and carers) was low for months. Bull et al [259] found that caregivers who felt they had more involvement in the discharge planning process had better health and more acceptance of the care-giving role.

Dellasega and Fisher [260] describe post-hospital care for rural dwellers in the United States. Participants in their study had cognitive or functional impairment or both. The most frequently used services were skilled nurse (32%), home health aide (11.4%), physiotherapy (17.1%), social worker (3%) physician (30%) home delivered meals and homemaker. The peak use was at two weeks with a decline in service use after that. Informal cares were most commonly used with help bathing being the most common service provided. At four weeks there was substitution of initial skilled nurse use with home health aide use. Neither professional nor informal care was associated with outcome in terms of Emergency Room visits, emergency physician visits, readmission or cognitive score

In a population recruited for an RCT, Brand et al [242] also performed a qualitative study examining the reasons for the failure of the intervention. They found that there was inadequate integration of the nurse practitioner into the existing systems, that the

stakeholders did not understand the nurse's role, that there were inadequate clerical resources available and that there was inadequate documentation.

Summary and Conclusions of discharge planning studies and reviews

So in summary, qualitative studies have shown high levels of unmet need both social and medical in the post-discharge period. In trials of discharge planning, meta-analysis and systematic review have generally shown limited and inconsistent outcomes. The interventions considered have been heterogeneous with only small benefits on a few outcomes such as residential care admission, hospital readmission or mortality. However, of interest to my thesis a number of reviews have shown a reduction in residential care and an associated improvement in quality of life. Interventions considered in these reviews have been CGA, combined discharge planning and support, and nurse-led home visiting to frail elderly. Looking at the individual randomised trials, positive outcomes in terms of hospital readmission, mortality and residential care admissions have been demonstrated where the intervention has been targeted at the more elderly or frail, where the intervention has spanned the hospital-home interface and where a multidisciplinary team has been involved. In descriptive studies high levels of post-discharge issues both for patients and carers have been identified, and quality of life has been improved by intervention.

2.6.2 Community based interventions to reduce rates of residential care admission

Systematic Reviews

As with discharge planning there have been a wide range of studies and interventions aimed at maintaining older people in their own home in the community. I will initially discuss systematic reviews, but it is important that many of these reviews will have considerable overlap between the original studies included in the review.

In an early analysis, Hedrick et al [261] performed a meta-analysis of the effects of home-care on preventing mortality and nursing home placement. Home-care was defined as health care or personal care services delivered in a person's home. There was a small, non-significant effect on reducing mortality, which was lower in seven out of 12 studies. Nursing home placement in contrast was significantly reduced with eight out of ten studies showing a reduction.

In one analysis Stuck et al [262] performed a meta-analysis of five types of comprehensive geriatric assessment: inpatient geriatric evaluation and management; inpatient geriatric consultation; home assessment services; hospital-home assessment services (for those recently discharged) and outpatient assessment services. Of the interventions of interest to this review, home assessment services reduced mortality and had a favourable effect on living location over time.

Van Haastregt et al [263] performed a systematic review of preventive home visits which included 15 trials. Analysis was difficult as all the trials used different methodology. An improvement in physical functioning was shown in five out of 12 studies, while two out of seven trials showed a reduction in the number of nursing home admissions and three out of 13 showed a reduction in mortality.

Elkan et al [264] also report a systematic review and meta-analysis, this time of 15 trials involving home based support. The general elderly population were included in nine studies and six specifically of frail, vulnerable elderly. In both groups there was a reduction in mortality and nursing home admission, with the risk of nursing home admission being almost halved in the frail elderly group.

Stuck et al [265] performed a systematic review and meta-analysis of 18 trials. In trials with more than nine visits, nursing home admissions were reduced, while functional decline was reduced by trials with multidimensional assessment.

Beswick et al [266] have performed a systematic review and meta-analysis of a number of community based interventions in elderly people. They identified 89 trials including nearly 100 000 people, with interventions being multifactorial and delivered in the community. They included 28 trials on the general elderly population, 24 on the specifically frail elderly and 21 on community based care after hospital discharge. These trials reduced the risk of residential care admission, hospital admission and falls, but not death.

Ryburn et al [267] performed a recent review of restorative home support. This type of support consists of replacing doing "for or to" clients in receipt of home support by involving them to "do with" home care workers. Their review found that by encouraging older adults to maintain independence and activity participation they could reduce demand for ongoing services in a cost-effective manner.

Most recently, Eklund et al [268] conducted a systematic review of community based interventions targeting frail older people, with specific interest in multidisciplinary, co-ordinated case management. From the nine trials they assessed, seven showed at least one significant outcome benefit. Five of these studies looked at patient outcomes, while two showed benefit on caregiver satisfaction. There was wide variety of intensity and length of intervention, and many potential outcomes. Only one study in their review directly assessed residential care admission [269].

So, systematic reviews appear to support the provision of home based support to the elderly, especially the frail elderly with consistently beneficial effects on nursing home placement and mortality. However as has been previously noted in this literature review there is a wide variation in the nature and intensity of interventions trialled, as well as the patient groups involved in each study. This makes systematic review difficult to interpret. I will therefore proceed to consider the individual trials in this area.

2.6.3 Controlled Trials

Chanelling studies

This was a series of US based trials conducted in the 1980s. [121] To be eligible patients had to have severe and unmet ADL or IADL disability.[270] Two interventions were trialled,[271] the first adding money to fill gaps in the existing social care, the second expanding community care services but within financial limitations. Despite the eligibility criteria, there were low levels of residential care admission, and this left the studies underpowered. In the initial analysis [272]{Wooldrige, 1988 #359} no significant differences were found, except with carer satisfaction and patient life satisfaction. [273] However, using a mathematical modelling technique[274] they found that providing nursing services to the severely physically impaired (that is wheelchair users) reduced the risk, as did providing home-health services to the cognitively impaired, and personal care and housekeeping to the functionally impaired. A "broad-brush" approach of increasing all services to all elderly showed no benefit on residential care admission. In a later mathematical model [275] where participants were allocated targeted services, nursing home admission was reduced from 13% to 4.5%.

Assessment of services promoting independence and recovery in elders (ASPIRE)

The ASPIRE study[10] was a New Zealand study of older people who would be eligible for long-term care but wished to remain at home. It included three ageing-in-place initiatives in three different cities within New Zealand. There were three arms to the trial, the first, Co-ordination of Services for Elderly (COSE), a community-based case-management approach, with case managers based in clusters of general practices. This reduced the risk of residential care admission by 43%, but was predominantly an assessment service, and was reliant on usual services to actually deliver the care. The second, Promoting Independence Programme (PIP) was facility-based rehabilitation for those who would not be able to maximise their function through a standard hospital stay. This reduced residential care admission by 16% and mortality by 14%. Unfortunately the numbers recruited into the study were too small for this result to be statistically significant. The third arm Community FIRST was a multidisciplinary team approach involving specialist nursing, physiotherapy and occupational therapy incorporating physical activity into the routine delivery of home care services, and delivered by specially trained support workers visiting up to four times per day. This model is an example of Restorative Home Support (RHS), and it was the first time this was introduced into NZ. This approach reduced residential care admission by 33% and mortality by 28%, and improved independence in ADLs, however again the numbers of older people participating in the trials were too small to reach statistical significance. It has however given enough support to this model of care for RHS to be implemented in a pilot form in Christchurch.

On meta-analysis of the pooled outcomes of the three arms of ASPIRE the ageing-in-place initiatives there was a significant delay in permanent residential care entry.

Positive Trials

A summary of trials aimed at supporting older people to remain in the community is shown in Table 7. An early study in this field was performed by Oktay and Volland [276]. Their study was on patients eligible for nursing home care, who were not felt to have any alternative to entering care. They were randomised to either nursing home admission or foster care in the community. Older people who went to foster care received a private room in the carer's house, including meals, laundry and ADL assistance. The carers were paid a small amount to cover expenses, and were given

specialised training by a geriatric nurse practitioner. Patient's care was monitored through daily recording forms, weekly telephone calls with the specialist nurse or social worker and monthly home visits. Those in foster care were more likely to maintain or improve ADL scores; however those in nursing care reported better life satisfaction.

Williams et al [277] report a study comparing usual community care with a multidisciplinary team approach. There were few significant findings from a raft of outcome measures, but the intervention group did have fewer inpatient hospital days and an associated decreased cost of care.

A study by Stuck et al [278] assessed the use of annual in-home assessments by a geriatric nurse practitioner, which included evaluation of risk factors for disability, recommendations and health education. After three years there was a reduction in the number of people requiring help with basic ADLs, and in the number admitted to residential care.

Bernabei et al [269] describe a trial of a community geriatric team including geriatrician, social worker and nurses. They found that the intervention group deteriorated less in ADLs, IADLs, mental state and depression. There was a trend towards more nursing home days in the control group.

Leville et al [279] used a community centre based intervention with a frail group of older adults. Geriatric nurse practitioners assessed and formed an individualised management plan with each participant based on attendance at the centre, which included exercise, chronic disease management and risk factors for disability. Peer support was offered by a trained group of other senior centre participants. They found a decrease in total hospital days in the intervention group, and either a decrease or stability in disability days compared with a decline in the control group. These changes were associated with significant cost savings. Intervention participants also had an increase in their level of physical activity although this was not reflected in changes on physical ability measures such as the timed walk.

Another study by Stuck et al [280] presents the results of a study of home visits by specialist geriatric nurses. Their key finding was the difference between nurses with one being highly effective, while others showed no difference in outcomes. Overall they found decreased dependence in IADLs in the higher functioning group, and no difference in the more dependant group.

Boult et al [281] examined the role of outpatient GEM, in community dwelling elders at high risk of hospitalization. They had a very intensive programme involving social workers, GEM clinic and multidisciplinary team (2 assessment appointments and then monthly visits) and 24 hour on-call services. The intervention group were less likely to lose functional ability, to experience health-related restrictions in ADLs, to have possible depression and to use home healthcare services. Unfortunately the study's significance was limited by pre-existing differences between intervention and control groups.

Scraeder et al [282] studied the impact of the addition of a registered nurse and case assistant to the staff of a primary care practice. They provided patient/ family assessments, care planning, and coordination of support services, also routine telephone monitoring, proactive post-illness follow-up, disease education and wellness promotion. Patients aged over 65 years were included if they had one or more risk factor including recent hospitalization, no caregiver, polypharmacy, difficulty walking, ADL limitations, memory problems, incontinence or disabilities requiring special care. The study showed a 49% reduction in mortality during the second year of follow-up.

Gill et al [283] investigated an intensive physiotherapy intervention for frail elderly people over aged 75 years. In the subgroup with moderate disability at baseline there were significantly lower disability scores at 7 and 12 months follow-up. There was no significant difference in the numbers admitted to nursing home care, but overall these numbers were low and the study may have been underpowered to detect this difference.

Tinetti et al [284] performed a trial of restorative home support in 2002, when they randomised patients newly requiring home support services for an acute deterioration in their condition. This included home nursing care along with physiotherapy and occupational therapy under the care of a physician. This resulted in lower use of the emergency department, shorter episodes of home care and greater chance of remaining at home.

Challis et al [285] performed a study of specialist geriatric input at the time of referral for residential care admission, and found that nursing home admission could be significantly reduced and that there was less decline in physical functioning. Many new conditions were identified which had not been previously recognised by case managers.

Fletcher et al [286] performed a cluster randomised trial assessing universal versus targeted assessment and geriatric versus primary care follow-up. They found a reduction in residential care admission in the universal assessment arm, with borderline significance (p=0.05). Minor end-points showed benefit of geriatric management on mobility, social interaction and morale.

Newcomer et al [287] studied the effect of preventive case management. Nurses conducted an annual screening questionnaire, monitored primary care visit appointment adherence, performed disease education, and condition self-management with an average of 7.7 hours per year (but a wide range). They also had a role in supporting the caregiver. They found no difference between treatment and controls in number of emergency visits, hospital admissions or nursing home admissions. However in the subgroup of patients with more than 3 IADL disabilities, nursing home admission was reduced from 45% to 10%.

Scott et al [288] report on the effectiveness of a group intervention incorporating peer support, education and the opportunity for nurse and/ or physician assessment. The subjects were patients over 60 years who had frequent outpatient attendances in the previous year. They found that this intervention reduced the use of inpatient and emergency services; increased communication between patients and physicians; and increased patient satisfaction. The group of participants was selected from those who felt comfortable interacting in a group environment, so the generalisability is questionable.

Vass et al [289, 290] report on a cluster randomised trial in which GPs and other primary healthcare workers received education on a short geriatric assessment programme covering important geriatric syndromes. This was compared with 2 routine home assessment visits per year without the education programme. The intervention group had a higher functional ability at 3 year follow-up, but there was no difference in mortality or residential care admission.

Melis et al [291] assessed the effect of a multidisciplinary assessment and management strategy in a cohort of patients who had presented to their primary care physician with a geriatric problem such as cognitive decline, falls or malnutrition. Patients were assessed by a specialist geriatric nurse and discussed with a geriatrician. The nurse then made follow-up visits implementing an individualised intervention for each patient. At

3 months the intervention group showed improvements in function and well-being while the control group had declined. At 6 months the effect for well-being persisted. The study was not able to be blinded to either patients or assessors, but the main outcome measures were by written completion of a questionnaire which the authors state could not be influenced by the researchers.

Recently in 2009, Beland et al [292] describe the SIPA system in the region of Quebec, Canada. This was a new model of care designed to address the previous fragmentation of geriatric care in the region. This involved multidisciplinary care with rapid response to crisis situations and intensive case-management. They demonstrated a decrease in acute hospital care and nursing home utilization, with an increase in community care. This was despite an underpowered study which was only powered to demonstrate a 50% decrease in nursing home days.

Another recent study of an education programme [293], this one delivered to Danish GPs and district nurses, reduced nursing home admissions and prevented functional decline in 80 year-olds for the duration of the programme. The effect however did not persist after the education intervention ended.

Negative trials

Toselund et al [294] investigated the outcome of outpatient GEM in a group of veterans with two or more ADL/ IADL impairments. There was a non-significant reduction in mortality due to small numbers in the trial which left it underpowered.

Coleman et al [295] report on the effectiveness of Chronic Care clinics. At these clinics patients receive an extended visit with physician and nurse to plan chronic disease management, a pharmacist review and a patient self-management and support group. They randomised high risk patients from general practices in a cluster randomisation method. They only had 96 patients in their intervention group, and it is therefore likely that the study was also considerably under-powered. There were no detectable differences in outcome.

Dalby et al [296] performed a randomized controlled trial on the effect of nursing visits over a 14 month period. They visited patients aged over 70 years who were considered at risk of a sudden decline in their health based on functional impairments, recent death of a spouse or hospitalizations in the previous year. They did not find any differences in death or residential care admission. However, their intervention was limited as the

nurses did not have the ability to link with domestic assistance or other members of the multidisciplinary team. They were also relatively underpowered.

In another study [297] examining those elderly at risk of functional decline (this time by postal questionnaire), a nursing intervention assessing 12 key dimensions with telephone follow-up and results fed-back to the GP, no difference in functional decline was recorded. Again, this was a single discipline (nursing only) intervention and their population was at lower overall risk of functional decline (19.7%) than other previous studies where up to 40% had suffered functional deterioration They also found that there was low compliance with recommended interventions by patients and their GPs.

Baumgarten et al [298] report on adult day care services. These services offer therapeutic and preventative health related activities. In their trial the intervention group were entered immediately into the day care programme while controls were placed on a standard waiting list of around 3 months. At 3 month follow-up there were no significant differences between the groups in depression, anxiety, ADL scores or caregiver burden score.

Gitlin et al [299] performed a study of an in-home occupational and physical therapy intervention. Patients were aged over 70 years and considered to be functionally vulnerable. There was a reduction in mortality, but numbers were very small so did not reach statistical significance.

Descriptive Studies

Murashima and Asahara [300] report the findings on comparison of two towns, one with 24 hour in-home care and the other with standard home care services. This was not a randomised trial and there may have been important baseline differences between the towns. However in the town with around-the-clock care there were fewer patients admitted to residential care.

Schein et al [301] describe four nursing interventions: coping assistance, lifespan care, risk management and physical comfort promotion. Their study includes patients felt to have at least a 40% probability of readmission to hospital. They received visits from a nurse case manager at least every 6 weeks and a phone call every month. The different interventions were compared but there was no control group. Coping strategies were the most effective intervention with a mean of 0.85 point increase in IADLs.

A Christchurch study by Hanger et al [95] looked at the provision of residential care to a group of elderly patients, who were supposed to have a short-term illness and be functionally independent, in place of an acute hospital admission. They found high numbers of patients remained in residential care.

In a study by Lo et al [302] those who received help with personal cares from children were significantly less likely to enter residential care. The likelihood of receiving help was greater with more children.

2.6.4 Summary

So in summary, as shown in Table 7, a number of interventions have been shown to reduce residential care use [10, 278, 285-287] {Challis, 2004 #35; Newcomer, 2004 #11; Parsons, 2006 #185}; Stuck, 1995 #266; Fletcher, 2004 #212}, functional dependence, [10, 269, 276, 278, 280, 281, 283, 285, 289, 290] hospitalisation[279] and death [10, 282] in community dwelling older people. Successful outcomes have been shown both with interventions targeting those at highest risk [10, 276, 281, 282, 285] and also with more general interventions such as universal assessment [286] or GP education [282, 289, 290]. More intensive interventions spanning a long period of time (for example months to years) are generally more effective [10, 278, 279, 281, 282]. "Negative" trials were often underpowered to detect differences with the intervention [294-296, 299].

Table 7`: Trials of Community-based interventions

This table summarises trials of community-based interventions to support older people to remain in their own homes. Abbreviations: MDT-multidisciplinary team; PT- physiotherapy; OT- occupational therapy; SW- social worker; GEM- geriatric evaluation and management; ADLs- activities of daily living; IADL- instrumental activities of daily living

Authors	Year of publication	Population	Intervention	Outcome
Beland et al [292]	2009		MDT care Rapid response team Intensive case management	Decreased acute hospital use Decreased nursing home use
Vass et al [293]	2009	Community dwelling 80 year-olds	GP and district nurse education	Prevention of functional decline
Melin et al [291]	2008	Geriatric syndromes presenting to general practice	Geriatric nurse specialist Discussion with geriatrician Individual management plan Follow-up home visits by nurse	Improved function Improved well-being
ASPIRE (1) [10]	2006	Patients eligible for residential care admission	General practice based case management	Reduced institutionalisation
ASPIRE (2) [10]	2006	Patients eligible for residential care admission	Inpatient rehabilitation	Reduced institutionalisation Reduced mortality
ASPIRE (3) [10]	2006	Patients eligible for residential care admission	Nursing, PT & OT joining routine homecare provision	Reduced institutionalisation Reduced mortality
Vass et al [289]	2005	Primary care	Educational programme to primary health care workers	Improved function
Scott et al [288]	2004	Frequent attenders at outpatients	Peer support Group education Nurse or physician availability as required	
Newcomer et al [287]	2004		Preventive case management (nurse led- mean 7.7h/y)	Reduction in nursing home admission in most functionally impaired group
Fletcher et al [286]	2004		Universal v targeted assessment Geriatric f-u v primary care f-u	Reduction in institutionalisation
Challis et al [285]	2004	Older people referred for residential care admission	Specialist geriatric assessment and management	Reduction in nursing home admission
Tinetti et al [284]	2002	Acute deterioration requiring new home support	Home nursing OT & PT Specialist physician oversight	Less use of emergency department Increased likelihoond of staying at home

Gill et al [283]	2002	Frail Age >75y	Intensive PT intervention	Lower disability scores in moderately impaired group
Schraeder et al [282]	2001	Age >65y 1 or more geriatric problem	Registered nurse and care assistant added to staff of primary care practice	Reduction in mortality
Boult et al [281]	2001	Community dwelling at high risk of hospitalisation	Intensive outpatient GEM, involving SW, MDT, OP clinic 24h on-call	Less functional decline Better ADLs Less depression Less use of homecare services
Leveille et al [279]	1998	Frail older people	Community centre based Geriatric nurse practitioner assessment Individualised management plan based at cente Trained peer support	Decreased hospital inpatient days Less disability days Cost savings
Bernabei et al [269]	1998		Community geriatric team	Less deterioration in ADLs, IADLs, depression
Stuck et al [278]	1995		Annual in-home assessments	Reduction in residential care admission Less assistance with ADLs
Channelling studies [121, 270-275, 303]	1989	Severe unmet ADL or IADL disability	Adding money to improve services *Or* expanding services within financial limitations	Targeted services reduced nursing home admission
Williams et al [277]	1988		MDT mangement	Fewer inpatient days
Oktay & Volland [276]	1987	Patients eligible for nursing home admission	Foster care in the community (v nursing home)	Improved ADL scores

2.7 Summary, gaps in existing literature and direction of thesis

This thesis is set in the period following discharge from a specialist older persons' health service, against the national and international background of a rapidly growing elderly population. Locally in Christchurch, New Zealand, this has led to a dynamically evolving service and introduction of new models of assessment and care.

This literature review has described my study group, the frail elderly. They are a group of people who have diminished physiological and psychosocial reserves, such that even an apparently minor insult or event can precipitate a catastrophic decline in health and function leading to adverse outcomes such as disability, dependency, residential care or hospital admission. For many older people moving to residential care is a positive decision based on their health and functional condition. However cross-sectional studies have suggested that many other older people in residential care have poorer quality of life, higher rates of depression and that they regret the decision to move into care. The group who have required specialist geriatric care and rehabilitation after an acute illness are a particularly vulnerable and high-risk population. We know this group are a frail and at risk group, but what predicts their outcome after discharge? Geriatricians claim to improve function and increase independence, but what are the actual outcomes following inpatient geriatric care?

In the existing literature there is little data on outcomes following discharge from a specialist geriatric service. Following acute hospital admission function, cognition, comorbidities, living arrangements and availability of carers have been key factors in subsequent residential care admission. Failure to regain pre-morbid function at the time of discharge has been shown to increase the risk of subsequent functional decline and adverse outcomes during further follow-up [12]. A wide range of factors have been identified in community-dwelling older people, and a number of groups have developed complex scoring tools or models to assess the risk of adverse outcomes. It is unclear how applicable these models may be when applied to the specific group who have been hospitalised, rather than to a general community-dwelling population.

This thesis describes a mixed methodology study to address the question of predictors of outcome following discharge in the frail elderly who have been admitted to a

specialist subacute geriatric assessment, treatment and rehabilitation service. The following sections will report on a retrospective audit of older people discharged from a specialist geriatric unit, followed by a prospective study examining factors influencing outcomes in this population, development of models to predict outcome and validation of these models. In the prospective study, factors which have been highlighted by this literature as being important in other subgroups of older people will be considered as well as the findings of the retrospective cohort study. In addition an in-depth qualitative study will take place to explore and illuminate in greater depth issues affecting older people and their carers in the period following discharge and decisions about residential care. In contrast to the many cross-sectional studies reported in this literature review, this series of studies will focus on examining the dynamics of events over the period of a year following hospital admission and the process of decision making surrounding residential care admission.

Once I have determined factors which influence outcome following discharge in frail older people, I wish to proceed to develop an intervention to support them to remain in their own homes. Discharge planning is a key area in the OPHS "Directions 2006-2010" strategic plan. Previous studies of discharge planning have been very heterogeneous in the patient groups involved, the nature, duration, frequency and intensity of the intervention. This has been reflected in the inconclusive outcomes of systematic reviews and meta-analyses, which have not shown any consistent results. In particular almost no reviews have considered supporting discharge with the aim of reducing residential care admission. In individual trials, those which have demonstrated a decrease in residential care admissions in the period after discharge from hospital have been targeted at higher risk groups, crossed the hospital-home interface and involved multidisciplinary team working.

In the context of the evolving service developments for older people in Canterbury DHB with the introduction of restorative home support, I wish to devise a support intervention which bridges the gap between specialist inpatient older person's health services, and community based multidisciplinary teams as this has been previously shown to have some benefit in other trials.

In the next section of this thesis I will consider some of the methodological considerations when conducting research in the elderly, in particular the use of mixed-

methodology research, the development of prognostic models, different methods of validation studies and the development and trialling of complex interventions.

2.8   Methodological considerations

2.8.1 Mixed-methodology research in the elderly

Mixed methodology research is gaining increased acceptance among the research community. It was discussed in a paper by Hanson et al in 2005 [304]. It implies collection and analysis of both quantitative and qualitative data, which may occur concurrently or sequentially. Quantitative research seeks to define a problem by standardising data collection, transforming it into numerical data and performing statistical tests. In contrast qualitative research seeks to understand outcomes and behaviour within their natural settings, to develop categories, and to describe the social phenomenon. Mixed methodology research draws on the strength of both forms of data collection by integrating the results of both techniques within the same study. Advantages of using mixed-methods are to increase the generalisability of results from a small sample and the ability to test, refine and modify models. The main advantage is to allow investigation of the issue in question as comprehensively as possible. There are a number of different mixed methods designs, which are influenced by the philosophical paradigm of the research team. Data may be collected sequentially, as in this thesis, or concurrently. Features of good quality in a mixed methodology study include clear definition of the study aim and research question, whether the type of mixed method is given and whether this matches the study aim and process, and whether data analysis and integration of the different methods matches the research aim and type of study.

In this thesis I use a sequential design, but initially collect quantitative data, followed by a qualitative investigation, before returning to quantitative methods to validate my findings. Data collection is influenced by both the literature review and the sequential nature of the study where earlier sections influence the development of later work.

In the following sections I will discuss the techniques used for data collection and analysis in this thesis, starting with the quantitative methodology used to develop and validate prognostic models.

2.8.2 Development of prognostic models

A recent series of articles in the British Medical Journal outlines some of the issues and methods around the development of prognostic models [305] [306] [307] [308]. These are becoming increasingly popular within medicine, to aid clinicians in the assessment and prediction of patients with multiple and complex interacting factors, where a single factor no longer allows adequate assessment of likely outcome. While they are not intended to take over the role of the clinician's expert evaluation, they may offer some objective evidence to assist in management, and may allow doctors and their patients to assess risk and guide future management strategies. They may also allow more intensive or invasive interventions to be targeted at high risk groups. Prospective cohort studies are the gold-standard method for developing a prognostic model as these allow collection of all relevant data and potential risk factors. As in this thesis multiple factors which may influence outcome can be collected and analysed, then the decision made regarding which factors will remain in the model. Prognostic models are usually built using multivariate techniques from a cohort of the patients of interest or at risk of a specific outcome. These are discussed by Royston et al in the second BMJ paper [306]. Once a model is developed it is important to validate it in other groups of patients, and these techniques are discussed in the next paragraph.

Validation Techniques [307, 309]

Following the development of a prognostic model, it is now generally accepted that further testing and validation of these models is desirable. Validation may take place within the same cohort of patients in the same location and at the same time as the original study (internal validation), in the same location but at a later time (temporal validation) or in an entirely separate location and time setting (external validation) [115]. Internal validation may establish whether a model is reproducible, and whether it measures what it was intended to measure within an identical patient group. However it does not establish wider applicability of the model. Temporal validation uses the same setting but a different cohort of patients, and is useful to establish whether the model has wider applicability, but as the same setting is used again the cohort of patients may be expected to give very similar results and hence may over-estimate the power of a model. It is often however a practical first step in validating a model. External validation, where a model is tested in a separate location on a separate (although

similar) group of patients helps to establish whether a model is more likely to be of wider use than merely in the original setting in which it was designed.

Another key issue raised by Altman and Royston [309] is distinguishing between whether a model is theoretically or statistically valid and clinically valid. The latter is important, and is less reliant on numerical data. To address this, researchers should ask the question "does this model give me important and useful information which can help with the management of this patient?" It is the aim of this thesis to identify a group of frail older people at high risk of entering residential care after spending a period of inpatient care under a specialist geriatric service and to devise support strategies for this group. To assist in this I will validate my original prognostic model in a temporal validation cohort.

While numerical data and statistical analysis have an important role to play in the development of models and estimation of risk in a given population, there are many factors especially in the frail elderly which are difficult to examine quantitatively. As discussed above I therefore chose a mixed methods design to my thesis. The following sections describe the two main qualitative methods utilised, telephone and face-to-face interviews. The advantages and limitations of both methods are discussed, and they will explain why both techniques were chosen for different parts of this thesis.

2.8.3 Qualitative data collection

Telephone interviews

Telephone interviews allow large numbers of people to be assessed quickly in a qualitative manner, exploring issues, clarifying questions and exploring answers. They are thought to provide good quality data, however it is usual to record telephone calls in written note form rather than recording for complete word-by-word transcription. Disadvantages include the loss of visual connection between the interviewer and their subject, which may be a concern especially for those with impaired hearing. Proxies may be used, but it is important to distinguish between when they are giving their own opinion and when they are giving the view of the older person themselves. In this thesis telephone follow-up was used so that the dynamic processes affecting older people after discharge from hospital could be more fully recorded.

Face-to-face interviews

Face-to-face interviews form the core of qualitative research in the elderly to date. They provide the opportunity to explore complex issues in depth. Using a semi-structured approach allows key information to be gathered with consistency across the study cohort, while allowing freedom to explore issues which arise. Tape- recording and transcription allow complete data collection and structured analysis, and eliminates the possibility of bias by the data-analyst. As with telephone interviews, personal interviews are more difficult in those with hearing and cognitive impairment.

Analytical Methods

There are a number of methods for analysing qualitative data, including the general inductive approach discussed by Thomas in 2006 [310]. The general inductive approach allows development of themes from raw data and is useful as it allows for evaluation of both expected and unplanned or unanticipated outcomes. Thomas describes the general inductive approach as:

1. "to condense extensive and varied raw text data into a brief, summary format;

2. to establish clear links between the research objectives and the summary findings derived from the raw data and to ensure that these links are both transparent (able to be demonstrated to others) and defensible (justifiable given the objectives of the research); and

3. to develop a model or theory about the underlying structure of experiences or processes that are evident in the text data."

In the general inductive approach raw data are collected, then categories are developed and ultimately formed into a model or framework that summarizes the data. The key feature of the inductive approach is that these categories and models are not formed prior to data collection, but allowed to develop from the raw data. Hence the general inductive approach was used to evaluate the qualitative data collected in the course of this study.

Finallly in this thesis I will discuss the use of these prognostic models and qualitative data to develop an intervention aimed at maintaining older people in their own homes. The next section discusses some of the issues in developing complex interventions.

2.8.4 Complex Interventions in the Frail Elderly

The design and implementation of randomised controlled trials for drug therapies is well established, however there have been fewer trials examining complex interventions such as home support services in the elderly, despite their wide use especially in public health and social services. In 2000 the UK Medical Research Council produced guidelines to assist in the development of trials of complex interventions [311].More recently these have been updated by Craig et al [312].

The development and evaluation of complex interventions has a number of phases which may take place consecutively or concurrently. They include development: identifying the evidence base, developing a theoretical understanding of how change is likely to take place, and modelling different aspects of the intervention; assessing feasibility and conducting pilot studies; evaluating effectiveness, which may or may not involve a traditional randomised trial depending on the circumstances but should include both processes and outcomes; and finally implementing the intervention. Often complex interventions cannot be standardised, but include a core theory which is then tailored to meet local circumstances. These recommendations will be considered when designing the intervention phase of my study. This literature review has described the existing evidence, and together with the initial retrospective cohort study has developed an understanding of the outcomes for older people after discharge from hospital. In the prospective and validation phases I will develop models addressing areas of need for older people after discharge, which will then be addressed by development of an intervention.

In terms of specifically including the frail elderly in clinical trials Ferruci et al [313]{Ferrucci, 2004 #483} have recently developed a series of guideline and recommendations. These are shown in Table 8, and are important to consider when developing a complex intervention.

Table 7: Recommendations of the Frailty Working group (from Ferruci et al [313])

Eligibility screening should include a multistage process to quickly identify those who are too well and those who are too sick.
Inclusion criteria should target those most likely to benefit, be meaningful to clinicians, and reflect advancements in the frailty research area.
Disability outcome measures should include self-reported, objective, and proxy measures.
Strategies to improve retention and compliance and to monitor their effectiveness should be an integral part of the study design.
Estimation of the cost and sample size should contemplate high dropout rates and interference by competing outcomes.

Finally in the next section of this literature review I will discuss the quantitative measures used during the study, in particular their development, previous use and how they have been shown to predict outcomes in other studies.

2.8.5 Scales and Measures

For the quantitative sections of this study and to develop a predictive model I wished to include a broad range of measures which covered physical health and functioning, cognition, mood and social supports, especially in the prospective study, which could then be narrowed down in the validation section. In his book Gupta discusses the use of measurement scales in the elderly. [314]

The choice of scales for this research was designed to assess a broad range of factors affecting the elderly population admitted to a subacute geriatric hospital which have been previously shown to affect outcomes in studies in the literature review. Many of the measures chosen were pragmatic, choosing measures already routinely used in our unit in order to avoid reduplication of effort and additional burden on the older people involved. In particular in phase one of my study I used a retrospective design, utilising data which was already collected as part of routine care. Phase two was then a prospective design collecting a broad selection of data, which was felt to be relevant from the initial retrospective study, clinical experience and the literature review. I felt it was important to measure frailty, defined by its broader definition as discussed above, cognition, mood, physical function, co-morbidities, medication use, and self-rated health status Following phase one and two of the study, including the qualitative work,

we added additional measures for the validation cohort to assess areas which had been highlighted as important. These were patient's locus of control, a more detailed assessment of social circumstances and carer stress. I aimed to choose measures which would assess important aspects of a patient's function and abilities while still keeping the assessment process simple enough to be administered to frail older people with reduced reserves of endurance and energy in a ward-based setting.

The individual measures chosen will be reviewed below.

Functional Independence Measure (FIM)

Function is a key baseline measure in rehabilitation settings, around which multidisciplinary team management is planned and implemented. Measurement of function can be important for communicating within the treatment team, planning discharge, predicting outcome, as well as for managing services and resources, and performing research.

The FIM is an 18 domain scale with 13 physical domains based on ADLs and 5 cognitive domains. Each task is scored from 1 (requiring full assistance) to 7 (fully independent) giving a range from 18 to 126 points. It was developed by the US National Advisory committee with the intention of developing a scoring system which could be used to achieve uniform measurement and recording of rehabilitation outcomes throughout the USA[315][316]. It is widely used internationally. It is in use in our unit where it is recorded at admission and discharge, as well as at regular intervals during admission to monitor progress in those who have longer admissions.

Modified Mini-Mental State Examination (3MS)

The 3MS is an extended version of the shorter MMSE, and both are widely used to assess cognitive function. The 3MS has good inter-rater reliability and is correlated with the MMSE. [317] It has high internal consistency, test-retest reliability, sensitivity and specificity [318]. This is the routinely used measure of cognition in our unit which is recorded if there is clinical suspicion of cognitive impairment or dementia.

Geriatric Depression Scale (GDS)

The GDS was originally developed as a 30-item score, [319] then simplified to a 15-item scale[320]which has been shown to have good sensitivity and specificity when compared with the longer and more established Montgomery-Åsberg Depression Rating Scale (MADRS) [321]. I used the 15-item scale in this research. The GDS uses dichotomous answers to a series of questions. It has been shown to have high sensitivity for detecting depression, but lower specificity (depending on the cut-off values chosen) and is therefore used in clinical practice as a screening tool to prompt further clinical assessment. A score of >5 points is suggestive of depression while scores of >10 points are almost always diagnostic of depression. It has been shown to be internally consistent and valid, being correlated with the gold-standard Research Diagnostic Criteria for depression. [319]

3m Timed Up-and-Go (TUG)

The 3m TUG [322] is a measure of functional balance and walking speed. Subjects are asked to rise from a chair, walk 3 metres, turn around, walk back and sit down. It is an especially useful test as it replicates a real-life task and conditions (such as rising from an armchair and walking to the toilet, then sitting down again). It has been shown to have high reliability. It has good content validity, correlating with other more complex measures of balance, gait, walking and functional ability such as the Berg balance scale, gait speed and the Barthel index of ADLs. It has been shown to be an independent predictor of nursing home admission[323] and falls, better than other balance and gait tests such as the timed 10m walk, TURN180, tandem walk and ability to stand from a chair unaided. [324]

Functional Reach (FR)

The functional reach test is a static test of standing balance. The subject is asked to stand in a stable position, and then lift their dominant arm. They are then asked to reach forward as far as they can without taking a step, touching the wall or falling. It has been shown to be correlated with a more complex laboratory measurement of balance- the centre of pressure excursion. [325] It also has good inter-rater reliability and has been validated against physical and instrumental ADLs, social mobility, mobility skills,

walking speed, one-footed standing balance and tandem walking, showing good discrimination for increasing physical frailty and disability. [326] It has been shown to predict falls in the elderly. [327]

Edmonton Frail Scale (EFS)

As previously discussed there are a number of potential scales available to assess frailty. We have chosen to define frailty in its broader context as a combination of physical, mental and psychosocial deficits, and wished to choose a measure which reflects this. The EFS [75] is a 10-item scale with a maximum score of 17. It includes items on cognition, comorbidity, medication use, disability on IADLs, social supports and physical function. The EFS has been shown to be valid in comparison with a physician's clinical impression of frailty, and correlated with the Barthel index. It has good inter-rater reliability. It is simple and quick to administer.

Charlson Index of comorbidity (CI)

The Charlson Index [328] is a commonly used index of comorbidities and includes 19 diseases weighted for severity. It has been shown to be predictive of mortality at one year in a cohort of patients of all ages admitted under general medicine and validated in a cohort of women with primary breast carcinoma. It is heavily weighted towards malignant disease and does not include many of the conditions which have been shown to be predictive of outcome in older people such as falls, incontinence, arthritis, or osteoporosis. It has not been assessed in relation to prediction of other adverse outcomes or specifically in an elderly population.

Individual important comorbidities

In view of the short-comings of the Charlson Index I developed a list of conditions which have been shown to be important in adverse outcomes in older people, including disability and residential care admission as well as mortality. Diabetes[117, 122, 132, 144], urinary incontinence [120, 122, 145], bowel incontinence [117, 123], heart failure [144], stroke [122, 132, 144], visual impairment [117], walking difficulty and falls[127], respiratory disease[142], cancer, especially with associated pain,[142] and depression [134, 144] are commonly mentioned conditions which predict residential care admission, but many of which are not included in the Charlson index. Predictors of functional decline include cerebrovascular disease [150, 329-332], hip fracture [329, 332], diabetes [150, 331, 333], heart disease[150, 330-333], hypertension [150,

[334], visual impairment [335], hearing loss [334], depression or anxiety [150, 330, 332, 334, 336-341], osteoarthritis [150, 330, 331, 334], COPD [330], urinary incontinence [334, 342] gait or balance disorders [334], cancer [150], falls[332] and undernutrition [334] These comorbidities were identified and recorded individually by review of notes, discharge summaries and medication charts.

Self-rated Health, Quality of Life (QOL)

A number of studies have shown that self-rated health is important in predicting functional decline in the elderly [158, 332]. There are a number of scales to measures health rating and quality of life, such as the short-form 36 (SF-36), however this has a number of limitations in its use in older people. This includes the large number of items and time to complete the questionnaire especially for those with visual or cognitive impairment, poor acceptability to older people, ceiling effects on some items and poor reproducibility.[343] I therefore elected to use a simple 10-point Likert scale to measure self-rated health and quality of life.

Locus of Control (LOC)

LOC has been shown to be an important factor in recovery from disability, with people with internal locus of control having better chance of recovery from disabling conditions. The Recovery Locus of Control scale was developed by Partridge et al [344], to measure this. It has 9 items- five measuring internal locus of control and four measuring external locus of control. The scale has good internal validity, and internal locus of control has been shown to be correlated with physical recovery from stroke or wrist fracture [344]

Carer Stress (COPE) scale

The Carers of Older People in Europe (COPE) index is a measure of carer's role perceptions and how well they are coping with their care giving role. It has 15-items, 6 negative impact and 5 positive impact along with 3 quality of support and 1 financial item. It has been designed and validated in Europe. [345] The negative items had good internal consistency, while the positive items were lower, but acceptable in most of the development countries. There was considerable variation in the quality of support items between countries. Scores were highly correlated with other measures of carer burden, anxiety, depression and quality of life. A recent New Zealand study [346] showed it to be

associated with carers' self-reported health, general health questionnaire and burden scores and reported need for additional help. Carers and health professionals reported it to be useful in discussing issues around caregiving and a valid addition to other assessment tools.

2.9 Aim of the thesis

This thesis aims to examine, using mixed methodology, the factors involved in making a sustainable discharge to the community from specialist inpatient Older Persons' Health care. I aim to evaluate risk factors for residential care admission in the period following discharge and, based on these risk factors, to develop and trial an intervention to support discharge to the community.

3. CHAPTER 3 PHASE 1: RETROSPECTIVE COHORT STUDY

3.1 Introduction to Phase one

Promoting and restoring function in older people is core geriatric medicine. However, what is less clear is how enduring our efforts might be. As previously discussed a proportion of people have multiple medical conditions with limited physiological and psychosocial reserves, leading to a high risk of functional decline- the "frail elderly" [18, 19]. These people are high users of health and social care. Predicting outcome is an important issue as it may demonstrate a high risk group for whom interventions could be specifically targeted to maintain independence. For many older people the most important and relevant outcome is the ability to remain in their own home, with mortality being less important. Many older people fear disability, dependence and residential care admission more than death [161].

In the literature review I describe a number of trials examining the outcome for older people after discharge from hospital. In particular the immediate outcomes especially after short-term acute medical care have been the focus of many of these studies. However there have been few studies of the longer term outcomes following hospitalization. ADL level[98], cognition[98, 103] and neurological diagnoses on admission [98] were predictive of 6-month outcome following acute hospital admission, while cognition and pension predicted outcome from an acute geriatrics ward [103]. In particular a decline in functional status during an inpatient stay predicted adverse outcomes in the subsequent 6-months [102]. Similarly a failure to regain pre-morbid level of function by discharge from a general medical service gave a high risk of subsequent further functional decline [12].

The only previous study of outcomes after inpatient rehabilitation in older people, which was conducted in the context of rehabilitation in subacute residential care in the USA, showed that function, dementia and comorbidities were significant factors [99]. However the question of what happens to older people after specialist treatment and rehabilitation in terms of whether they are able to remain in their own homes, and what factors contribute to a successful and durable discharge remain less clear.

The aim of this phase of the research was to determine factors which predicted longer term outcomes following an admission to a specialist subacute geriatric treatment and rehabilitation facility.

3.2 Methods of Phase 1

This phase was a retrospective cohort study of all patients discharged from our specialist Older Persons Health unit over a six month period. Most (70%) of older people admitted to the unit have undergone an acute medical or surgical admission, and have suffered a functional decline associated with their acute illness which has meant they were unable to return home immediately from hospital. The remainder (approximately 30%) have been admitted directly from the community usually with geriatric syndromes such as falls or confusion. This study used data which was routinely collected in our unit for quality-assurance purposes during the older people's hospital stay. This included age, gender, length of stay, admission domicile and discharge destination. Function was measured by the Functional Independence Measure (FIM) and this was recorded at admission and discharge by the older persons' primary nurse with advice from the ward multidisciplinary team. Older people who died during their hospital admission were not included in the study, neither were those transferred back to acute inpatient care.

Our region has a centralised computer system covering 450 000 patients (59 000 older people) which includes details of all medical admissions, deaths and needs assessments for residential care A needs assessment is mandatory to enter residential care, so I can be certain that we captured all the relevant outcomes for my cohort. This system was used to record patient demographics, number and date of any hospital admissions, date of any change in domicile and mortality data in the first year after discharge.

Patients were discharged to their own home, a relative's home or one of four different levels of residential care, as discussed in the introductory chapter. All patients discharged to their own home were assessed for community supports including domestic assistance, personal care, district nursing and meals-on-wheels as indicated.

After discussion with the local ethics committee, this section of the thesis was considered to be a quality assurance project, based on a retrospective records review, and further ethical approval was not required.

Statistical analyses were performed using Microsoft Excel™ and SPSS v13.0 (SPSS Inc., Chicago, USA). Descriptive statistics were calculated. Kaplan-Meier curves were plotted to describe the time course of changes in domicile. Students unpaired t-tests and Chi-square tests were used to compare groups. Multivariate logistic regression analysis was then used to calculate the association between risk factors and outcomes. Variables were entered sequentially into the multivariate model and retained in the model if they reached statistical significance.

3.3   Results of Phase 1

A total of 848 patients were discharged from the four general wards over a 6-month period. Of these 94 people were transferred from the unit to acute care, and were excluded. A further 202 patients were excluded due to the FIM being incomplete. This left a cohort of 552 patients in the study. From this group 367 returned to their own homes, 103 went to rest homes and 82 to hospital level care. There was a non-significant trend towards those who were excluded being male (36.5% male in study group versus 44% in excluded group, p=0.07). There were no significant differences in age or length of stay. Baseline characteristics of the cohort divided by their discharge domicile are given in Table .

Table 9: Baseline variables for the retrospective cohort

This table illustrates the baseline characteristics for the cohort, divided into groups by their discharge destination at the time of discharge from our unit. Abbreviations: n- number; CI- confidence interval, y- years; FIM- functional independence measure; LOS- length of stay; d- days; pts- points

Discharge destination (n)	Own home (367)		Rest Home (103)		Hospital level care (82)		All (552)	
	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
Age (y)	81.3	80.6-82.0	84.2	82.8-85.6	83.6	81.8-85.4	82.2	81.6-82.8
Admission FIM (pts)	93.2	91.0-95.4	81.3	76.9-85.7	50.5	45.8-55.2	84.7	82.5-86.9
Discharge FIM (pts)	109.1	107.4-110.9	94.7	90.8-98.6	54.7	49.3-60.1	98.3	96.1-100.6
Change in FIM (pts)	15.9	14.4-17.4	13.4	10.8-15.9	4.2	1.6-6.8	13.7	12.5-14.9
Total LOS (d)	26.3	23.1-29.5	13.5	9.4-17.6	17.7	9.4-25.9	23.4	20.7-26.0
Time to death (d)	163.5	139.9-187.1	182.7	139.2-226.1	107.8	82.0-133.6	151.7	134.9-168.6
Time to readmission (d)	116.5	103.0-130.0	131.5	104.9-158.1	72.0	32.6-111.4	116.3	104.7-127.8
Time to residential care (d)	145.3	126.7-163.9	174.1	139.2-226.1	N/A	N/A	140.3	126.3-154.3

3.3.1 Discharge stability

There was a steady linear decline throughout the year in patients remaining in their discharge domicile. This is illustrated in Figure 4 for those discharged to their own homes. 299/367 patients discharged home remained alive at one year. 72% of those remaining alive, or 62% of the total discharged to their own home remained there at one year. Mortality in those discharged home was 13.8%.

Figure 4: Kaplan-Meier curve for outcomes in the first year after discharge
N= 367 people
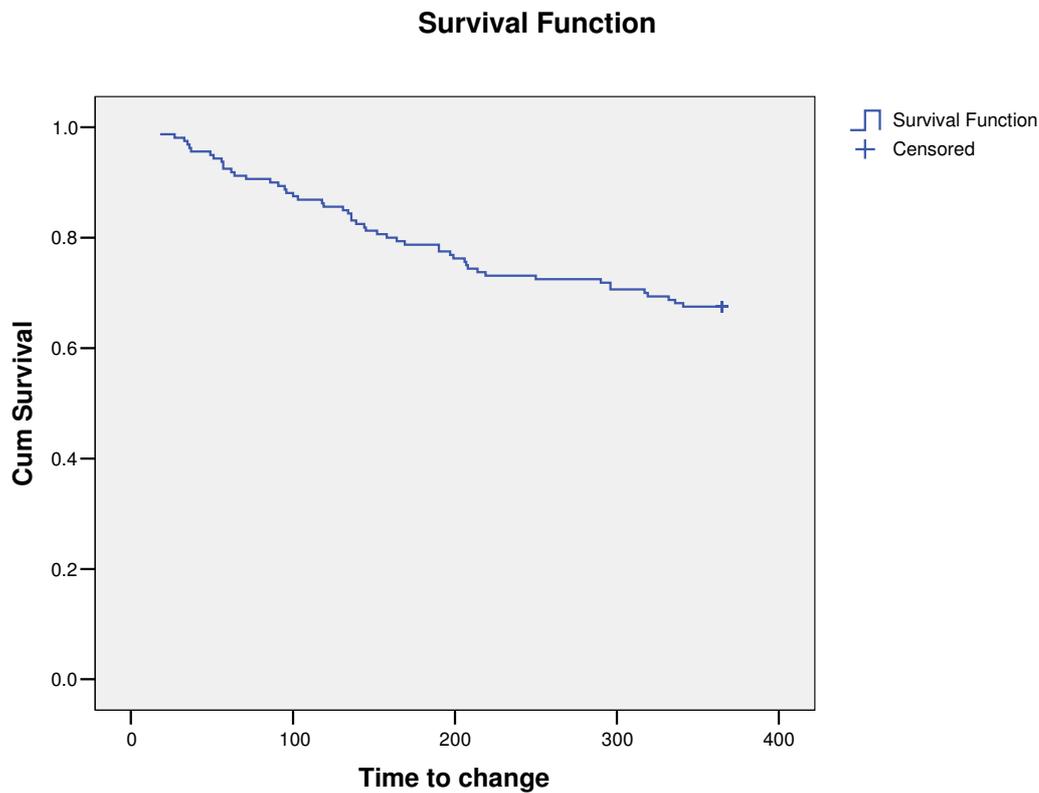
3.3.2 Predictors of change in domicile and death

On multivariate logistic regression analysis, residential care admission in the first year after discharge for those discharged to their own homes was independently predicted by older age, RR 1.05 per year (95% CI 1.01-1.10), p=0.02, while higher FIM score on discharge was protective, RR 0.97 per FIM point (95% CI 0.96-0.99), p<0.001. FIM on discharge was a better predictor than FIM on admission or change in FIM during the hospital stay. Total FIM was also better than the physical or cognitive subscales alone. Living with others (spouse or children) as opposed to alone was also protective, p=0.04.

3.4 Discussion of Phase 1

I present the findings of a large retrospective cohort of a group of patients discharged from subacute inpatient care in an older persons' health service. I have captured a frail population who have required rehabilitation and treatment in a specialist unit.

My principal conclusions are that for those patients who are discharged to their own home following rehabilitation, the majority have good outcomes. They and their relatives should be reassured that for most older people discharge home is successful, even in the frail elderly. It is pleasing to see that 62% of discharges remained at home in the longer term, and that with appropriate discharge planning and support this can be successful and durable.

I have demonstrated that some of the predictive factors in determining who will require residential home care include the functional status, age and living arrangements. Functional status on discharge is the strongest predictor of 12 month domicile stability, this is in keeping with the previous study of Boyd et al [12]. Other factors are also significant, illustrating the important interaction between function and environment that is fundamental in geriatric medicine practice. It is rarely one factor alone which determines outcomes, but a complex mix of different variables.

A weakness of this study is that as a retrospective cohort study, some patient details were not available to me, and their predictive implications cannot be analysed. I used data routinely collected during an inpatient admission at our unit (that is age, gender, FIM and living arrangements) and did not attempt to collect any additional data. In particular frailty, medical comorbidities and cognitive function were not included. There

are 5 cognitive/ social questions within the FIM so I measured cognitive function to some extent, but in a limited way, and formal measurement of cognition would have been desirable. The cognitive subscale of the FIM was not significantly predictive of outcome. In addition this retrospective study did not use any data on frailty, which as discussed in the literature review is a key issue in the elderly, in particular the hospitalised elderly. I have proceeded to perform a prospective cohort study to address these weaknesses which will be described in the next chapter of this thesis.

This study may also have been influenced by selection bias, with only patients considered to have rehabilitation potential admitted to the service. This limits the generalisability of my findings to a wider population.

Some eligible people (22.6%) did not have their FIM recorded during their hospital admission, and were therefore excluded. They were statistically similar in age and gender to those included, however other potential confounding factors were not available and could influence the outcomes of this study.

This is one of the first studies to follow patients discharged from specialist inpatient geriatric treatment and rehabilitation for a longer period to look at the durability of discharge domicile. I have focussed on residential care, not mortality, as my primary outcome as this has been shown to be more meaningful to my population [161]. My study supports the contribution of poor functional status to residential care admission in the year following hospital admission, but with a number of important limitations which will be addressed in the next section of this thesis.

4. CHAPTER 4   PHASE 2A: PROSPECTIVE COHORT STUDY

4.1 Introduction to Phase 2(a)

In my literature review I have discussed variables which predict outcomes for the frail elderly in a variety of settings. There is very limited evidence about long-term outcomes for those who have undergone subacute geriatric care and rehabilitation.

In the previous chapter (chapter 3) I have described a retrospective cohort study which demonstrated that function (as measured by the FIM) on discharge predicted 12 month outcomes. However the retrospective nature of this section meant that data on frailty, cognition, comorbidity and detailed social circumstances were not available. As discussed in the literature review (see Table 3 and Table 4), previous studies have shown function[90, 98-101] (in particular a decline in function during hospitalisation)[102], cognition [98, 99, 101, 103], self-rated health [137], living alone [90, 100], comorbidity [99, 101] and biochemical markers [101] were predictive of longer term outcomes following hospitalisation. However the majority of these studies were of older people discharged from acute care, and there is little data on outcomes following specialist geriatric care. Frailty in particular is increasingly recognised as an important syndrome in the elderly which may predict and affect outcomes, but there have been no studies to date examining the link between frailty, hospitalisation and the requirement for residential care.

In this section of the thesis I will describe a prospective cohort study to examine and add to the evidence for frail older people discharged from subacute hospital care and address the weaknesses of the retrospective cohort and those factors identified as important by the literature review.

The aims of this phase of the research were to describe the outcomes in the year following discharge for older people discharged from a specialist older persons' healthcare unit, to determine predictors of longer term outcomes and develop a predictive model. Specifically I wished to examine the role of function, frailty and cognition in longer term outcomes following discharge. I also wished to examine in a dynamic manner the outcomes for older people over a period of one year following

discharge and identify factors which may be identified at the time of discharge which contribute to adverse outcomes.

4.2 Methods for phase 2(a)

4.2.1 Data collection

Phase two(a) was a prospective cohort study. All patients discharged from the four general wards at the unit over a six month period were eligible for inclusion. The unit has been previously described in the introduction (section 1.1) and chapter 3 on the retrospective methods as well as in my earlier paper [347]. The specialist stroke rehabilitation, orthogeriatric and psychiatry wards were not included. These populations have been previously investigated and described, unlike the frail elderly in subacute care. In addition the stroke services in Christchurch were undergoing their own period of service development which was separate from this study. Also in terms of feasibility for a single researcher there was a limit on the numbers of patients who could be assessed.

Patients were recruited in the last 1-2 days of their hospital admission. All patients being discharged to their own homes were eligible. Patients were identified by regular liaison with the junior medical staff and ward clerks. Patients were invited to take part in the study by the researcher and provided with written information about the study. They were advised verbally and in the written material that participation was voluntary and would not affect their medical care in any way. Written consent was obtained. Exclusion criteria were age under 65 years, severe dementia such that they were unable to answer the questionnaires or provide informed consent, non-English speaking and those discharging home for palliative care. This study had the approval of the Upper South B regional ethics committee (Reference URB/06/12/096).

Patients who agreed to take part then underwent an interview during which the following data were collected:

- Age
- Functional Independence Measure (FIM)
- Edmonton Frail scale (EFS)

- Modified mini-mental state test (3MS)

- Geriatric depression score (GDS)

- 3m Timed up-and-go (TUG)

- Functional reach (FR)

- Self-rated (SR) health and quality of life (QOL) (on 10-point Likert scales)

- Social circumstances (marital status, living alone, main carer)

Medical notes were then reviewed to collect a list of comorbidities identified as important from the literature, the Charlson index (CI) was also calculated.

4.2.2 Follow-up of study cohort

Patients were telephoned at 3, and 6 months and asked the question "compared with when you left hospital do you think you have got worse, stayed the same or improved?" These responses were then grouped into 2 groups, deteriorated versus stable or improving. If at any time, either 3 or 6 months, the older person reported their health as "getting worse" they were coded as "deteriorating" for the purposes of statistical analysis.

Patient outcomes were followed-up using the local computerised patient management system (SAP). This includes details of all deaths, hospitalisations and needs assessments for residential care. A needs assessment by the District Health Board is mandatory to enter residential care in NZ, so we can be certain that all relevant outcomes have been recorded. There were four potential outcomes for my patients, remaining alive and in their own homes; remaining alive and moving into residential care, remaining in their own home and dying, or moving into residential care then dying. In addition whether a person had undergone further hospital admission(s) was recorded.

4.2.3 Statistical analysis

Statistical analysis was performed using Microsoft Excel™, and SPSS v17.0. Descriptive statistics were calculated (mean/ median, quartiles, standard deviation). The outcome of telephone calls at 3 and 6 months were combined so that the worst self-report was considered (so, if at any time the patient reported they were getting worse

this was the outcome selected). After biostatisitical advice I estimated the required sample size using the method of Hsieh et al[361], however in reality the sample size was largely guided by pragmatic issues of recruitment and time available for the study. I was advised that post-hoc analysis of power and sample size is considered to be a poor methodological approach[362] so this was not performed with the revised sample size. After advice from my statistician we consider the sample in this phase of the study to be sufficient to detect all important differences in outcome measures.

Univariate analysis

For continuous variables independent samples t-testing was performed for four outcomes:

1. Any change in domicile (including death, whether or not this was preceded by residential care admission)

2. Any residential care admission

3. Any death (whether or not this was preceded by residential care admission)

4. Hospitalisation

For categorical data chi-square tests were calculated and odds ratios and 95% confidence intervals obtained. The same four outcomes were used.

There was concern that due to the high numbers of variables tested there was a significant risk of false positive results. Following biostatistical advice I therefore performed Benjamini-Hochberg (B&H) analysis [348] to take this into consideration. However given that the principle purpose of the univariate analysis was to identify variables to enter into the multivariate testing, this is not discussed further in this part of the thesis. This may be found in appendix 1.

Multivariate analysis

Binary logistic regression analysis was performed for the four outcomes above against no change in domicile or no hospitalisation. Initial variables were chosen from those which were significant on univariate testing and those which clinically we felt to be important. Hence, age, living circumstances, FIM, TUG, FR, EFS, CI, the combined outcome of telephone calls and readmissions to hospital were tested. Individual comorbidities were then added and removed sequentially aiming to improve goodness-

of-fit of the model. Nagelkerke's R^2 was used to assess goodness of fit, aiming for a value closer to 1.0. Finally interaction terms between function, frailty, co-morbidities and dementia were tested. Once the final model was reached odds ratios were calculated. A Chi-square table was produced to show the predictive value of the models.

4.3 Results of Phase 2a

4.3.1 Descriptive statistics

In this phase of the study 273 individual patients were discharged from Princess Margaret Hospital during the study period (February to May 2007). Of these 159 had complete data collection and were included in the study cohort. Of the remainder 114 were either not referred or not assessed due to lack of researcher availability. Four were readmitted to PMH within the study period and were not assessed on their subsequent admission(s), 6 declined to participate, 4 were under 65 years, 4 did not speak English, 3 were unable to consent and 1 was discharged for terminal care. A further 34 were lost at the point of telephone follow-up being unable to be contacted at 3, 6 or 12 months. Overall, complete data were available from 39% of discharges.

At 12 months 105 (67%) patients remained in their own home, 38 (24%) had entered residential care, 1 was in the acute hospital and 22 (14%) had died, 8 of whom had not first entered residential care.

Of those not referred to the study, outcomes were not statistically different with 78 (68%) remaining in their own home, 29 (25%) moving to residential care and 18 (15%) had died. There was also no significant difference in gender breakdown or age, with both included and excluded cohorts having a mean age of 81.0 years.

We did wish to collect basic data from carers, such as gender, age, relationship to patient, hours spent caring and carer stress. However in practice I found it difficult to contact carers, and to obtain consent from them for their inclusion in the study.

Basic descriptive statistics were calculated; the mean and standard deviation for the normally distributed variables, and median and inter-quartile range for the skewed variables. These are shown in Table 10.

Table 10: Descriptive statistics

This table shows the baseline descriptive variables for my cohort of 159 patients. Abbreviations: FIM- functional independence measure; EFS- Edmonton frail scale; 3MS- modified mini-mental state examination; GDS- geriatric depression scale; TUG- 3-metre timed up-and-go; FR- functional reach; CI- Charlson index; SR- self-rated; QOL- quality of life

Variable	Mean	SD	Median	Lower Quartile	Upper Quartile	Minimum	Maximum
Age	81.0	7.1	81.0	75.0	86.0	65.0	100.0
FIM			114.0	105.0	121.0	34.0	126.0
Physical FIM			81.0	75.0	87.0	13.0	91.0
Cognitive FIM			33.0	30.0	35.0	16.0	35.0
EFS	8.8	2.5	9.0	7.0	11.0	3.0	14.0
3MS			90.0	79.0	95.0	49.0	100.0
GDS			2.9	0.20	5.00	0.0	13.0
TUG			22.0	16.0	32.0	8.0	100.0
FR	16.8	10.0	16.0	9.0	25.0	0.0	40.0
CI			2.0	1.0	4.0	0.0	8.0
No. Medications	8.7	3.6	9.0	6.0	9.0	0.0	18.0
SR Health	5.8	2.1	5.0	5.0	7.0	1.0	10.0
SR QOL			7.0	5.0	9.0	1.0	10.0

The number of patients with each diagnosis from the categorical data is shown in Table 11.

Table 11: Numbers of patients with diagnosis

Variable	Yes (%)	No(%)
Further admissions	103 (64.8)	56 (35.2)
Dementia	24 (15.1)	135 (84.9)
Depression	47 (29.6)	112 (70.4)
Diabetes	28 (17.6)	131 (82.4)
Hearing impairment	13 (8.2)	146 (91.8)
Visual impairment	41 (25.8)	118 (74.2)
Congestive cardiac failure	40 (25.2)	119 (74.8)
Hypertension	79 (49.7)	80 (50.3)
Ischaemic Heart Disease	69 (43.4)	90 (56.6)
Osteoarthritis	80 (50.3)	79 (49.7)
Osteoporotic fracture	34 (21.4)	125 (78.6)
Stroke	37 (23.3)	122 (76.7)
Atrial fibrillation	42 (26.4)	117 (73.6)
Urinary Incontinence	40 (25.2)	119 (74.8)
Chronic Renal Failure	27 (17.0)	132 (83.0)
Chronic Pulmonary disease	38 (23.9)	121 (76.1)
Falls	51 (32.1)	108 (67.9)
Benzodiazepine use	31 (19.5)	128 (80.5)

4.3.2 Survival Analysis

Kaplan-Meier curves were plotted for each outcome (combined outcome of residential care admission or death, residential care admission remaining alive at one year follow-up, death, and admissions to hospital). These are shown in Figures 5-8.

Figure 5: Kaplan-Meier curve for the Combined Outcome

    N = 159 people
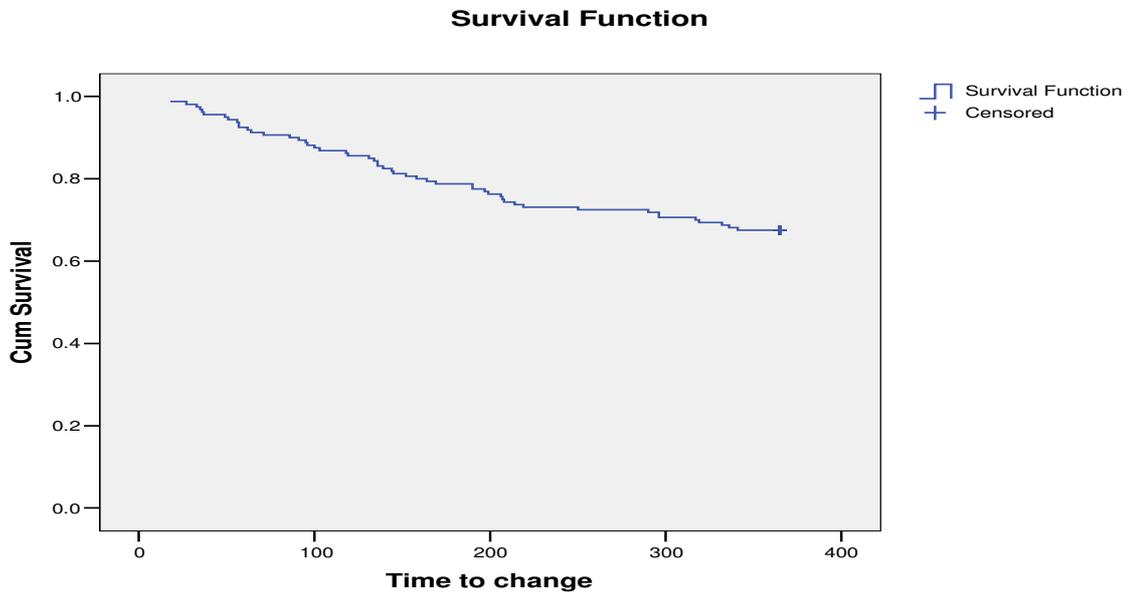
Figure 6: Kaplan-Meier curve for mortality

    N= 159 people
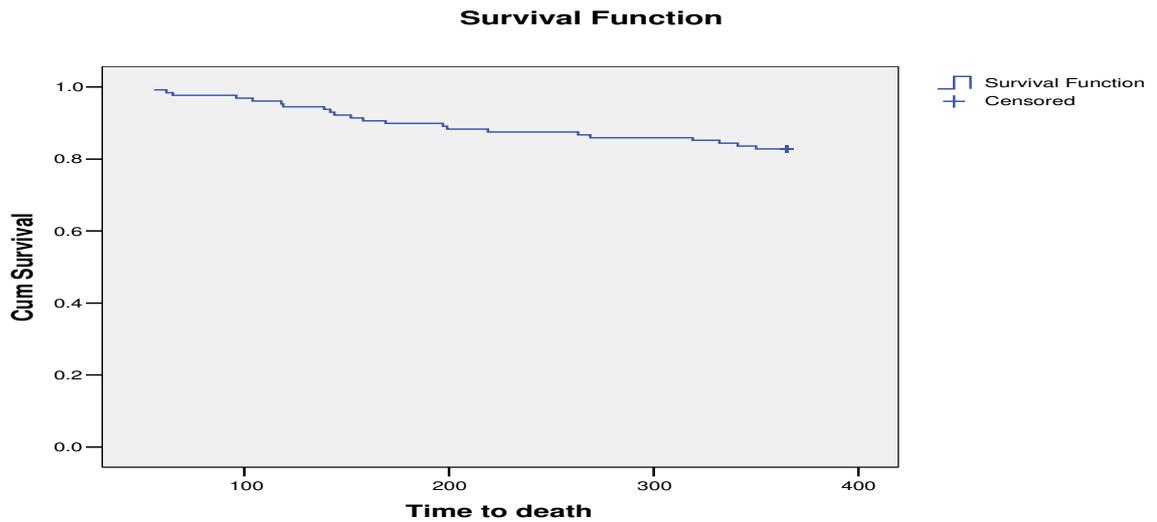
Figure 7: Kaplan-Meier curve for Residential Care Admission

N= 159 people

Survival Function
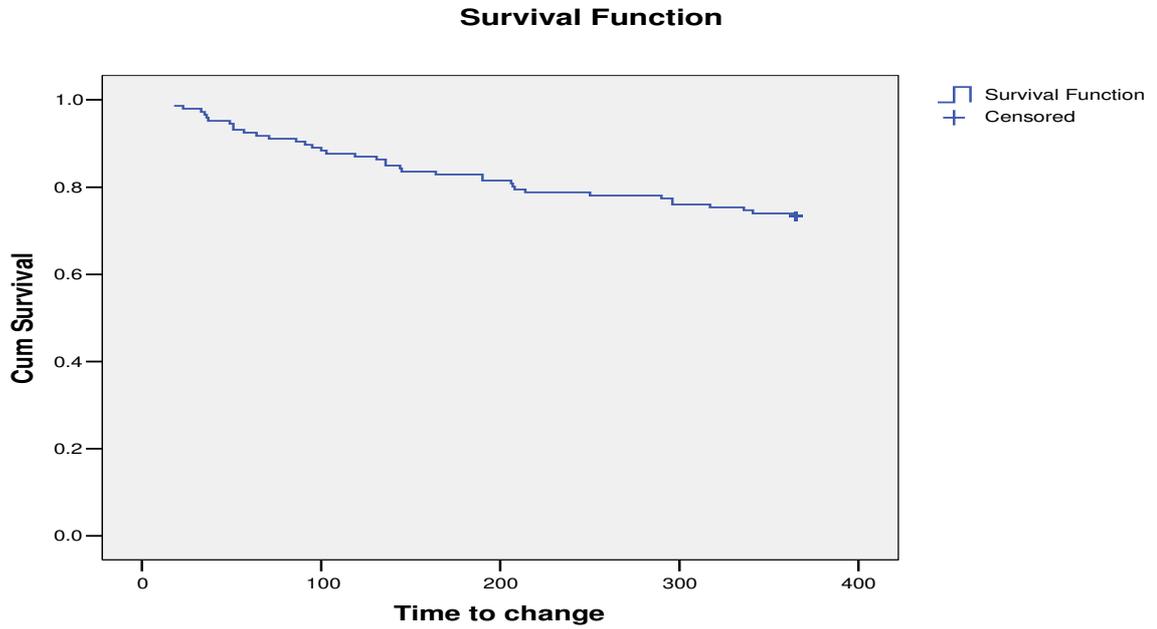
Figure 8: Kaplan-Meier curve for hospital admission

N= 159 people

Survival Function
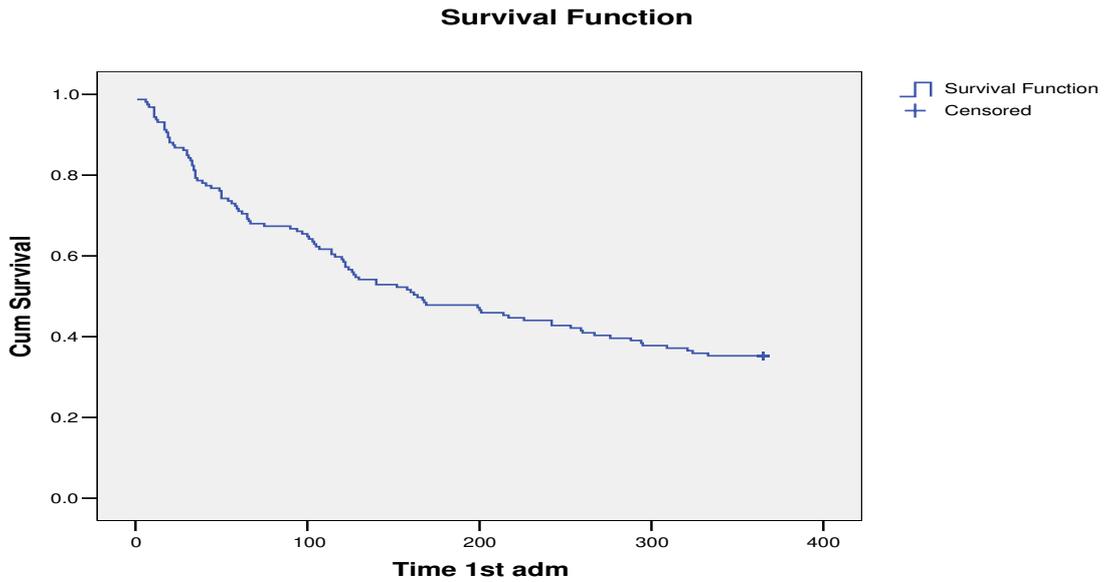
From the total population 67.5% survived the year living at home with 32.5% either moving into residential care or dying; 22 (17.2%) of patients died, of whom 13 did not first move into residential care. For the outcomes of residential care admission, death or both there was a steady decline in numbers remaining at home during the year.

The majority, 103 patients (74.8%), had at least one further admission to any hospital (acute or older person's health services) during the year. In contrast to the steady rate of residential care admissions across the year, there were increased numbers of hospital admissions early in the year which then tended to level off as the year progressed. For a number of older people (about a third of those readmitted to hospital) there was a clear temporal relationship between moving into residential care with an immediately preceding hospital admission.

4.3.3 Univariate Analysis: phase 2a

T-tests

Independent samples T-test were used to compare continuous variables for the outcomes:

1. Combined outcome of change in domicile or death

2. Death alone

3. Any residential care admission

4. Hospital admissions

Results are shown in Tables 12-15. Significant results are highlighted with a *.

Table 12: T-test for combined outcome of residential care admission or death

This table shows the t-test for the continuous variables for the combined outcome. Abbreviations: FIM- Functional independence measure; 3MS- modified mini-mental state examination; GDS- geriatric depression scale; TUG- 3m timed up-and-go; FR-functional reach; EFS- Edmonton frail scale; CI- Charlson index; SR- self-rated; QOL-quality of life; *p-value <0.05

	Change?	Mean	SD	Mean difference	95% CI Lower	95% CI Upper	p-value
Age	Y	82.0	7.6	2.1	-0.6	4.8	0.12
	N	79.9	6.8				
FIM	Y	105.5	17.6	-7.6	-13.1	-2.9	0.007*
	N	113.0	12.9				
3MS	Y	85.0	11.2	-3.1	-7.1	0.9	0.13
	N	88.1	10.1				
GDS	Y	3.0	3.0	0.03	-1.1	1.2	0.96
	N	3.0	2.9				
TUG	Y	36.0	29.8	8.2	-1.7	18.0	0.10
	N	27.8	24.1				
FR	Y	14.4	9.0	-3.9	-7.4	0.04	0.05*
	N	18.1	10.0				
EFS	Y	9.4	2.2	1.14	0.2	2.1	0.02*
	N	8.3	2.6				
CI	Y	2.2	1.7	-0.00	-0.7	0.7	1.00
	N	2.2	1.8				
SR health	Y	6.0	2.0	0.3	-0.4	1.1	0.38
	N	5.6	2.0				
SR QOL	Y	6.4	2.3	0.9	0.03	1.7	0.04*
	N	7.2	2.2				

Table 13: T-test for mortality

This table shows the t-test for the continuous variables for the outcome of mortality. Abbreviations: FIM- Functional independence measure; 3MS- modified mini-mental state examination; GDS- geriatric depression scale; TUG- 3m timed up-and-go; FR- functional reach; EFS- Edmonton frail scale; CI- Charlson index; SR- self-rated; QOL- quality of life; *p-value <0.05

	Died	**Mean**	**SD**	**Mean difference**	**95% CI** Lower	**Upper**	**p-value**
Age	Y	81.0	7.8	0.5	-3.6	4.6	0.80
	N	80.5	7.0				
FIM	Y	102.5	15.5	-9.3	-17.7	-0.9	0.03*
	N	111.8	14.5				
3MS	Y	85.2	8.4	-2.2	-6.3	3.9	0.48
	N	87.4	10.7				
GDS	Y	3.8	3.4	0.9	-0.9	2.6	0.32
	N	2.9	2.9				
TUG	Y	35.9	30.0	6.3	-8.7	21.4	0.41
	N	29.5	25.6				
FR	Y	12.0	7.7	-5.6	-11.2	0.08	0.05*
	N	17.6	10.0				
EFS	Y	9.5	2.4	1.0	-0.5	2.4	0.19
	N	8.5	2.5				
CI	Y	2.3	1.8	0.2	-0.9	1.2	0.75
	N	2.2	1.8				
SR health	Y	5.9	1.9	0.3	-0.9	1.4	0.66
	N	5.6	2.0				
SR QOL	Y	6.5	2.8	0.9	-0.4	2.2	0.15
	N	7.5	2.2				

Table 14: T-test for residential care admission

This table shows the t-test for the continuous variables for the outcome of residential care admission. Abbreviations: FIM- Functional independence measure; 3MS- modified mini-mental state examination; GDS- geriatric depression scale; TUG- 3m timed up-and-go; FR- functional reach; EFS- Edmonton frail scale; CI- Charlson index; SR- self-rated; QOL- quality of life; *p-value <0.05

	RH	Mean	SD	Mean difference	95% CI Lower	Upper	p-value
Age	Y	81.5	7.5	1.4	-1.4	4.2	0.32
	N	80.1	6.7				
FIM	Y	107.0	17.7	-6.1	-12.0	-0.3	0.04*
	N	113.0	13.0				
3MS	Y	85.0	12.0	-3.5	-7.8	0.8	0.11
	N	88.2	10.2				
GDS	Y	2.7	2.7	-0.3	-1.5	0.9	0.61
	N	3.0	3.0				
TUG	Y	38.0	32.0	9.6	-1.1	20.3	0.08
	N	28.1	24.3				
FR	Y	16.0	9.9	-2.1	-6.1	2.0	0.32
	N	18.0	10.0				
EFS	Y	9.3	2.2	1.03	0.01	2.1	0.05*
	N	8.3	2.6				
CI	Y	2.3	1.9	0.16	-0.6	0.9	0.66
	N	2.1	1.7				
SR health	Y	6.0	2.1	0.39	-0.4	1.2	0.35
	N	5.6	2.1				
SR QOL	Y	6.4	2.1	1.0	0.1	1.9	0.03*
	N	7.3	2.2				

Table 15: T-test for hospital admissions

This table shows the t-test for the continuous variables for the outcome of residential care admission. Abbreviations: FIM- Functional independence measure; 3MS- modified mini-mental state examination; GDS- geriatric depression scale; TUG- 3m timed up-and-go; FR- functional reach; EFS- Edmonton frail scale; CI- Charlson index; SR- self-rated; QOL- quality of life; *p-value <0.05

Hospital Admission		Mean	SD	Mean difference	95% CI Lower	Upper	p-value
Age	Y	81.0	7.0	0.9	-1.6	3.5	0.46
	N	80.0	7.2				
FIM	Y	110	16.0	-3.6	-8.9	1.6	0.17
	N	113	12.5				
3MS	Y	87.0	9.7	-0.6	-4.4	3.1	0.74
	N	88.0	11.7				
GDS	Y	3.1	2.9	0.5	-0.8	1.3	0.62
	N	2.8	3.1				
TUG	Y	31.3	27.4	3.1	-6.1	12.4	0.51
	N	28.2	23.7				
FR	Y	16.5	10.2	-1.4	-5.0	2.1	0.43
	N	17.9	9.3				
EFS	Y	9.0	2.5	1.0	0.1	1.9	0.03*
	N	8.0	2.4				
CI	Y	2.5	1.8	0.9	0.3	1.5	0.005*
	N	1.6	1.6				
SR health	Y	5.5	2.0	-0.3	-1.0	0.4	0.39
	N	5.8	2.1				
SR QOL	Y	6.4	2.3	-0.5	-1.3	0.3	0.23
	N	6.9	2.2				

For categorical variables, chi-square tests were calculated. Results are shown Table 16-19. Significant variables are highlighted with a *.

Table 16: Chi-square tests for the combined outcomes of residential care admission or death

This table shows the results of Chi-square tests for the categorical variables on the combined outcome. Abbreviations: OR- Odds ratio; F- female; M- male. * p-value<0.05

		Change in domicile		OR	95% Confidence interval		p-value
		N	Y				
Gender	F	58	23	1.1	0.5	2.3	1.00
	M	36	15				
Lives alone?	N	45	16	1.3	0.6	2.7	0.57
	Y	49	22				
Dementia	N	87	31	2.8	0.9	8.7	0.11
	Y	7	7				
Depression	N	65	25	1.2	0.5	2.6	0.84
	Y	29	13				
Diabetes mellitus	N	77	33	0.7	0.2	2.0	0.61
	Y	17	5				
Hearing loss	N	87	34	1.5	0.4	5.3	0.73
	Y	7	4				
Vision loss	N	74	26	1.7	0.7	4.0	0.26
	Y	20	12				
Cardiac failure	N	71	28	1.1	0.5	2.6	0.83
	Y	23	10				
Ischaemic heart disease	N	53	22	0.9	0.4	2.0	1.00
	Y	41	16				
Osteoarthritis	N	48	21	0.9	0.4	1.8	0.70
	Y	46	17				
Osteoporeotic fracture	N	73	31	0.8	0.3	2.0	0.81
	Y	21	7				
Stroke	N	70	32	0.6	0.2	1.5	0.26
	Y	24	6				
Urinary incontinence	N	76	28	1.5	0.6	3.7	0.36
	Y	18	10				
Renal impairment	N	81	29	1.9	0.8	5.0	0.20
	Y	13	9				
Chronic lung disease	N	74	28	1.3	0.6	3.2	0.85
	Y	20	10				
Falls	N	68	24	1.5	0.7	3.4	0.30
	Y	26	14				
Phone call-	N	74	24	2.2	1.0	4.9	0.08

deteriorating	Y	20	14				
Hospital admission(s)	N	42	7	3.6	1.4	8.9	0.05*
	Y	52	31				
Total		**132**	94	38			

Table 17: Chi-square tests for mortality

This table shows the Chi-square tests for the independent variables for the outcome of mortality.

Abbreviations: OR- Odds ratio; F- female; M- male; * p-value <0.05

		Death		OR	95% Confidence Interval		p-value
		N	Y				
Gender	F	76	5	2.8	0.9	9.2	0.13
	M	43	8				
Lives alone?	N	53	8	0.5	0.2	1.6	0.26
	Y	66	5				
Dementia	N	106	12	0.7	0.08	5.7	
	Y	13	1				
Depression	N	81	9	1.0	0.3	3.3	1.00
	Y	38	4				
Diabetes mellitus	N	98	12	0.4	0.05	3.2	0.69
	Y	21	1				
Hearing loss	N	109	12	0.9	0.1	7.7	1.00
	Y	10	1				
Vision loss	N	89	11	0.5	0.1	2.6	0.73
	Y	30	2				
Cardiac failure	N	90	9	1.4	0.4	4.8	0.74
	Y	29	4				
Ischaemic heart disease	N	69	6	1.6	0.5	5.1	0.56
	Y	50	7				
Osteoarthritis	N	60	9	0.5	0.1	1.6	0.25
	Y	59	4				
Osteoporeotic fracture	N	93	11	0.7	0.1	3.1	0.74
	Y	26	2				
Stroke	N	89	13	*	*	*	0.04
	Y	30	0				
Urinary incontinence	N	94	10	1.1	0.3	4.4	1.00
	Y	25	3				
Renal impairment	N	100	10	1.6	0.4	6.3	0.45

				OR	95% Confidence interval		p-value
	Y	19	3				
Chronic lung disease	N	94	8	2.4	0.7	7.8	0.17
	Y	25	5				
Falls	N	83	9	1.0	0.3	3.5	1.00
	Y	36	4				
Phone call-deteriorating	N	86	12	2.2	0.03	1.7	0.18
	Y	33	1				
Hospital admission(s)	N	49	0	*	*	*	<0.01*
	Y	70	13				
Total	**132**	119	13				

* unable to compute OR with value of 0 in one of the cells.

Table 18: Chi-square tests for residential care admission

This table shows Chi-square tests for the categorical variables for the outcome of residential care admission. Abbreviations OR- Odds ratio; RH- residential care; F- female; M- male; * p-value <0.05

		RH admission		OR	95% Confidence interval		p-value
		N	Y				
Gender	F	57	23	0.6	0.2	1.7	0.48
	M	36	9				
Lives alone?	N	45	10	2.0	0.8	5.0	0.18
	Y	48	22				
Dementia	N	86	25	3.9	1.2	13.0	0.03*
	Y	7	7				
Depression	N	64	21	0.9	0.3	3.3	0.63
	Y	29	12				
Diabetes mellitus	N	76	28	0.9	0.3	2.8	1.00
	Y	17	4				
Hearing loss	N	86	28	1.7	0.4	7.1	0.44
	Y	7	4				
Vision loss	N	73	19	2.5	1.0	6.3	0.07
	Y	20	13				
Cardiac failure	N	70	25	1.0	0.4	2.7	1.00
	Y	23	7				
Ischaemic heart disease	N	52	22	0.7	0.3	1.8	0.65
	Y	41	10				
Osteoarthritis	N	47	15	1.1	0.5	2.7	0.83

				OR	95% CI		p-value
	Y	46	17				
Osteoporeotic fracture	N	72	25	0.9	0.3	2.6	1.00
	Y	21	7				
Stroke	N	69	25	0.9	0.3	2.6	1.00
	Y	24	7				
Urinary incontinence	N	75	26	1.6	0.6	4.5	0.41
	Y	18	8				
Renal impairment	N	80	25	2.0	0.7	5.9	0.23
	Y	13	7				
Chronic lung disease	N	73	25	0.9	0.3	2.8	1.00
	Y	20	7				
Falls	N	67	20	1.7	0.7	4.4	0.33
	Y	26	12				
Phone call-deteriorating	N	72	14	4.0	1.6	10.1	<0.01*
	Y	20	18				
Hospital admission(s)	N	41	9	2.1	0.8	5.4	0.17
	Y	52	23				
Total	119	93	32				

Table 19: Chi-square tests for hospital admission

This table shows the Chi-square tests for the categorical vaiables for the outcome of hospital admissions. Abbreviations: OR- Odds ratio; F- female; M- male; * p-value <0.05

		Admission		OR	95% Confidence Interval		p-value
		N	Y				
Gender	F	39	42	3.8	1.7	8.6	<0.01*
	M	10	41				
Lives alone?	N	19	42	0.6	0.3	1.3	0.21
	Y	30	41				
Dementia	N	43	75	0.8	0.3	2.4	0.77
	Y	6	8				
Depression	N	34	56	1.1	0.5	2.3	0.85
	Y	15	27				
Diabetes mellitus	N	40	70	0.8	0.3	2.1	0.81
	Y	9	13				
Hearing loss	N	47	74	2.9	0.6	14.0	0.21
	Y	2	9				
Vision loss	N	40	60	1.7	0.7	4.1	0.29
	Y	9	23				

Cardiac failure	**N**	43	56	3.5	1.3	9.1	0.01*
	Y	6	27				
Ischaemic heart disease	**N**	32	43	1.8	0.9	3.6	0.15
	Y	17	40				
Osteoarthritis	**N**	22	47	0.6	0.3	1.3	0.21
	Y	27	36				
Osteoporotic fracture	**N**	35	69	0.5	0.2	1.2	0.13
	Y	14	14				
Stroke	**N**	39	63	1.2	0.5	2.9	0.67
	Y	10	20				
Urinary Incontinence	**N**	37	67	0.7	0.3	1.7	0.51
	Y	12	16				
Renal impairment	**N**	45	65	3.1	1.0	9.8	0.05*
	Y	4	18				
Chronic lung disease	**N**	40	62	1.5	0.6	3.6	0.40
	Y	9	21				
Falls	**N**	34	58	1.0	0.5	2.1	1.00
	Y	15	25				
Phone call-deteriorating	**N**	35	63	0.8	0.4	1.8	0.68
	Y	14	20				
Total	**132**	48	83				

As mentioned in the introduction we considered the use of the method of Benjamini and Hochberg to control for multiple comparisons. Details of this method and the full results are shown in appendix one. This method limited the number of significant results from the univariate analysis to allow for the multiple comparisons. It suggests that with the large number of variables tested and the relatively small numbers of participants most of the univariate results should be interpreted as non-significant. However as the aim of the univariate analysis was principally to guide variables to enter into the multivariate analysis we continued to this step using the univariate statistics as a guide.

4.3.4 Multivariate Analysis.

Combined Outcome

For the combined outcome of death or residential care admission the variables which were significant, or approached significance, on univariate analysis were initially included in the multivariate analysis. Binary logistic regression analysis was used. For the initial analysis hospital admissions, self-rated quality of life and self-reported deterioration on telephone follow-up were significant with an overall r^2 for the model of 0.297. Results are shown in Table 20a.

As the FIM, EFS, and FR were all significantly correlated, it was not expected that they would be independently significant on the multivariate analysis. The EFS, which approached significance, was therefore retained and the non-significant FIM and FR removed from the analysis. The data on further hospital admission which were highly predictive (p=0.002) as well as those who self-reported deterioration at follow-up (p=0.022) so these were also retained in the model. However this change did not affect the value of r^2 (0.288). Results are shown in Table 20b.

Following this other variables were added and removed in a stepwise manner, aiming to identify those which improved the value of r^2, and were significant. Age was not independently significant, but added to the value of r^2. History of CVA was also significant. This analysis is shown in Table 20c.

Finally, interaction terms between EFS, FIM, CI and dementia were tested. None of these interaction terms significantly improved the model. The r^2 value for the final

model was 0.339, indicating that the model explains 30-40% of the variability in outcomes. The final model correctly predicted 78.8% of outcomes, shown in Table 21

Table 20a-c: Multivariate analyses for combined outcome of residential care admission or death

Tables a, b and c show the development of the multivariate model for the combined outcome of residential care admission. Variables were chosen initially based on the univariate analysis, then added and removed sequentially to achieve the best fit, shown in table c. Abbreviations: FIM- functional independence measure; FR- functional reach; EFS- Edmonton frail scale; SR QOL- self-rated quality of life; CVA- previous stroke

a. Iteration 1

Variable	RR	95% CI for RR		p-value
FIM	1.0	0.97	1.05	0.68
FR	1.0	0.93	1.02	0.31
EFS	1.3	0.99	1.62	0.06
SR QOL	1.4	1.09	1.72	0.007
Dementia	3.2	0.86	11.8	0.08
Admission(s)	5.3	1.81	15.67	0.002
"Deteriorating"	3.1	1.18	8.17	0.02

b. Iteration 2

Variable	RR	95% CI for RR		p-value
EFS	1.3	1.06	1.54	0.01
SR QOL	1.4	1.11	1.70	0.004
Dementia	2.8	0.78	9.78	0.11
Admission(s)	5.1	1.76	14.8	0.003
"Deteriorating"	3.0	1.15	7.88	0.02

c. Iteration 3

Variable	RR	95% CI for RR		p-value
EFS	1.3	1.05	1.56	0.01
SR QOL	1.4	1.12	1.75	0.003
Dementia	2.7	0.73	8.74	0.14
"Deteriorating"	3.4	1.27	9.03	0.02
Admission(s)	5.4	1.81	16.4	0.003
Age	1.1	0.99	1.13	0.12
CVA	3.3	1.04	10.7	0.04

Table 21: Predictive value for combined outcome

This table shows the predictive value of the final iteration of the model. It shows a high negative predictive value of 90.4% and a moderate positive predictive value of 50.0%. The overall predictive value of the model was 78.8%.

		Predicted Change		Percentage Correct
		N	Y	
Observed Change	N	85	9	90.4
	Y	19	19	50.0
Overall Percentage				78.8

Residential Care Admission

For the outcome of residential care admission a similar approach was taken. Initially variables which were significant on the univariate analysis were included. Independently significant variables were self-rated QOL, dementia, admission(s) and deteriorating health on telephone follow-up. The EFS was significant at the 10% level (p=0.07). This is shown in. Table 22a. The r^2 value for this version of the model was 0.255.

Next the non-significant variables of the FIM and TUG, were taken out of the model. The r^2 remained similar at 0.284. This version of the model is shown in Table 22b.

The EFS was replaced with the FIM, but this was non-significant and the removal of the EFS decreased the r^2. Following this variables were added and removed sequentially and retained if they were significant and/ or added to the goodness-of-fit. Visual impairment approached significance and improved the r^2 value. Age, gender, living alone and the other comorbidities tested were excluded from the model. The model is shown in Table 22c. The r^2 value for this version of the model was 0.316, and it correctly predicted 80.8% of the outcomes, with a high negative predictive value of 93.6%.

Finally interaction terms between FIM, EFS, 3MS, dementia and CI were tested. None of the interaction terms added significantly to the predictive value of the model. The predictive value of the final model is shown in Table 23.

Table 22 a, b and c: Multivariate analysis for residential care admission

Tables 21 a, b and c show the development of the multivariate model for the combined outcome of residential care admission. Variables were chosen initially based on the univariate analysis, then added and removed sequentially to achieve the best fit, shown in table c. Abbreviations: FIM- functional independence measure; TUG- 3m timed up-and-go; EFS- Edmonton frail scale; SR QOL- self-rated quality of life.

a. Iteration 1

Variable	RR	95% CI for RR		p-value
FIM	1.0	0.97	1.08	0.60
TUG	1.0	0.97	1.03	0.48
EFS	1.3	0.98	1.64	0.07
Dementia	4.3	1.15	16.04	0.04
"Deteriorating"	3.4	1.27	9.37	0.02
Admission	4.0	1.35	11.93	0.01
SR QOL	1.4	1.06	1.75	0.02

b- Iteration 2

Variable	RR	95% CI for RR		p-value
EFS	1.26	1.03	1.54	0.02
Dementia	4.30	1.15	16.0	0.05
Deteriorating	3.42	1.27	9.21	0.02
Admission	3.95	1.33	11.8	0.01
SR QOL	1.35	1.07	1.70	0.01

c. Final iteration

Variable	RR	95% CI for RR		p-value
EFS	1.27	1.04	1.56	0.02
SR QOL	1.35	1.07	1.71	0.01
Dementia	4.30	1.15	16.04	0.03
Visual impairment	2.65	0.94	7.44	0.09
"Deteriorating"	3.90	1.41	10.75	0.009
Admission	3.67	1.22	11.06	0.02

Table 23: Predictive value of the final model for residential care admission

This table shows the predictive value for the final version of the model for the outcome of residential care admission. There was a strong negative predictive value of 93.6%, but a lower positive predictive value of 38.7%. Overall the model correctly predicted 80.8% of outcomes.

		Predicted Change?		Percentage correct
		N	**Y**	
Observed Change?	**N**	88	6	93.6
	Y	19	12	38.7
Overall Percentage				80.8

Hospital Admissions

Once again for the outcome of subsequent hospital admissions development of the model started with the variables which were significant on univariate analysis. The only significant variable was gender. Other variables which approached significance were also added. The initial model is shown in table 24a for which the r^2 value was 0.239.

Next variables were added and removed sequentially from the model. CCF and DM. added significantly to the value of r^2, without being individually significant. Other variables tested and excluded were living alone, FIM, self-rated health and QOL, 3MS and dementia. This version of the model is shown in. Table 24b.

Table 24: Multivariate analysis for hospital admissions

Tables 23 a and b show the development of the multivariate model for the outcome of hospital admission. Variables were chosen initially based on the univariate analysis, then added and removed sequentially to achieve the best fit, shown in table b. Abbreviations: CCF- congestive cardiac failure; EFS- Edmonton frail scale; CRF- chronic renal failure; DM- diabetes mellitus

a. Iteration 1

Variable	RR	95% CI for RR		p-value
CCF	2.3	0.77	6.86	0.13
EFS	1.2	0.98	1.37	0.08
Male gender	3.4	1.40	8.30	0.007
CRF	1.9	0.54	6.79	0.32
Charlson	1.2	0.91	1.54	0.21

b. Final iteration

Variable	RR	95% CI for RR		p-value
Male gender	4.2	1.68	10.8	0.002
EFS	1.2	1.01	1.42	0.04
Charlson	1.3	0.99	1.70	0.06
CCF	2.2	0.72	6.46	0.17
DM	3.0	0.94	9.45	0.06

Finally the interaction terms between the FIM, EFS, 3MS and CI were tested. The interaction terms did not add significantly to the value of the model. The chi-square table for the final model is shown in Table 25. It can be seen that the model has a strong

positive predictive value of 80.7%. This model explains between 20 and 30% of the variation in hospital admissions in our group of patients.

Table 25: Predictive value of the final model for hospital admissions

This table shows the predictive value of the multivariate model of hospital admissions. The model had a moderately good negative predictive value of 61.2% and a strong positive predictive value of 80.7%. Overall the model correctly predicted 73.5% of outcomes.

	Predicted Change?		Percentage
	N	Y	correct
Observed N	30	19	61.2
Change? Y	16	67	80.7
Overall Percentage			73.5

4.4   Discussion for Phase 2(a)

4.4.1 Study population and exclusions

This unit has been previously described. Older people using the service are a frail population who have experienced functional decline mostly following an acute illness. My study group was also among the most frail in this population as evidenced by the high scores on the EFS, with a mean of 8.8. So this study is important in describing outcomes for a previously under studied population.

Despite intensive information campaigns among staff in the hospital a large number of patients were not referred for inclusion in my study. This had the potential to bias my results; however the group who were not included were matched to the study group in terms of age, gender and outcomes at one year. Without consent I could not access their clinical records to look for further information on function, frailty, cognition or comorbidities so unfortunately there was only limited data upon which to evaluate their similarity to the study population. One can speculate that they may have not been referred because they were considered too unwell, frail or cognitively impaired, but they

may also have not been referred because they were considered too well and therefore not of interest to the study. In practice the best guide we had regarding their similarity is that their outcomes were the same as the included population. I believe that despite the lower than ideal number of participants our population was similar to those excluded, and the lessons learned from my study are applicable more widely to the hospitalised frail elderly. In future studies of this type consideration should be given to this issue, and a technique such as active surveillance of the wards may help identify those who would be eligible for inclusion in the study.

Further loss of numbers occurred at the time of telephone follow-up. The final numbers of 125 patients out of potentially 321 (39%) with complete data collection is somewhat disappointing, but highlights the difficulties faced in studying this frail group of people. This study was always intended to be a "real world" population, to educate and inform day-to-day management and service development which meets the needs of the "real" frail elderly population. Current thinking on the development of complex interventions[312] recognises the constraints of a real-world setting, including high levels of drop-outs, and a critical phase of development is gathering evidence and developing a theoretical base within the setting in which it is intended to be used.

The exclusion of people unable to consent due to severe dementia was made from a practical viewpoint, as it was difficult for one researcher working alone with a number of discharges every day to arrange time to meet with relatives in order to gain consent and complete questionnaires. However in practice only three people were excluded for this reason, while 15 (24.1%) with mild or moderate dementia were able to be included, so any impact on the results or future generalisability should be minimal.

4.4.2 Survival at home

It is encouraging to see that despite their age and frailty the majority of my study group were able to remain at home after one year with 67.5% remaining in their own homes, while 32.5% either died or moved to residential care. This is similar to the result of my retrospective cohort. Other studies have shown a rate of 61% [98], 73.1% [97]and 94% [102], while Lichtenberg et al found much lower rates in their population of post-rehabilitation patients in the USA, as low as 27% in the group who needed subacute nursing home care after discharge [99]. In my study these changes in domicile occurred at a steady rate during the year, there was no trend to early discharge failure which may have suggested

too many "early" or "inappropriate" discharges. This should encourage geriatricians to support discharge home if that meets the patient's wishes even if they appear frail. It should also prompt general physicians to refer patients for comprehensive geriatric assessment and rehabilitation as our outcomes are generally positive. It is recognised that older people at the point of entry to residential care, when assessed by a specialist geriatrician or psychogeriatrician have high levels of previously undiagnosed morbidity. In one study [285], older people receiving a specialist assessment prior to residential care entry had lower levels of decline in physical function, reduced residential care admission and less acute hospital utilisation.

Of the 39 patients who were initially discharged to their own home, but then moved to residential care at a later time, 24 had a further acute hospital admission immediately preceding their move. About half (18) had a further admission to the geriatric service for an attempt at rehabilitation which was unsuccessful. The remainder (15/39) went directly from home to residential care. So in total 21 older people moved into residential care without further inpatient assessment by a specialist geriatric team. This highlights the importance of monitoring and support of these frail older people, as waiting for the "crisis" and hospital admission is often too late for these patients to recover lost function and return home, but specialist geriatric input may prevent or delay residential care admission.

4.4.3 Predictors of residential care admission

Moving to residential care has been shown to be regretted by many older people [90] and to be associated with poorer quality of life and increased rates of depression [91, 92]. Older people have been found to prefer death to remaining alive with significant disability [161]. I believe that this section of my study contributes an important overview of factors which predict residential care admission in a frail group of older people. In addition using a prospective cohort design has enabled us to follow the process of residential care admission for these older people, and has allowed us to record pre-existing risk factors and how these may subsequently interact to influence outcomes for older people.

Key factors in predicting outcomes were frailty as measured by the Edmonton Frail scale, the clinical diagnosis of dementia, visual impairment, further hospital admissions, self-rated quality-of-life at the time of discharge; and subsequent self-rated health at the time of telephone follow-up.

Frailty, as discussed in the literature review, is an important, and increasingly recognised issue for the elderly population, where it has been shown to be associated with poorer outcomes. Frailty is characterised by loss of reserves among multiple systems and is associated with a high risk of physical or mental decline after even apparently minor insults. This increases the risk of adverse outcomes such as falls, weight loss, incontinence, delirium, ADL disability and ultimately hospitalisation, residential care admission and death.

In this study I chose to use the scale developed by the Edmonton group [75] which is a comprehensive scale including 11 different domains making up the syndrome of frailty. This was preferred to the shorter 5-point definition of Fried et al [19] which use physiologically based criteria and does not take physical disability, mental health or polypharmacy into account. However the EFS remains simple to perform and is practical for use on a geriatric or general medical ward. The EFS has been previously shown to correlate with a comprehensive assessment by a geriatrician, and also with the Barthel index of ADLs. To my knowledge however this is the first study in which it has been used to predict outcomes among older people.

This study demonstrates the relationship between frailty and adverse outcomes in an elderly population who have undergone specialist geriatric care and rehabilitation. The EFS was a predictive factor for the combined outcome of residential care admission or death, for residential care admission only and for further hospital admissions.

Unlike the findings of my retrospective cohort study, function was not independently significant on multivariate analysis. On univariate analysis the FIM score was significant for the combined outcome and residential care admission. The FIM and EFS were correlated, so one would not expect them both to remain significant on multivariate testing, where it was the EFS which was most strongly predictive.

Dementia was also significant, again in keeping with existing literature [98, 99, 103], while the measure of cognitive impairment on 3MS testing was not. This probably reflects the fact that once cognitive impairment impacts on function this will lead to both the clinical diagnosis of dementia being made and difficulty managing at home.

Older people's self-rated health and quality-of-life were also important factors influencing outcome following hospital admission. Poorer self-rated quality of life at the time of discharge from hospital was associated with an increased risk of subsequent

residential care admission. I also contacted our study group every 3 months by telephone and self-rated health reported at this time was a strong predictor of outcome: 40% of those who felt their health was deteriorating subsequently entered residential care compared with only 14% of those who reported their health as improving. Previous studies have reported a strong association between self-rated health and mortality in the elderly[171, 180, 182, 183], but there have been no previous studies looking at the relationship between self-rated health and residential care admission.

The r^2 value for my study was modest, reflecting the fact that the final model predicts about one-third of variation in residential care admission, but there are likely to be other unmeasured variables which contribute to outcomes for this group of patients. Factors mentioned in the literature include social and financial circumstances [116, 120, 121, 125-127, 129, 132, 146, 147, 349].

4.4.4 Predictors of mortality

For mortality, on univariate analysis the most significant variables were FIM, FR, male gender, being unmarried, and hospital admissions. There were only 22 deaths (13.8% mortality) in our cohort, and with such small numbers confidence intervals are wide and results should be interpreted with caution.

This mortality rate is lower than other studies of post-hospital prognosis of 21% [97] to 29%[98], but again highlights the importance of function in predicting outcomes for this frail group of patients. One study which developed a predictive model for mortality rates in the frail elderly included several functional measures such as the ability to walk several blocks, to move large objects or to bathe or shower [350]. Other studies have also highlighted the importance of ADL and IADL disability [115, 165, 167, 168, 174]. In comparison some studies have focussed more on comorbidities [164, 173], especially neoplasm [164, 168] and cardiovascular disease or heart failure [168]. This cohort supports the importance of functional measures and comorbidities.

4.4.5 Predictors of hospital admissions

The majority of my study group (103/159 or 74.8%) had one or more hospital admission during the year, highlighting their medical instability, frailty and often limited social reserves on which to call. Frailty was once again significant, as was the Charlson Index and individual comorbidities of congestive cardiac failure and chronic renal

impairment., as well as male gender. On multivariate analysis, variables which contributed significantly to the model were the EFS, CI, CCF, DM and male gender.

Once again the frailty score contributes significantly to the outcome model. This highlights the importance of frailty in this group of older people, and identifying and managing this in the community may prevent hospital admissions and the risk of complications, functional decline, iatrogenic illness or polypharmacy.

It is interesting that the other variables in the model represented burden of illness and/or unstable chronic medical conditions, and that this relationship is different from that seen in residential care admission. It suggests that older people who are frequent attendees at hospital are likely to have a high burden of disease and unstable medical conditions. Repeat attendees at hospital are often labelled as "failed discharges" "bed blockers" "acopia" or "unable to cope" and pushed towards residential care, as described by Victor and Vetter [359], and Obeid and Ogle [360], with both studies describing high levels of physical medical problems and disability as well as "social" problems in older adults admitted to hospital. In addition Victor and Vetter[359] found that those labelled as "bed blockers" did not have longer stays in hospital than those admitted with acute medical conditions. My data suggest that these older people actually have unstable medical conditions such as CCF, or a high burden of disease indicated by the CI. Elderly people who present to hospital regardless of previous admissions should receive a full medical evaluation, management and where necessary rehabilitation before being moved towards residential care.

Other studies have also highlighted the importance of severity of clinical disease, admission diagnosis [98] or comorbidity in predicting hospital admissions. However, others have also found a contribution of type of caregiver, (spouse versus children) [98] social isolation, a difficult environment or low income [103]. These factors were not well assessed in my trial. Nagelkerke's r^2 for hospital admissions in our group was 0.291, again suggesting that there are unmeasured factors which contribute to this outcome, and hence social or environmental factors may also be significant.

4.4.6 Study Limitations

Weaknesses of this study include the lack of data on carers' health status and carer burden or stress. I had hoped to collect data on carers but in practice I found it difficult to collect. I contacted, obtained consent and made the initial assessment while the older

people were still inpatients in our unit, and these interviews usually did not coincide with visiting hours. In future studies I would make more effort to include carers in our assessment and assess burden at the time of telephone follow up. We did record marital status and whether the older person lived alone, but these variables were not statistically significant.

The smaller than intended numbers are also a disappointment and have limited the development of models particularly for the subgroup looking at mortality. As already discussed this may also have introduced bias into the study, although I speculate that the group who were not included were a random selection of the cohort of patients discharged. They were not statistically different to the study group in terms of age, gender or outcomes.

4.5   Summary of results of phase 2(a)

In summary the results of the prospective cohort study show that:

- 67.5% of subjects remain at home at one year despite age, functional disability and frailty.

- There is a steady linear decline in the numbers remaining at home during the year.

- Most patients will have one or more hospital admissions and a significant proportion of these will immediately precede residential care admission.

- For the combined outcome of residential care admission or death significant predictors were:

  - Age

  - Frailty (as measured by the Edmonton Frail scale)

  - Further hospital admissions

  - Dementia

  - Previous stroke

  - Self-rated quality of life

  - Self-reported deterioration at follow-up.

- For the outcome of residential care admission significant predictors were:

  ➢ Frailty

  ➢ Dementia

  ➢ Visual impairment

  ➢ Self-rated quality-of-life

  ➢ Self-reported deterioration at telephone follow-up

  ➢ Further hospital admissions

- For the outcome of mortality, the numbers were too small to complete multivariate regression, but significant variables on univariate analysis were:

  ➢ Overall function

  ➢ Physical function (Physical subscale of FIM, with functional reach being borderline significant)

  ➢ Hospital admissions

  ➢ Previous stroke

- For the outcome of hospital admissions significant factors were:

  ➢ Male gender

  ➢ Frailty

  ➢ Comorbidities, as measured by the Charlson index

  ➢ Diabetes mellitus

  ➢ Congestive cardiac failure

- All the models explained about 30-40% of the variation in the outcomes, suggesting there were a number of unmeasured factors contributing to outcomes.

5. CHAPTER 5   PHASE 2B: QUALITATIVE STUDY AND ANALYSIS

5.1   Introduction to Phase 2(b)

In my previous sections I described the quantitative analysis of outcomes for a cohort of frail elderly patients in the year following discharge from a specialist Older Persons Healthcare service. In it I demonstrated that frailty, dementia, visual impairment, self-rated quality-of-life at discharge, further hospital admissions and deteriorating self-rated health at follow-up were significant risk factors for residential care admission. However, the model only explained 30-40% of the variation in outcomes, and a number of variables were poorly measured, in particular social support and care networks. Therefore as part of my telephone follow-up I undertook an exploratory qualitative interview with the patients or, where the patient was unavailable their key carer. Following this I purposively selected a smaller group of patients and undertook in depth face-to-face interviews. The aim was to explore the areas that are seen as important to patients and/or their carers in preserving independence at home in the period following discharge from hospital.

5.2   Methods of Phase 2(b)

Data for this study were obtained using two distinct methods: telephone questionnaires and face-to-face interviews. Both methods were based on a general inductive analytic approach as described by Thomas [310]. For the telephone interviews responses were clustered around key themes and depicted graphically. Older people were recruited as previously described in phase 2(a). In brief all older people discharged from subacute geriatric care to their own home over a 6-month period were approached at the time of their discharge from hospital. They were followed up for one year following discharge on the computerised hospital records system and with telephone calls at three and six months. At the time of each of the telephone contact they were asked to rate their own health as improving, remaining the same or getting worse. They were then asked 3 open-ended questions: "what is going well?" "what is going badly?" and either "what would make a difference to you being able to remain at home?" or for those who had already moved into residential care "what could have helped you to remain at home?" Responses were recorded in detailed note form during the telephone call. These notes

were collated, read multiple times, classified into key themes, and the frequency with which each theme was mentioned was charted graphically. Examples of notes for each key theme are given; these are paraphrased from the conversation with the participant.

Following this, a subgroup of older people who had moved into residential care was identified and matched by age and gender with a group who remained in their own homes. They were identified at the time they entered residential care and interviewed within a one month period. Their matched group were also interviewed within that time-frame. They underwent in-depth face-to-face interviews, key topics of which are shown in Table 26.

Table 26: Key face-to-face interview topics for older people

Rest home participants	Own home participants
Factors important in making the decision to move into rest home	Factors important in enabling you to remain at home
How could rest home admission have been prevented?	
	What factors would cause you to consider rest home care?
How did support at home affect your decision?	How did support at home affect your decision?
How did disability affected your decision?	How did disability affected your decision?
How did health problems affect your decision?	How did health problems affect your decision?

Each older person was also asked to identify his or her main carer and this person was also approached and interviewed. Key topics for the carer are shown in Table 27.

Table 27: Key face-to-face interview topics for carers

Rest home participants	Own home participants
Factors important in making the decision to move into rest home (specifically ask about cognition, function and co-morbidities if these are not volunteered.)	Factors important in enabling them to remain at home (specifically ask about cognition, function and co-morbidities if these are not volunteered.)
What may have made a difference to the decision?	What made a difference to them staying at home?
How did you see the alternatives for (the subject)?	How do you see the alternatives for (the subject)?
What was your experience of the subject being at home? What impact did that have on you?	What is your experience of the subject being at home? What impact does that have on you?

Face-to-face interviews were recorded and transcribed by a professional transcriber. Transcriptions were read and re-read multiple times by the principal researcher and broken down into separate statements. These were then grouped so that key themes emerged. Quotations illustrating each theme were extracted from the narrative, and are given here as direct quotations. The quotations are italicised. The quotations, themes and interpretation of these themes were discussed and agreed upon during supervision sessions with other members of the research group to ensure consistency and trustworthiness.

5.3 Results of phase 2b

The study recruited 159 older people of which 144 were able to be contacted by telephone at least once at either three or six months. By twelve-months 105 remained at home and 39 had moved into residential care. There had been 22 deaths (of whom 8 had first moved into care).

5.3.1 Telephone Interviews

The results from the telephone interview questions "what is going well?" and "what is going badly?" are shown in Figure 9 and Figure 10. Older people could make multiple comments, and all of these are included. It can be seen that when asked what they thought was going well there was quite an even spread in the number of responses between supports, mobility, physical health and ADLs. In contrast the vast majority of negative comments were made about participant's physical health.

Supports included comments on important people who helped an older person to continue to live at home. This topic included both formal supports, such as district nursing or home help and informal, mostly family, supports. Often when things were felt to be going badly illness or death of an informal caregiver was highlighted.

Mobility included any comments regarding the older persons' ability to get around either inside or outside the house ranging from walking with an aid to use of electric scooters to get out and about.

The heading of ADLs was a smaller category and included comments mostly about instrumental activities of daily living such as cooking or shopping.

Physical health was one of the largest categories especially relating to things "going badly." Any physical health problems that were mentioned were included, but problems with pain, dyspnoea and urinary incontinence or catheters were particularly prevalent.

Figure 9: Summary of responses noted to the question "What is going well?" by category

N=144 people
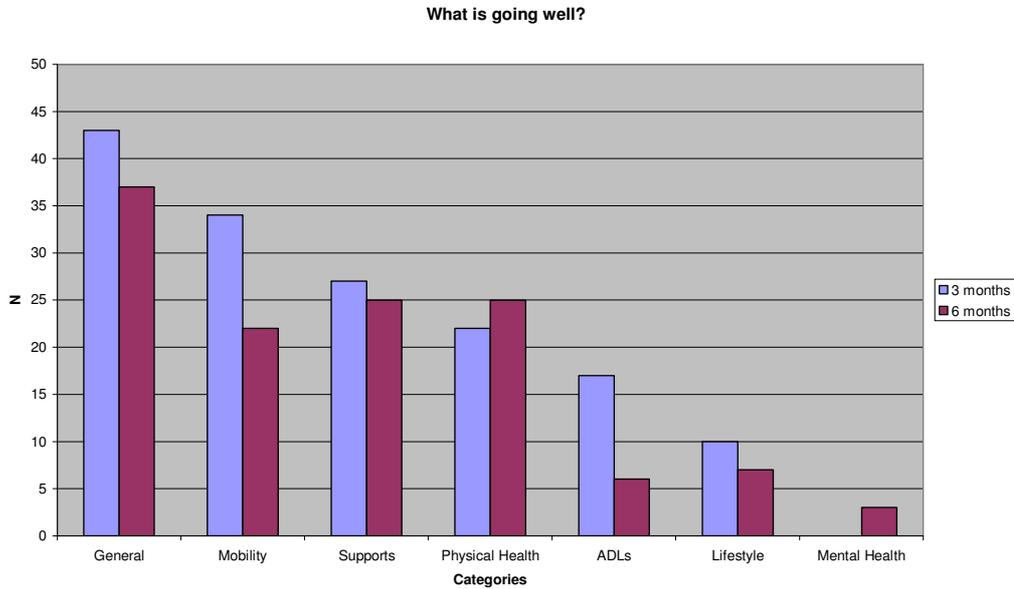
What is going well?

Figure 10: Summary of responses to the question "What is going badly?" by category

N=144 people

What is going badly?

.
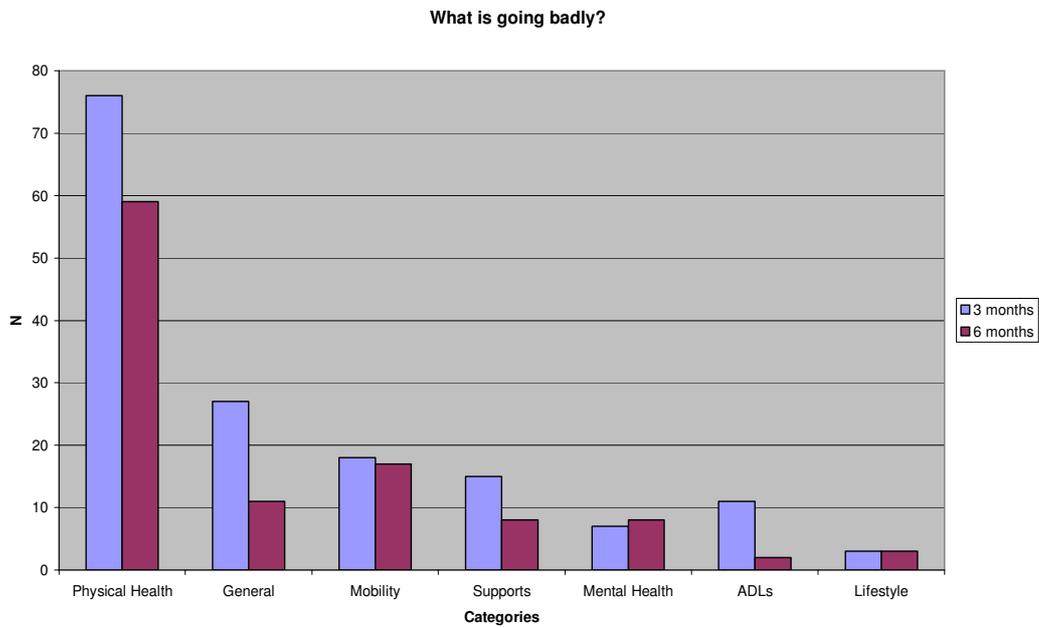
Illustrative examples from the notes taken at the time of the telephone calls are given below. Examples of statements are given in Table 28. These statements are derived

from my notes, and hence are given in the third person and are not intended as direct quotations.

Table 28: Examples of noted responses to the questions "what is going well?" and "what is going badly?" during telephone interviews

	Going well	Going badly
Supports	Relationships with children going well. They are looking after him. All the support is good, knows he could get help if he needs it.	Friction between him and wife with her having to give personal cares. Does get lonely.
Mobility	Has got rid of trolley, mobility good, able to get out and about.	Struggles to get down steps to get to letter box. Frustrating
Mental Health	More energy and feeling better in herself.	Forgetting a lot of things, very depressing.
Physical Health	Pain in neck and shoulders has gone now. Able to achieve her physio goals (eg getting legs up onto bed).	Back is painful, so he is unable to sit in a chair too long. Fluid on the legs, with blistering, hasn't been improving. Bladder completely gone, not able to get to toilet or commode in time .
ADLs	Managing cooking, laundry and vacuuming. Can go to toilet by himself.	Getting back-ache at times, especially when doing household chores eg dishes.
Lifestyle	Getting out to the library.	Not as easy to get to church.

The next questions in the telephone interviews were "what would make a difference to you being able to remain at home?" for those in their own homes and "what could have prevented you needing to move to residential care?" for those in residential care. Results are shown in Figure 11 and Figure 12.

Figure 11: Responses noted for "What would make a difference to you being able to remain at home in the future?" for those remaining in their own home (N=105)
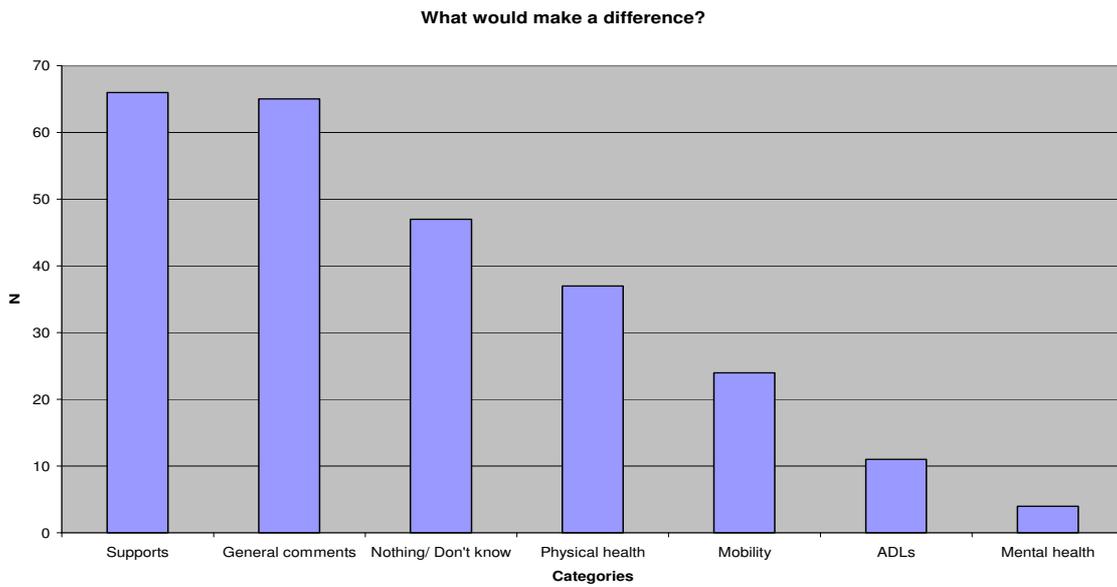

Figure 12: Responses noted for "What would have made a difference to enable you to have remained at home?" for those who had already moved to care (N=39)
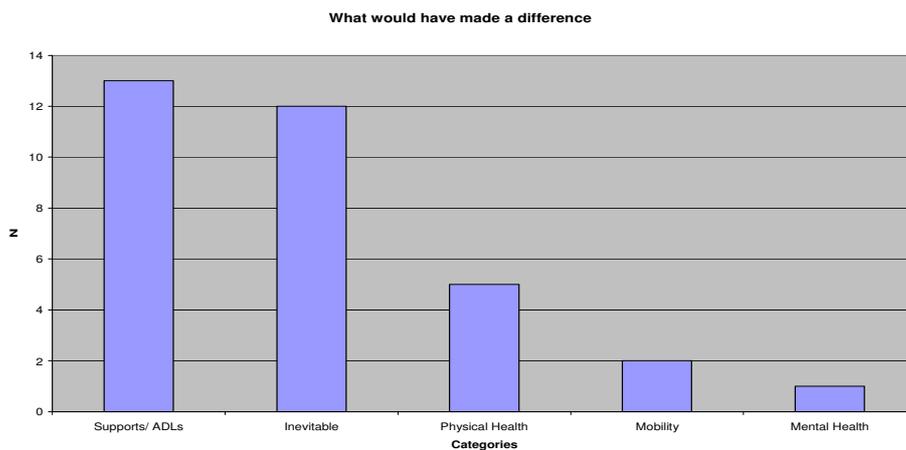
In contrast to the previous questions, here it was supports at home which attracted the majority of the answers with physical health problems moving

down in importance. Increasing formal care, especially with heavier household tasks such as vacuuming was mentioned, as was the need for services to remain regular and reliable. My notes record participants mentioning being able to have better continuity of care, especially around the time of hospital admissions when services need better co-ordination; and needing additional help at home such as someone to hang clothes out, iron, and make the bed. Many comments on the role of informal carers were also made, especially the constant threat of illness to an elderly partner, or balancing support, family life and employment for younger carers. Older people particularly worried about how to find ways to enable relations such as a niece or daughter to do other things than caring for them.

Loneliness and the need for company were also key issues; one person wished they could have someone to talk to at night, while another reported finding the days long on her own at home where she felt lonely.

Supports were also the biggest area in which people who had already moved to residential care felt could have been improved in order to keep them at home. Many forms of support were mentioned including company, safety, practical tasks and resources for carers. One woman reported her move to care being precipitated by being unable to get herself to bed at night and having to call her daughter every evening, which she felt was not fair to her daughter and hence not sustainable.

A lot of people (47 comments) also saw an ultimate future move to residential care as inevitable, and their perception was that nothing could be done to prevent this. Similarly once participants had moved to residential care a large number of them and their carers reported the move as inevitable.

5.3.2 Face-to-face interviews

These topics were then investigated in more depth through semi-structured in-depth face-to-face interviews. Eight older people who had moved to residential care were interviewed along with their key caregivers. Seven people matched by age and gender who had remained in their own home and their carers were also interviewed. One man initially moved into residential care and then returned home, he was interviewed twice and acted as his own "control."

Older people's themes

Key themes included a sense of the inevitable about the move, the role of others (including carers and doctors) in deciding on the need to move, the importance of a carer's health and stress, their own physical health and repeated admissions to hospital, loneliness and the loss or changing of roles at home.

Inevitability was a prominent theme with older people reporting that they had reached a point where their health or functional abilities, even with all the available supports, meant it was no longer realistic for them to remain at home.

Carer's health and carer stress was another key theme with those who moved often reporting problems with their informal carers having poor health or too much stress, and also their sense of not wanting to be a burden to their friends and relatives.

Professional care providers were also important, but for many it was the feeling of contact with the "outside world" and the reassurance that there was someone caring for them which was as important as the service they actually provided.

A number of older people talked about their roles such as with shopping, cooking or financial management. Those who moved reported being unable to continue with key roles, while those who remained at home felt that being able to continue with these roles was important.

Further hospital admissions also played a pivotal role in the decision to move. Those who had moved often did so after one or more hospital admissions. They often felt that such admissions were unacceptable to hospital staff and that residential care was suggested to them as a way to avoid these admissions.

As in the telephone interviews physical health was another key theme which emerged. Many physical health problems were mentioned including uncontrolled pain, visual impairment, falls and general debility.

. Table 29 illustrates the comparison of comments made by "movers" and "stayers" on different themes. These are verbatim quotes from the transcribed interviews.

Table 29: Comparison of comments made by "movers" and "stayers"

Movers	Stayers
Role of the carer	
"it was my wife's suggestion and I didn't disagree with it"	*"without my son I couldn't be on my own…he does my medication and reading and writing."*
"my wife moved first…I must move"	
"my main carer was admitted, and my brother was unwell, so I lost my main supports."	*"Maybe if my wife passed away before me…I'd have to then because I'd have nobody."*
"friends are all elderly, so not capable of doing hard medical or physical work."	
Carer stress/ burden of care	
"you don't realise till something like this happens how dependant you become on people. And it's not fair to them you see."	*"meals on wheels, they take the stress off the wife with a certain amount of shopping and they take the main meal worry off us."*
"my niece who was prepared to come over and stay the night with me until I got stronger, but I just felt that's not really fair to her. She's got family to think of."	*"got lovely neighbours…we're always there for one another."*
"but those two things made her feel a bit uncomfortable, stressed out, ill at ease on occasion…I just didn't keep my balance very well and this resulted in my wife being a bit concerned about what I was doing and whether I could be trusted to stop outside….and now all these things together added up to quite a degree of stress and illness on her part."	*"we all looked after her (neighbour) while he (neighbour) was in hospital and made sure she was all right, and I made sure she had her meals and things, and she did the same for him (husband) when I was in hospital."*
	"They're all the same age and everyone has got illnesses. So we look after each other, one needs something, the other one will go get."

Formal care providers : providing care and company	
"I was lonely, for the first time in my life I felt lonely… you get a bit fearful… when you've got that type of pain on your own it's quite frightening"	*"[Named Provider] keep an eye on you. Which is, it makes you feel you're not alone."* *"[Named Provider] regarding putting my stockings on, they come to see me, daily."* *"I think the main thing, as I've touched on, is the contact"*
Changing activities and roles	
It's not the same when you can't actually go to the supermarket and choose your goods" *"or do any baking which I loved doing, cooking. Well that was the hard part because that was one of my favourite things to do."* *"she adopted the tradition of Chancellor of the Exchequer if you like, money, the boss."*	*"I've been supplied with an electric scooter…I'll go up town and in and out, be a bit nosey, see what's going on"* *"I sometimes bake a cake for my son…I baked a cake yesterday."* *"I'd be lost without my van"*

Hospital admission	
"But that final bit in hospital was the finish really. I just wasn't well at all. I couldn't cope. I couldn't do anything. I was tired and dreadful." *"I knew I couldn't stay at home and avoid going back and back to the hospital."* *"the hospital didn't want me any more. The hospital decided."*	*(No comments)*

Physical health problems and attitudes to health	
"I'd never have left home if it wasn't for my eyesight"	*"Did the fall affect your ability to stay at home?" "No, I don't think so, because I've got that contact"*
"Severe back pain…unable to bend…unable to cope any longer"	*"My friend is here before the ambulance and she was a nurse like"*
"Every day we are getting weaker and weaker, no hope of getting better"	*"falling over and not being able to get up is my chief worry, but the [service provider] come out and pick me up."*
Inevitability and Positive Mental Attitude	
"really no choice as far as I was concerned"	*"I was eligible for another fortnight respite…it's a nice place...but I preferred to be home*
"nothing further could have been done, it was inevitable"	*"I wouldn't throw the towel in"*

Carers' themes

Carers talked about the cascade of ill-health and especially iatrogenic complications which can affect frail elderly people. This theme illustrated how even minor illnesses can lead to a cascade of deteriorating health problems ultimately leading to residential care.

Mental health was another key theme in the carers' interviews. Both depression and dementia were discussed although usually these led to the final common pathway of functional decline.

As with the older people's interviews carer stress was an important theme. Carers described their own health issues and stress, as well as problems such as other demands on their time and energy like other family commitments and career. However positive experiences of caregiving were also mentioned.

Finally inevitability with all possible supports having been tried was also a key theme. Carers felt they could not manage the health and disability problems even with all the supports that had been provided.

Examples of carer interview themes

One woman's daughter reported on her mother's recent progress with repeated hospital admissions, medication side-effects and iatrogenic illness:

> *"… leg ulcer, that seemed to be quite persistent and not improving... morphine and immobility caused her to get constipated… she ended up with a whole lot of abdominal pain and she was just in so much pain and she pressed her life link alarm and went to hospital in the ambulance… then she also got the diarrhoea bug… ended up being in hospital for three weeks."*

Another man's wife talked about her husband's hospital admissions:

> *"He picked up a bladder infection, which he's prone to because of wearing a catheter…he had to go back to have intravenous antibiotics…picked up the norovirus…went in at 60k, on Friday when they weighed him, he was still vomiting, and still diarrhoea, he was 35k…He came home for ten days and went back in with pneumonia…now has to be transferred by hoist".*

These statements highlight that even a hospital admission with a seemingly "minor" health problem such as constipation or a urinary tract infection can have a major impact on the health of a frail older person, leading to the "domino" effect where one factor can tip the balance into a cascade of deterioration which ultimately impacts on the person's function and ability to remain at home.

Mental health was also identified as a key issue. Both depression and dementia were mentioned as precipitants of residential care admission. Again functional decline caused by the illness seemed to be the final key pathway through which living circumstances were determined. One carer talked about her husband's depression saying

> *"…he was then very depressed…because he couldn't do what he wanted to do…we couldn't get him to eat properly because he was depressed"*

Another talked about the loss of confidence associated with a diagnosis of serious illness, saying

> *"he lost a lot of confidence after he got a catheter and he also got prostate, he got prostate cancer round about the same time…. He thought he was going to die, lots and lots of awful things really through his mind."*

Dementia and cognitive impairment were particularly important issues when the person was living alone away from their main carer.

For those who moved there were increased levels of carer stress and poor health among carers identified as precipitating the move. For some carers it was the cumulative effect of years of caring, while for others it was their own frail and deteriorating health which tipped the balance. For example one wife caring for her increasingly disabled and dependant husband reported on her own health and ability to cope:

> *"…it was the inability to look after him actually because my health's not good and to tell you the truth I've had years and years and years and years of it now with A… it's been very difficult… I think it was just cumulative effect …just got to the stage where I just felt I couldn't cope any more."*

Meanwhile on the same theme of carer stress and burden friends reported on two other couples:

> *"… S (wife) was well and truly I think overworked…she always ran around…she used to come to the car and say 'oh he's hard to take' "*
> *"(B's wife) had a heart attack at home which nobody knew about and then gone into hospital and had another one and a minor stroke…neither one of them could look after themselves separately or together."*

Night-time was also a big issue for many carers who did not live with the older person, as at these times there was less access to professional help and a greater burden for the carer. One neighbour reported

> *"her friends and myself I suppose really started to see changes in M and it sort of sent out warning bells that, you know, she started to become quite fearful of being on her own…. it seemed to be in the middle of the night…. Primarily her friends who started to come out with, um, "oh M maybe you should look into a home" because she'd been ringing them up, you know, in the middle of the nights."*

For others, particularly adult children acting as caregivers were concerned at the impact caring for an older person would have on their other personal or professional life which was the deciding factor. One daughter-carer said

> *"a lot of people assumed that, you know, she would live with me….. I just felt, I'd end up really resenting her I suppose….. I've only just started my career after being a homemaker with my children…"*

In contrast in those who remained at home the carers often had a much more positive experience of caregiving and several recognised the positive benefits they gained. One said

> *"if you've been together this long well you know each other inside out. So that's no problem."* and a husband reported *"it's been good for me! I mean I'm glad I've been able to do it."*

Some carers actually found it easier to have their relative at home with them than having to make frequent rest home visits. One son commented on the amount of time needed to make a visit to his mother in residential care, *"you go down there for five minutes but you have to be there for half an hour,"* while one child whose mother was living in her own home found some positive benefits of regularly visiting her.

> *"…it's a wee bit restrictive (daily visiting) but not too bad. It's actually easier for me than when she was in a home, because I was at home and having to visit her every night, and that was a long trip to the home and back again, whereas this, here I just come here and she has my dinner ready. "*

Carers whose friend or relative had moved generally did not see any option being left available to residential care, many felt that all the additional options had been explored and made no difference. This could include physical issues such as lifting, extra professional care and family support. One wife talked with a sense of futility about the level of care, particularly personal and at times intimate cares which her husband required.

> *"I didn't think extra supports at home would make much difference….The only thing that possibly could have been a help would have been to get somebody in two or three times a week so I could go out for an afternoon perhaps……I really felt anyone else would have to help him get up to have a pee and all this sort of thing was, you know, a bit much to expect of anybody….I don't know if they have male carers because he certainly wouldn't want to have sat and pee-ed into his bottle in front of a female."*

A daughter felt that all the medical supports had been trialled:

> *"Mum had tried on her previous admissions, having extra support at home, having the district nurse come in every day and weighed her, you know, for her fluid retention and everything like that…it was still in the middle of the night business."*

A wife felt that there were no options available to her saying: *"I can't deal with him here now the way he is… and because he's not transferring, you see they've transferring him now in a hoist. "*

A daughter talked about her parents' care and the burden this placed on her young family:

> *"…they needed twenty four hour care…I've got to do this and myself, I've got a husband and four girls, twenty four down to fourteen, so that would be full on and I thought well I'd enlist the help of my family, but then they realised and they couldn't do it because they've got their own family…. it's an impossible thing to actually be able to….my sister and I did it for one night and realised that it was impossible."*

In contrast those carers who remained at home with the subjects had a more positive approach to health problems. One carer spoke of his mother's desire to remain in the family home despite medical problems which would cause other people to enter residential care, and his desire to help her in her goal.

> *"…if she can get the help she requires and she can live the rest of her life where she wants to be and where she's happy, that means more to me than anything else…her husband died in the family home and I think that's what she wants to do…I think if she had a fall and it was her last fall in her own home I think she'd be the happiest woman in the world."*

So in summary a number of key themes were developed from in-depth analysis of the face-to-face interviews. These included carer stress, burden and rewards of caregiving; physical health, including iatrogenic illness, the potential for a catastrophic decline in health from even an apparently minor illness and coping with poor health; the adverse impact of repeated hospital admissions; and the inevitability of residential care admission for some people. These themes will be explored further in the discussion.

5.4 Discussion of Phase 2(b)

In the previous quantitative phases of this thesis, I demonstrated that frailty, dementia, function, hospital admissions and self-rated health are important in predicting residential care admission in the year following a hospital admission. However our statistical model only explained 30-40% of the variation in outcome, and hence there were significant unmeasured factors contributing which needed exploration.

I have performed two qualitative investigations to explore older people and carers' experiences about decisions to move into residential care or remain at home. The first were telephone interviews with all the older people who had previously been part of the quantitative analysis. The second was to perform in-depth face-to-face interviews with a smaller group of older people who had moved to care, along with age matched "controls" who had remained at home and, for both groups, their carers.

Key themes that emerged from the older people in the in-depth interviews were:

- The role of the carer, carer stress and burden of care

- Loneliness

- Role of hospitalisation

- Attitudes to health

- Perception of inevitability

Carers highlighted some of the same issues and had some differences:

- Carer stress versus benefits of caring

- Iatrogenic illness and the "domino" effect of declining physical health

- Mental health; depression and dementia

- Attitudes to adverse events

- Inevitability; the end of the road

5.4.1 Medical v social

In the telephone interviews it was interesting to note that when asked "what is going badly?" older people highlighted physical health concerns such as pain, continence or

heart problems. In contrast when asked "what would help you to remain at home?" or "what would have made a difference to you being able to remain at home?" it was social issues which were raised, such as carer strain or illness, formal supports and loneliness. Physical and mental health, as well as social circumstances were talked about by older people and their carers in the in-depth interviews. Often there was a sense of inevitability, particularly around poor physical health, which older people and carers felt had been investigated and treated to the maximum, and that the hospital system just wanted them to go into care now. In contrast social supports were often spoken about positively, some carers found care-giving very worthwhile and fulfilling, while using formal supports to the full was seen as key to not overburdening informal carers. Hence, this may explain the discrepancy between the physical/ social split seen during the telephone interviews, as older people felt that their physical health problems had been treated to the maximum and further treatment would not impact on their outcome, but social supports could be increased.

5.4.2 Minor or remediable problems tipping the balance

Another finding in the telephone interviews was that apparently minor or remediable problems such as pain or needing help with grocery shopping were seen as important in leading to residential care admission. To my mind as a doctor this seems quite simple- if someone has pain then treat with analgesia, and even if they move to residential care pain will still be a problem, so this is not a solution. However to the older people this did not seem to be the case.

To explain this I have developed the model in Figure 13. Lines a and b (solid) represent the gradual decline in functional ability and frailty which is seen with increasing age. Each person will have their own mean trajectory, around which they will fluctuate, with, for example, acute exacerbations of disease processes and at times will dip to the point where they require hospital admission. This gradual decline in frailty is well recognised among the geriatric community [351]. However it is less well recognised by older people themselves who may report themselves as simply "getting older," and regard this decline as inevitable.

At some point they will reach the threshold of function or frailty (line c- black dashed) at which stage residential care admission becomes indicated. However in addition to their background rate of functional decline each person will have personal attributes,

which may be disease processes, social supports, resilience and determination as well as professional opinions. These may be negative (arrow d), hence moving a person to residential care earlier or positive (arrow e), delaying residential care admission. Hence even apparently minor insults or remediable conditions may precipitate residential care admission, or likewise an apparently highly frail person may survive at home for far longer than anticipated. When an older person tries to explain what leads to residential care admission they may not recognise or be able to describe the background decline or fluctuations, and hence simply report the symptoms which are or were the "final straw." So for example in the case of back pain, while an older person may say "I had back pain and so I had to move to care." I suggest that the underlying situation was more complex, and my interpretation of it would be along these lines:

> I have chronic back pain for which I have been in hospital multiple times and there is nothing more that can be done like an operation. I don't want to take morphine as that is only for people who are dying and it makes me really bound up. The staff at the hospital are busy and don't give me priority for care when I am there and I feel guilty for wasting their time. I have also been gradually deteriorating in what I can manage to do on a day-to-day basis for months, and my children are all busy so I don't want to ask for help. The back pain is particularly bad at night when I feel very frightened and lonely. My wife is also looking tired and stressed. So all together I think the best thing would be if I moved to care.

Figure 13: Illustrative model of the Frailty trajectory and residential care "threshold"

Key
a   Gradual decline in function/ frailty
b   Fluctuations around mean
c   Level at which residential care becomes necessary
d & e   Personal attributes which affect residential care entry
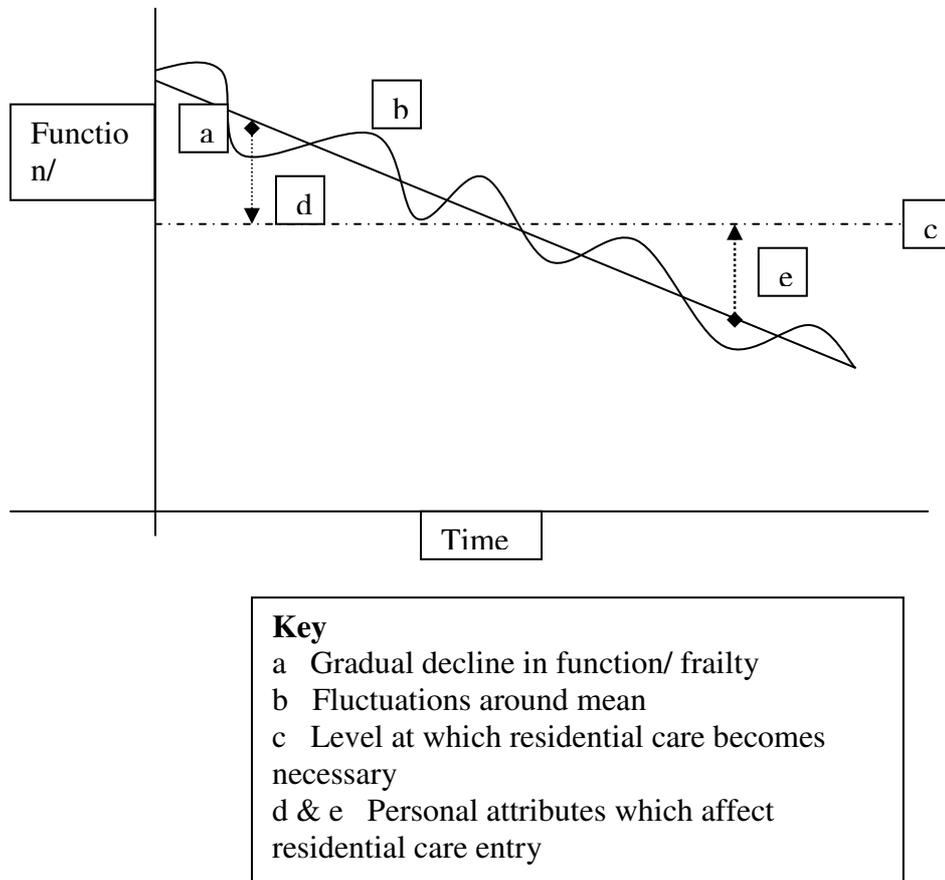
In the context of this model I was able to measure functional decline and frailty quantitatively, but there is a gap between frailty, functional measures and residential care admission. Here I explore some of the qualitative factors which interact to result in adverse outcomes for a frail population.

Health, stress and burden on carers are a key factor, and that is clearly described by both patients and carers in my study. When informal supports collapse due to frailty, poor health or stress on the carer, then it is often impossible for the person to remain independent. My quantitative study was not designed to measure carer stress, but it was frequently mentioned in both a positive and negative light during my telephone follow-ups and in-depth interviews. In my study older people talked about their reliance on carers for them to remain at home, of their concern or guilt about the burden or stress

they were placing on carers and about feeling isolated and lonely. Meanwhile carers talked about how they managed to continue caring while they had their own health issues, other demands on their time such as career or family, the amount of time required, and, in contrast, the benefits which could be gained from caregiving. Previous studies (most quantitative) [129] [117] [126, 141, 148] have also shown the importance of informal carers, and this section of my study illuminates that relationship further. Important carer issues in previous studies included the amount of informal care [129], gender of the carer [129], and the carers' perception of the burden placed on them by caring [129, 141]. Carer stress was another risk factor [117], and whether the older person lived together with or separately from the carer [117, 148]. In particular whether the older person lived with a spouse [141], or a combination of a spouse and children [126] was important. Finally, community-based social networks can support older people to remain in their own homes [147].

Another key finding was the role of iatrogenic illness and hospital staff in residential care admission. There was widespread opinion that repeat admissions to the acute hospital were viewed badly and should be avoided by moving into residential care, and that often the hospital staff "pushed" the patients in this direction. This is in complete contrast with the ethos of geriatric rehabilitation, and highlights the need for ongoing education of acute medical and surgical services. It was also clear from my quantitative study that hospital admissions were often predicted by unstable medical conditions such as cardiac failure or a high level of comorbidity which were completely different from the factors which predicted residential care admission, such as frailty.

Iatrogenic illnesses included hospital-acquired pneumonia, catheter associated urinary tract infection, norovirus diarrhoea, and medication adverse effects. This illustrates the frailty and vulnerability of this population, and the care that should be taken to avoid unnecessary hospital admissions and medication use. These illnesses may cause the fluctuations seen in my model, and with appropriate care and rehabilitation should be recoverable, but instead results from this study suggest they are often the factor which precipitates a move to residential care. Despite these factors being commonly seen as leading inevitably to residential care admission, Hanger and Sainsbury [87, 352] have shown that with a determined attitude sufferers may be able to overcome even apparently major difficulties and remain in the community.

In previous chapters I have demonstrated the importance of frailty, function, cognition and self-rated health. In keeping with the finding of the importance of self-rated health this qualitative study showed the importance of attitude and the sense of control that patients had over their outcomes. Mental health including cognition was also highlighted as an issue.

5.5 Conclusion of Phase 2(b)

In this section of the thesis I have described two qualitative analyses of the issues around residential care admission in older adults. These were a descriptive analysis of a large cohort of older people undergoing telephone follow-up after a hospital admission, which then guided a smaller purposive sample of older people for in-depth interviews using a general inductive analytic approach for analysis. Along with the factors identified in the quantitative analysis I found that informal supports and carer stress were important factors around the time of residential care admission. In keeping with the previous section, I found that hospital admissions, especially when these resulted in iatrogenic illness also had a major impact on the ability to remain at home. Finally patients and carers attitude to residential care admission appeared important, with those who described the move as "inevitable" or "unavoidable" being more likely to move.

I propose a model in which the trajectory of frailty and functional decline is moderated by other factors such as availability of informal supports, physical and mental health problems to influence the decision to move into residential care. Although a number of older people will indeed have reached the point where residential care admission is entirely appropriate, for others many of these factors may be amenable to better care: physical, mental or social.

6. CHAPTER 6   PHASE 3: VALIDATION STUDY

6.1 Introduction to Phase 3

In a previous section (chapter 4) I described a prospective cohort study to develop a model establishing risk factors for the adverse outcomes of death, residential care admission or hospital admission(s) in the year after an admission to our specialist Older Persons Health unit. Models are shown in Tables 30, 31 and 32. For the primary outcome of residential care admission variables in the model are the EFS, self-rated QOL, dementia, visual impairment, "deteriorating" health on telephone follow-up, and further hospital admissions. For the combined outcome of death or residential care admission the variables in the model are the EFS, self-rated QOL, dementia, "deteriorating" health on telephone follow-up, further hospital admissions, age and previous CVA. For the outcome of hospital admission the variables in the model are male gender, EFS, CI, CCF, .and DM.

Table 30: Model for Combined outcome of death or residential care admission

This table shows the model for the combined outcome of death or residential care admission. This model was developed from the earlier multivariate analysis (chapter ?). Points are awarded based on the relative risk for each variable. Abbreviations RR-relative risk; EFS- Edmonton frail scale; SR QOL- self-rated quality-of-life; CVA-previous stroke; pt- point; y- year

Variable	RR	95% CI for RR		p-value	Points
EFS	1.3	1.1	1.6	0.01	1.3 (per pt)
SR QOL	1.4	1.1	1.8	0.003	1.4 (per pt)
Dementia	2.7	0.7	8.7	0.14	2.7
"Deteriorating"	3.4	1.3	9.0	0.02	3.4
Admission(s)	5.4	1.8	16.4	0.003	5.4
Age	1.1	1.0	1.1	0.12	1.1(per y)
CVA	3.3	1.0	10.7	0.04	3.3

Table 31: Model for residential care admission

This table shows the model for the outcome of residential care admission. Points are awarded based on the relative risk from the multivariate analysis. Abbreviations: RR- relative risk; EFS- Edmonton frail scale; SR QOL- self-rated quality-of-life; pt- point

Variable	RR	95% CI for RR		p-value	Points
EFS	1.3	1.0	1.6	0.02	1.3 (per pt)
SR QOL	1.4	1.1	1.7	0.01	1.4 (per pt)
Dementia	4.3	1.2	16.0	0.03	4.3
Visual impairment	2.7	0.9	7.4	0.08	2.7
"Deteriorating"	3.9	1.4	10.8	0.009	3.9
Admission	3.7	1.2	11.1	0.02	3.7

Table 32: Model for hospital admissions

This table shows the model for hospital admissions. This is based on the earlier multivariate analysis with points awarded based on the relative risk for each variable. Abbreviations are RR- relative risk; EFS- Edmonton frail scale; CI- Charlson index; CCF- congestive cardiac failure; DM- diabetes mellitus; pt- point

Variable	RR	95% CI for RR		p-value	Points
Male gender	4.2	1.7	10.8	0.002	4.3
EFS	1.2	1.0	1.4	0.04	1.2 per pt
CI	1.3	1.0	1.7	0.06	1.3 per pt
CCF	2.2	0.7	6.5	0.17	2.2
DM	3.0	0.9	9.5	0.06	3.0

In this section of the thesis I outline the validation of these models.

In addition, I found that the models only explained 30-40% of the variation in outcome from the initial modelling phase. Therefore the validation cohort was also used to test a number of additional scales and measures which I hypothesised would improve the predictive value of the models. In the qualitative phase of this study health conditions (especially when these led to hospital admission or iatrogenic illness), patients' and

carers' attitudes to health issues, loneliness and burden on carers were among the factors which were highlighted as important.

The aims for this phase of the study were firstly to assess the sensitivity, specificity, negative predictive value and positive predictive value of the models developed in phase 2(a) of this study Secondary outcomes were to assess formal measures of patients sense of control over their treatment and carers ability to cope following discharge.

6.2   Methods for Phase 3

Phase 3 was principally a temporal validation study of the quantitative models discussed earlier, with additional testing of clinically important variables highlighted during the qualitative interviews. Recruitment for this study took place 2 years after the initial cohort was recruited.

Patients were recruited from our unit as previously described (phase 2a). This phase of the study was covered under an extension to the previous ethics committee approval. All patients discharged to their own homes over a 1-month period were eligible, with exclusion criteria being the same as in the previous phases, that is severe dementia so that they were unable to give informed consent, non-English speaking with no available interpreter, and discharged for terminal care. Informed consent was obtained. They underwent an evaluation during which the 3MS (if not already recorded as part of routine care), and EFS were recorded. Medical notes were reviewed, the diagnoses of comorbidities recorded, and the CI calculated. The MDT were then consulted and the FIM obtained.

Patients were contacted by telephone at 1, 3 and 6 months and asked the question "since discharge from hospital do you feel you have remained the same, improved or got worse in your overall health?"

Outcomes in terms of hospital admissions, residential care admission and death were recorded from the hospital computerised patient management system (SAP). They were recorded at 1, 3, 6 and 12 months.

In addition to the variables required for the validation cohort I wished to quantitatively examine variables which may account for some of the unexplained variation in my model. From my qualitative work I decided to evaluate carer stress using the COPE

tool[345]and patients' locus of control (LoC)[344]. Patients were also asked "since discharge from hospital do you feel lonely at home?"

Descriptive statistics were calculated and compared with the original cohort using unpaired t-tests for continuous variables and chi-square tests or Fishers exact test (for small numbers) for categorical data. This allowed us to assess the comparability of our cohorts.

Patients were scored according to the variables in the models, depending on the RRs. These were then used to generate a ROC curve with an optimal cut-off point to maximise sensitivity and specificity. As my predictive models are intended to be used as a clinically useful screening tool to identify at-risk individuals for more intensive follow-up, I aimed for a higher sensitivity at the expense of lower specificity.

6.3   Results of Phase 3

6.3.1 Descriptive statistics

70 patients were recruited to the validation cohort, of whom 5 did not have complete data collection, so 65 are included in the analysis. Descriptive statistics are shown in. Table 33.

Table 33: Descriptive Statistics for the cohort

Abbreviations: FIM- functional independence measure; LoC- locus of control; EFS- Edmonton frail scale; 3MS- modified mini-mental state examination

	Minimum	Maximum	Mean	Standard. Deviation
Age	65	96	81.4	6.8
Charlson Index	0	9	2.8	2.5
FIM	77	126	106.8	10.8
LoC	25	41	32.4	3.5
EFS	1	13	8.3	2.5
3MS	65	96	89.0	6.1

In comparison with the derivation cohort there were no statistically significant differences between the two cohorts in any of the categorical variables. Results are shown in Table 34.

Table 34: T-test results comparing derivation and validation cohorts

This table shows a comparison of the baseline statistics for the validation cohort compared with the original derivation cohort. There were no statistically significant differences between the cohorts. Abbreviations: FIM- functional independence measure; 3MS- modified mini-mental state examination; EFS- Edmonton frail scale

	Cohort	Mean	SD	p-value
Age	Validation	81.4	6.8	0.62
	Derivation	81.0	7.1	
FIM	Validation	106.8	10.8	0.15
	Derivation	110.0	16.9	
Charlson Index	Validation	2.8	2.5	0.09
	Derivation	2.3	1.9	
3MS	Validation	88.9	6.1	0.06
	Derivation	86.2	11.3	
EFS	Validation1	8.3	2.5	0.25
	Derivation	8.7	2.5	

In terms of the categorical variables there was no significant difference in gender breakdown between the derivation and validation cohorts. All the comorbidities except CCF were less common in the validation cohort. In particular dementia, visual impairment and stroke were significantly less common. Results of the Chi-square and Fishers exact tests are shown in Table 35.

Table 35: Chi-square tests

This table shows the comparison between categorical variables in the validation and original derivation cohorts. Chi-square tests were used with Fishers exact test where there were small numbers in the groups (for example for dementia and visual impairment). Abbreviations: CCF- congestive cardiac failure; CVA- previous stroke; M- male; F- female; * significant

Variable		Cohort		p-value
		Derivation	**Validation**	
Gender	M	60	28	0.75
	F	99	42	
Dementia	Y	25	4	0.05*
	N	134	66	
Visual	Y	40	5	<0.01*
impairment	N	119	65	
CCF	Y	40	16	0.69
	N	119	54	
CVA	Y	36	2	<0.01*
	N	123	68	

6.3.2 Validation of the Models

Receiver operated characteristic curves (ROC) were plotted for the outcomes of residential care admission, hospital admission and the combined outcome of death or residential care admission. I found that the best predictive model was for residential care admission with an AUC of 0.775, p-value for this model 0.002. The ROC curve and AUC for residential care admission is shown in Figure 14. I chose a cut-off value of 11.6 points from the co-ordinates of the curve (Table 36) to predict residential care admission, this would produce a sensitivity of 93.3% and specificity of 34.1%. As these models are intended to be used as a screening tool to identify those at higher risk of adverse outcomes for potentially higher levels of post-discharge support a high sensitivity was considered to be the most important value to consider in the development of the models and selection of cut-off values.

The model for the combined outcome of death or residential care admission was also significantly predictive; the ROC curve, AUC and cut-off values for different levels of sensitivity and specificity are shown in appendix 2. The model for further hospital admission was not significantly predictive; again the ROC curve, AUC and cut-off values are in appendix 2.

**Figure 14: ROC curve for Residential Care Admission**

N=65 people

ROC Curve for Residential Care Admission
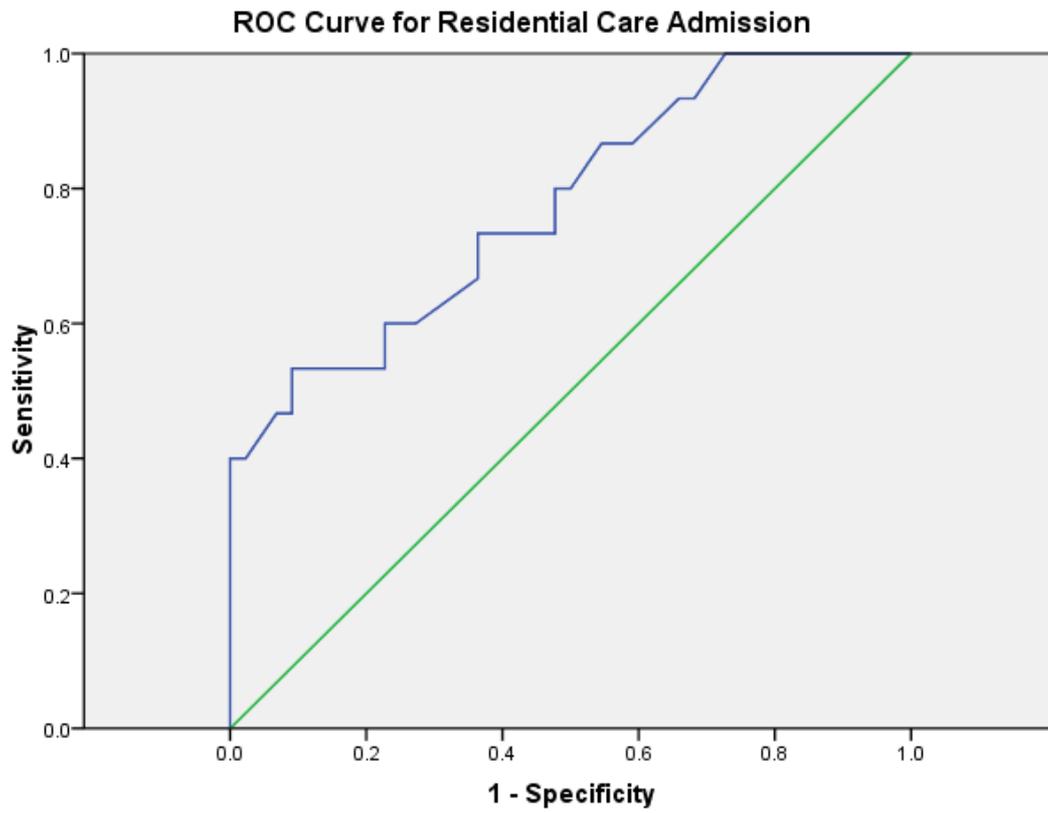
AUC 0.78 (95% CI 0.64-0.92) p= 0.002

Table 36: Coordinates of the curve for residential care admission

This table shows the coordinates of the receiver-operated curve for the outcome of residential care admission. This indicates the sensitivity and 1-specificity for a range of different cut-off points for the model, from which I propose a cut-oof point of 11.6 point as giving a high sensitivity and reasonable (although low) specificity for the purposes of a screening test.

Coordinates of the Curve

Positive if Greater Than or Equal To[a]	Sensitivity	1 - Specificity
.3	1.00	1.00
3.25	1.00	.98
5.85	1.00	.93
8.45	1.00	.82
9.65	1.00	.73
10.85	.93	.68
11.60	.93	.66
12.25	.87	.59
12.90	.87	.55
13.55	.80	.50
14.10	.80	.48
14.20	.73	.48
14.95	.73	.39
15.80	.73	.36
16.35	.67	.36
16.80	.60	.27
16.90	.60	.27
17.45	.60	.27
18.05	.53	.23
18.15	.53	.21
18.30	.53	.16
18.85	.53	.14
19.35	.53	.09
19.50	.47	.09
20.10	.47	.07
21.25	.40	.02
22.55	.40	.00
23.25	.27	.00
23.55	.20	.00
24.15	.13	.00
24.70	.07	.00
25.90	.00	.00

6.3.3 Predictive Value of individual scales

In addition to using the models I had developed in Phase 2 of this study, I was interested to examine whether the main scales used (EFS and FIM) were independently predictive of outcome, or whether my working hypothesis was true, that is that the predictive value of these scales could be improved by considering additional factors. I therefore proceeded to test the FIM and EFS individually on my validation cohort for the outcomes of residential care admission, hospitalisation and the combined outcome of death or residential care admission. ROC curves are shown in appendix 2. It can be seen from the ROC curves that neither the FIM nor EFS individually predict any of our outcomes of interest. The EFS comes closest, with the outcome of residential care admission, but does not reach significance.

6.3.4 New Variables

COPE scores were obtained from the person the older person considered to be their main carer. 29 COPE scores were able to be completed, the majority of those missing were because the person had already moved into care by the time of assessment, or could not identify a carer.

Mean positive COPE score was 9.3 and mean negative COPE score was 17.0. There was no significant difference between those who moved into residential care and those who remained at home in either positive or negative COPE scales (p=0.76 and p=0.76 respectively). Likewise there was no significant difference for the combined outcome (p=0.76 for negative scale and p=0.76 for the positive scale). Hospital admissions also did not show any significant differences (p=0.99 for the positive scale and p=0.45 for the negative scale).

Mean Locus of Control score was 32.4. There were no significant differences in LoC for the outcome of residential care admission, (p=0.17); the combined outcome (p=0.17) and hospital admissions (p=0.89)

In addition at the time of follow-up I asked older people whether they felt lonely at home. Those who reported feeling lonely were more likely to move into residential care with 5/14 (36%) of those who were lonely subsequently moving compared with just 6/40 (15%) of those who did not report feeling lonely (p<0.001).

6.4   Discussion of Phase 3

I have studied a validation cohort of 65 patients, to determine the validity of the models we developed in the previous chapter. The cohort who was recruited for this phase was significantly less likely to have a diagnosis of dementia, visual impairment or previous stroke recorded. These differences may have reduced the sensitivity of the model to detect a high risk population. The validation cohort was otherwise well matched in age, FIM, EFS and CI.

On testing predictive validity by producing ROC curves I found that the best model was that for residential care admission only, while the combined outcome of death or residential care could also be predicted with moderate confidence. Using a low cut-off point the model can identify with good sensitivity patients at risk of poor outcomes in the year following hospitalisation. This approach has lower specificity (that is it identifies a larger number of people who will not have the adverse outcome), but for a clinical screening tool it is desirable to achieve good sensitivity. The model is not predictive of hospital admissions. The FIM and EFS when used alone in our validation cohort did not accurately predict which older people were likely to have adverse outcomes following hospitalisation.

My original quantitative model only explained 30-40% of the variation in outcomes, and I wished to consider whether there were other unmeasured factors which could influence outcome. Based on our qualitative work we identified carer stress, and a patient's sense of control about decisions as potentially important factors. However when I measured these using the COPE and LoC tools there were no significant differences in these scores between those with adverse outcomes and those without. Interestingly however, if an older person reported feeling lonely at home, they were significantly more likely to move into care. In the recent OPERA study [90] being alone at home for long periods of time was statistically more common in people who moved into residential care, and this study is an agreement with that finding.

The weaknesses in this section of the thesis include the differences in the person gathering the information at the time of recruitment into the study. In the original cohort patients were recruited by a senior medical registrar with much clinical experience, and who used multiple sources to determine in particular comorbidities and the diagnosis of dementia. In contrast the validation cohort was initially recruited by a 4th year medical

student with less experience. There were significant differences in some variables, in particular the diagnosis of dementia, between development and validation cohort, which could potentially have weakened the accuracy of the models being tested. I believe it is more likely that these differences reflected the variation in assessor, rather than being true differences between the cohorts who were otherwise well matched, or alternatively that they occurred by chance.

However despite these weaknesses I believe that we have demonstrated the models to be practical and useful to identify a population at high risk of adverse outcomes at the time of discharge from hospital. In the next section I will describe the development of an intervention designed to identify and manage this at-risk and frail population.

6.5 Summary of Phase 3

- The model developed in previous phases of this study identifies with good sensitivity older people at risk of residential care admission.

- Formal quantitative measures of carer stress (COPE tool) and patient's locus of control (LoC) do not significantly predict outcome despite the findings of the qualitative phase of this study.

- Older people who report feeling lonely are significantly more likely to enter residential care

7. CHAPTER 7   PHASE 4: INTERVENTION STUDY

In developing an intervention I wished to take into consideration the outcomes and modelling performed in the initial phases of my study, the literature review, and the background service developments and evolution locally. The aim of this phase of the thesis was to develop an intervention which bridged the interface between specialist inpatient services and community services, in the context of the dynamically changing service provision in Christchurch and the piloting of a community-based multidisciplinary team (MDT) utilising a restorative home support (RHS) model. In particular I wished to identify frail older people who were struggling to manage at home following discharge and involve them in the new model of care to enable them to remain in the community (ageing in place) for as long as possible.

In my first three phases of this thesis I found that frailty, dementia, hospital admissions, poor self-rated QOL, and deteriorating self-rated health at follow-up, were factors which predicted residential care admission with good sensitivity but low specificity. One of the key findings was that self-reported deterioration in health on telephone contact was included in the model. I believed that this offered the opportunity for case-finding for an intervention.

In the literature, a meta-analysis by Mistiaen et al [188] failed to demonstrate a benefit from telephone follow-up after discharge, but this review was limited by the heterogeneity of the interventions in the included studies. Naylor et al [216, 217] found that weekly telephone calls combined with pre-discharge planning and post-discharge visits reduced the number of readmissions and total hospital days in the first 6 weeks. In comparison other studies used a one-off telephone call, and demonstrated no benefit [226][227].

In light of the results of my predictive modelling studies, the idea of telephone follow-up with a multidisciplinary team intervention for those who reported deteriorating health seemed to be an appropriate intervention. However in view of the existing literature it was important to be able to offer further intensive intervention for those in whom the telephone calls highlighted concern. In light of the roll-out of restorative home support it was important to consider older people receiving this care as it is intended to become the future "gold standard" of care for all older patients in Christchurch, so any new intervention will have to be effective in its own right, in

addition to this service. The introduction of restorative home support and associated community multidisciplinary team meetings also gave my study the possibility of an intensive intervention for those older people who reported their health as deteriorating. This intervention would take the form of assessment by a clinical assessor on the RHS pilot if they had not already been seen, and discussion and follow-up by members of the MDT. I, acting as a senior registrar in geriatric medicine, also attended the multidisciplinary team meetings, made follow-up home visits and comprehensive geriatric assessments of these older people. People who were not part of my intervention study would receive usual care. For those in the pilot areas this would be assessment by the restorative team when their usual follow-up became due, with no telephone follow-up and no medical intervention apart from usual GP care. For those discharged from hospital but not in the pilot areas follow-up would be determined by the inpatient team, but in most cases would be usual GP care and referral when necessary through the normal channels to tertiary care.

The flow-chart for older people's entry and progress through the trial is shown in Figure 15.

The intervention study inclusion and exclusion criteria were:

- All older people discharged from subacute geriatric care who lived in the target areas for the pilot of restorative home support were eligible.

- Exclusion criteria were: aged <65years, severe dementia such that they were unable to give informed consent, non-English speaking with no available interpreter and discharged for terminal care.

The intervention study assessment was:

- Older people were assessed at the end of their hospital admission using the Edmonton Frail scale (EFS). The diagnosis of dementia and other comorbidities were obtained from the notes.

The intervention was:

- Once discharged subjects were contacted on their nominated number by telephone. This occurred either fortnightly or monthly depending on their level of need.

- Older people were asked to rate their health since discharge as improving, stable or deteriorating.

- For those who rated their health as deteriorating a home visit was made by myself to conduct a comprehensive geriatric assessment.

- Those who reported their health as deteriorating were discussed at the next MDT meeting. If subjects had not already been assessed for RHS, then this triggered an assessment. If the subjects were already part of the pilot then their goals and management were discussed in light of any new information obtained by the geriatrician visit and modified accordingly. Recommendations were fed-back to GPs and where necessary further referrals were made.

- Telephone contact continued until the end of the study (December 2009).

The aims of the intervention study were:

- To assess the feasibility of telephone follow-up and multidisciplinary team management in the context of the introduction of a restorative home support programme to reduce adverse outcome (residential care, death and hospitalisations) in frail older adults discharged from a specialist subacute geriatric inpatient unit.

- To develop an intervention which spanned the interface between specialist inpatient services and community-based multidisciplinary team, within the context of a dynamically evolving service.

- To assess the acceptability to patients, carers, GPs and the MDT of this intervention.

- To assess the timing and frequency of telephone calls

- To assess the effect size of such an intervention to calculate sample size for a subsequent randomised controlled trial.

From the outset, this was planned primarily for feasibility and not to evaluate effectiveness. Evaluation of effectiveness would require much bigger numbers and fell outside the scope of this thesis.

Figure 15: Flow-chart of the intervention process

This figure illustrates the process of selecting and following older people in the pilot intervention study. Abbreviations: MDT- multidisciplinary team; GP- general practitioner; RHS- restorative home support; HBSS- home based support services
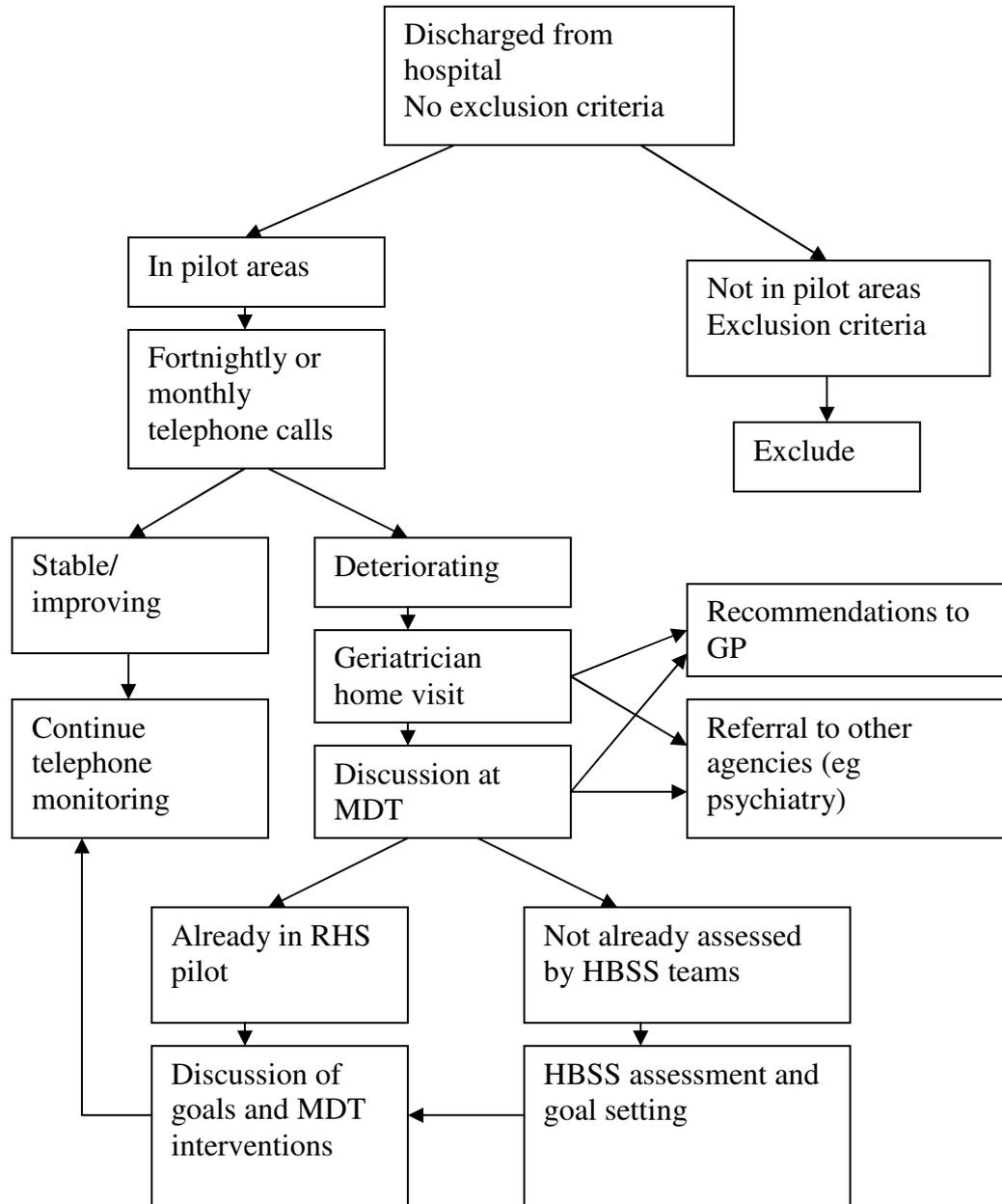
7.1   Results of the Intervention Study

7.1.1 Description of the Cohort

Between September and November 2009 twenty-six older people were recruited into the study. During the recruitment period three eligible older people declined to participate. The included population had a mean (SD) age of 82.7 (4.5) years. In terms of their social circumstances, seven were married and lived with their spouse while 19 lived alone. Of these, seven were unable to identify any informal caregiver, 11 had a child as principal carer and one had a friend. The mean (SD) EFS was 8.7 (2.5) points. They were receiving a mean (SD) of 3.8 (2.3) hours of personal care and 1.8 (1.1) hours of publicly funded domestic assistance. Three (12%) were diagnosed with dementia.

7.1.2 Outcomes for the Cohort

Subjects were followed up until December 2009, at which time the study was terminated. At this time all study participants had their current living circumstances and any hospitalisations recorded. Participants had been involved in the study for between two weeks and four months, and received one to four phone calls.

At the end of the study 21 older people remained at home, one had moved to an independent unit within a rest home complex, one had moved into a rest home and three had died. At the time of follow-up telephone calls, five older people reported their health as improving, four as stable and six as deteriorating. Three died before follow-up. One moved to a rest home within a month, one to an independent unit within a rest home complex, and one other patient did not speak English. When she was recruited it was agreed that her daughter would act as interpreter, but when it came to actually making contact the daughter was not available. Five other people could not be contacted by telephone.

In comparison to my previous cohorts fewer older people entered residential care, 1 person (4%) moved to rest home care and 1 (4%) moved to an independent unit within a residential care complex. This is compared with 7% entering residential care at 3 months in my initial prospective cohort. However only 2% of this initial cohort had died at 3 months compared with 3 (12%) from this intervention study group.

Given the small numbers involved neither of these differences is statistically significant.

There were 19 further hospital admissions in 14 patients, meaning that 54% of total participants had at least one admission, this compares with 30% in the first three months of the initial cohort study.

7.1.3 Interventions performed

Table 37 shows the interventions performed during the study period for those who reported their health as deteriorating. Three cases were brought to full MDT discussion of whom one remained at home with intensive intervention at the end of the study period, one for whom the services failed to commence as planned and was unable to manage without services, so she moved to residential care immediately, and one who was referred to psychiatric services for the elderly (PSE) who was therefore not eligible for ongoing MDT intervention under the RHS pilot (her ongoing services were provided by the PSE community team, under whose care she remained at home at the end of the study).

Table 37: Interventions and outcomes during the study for the older people who reported deteriorating health

Abbreviations: MDT- multi-disciplinary team; PSE- psychiatric services for the elderly; RHS- restorative home support; GP- general practitioner;

Patient	Problem(s) identified on medical review	Intervention	Outcome
1	Weight loss, poor food intake Poor mobility, falls risk Poor hygiene Heart failure	MDT review and discussion Dietician Physiotherapy (Otago exercise programme) Investigations and GP review of heart failure	Remained at home with intensive input from RHS staff
2	Depression Carer stress (main carer for husband with dementia)	Referred to PSE Letter to GP	Remained at home with PSE follow-up. Husband moved to RH
3	Admitted acutely to hospital before medical review could be performed	None	3 further admissions, in hospital at final follow-up
4	Admitted to hospital and died before medical review could be performed	None	Died
5	Weight loss	Dietician review Special authority for dietary supplements	Remained at home
6	Dysphagia, Weight loss, poor appetite, difficulty preparing own meals	Declined investigations Dietician review Special authority for dietary supplements RHS support worker to target meal preparation MDT discussion Letter to GP	Community services failed to start after discharge, unable to manage at home without services, moved to residential care
7	Cough and dyspnoea	Telephone assessment and reassurance. Repeat phone call after 1 week- improved	Remained at home

7.1.4 Opinions of the Older People

Older people and their carers were surveyed in December 2009 by postal questionnaire. The questions were:

1. "Were you aware of the telephone follow-up?"

2. "How often do you think that telephone follow-up should be made?" with a choice of weekly, fortnightly, monthly or not at all.

3. "How useful do you think the follow-up has been?" with a choice of very useful, useful, a little useful and not at all useful.

4. "Has the follow-up affected your health?" with the choice of yes a lot, yes a little, or no not at all.

Ten older people and two carers responded to the questionnaires, a response rate of 45% for the patients, and 18% for the carers. Nine were aware of the telephone calls and three were not aware. Interestingly one of those who stated she was unaware of the intervention had been one of those who had undergone a domiciliary visit, as a result of which she had been referred to psychiatric services where she was having ongoing follow-up.

The majority of respondents (eight people; six subjects and two carers) felt that the intervention should be fortnightly. Only one suggested more frequent (weekly) telephone calls and three felt that monthly would be adequate. One comment was that the frequency of phone calls should be individualised depending on the reasons for hospitalisation.

Most people felt that the telephone calls had been a little useful (four older people and both carers), three felt that they had been useful and one felt that they had been very useful. Only one person felt that the telephone contact was not at all useful.

Five older people felt that the follow-up arrangements had helped their health a little; three felt it had helped a lot and one not at all.

One carer felt that the intervention had been supportive to them as a caregiver.

7.1.5 The Multidisciplinary team

Development of the RHS pilot

During the course of this study the multidisciplinary team was in a state of evolution and development with older people being gradually included in the RHS pilot. I found that older people already receiving home support services were given a lower priority to being assessed than new clients, so a large number of my subjects were not made a high priority for inclusion in the restorative pilot. In addition a number of older people were discharged from hospital with short term services only, and these people were not included in the RHS services. We decided to keep them in the study population and follow them by telephone, then refer to the MDT meetings for consideration of RHS team involvement if they were requiring help. One subject who reported deteriorating health was only receiving privately funded domestic assistance. When he reported his health as deteriorating he was referred for assessment for the RHS pilot, the outcome of which was still pending at the end of this study.

There were significant difficulties in communication between layers of the MDT. When planning the study my initial contact was with CDHB "planning and funding" team and the University of Auckland facilitator. My involvement was not discussed with the clinical assessors until the first multidisciplinary meeting. Others lower down the chain had no awareness at all of the pilot study, and hence many were bemused when asked to assess older people from my cohort. In addition there was no cover for members of the MDT when they were away and as the meetings were only held monthly this had the potential to delay intervention critically in older people on the cusp of residential care admission, as well as to hamper communication between my study and the RHS pilot.

Even when older people reported their health as deteriorating they were not always discussed at the MDT. Of the three people discussed, one was referred to PSE and hence did not fall under the remit of the pilot. One person was deferred initially as she had gone into respite care, then the next month her case manager was away for personal reasons. We did discuss her case in the absence of the case manager, but this caused significant unhappiness as it was felt that decisions or suggestions for care were made without the full information being available. The third patient to be discussed had a plan agreed, but unfortunately the services which had been agreed at

the meeting failed to start for administrative reasons and this lady moved immediately into residential care. Another older person was readmitted to hospital and from there directly into a studio unit in a rest home complex without reassessment.

7.2   Discussion of Intervention study

This section of the thesis examines the use of regular telephone follow-up to identify a population at high risk of residential care admission in the post-discharge period. Pairing the study with the pilot of restorative home support in Christchurch provided the opportunity to bridge the gap between inpatient and outpatient services and for multidisciplinary intervention, follow-up and ongoing community-based rehabilitation.

The situation in which my pilot study took place was that of an evolving and dynamic service, with ongoing development of the restorative home support pilot. I felt it was important to work within the local context, to aim to develop a service which bridged the existing gap between inpatient specialist care, and the newly developing RHS multidisciplinary community team. As this is the ongoing trajectory of development of home-based services in Christchurch, setting up a service separately from this framework would not have addressed the current needs of the Older Persons Health service or the patients.

7.2.1 Acceptability to Older People and Carers

In terms of acceptability, the majority of older people and their carers appreciated the intervention, and found it useful to at least some degree, and beneficial to their health. Most stated a preference for fortnightly follow-up. Only one respondent felt that the telephone contact had not been at all useful, and one reported no benefit to their health.

7.2.2 Acceptability to Multidisciplinary team

It is difficult to assess the acceptability of my pilot to the RHS-based MDT. In general our interactions were professional and they appeared to take my comments and suggestions with respect. However many of them appeared not to fully understand what the purpose of my attendance at their meetings was, and I felt that my presence

would not be missed at the termination of my study. A number of feasibility issues, some of which may also have impacted on acceptability, are discussed below.

7.2.3 Feasibility

A number of issues with feasibility were identified. For the purposes of this study a dedicated research registrar was available to recruit the patients and carers at the time of discharge, make the telephone calls, arrange follow-up, perform home visits and CGA, attend and provide input to the MDT meetings and communicate with GPs. However in a real-life setting it is unlikely that dedicated medical staff would be available. Consideration of the most appropriate person to make telephone calls, assess patients who are identified as at risk and attend the MDT meetings would need to be a part of any future development of this intervention. Follow-up by their own inpatient team would enhance continuity of care, but is probably not practical given the workload of inpatient teams. A dedicated community-based geriatrician or registrar would be one alternative, but this may need to be a newly created position and there would be issues around funding of such a position. A specialist community gerontology nurse would be another alternative, but again this may need to be a newly created position or additional hours.

Another issue identified was with the functioning of the MDT. With meetings only taking place monthly there could be an important delay between identifying an older person who was in difficulties, discussion at the meeting and implementing interventions and support. There was additional delay in at least one case in my cohort caused by the absence of the case manager from the meeting leading to deferral of her case discussion by a further month. Three people died before intervention could be made, one moved to residential care while waiting for services/ intervention to commence, and the majority (54%) of the cohort had at least one acute hospital admission. Of course it is impossible to tell whether any of these adverse events could have been prevented with a more timely intervention, but the instability and frailty of these people, and hence the importance of prompt assessment and treatment, would need to be considered when developing interventions. Finally, on a practical note, it proved impossible to contact five older people in the study by telephone, despite talking with them and collecting a telephone number at the time of discharge. The

reasons for this are unknown, but this warrants further consideration of how best to remain in contact with older people after discharge.

The duration of the intervention would have to also be critically examined. In my modelling chapters I demonstrated a linear decline in the number of older people remaining at home over the first year after discharge, and this finding suggests that an intervention could continue to be effective for at least 12 months. However the practicality and reality of service allocation and use of resources would need to be considered.

7.2.4 Limitations

This section of my study was intended to be a pilot study of a new intervention, and to develop means of working with the new and still evolving CDHB restorative home support pilot. As such the numbers in the study were small and statistically significant outcomes were not obtained. Outcomes we do describe cannot necessarily be separated from the effects of introducing the new pilot, both beneficial and adverse, as well as the influence of "teething/implementation issues" such as those described above regarding the multidisciplinary team meetings.

The RHS pilot was still undergoing development and change during this study. A large number of the older people in my study were not actively involved in the RHS pilot as they either had existing home support services and were awaiting reassessment, or they had short term services after discharge and hence were not eligible for RHS. This meant that when problems were identified at the time of telephone follow-up, MDT follow-up services were not available.

We chose to include all older people discharged from hospital in order to maximise the numbers in the study. It could be argued that we should have targeted the intervention at the high risk population identified by our model, such as those with high scores on a frailty scale, to maximise the effect size, but this would have limited our numbers too much, however this could be considered in future use and/or studies of this intervention.

There is also the risk with an intervention such as this that it would have the effect of disempowering and deskilling general practitioners, who are likely to have been involved with their frail elderly patients for many years. However we know this group

of patients are on the brink of managing to remain at home and assessment and management of their problems may take more time and skills than GPs have available. I did send questionnaires to GPs whose patients were involved in the study, but only received two replies. This issue could also be addressed as part of a further evaluation of this study.

8. CHAPTER 8   FINAL DISCUSSION

This thesis discusses the outcomes for groups of frail older people who have undergone an admission to a specialist subacute geriatric care and rehabilitation unit. It is a mixed methodology study, including a retrospective cohort study; a prospective cohort study and development of models to predict adverse outcomes; a validation study for those models; a qualitative exploration of older people and their carer's attitude and decision making processes around residential care admission; and finally a pilot intervention study.

Geriatric medicine claims to improve function and independence in older people, however there have been few studies examining the outcomes following inpatient geriatric care and rehabilitation. This thesis sets out to explore the outcomes for older people following inpatient geriatric care, as well as older people and their carers' decision-making processes, the factors which influence residential care admission in this group of people and finally a potential intervention to support older people who wish to remain at home.

Most older people would prefer to retain independence and live in their own home and communities for as long as possible. In a recent New Zealand study almost three-quarters of those surveyed were happy to have remained at home, while most of those who had moved into residential care regretted their decision [90].

Residential care admission has been shown to have detrimental effects on older people. Studies have shown poorer quality-of-life and higher rates of depression [93] [92] [91]. However, as most of these studies were of a cross-sectional design it is difficult to establish cause-and-effect. It is an important issue though as loss of independence and disability are more feared outcomes than death to older people [161].

Hospital admission can also be an adverse event for older people, putting them at risk of iatrogenic, hospital acquired illnesses, residential care admission and death. It has been demonstrated that acute illness and hospital admission are often associated with loss of function in older people, especially the frail elderly.

There have been few studies of outcomes for older people following an inpatient admission including subacute care and rehabilitation. The only study of post-rehabilitation outcomes was that of Lichtenberg et al [99] who found that predictors of

outcome were function as measured using the FIM, cognition, and comorbidities measured using the Charlson index. However this study was set in the USA, and they used a nursing home setting to provide rehabilitation rather than a specialised rehabilitation facility. Funding for rehabilitation is also different in USA when compared with NZ, and in addition in this study the population was predominantly African-American. So this study adds important information on the outcomes for older people discharged from subacute care.

Key predictors of outcome in previous studies of outcome following acute hospital care have been functional status [103 102 98, 100], cognition [98, 103], and social circumstances [98, 100, 103].

8.1 Survival at home

In my retrospective (chapter 3) and prospective (chapter 4) cohorts I have demonstrated that despite frailty and functional impairment the majority of older people discharged to their own homes following subacute geriatric care and rehabilitation are able to remain there (62% in the retrospective cohort and 67.5% in the prospective cohort). There was a steady linear decline over the course of the year in those able to remain in their own homes, with no early decline. This suggests that there were not a significant number of "inappropriate" or "failed" discharges.

This finding should be an encouragement to those professionals who work with the frail elderly to support a trial of home discharge if that is the wish of the patients and their caregivers as many of them will be successful despite many obstacles. This supports the earlier finding of Hanger and Sainsbury [87] that even patients who were deemed to have no chance of remaining at home and who returned home despite all advice being to the contrary had a good chance of survival.

8.2 Predictive factors for residential care admission

In this series of studies I developed a quantitative model to predict residential care admission in older people discharged from hospital. This model correctly predicted 30-40% of outcomes. I then proceeded to a validation study, in which the model was useful in predicting adverse outcomes, with an AUC of 0.78 (p=0.002), and when a cut-off value of 11.6 points was used, a sensitivity of 93%. In addition I used

qualitative methods to explore older people and their carers' experiences of the time period following a hospital admission, and decision making processes around residential care.

8.2.1 Frailty

This study is about the frail elderly. This is an emerging concept in geriatric medicine, with the ageing population and increasing demands on medical and social services. As discussed in the literature review this is a group of older people with limited physiological and psychosocial reserves, in whom even a minor insult often leads to a "domino" effect of physical, mental and social breakdown [19, 353, 354].

In previous studies frailty independently predicts falls, decreased mobility, ADL disability, hospitalisation and death [19]; functional impairment [26], and development of chronic diseases, especially Alzheimers [53]. Another study showed that following an ED attendance, the frail elderly were more likely to experience further ED attendances, hospitalisation, residential care admission and death [59]. However there is little pre-existing evidence on the outcome of residential care admission, particularly in those older people who have been hospitalised.

Our population is those in whom an acute illness has led to functional decline such that they were unable to return home without a period of further inpatient treatment and rehabilitation. This group are at high risk of adverse outcomes including residential care admission, and further hospital admissions.

In the prospective cohort and validation study, frailty has been shown to be a key factor in determining outcomes of residential care admission and further hospitalisation. For each point increase on the Edmonton Frail scale there was a 10-20% increase in the risk of residential care admission or death and a similar increase in risk of further hospital admission. These findings were supported by the validation cohort.

This is the first time the EFS has been used to predict outcomes following hospitalisation in the frail elderly, and it has been shown to be a useful and simple-to-administer tool in this context. These studies support the role of a formal evaluation of frailty in the hospitalised elderly, as identification of frailty at this time may help to

identify a group at high risk of adverse outcomes after discharge, and to offer additional support after they return home.

Identifying frailty as a risk factor for adverse outcomes following hospitalisation may facilitate interventions to support these older people and their carers in the post-discharge period. Exercise [81](Hubbard 2009), nutritional support (Fiatarone1994), and review of polypharmacy [62] have all been shown to improve outcomes for the frail elderly.

8.2.2 Function

Functional status has been associated with adverse long-term outcomes in a number of previous studies following acute hospital admission in older people [98, 102, 103, 100, 101] and following rehabilitation[99]. In a study of nonogenarians who had undergone specialist geriatric care and rehabilitation Elphick et al[105] found that the Barthel Index was predictive of discharge destination. Function has also been shown to predict immediate discharge destination [18, 98, 99, 103-108], and ADL functional outcomes in community-dwelling elders [114, 118-121, 123, 124, 126, 128, 130-136].

In my retrospective study, function as measured by the Functional Independence Measure was the strongest predictor of adverse outcomes. The FIM was also significant on univariate analysis in the prospective cohort 0, but the EFS and FIM were highly correlated, and it was the EFS which remained significant after multivariate logistic regression analysis.

8.2.3 Self-reported Health and Quality-of-Life

Self-reported Quality-of-Life at the time of discharge on a 10-point Likert scale was significantly predictive of the combined outcome and residential care admission. In addition I contacted the cohort every 3 months by telephone. Those who reported their health as deteriorating at the time of follow-up had a 40% chance of subsequently entering care, compared with just 14% of those who felt their health was improving. Previous studies have shown a strong association between self-rated health in the elderly and mortality [171, 180, 182, 183], but this is the first study to establish a relationship between self-rated health and residential care admission.

This finding suggests the possibility of a simple method to increase follow-up in those patients who have been demonstrated to be frail or at high risk of adverse outcomes. I

hypothesise that regular telephone follow-up may allow early identification of people who are having difficulties at home and implementation of follow-up. This has been investigated further in the intervention phase of this thesis.

8.2.4 Dementia

Dementia is another key factor which predicts adverse outcomes, especially residential care admission, in these study groups. In previous studies cognition [98, 103] [18, 99, 104, 106, 107, 109] has been demonstrated to influence residential care admission, hospitalisation and mortality. In this study, adverse outcomes were predicted by clinically diagnosed dementia, which increased the risk of the combined outcome by nearly three-times; and residential care admission by over four-times. The 3MS score alone was not significant.

8.2.5 Hospital Admissions

Further hospital admissions were also predictive of residential care admission on the quantitative model, and were also spoken about by older people and their carers on in-depth interviews. Hospitalisation in this frail elderly group put them at high risk of iatrogenic illness such as nosocomial infections, and deconditioning, which predisposed to a catastrophic decline in function. Opinions were also expressed that staff, in particular doctors, at the hospital had negative attitudes towards older people with multiple admissions, and tended to push them towards residential care. In my study 24 patients moved to care immediately following a hospital admission, many of whom went directly from acute care without a further attempt at rehabilitation. Further hospital admission in the year after discharge increases the risk of residential care admission by four times. This finding is in keeping with the OPERA study [90] where older people who had moved into care felt that the decision had been taken out of their hands by health professionals especially hospital doctors. Other studies have highlighted the derogatory words used to describe older people who have multiple admissions to hospital such as "bed-blockers," "failed discharge," and "acopia." In a study of those labelled as having "acopia" by the emergency department, high levels of acute medical problems were discovered [151]. Older people who present to hospital should undergo a comprehensive medical and social assessment, and usually an attempt of rehabilitation before being moved towards residential care.

8.2.6 Comorbidities

In contrast to the outcomes of residential care admission and death where frailty and function were key factors, the Charlson index of comorbidities was predictive of hospital readmissions, where each additional point increased the risk of hospital admission by about 30%. As well as the Charlson index, the specific diagnoses of diabetes mellitus and congestive cardiac failure increased the risk of readmission. In previous studies the Charlson index has been shown to be predictive of mortality [101, 169], while CCF has been included in a risk score [168] and diabetes has also been shown to increase risk of residential care [117, 122, 132, 144]. In previous studies of hospitalisation, severity of clinical disease [98, 154, 156, 355] and comorbidity [153, 159], in particular the Charlson index [116] have been demonstrated to predict further hospital admissions.

8.2.7 Carer burden

In this thesis, carer stress was not well assessed in the initial retrospective or prospective studies. However in the qualitative telephone and face-to-face interviews the influence of carers, both positive and negative, in maintaining older people at home was among the most commonly discussed issues. This was discussed by both the older people themselves and their carers. These comments included carer's health, the physical burden of disabled elders, the time pressures of caregiving particularly when caregivers had other family such as young children and the mental stresses placed on carers. These factors were often the critical determinant which finally precipitated residential care admission. On the other hand a number of carers felt that they gained significant benefits from caregiving.

I did attempt to quantify the burden of care using the COPE scale in my third cohort. This however was not statistically significant.

Being aware of carer stress and putting services in place to support key carers at home is clearly a critical factor in maintaining older people in the community. Managing the stresses and developing those aspects of caregiving that people found worthwhile are important challenges in the medical and social support of older people to promote and maintain independence in the community.

8.3   Predictors of Mortality

Mortality was a secondary outcome of this study. My mortality rate was too low to develop a prognostic model, but on univariate analysis it was physical function which was key, with the FIM and the FR being significant. Previous stroke and further hospital admissions were also significant, although many of the hospital admissions immediately preceded death.

The mortality rate in this study is slightly lower than other studies of post-hospital prognosis, which range from 21%[97] to 29%[98], but again highlights the importance of function in predicting outcomes for this frail group of patients. One study which developed a predictive model for mortality rates in the community dwelling frail elderly included several functional measures such as the ability to walk several blocks, to move large objects or to bathe or shower [350]. Other studies have also highlighted the importance of function[98, 103], ADL and IADL disability [130, 165, 167, 168, 174]. In comparison other studies have focussed more on comorbidities [164, 173], especially neoplasm[164, 168] and cardiovascular disease or heart failure[168]. Markers of frailty such as malnutrition [103] and pressure areas [103] have also been predictive of mortality.

8.4   Predictors of hospital admissions

In previous studies hospitalisation has been predicted by male gender[116, 153], age[116, 153], social isolation, difficult home environment, low income[116], disability [102], in particular declining function, severity of clinical disease [98, 154, 156, 158] and comorbidity[116], polypharmacy[116] cognitive impairment[156] depression[154, 160], and social circumstances [155-157].

In contrast to data on residential care admission and mortality from this study, the survival curve for hospital admissions shows an early rapid increase in the number of admissions which tailed off as the year progressed. The majority of my study group (103/159 or 74.8%) had one or more hospital admission during the year, highlighting their medical instability and frailty.

In this study, in contrast to the outcomes of residential care admission and death where frailty and function were key factors, the Charlson index of comorbidities was

predictive of hospital readmissions, where each additional point increased the risk of hospital admission by about 30%. As well as the Charlson index, the specific diagnoses of diabetes mellitus and congestive cardiac failure increased the risk of readmission. In previous studies the Charlson index has been shown to be predictive of mortality [101, 169], while CCF has been included in a risk score [168] and diabetes has also been shown to increase risk of residential care admission [117, 122, 132, 144].. In previous studies of hospitalisation, severity of clinical disease[98, 154, 156, 355] and comorbidity [153, 159], in particular the Charlson index [116] have been demonstrated to predict further hospital admissions.

8.5   Potential Interventions

So what can be done to support these frail people in the community? Firstly, I believe it is important to recognise the background frailty and associated decline in function and manage this appropriately, even though the older people themselves may not report it. Frailty may be monitored with a number of instruments; I chose the Edmonton Frail scale [75] for this study as it is multidimensional, covering the major features of frailty, without being too cumbersome. Fried et al [19] use five key features of frailty in their work. These are weight loss, self-reported exhaustion, decreased grip strength, slow walking speed, and decreased physical activity. Older people should be educated and encouraged not to simply dismiss these problems as "old age" or "inevitable" but to report them to health professionals. Professionals also play a critical role in asking specifically about the features of frailty, as this is much more likely to lead to older people discussing their symptoms.

This should also prompt health professionals to provide interventions which have been shown to improve function and outcome in the frail elderly. Comprehensive geriatric assessment (CGA) has been shown in meta-analysis to improve mortality [356], residential care admission, and hospital admission, also, physical and cognitive function [262]. In this meta-analysis CGA included inpatient assessment and rehabilitation; inpatient geriatric consultation teams, outpatient home assessment and hospital-at-home programmes as well as outpatient assessment services. Other studies which have shown benefit in function include physician led community care services [210], outpatient CGA following an acute medical admission [220], and geriatric multidisciplinary clinics [357].

Exercise and improved nutrition [61, 81] are two key interventions which can improve outcomes in the frail elderly. In a meta-analysis preventative community visits have been shown to reduce the risk of nursing home admission and improve function [358]. Polypharmacy is recognised as an important issue in the elderly, predicting mortality [76], and so medication review and minimisation should be integral. Finally for those who return to hospital, inpatient comprehensive geriatric assessment has also been shown to reduce residential care admission [190], and I believe that the results of this thesis support CGA for the majority of older people admitted to hospital prior to making decisions about residential care.

Once the background frailty and loss of function have been addressed and minimised it is also clear that even apparently minor insults or problems can make a huge difference to an older person's ability to remain at home. In my qualitative study many older people highlighted the effect of hospital admissions and iatrogenic illnesses on their functional level. They also spoke of the attitude of health professionals who they felt pushed them towards residential care if they were having multiple hospital admissions. However in my prospective cohort study I found that there were different predictors of outcome for residential care and hospitalisation, with those older people who had hospital readmissions being predicted by comorbidity as opposed to frailty in those who entered residential care. Therefore older people presenting with "minor" illnesses should be fully assessed and treated, with consideration given to their background social circumstances as well. In other countries specialist clinical assessment for community dwelling older people prior to residential care entry has been shown to uncover high levels of previously undiagnosed problems, to reduce the need for residential care and for the older people involved to have less decline in function [285]. This study suggests that a similar picture may be found in the period following a discharge from hospital. Older people may consider their symptoms too minor to present to their general practitioner, so issues such as pain, which was highly prevalent in my study, should be actively sought. Supports at home were identified by about half of our cohort as important to aid them in them remaining at home, so both formal and informal support networks must be assessed, and extra services provided at the time of "crisis".

In the telephone interviews supports at home were the most commonly mentioned factor in determining the older person's ability to remain at home, and also the factor

that may have been altered to support those who had ultimately moved into care to remain at home. It is critical not to neglect the influence of carer stress in caring for and making decisions about the future of older people even when this cannot be formally quantified and this is the key message of the qualitative sections of this thesis. In contrast a number of people talked about benefits they felt they had gained from caring for an older person, and there is scope to identify and aim to enhance these positive aspects of caring in future studies.

These parts of my thesis highlight the complex interplay of factors involved in maintaining older people in the community after a hospital admission. I have examined the outcomes for groups of frail older people discharged from a specialist geriatric service in the year following their admission. Key factors have been highlighted using both quantitative and qualitative methodology.

8.6   Pilot Intervention Study

In the final part of my thesis I describe the development of an intervention to support older people after their discharge from hospital. From the literature review it can be seen that successful interventions are those which target the most frail, elderly, or clinically high-risk. They are usually more intensive (more visits and/or more frequent visits) and cross the hospital-home interface. Multidisciplinary team working is a key feature.

In designing my intervention I used the risk-factor of deterioration in health reported on telephone follow-up as the key to case-finding for my intervention, as these people had a 40% chance of subsequently entering residential care. Older people were assessed as inpatients, then when they returned home they were contacted monthly or fortnightly by telephone. If they reported their health as deteriorating a comprehensive geriatric assessment, discussion at a multidisciplinary team meeting and introduction or revision of restorative home support was undertaken. Older people and their carers found this intervention to be useful and acceptable.

This was intended to be a pilot feasibility study, and I believe that I have demonstrated that regular telephone follow-up is a feasible and acceptable intervention in older people to support their discharge home after a hospital admission. Further studies are needed to determine the optimum frequency of calls

and the duration of the intervention. The overall design of community services in Christchurch remains in a state of flux, and this study may assist in guiding the future development of discharge planning and follow-up services from our inpatient unit to improve links between specialist inpatient geriatric care and community-based multidisciplinary team services. In particular these frail older people are on the brink of continuing to manage at home, and timely identification and MDT intervention when problems are developing is a critical feature of future geriatric care.

8.7 Summary

This thesis describes a five stage study focussed around the inpatient specialist older person's healthcare service. All older people (aged >65y) discharged from an inpatient stay at the unit were eligible for inclusion. Patients on the specialist stroke rehabilitation, orthogeriatric and psychogeriatric wards were excluded. Other exclusion criteria were non-English speaking, severe dementia and discharges for terminal care. Older people who were unable to be contacted by telephone at 3, 6 or 12 month follow-up were also excluded. From this larger cohort a subgroup of older people who had entered residential care, matched by age and gender with a group who remained at home was recruited for in-depth qualitative interviews. Finally a cohort of older people discharged to their own homes in the area of the city in which the pilot of restorative home support was taking place were involved in the pilot intervention study, utilising regular telephone contact to identify those at high risk of adverse outcomes and offering comprehensive geriatric assessment and multidisciplinary team intervention.

So to summarise the findings of this study I will finally review the original aims and findings of each section:

Phase One: To determine factors which predicted longer term outcomes following an admission to a subacute geriatric treatment and rehabilitation facility (in a retrospective study,using routinely collected data)

- The majority of older people (62%) were able to remain at home at 12 months after discharge

- The FIM score on discharge was the strongest predictor of residential care admission at one year.

Phase Two(a): To describe the outcomes in the year following discharge from a specialist subacute geriatric service, to determine predictors of longer-term outcomes and to develop a predictive model

- Again, the majority of older people are able to remain at home at one year (67.5%)

- Predictors of residential care admission were frailty, dementia, visual impairment, self-rated QOL, self-reported deterioration at the time of telephone follow-up, and further hospital admissions.

- There was a low overall mortality rate, on univariate analysis it was physical health issues as measured by the physical subscale of the FIM and the FR as well as further hospital admissions which predicted mortality.

- Predictors of further hospital admissions were different from those which influenced residential care admission. Here it was comorbidity, measured by the Charlson Index, as well as the diagnoses of CCF and DM. Frailty was also significant.

Phase Two(b): To explore in a qualitative manner the areas that are seen as important to patients and their carers in preserving independence at home.

- Important factors included carer stress, the impact of carers' own health, hospital readmissions, the attitudes of other health professionals, the role of iatrogenic and hospital-acquired illness, loneliness, and older people and carers attitudes in particular the impression of residential care being ultimately "inevitable".

Phase Three: To assess the models developed in stage 2(a) of this thesis, as well as additional measures of carer stress and older people's coping strategies which were highlighted as important by the qualitative section.

- The best model was that for residential care admission which had a sensitivity of 93% to predict residential care admission. The combined outcome was also significantly predictive but the model for further hospital admissions was not.

- The LoC and COPE scores did not significantly predict adverse outcomes or improve the models.

- Older people who reported loneliness were significantly more likely to enter residential care

Phase Four: To develop a support intervention which bridged the interface between specialist inpatient services and the developing community services in Christchurch, and to use this intervention to support older people remaining in their own homes in the period after discharge from hospital.

- I developed an intervention based around regular telephone contact with older people after their discharge, with CGA and MDT discussion for those who reported their health as deteriorating. This intervention was useful and acceptable to older people and their carers. There were however problems in the interaction between my study and the newly developing community services in Christchurch and further work would be required if this intervention is to be taken any further.

8.8   Implications for Research

Following this study, further research into support interventions in the community should be carried out. I believe that my intervention has been shown to be acceptable and useful to older people. Ideally, in order to evaluate this further a controlled trial should be conducted. This should identify the person in day-to-day practice who should make telephone calls and follow-up visits, and target the high risk group identified by the modelling phases of this thesis rather than all discharges. It would also be able to address the duration of the intervention.

Another area which has been highlighted in this thesis is the role of caregivers, and in particular carer stress. In the qualitative phase of this thesis the relationship between burden of care/ carer stress and moving to residential care was frequently discussed. However I could not establish a relationship between a formal quantitative measure of carer stress, the COPE index, and outcomes. Another cohort study using a more formal measure of carer stress such as the caregiver reaction assessment (CRA), which is already used as part of the RHS assessment process, would help to elucidate further the relationship between adverse outcomes in the frail elderly and their carers.

Once we have further data on this group of patients (the frail elderly who have had an episode of subacute geriatric care) it may be possible to extend the intervention to

other groups of older people such as those who have had an acute hospital admission or Emergency Department attendance.

Another potential area for research is the possibility of screening all older people for frailty in general practice or at the time of hospital admission. I have demonstrated that frailty is a key factor in predicting adverse outcomes including residential care admission and hospitalisation in older people. The literature has a number of evidence based interventions such as CGA, exercise programmes, nutritional support and medication review which benefit the frail elderly. However for these interventions to work, the first step is to identify frailty. It would be interesting to see whether screening for frailty identified more older people, and whether this would go on to translate into improved outcomes by implementing these interventions.

One issue which was highlighted in the qualitative sections of my thesis was the role of health professionals to repeated hospital admissions by older people, and that they had the perception that older people should move to residential care if they are requiring frequent hospital admissions. Older people are aware of this dynamic, and prefer not to go back to hospital and face this attitude, and for many this was the final straw which made them decide to move into residential care. However we found that hospital admissions were predicted by different factors to residential care admissions, while other studies have shown that among older people attending hospital who are labelled as having "acopia" there are high levels of acute medical illness [151], while an older Christchurch study showed that even in those who were considered completely unable to remain at home, if they had the determination to go against health professionals advice and remain at home, high numbers managed this successfully [87]..There may be scope for further research targeting the knowledge and attitudes of health professionals in the acute services.

8.9 Implications for Practice

The main message of this thesis for clinicians is that it is possible to identify a group of the frail elderly at high risk of adverse outcomes after discharge from subacute geriatric care and rehabilitation. This thesis used scales and measures which are routinely available in clinical practice and are quick and simple to administer. High risk patients may benefit from additional support to that available from GPs.

Multidisciplinary team intervention has been shown to reduce long-term care, especially in the frail elderly in one meta-analysis [193]. I have developed a potential intervention for those felt to be at high risk, which was supported by older people and their carers, which has the potential to form the basis for an intervention after further refinement.

8.10 Final Summary

This thesis describes a multiphase, mixed methodology piece of research into the frail elderly discharged from subacute geriatric care and rehabilitation. There is existing literature in outcomes in community dwelling elders, and following acute hospital admission, but little specifically looking at outcomes those who have undergone subacute geriatric care. In terms of interventions there have been a number of systematic reviews, meta-analyses and RCTs, but with inconclusive outcomes and very few examining residential care admission as the principle outcome.

Key findings of this thesis are given below.

- The Edmonton Frail scale predicts residential care admission in the year following hospital discharge.

- Self-reported deterioration in health at the time of telephone follow-up 3 and 6 months after discharge from hospital also predicted the adverse outcomes of residential care and mortality.

- Other key factors which predicted residential care admission included dementia, and further hospital admissions.

- This combination of variables has been tested in a validation cohort, and has been found to be valid with a sensitivity of 93% and specificity of 34%. As this tool would be intended as a screening tool to identify those at high risk for more intensive post-discharge input this reduction in specificity to improve sensitivity seems appropriate.

- For the outcome of hospital admissions it appeared to be unstable medical conditions measured by the Charlson index and diagnosis of cardiac failure, diabetes mellitus, as well as male gender, and EFS.

- In qualitative analysis a number of key themes emerged. I found that social support networks and carer stress were key areas which older people and their carers identified as important in decision making. Other factors were physical health, iatrogenic illness, hospitalisation, and the attitude of health professionals, relatives/ carers and the older person. Often it seemed that there was a relatively minor issue which tipped the balance into residential care admission. I proposed a model of background frailty and functional decline where the final decision may be influenced in either direction by attributes of the older person, their carer, their doctors and their physical health.

- Finally I developed an intervention based on the finding that telephone follow-up was one of the factors predictive of residential care admission. I hoped that by identifying an at risk population early and bringing them for multidisciplinary team review it would be possible to reduce or delay the numbers going to residential care. The intervention consisted of regular telephone calls (fortnightly or monthly) to older people after discharge from hospital, conducting a comprehensive geriatric assessment and bringing them for discussion at the multidisciplinary team meetings of the restorative home support pilot

- This intervention was acceptable to the patients, earlier and more frequent (fortnightly) calls were preferred.

- In terms of feasibility there were a number of issues around the functioning of the multidisciplinary team, including timing and frequency of meetings, and communication both within the team and between the team and service providers which would need to be resolved before this intervention could be put into practice.

- Further research into a potential intervention to support frail older people after discharge is appropriate. This would include further consideration of feasibility issues, and then a randomised controlled trial with larger numbers of older people.

- I suggest that screening for frailty, either in general practice or at the time of acute admission to hospital may also identify a group at high risk of adverse outcomes, who could benefit from a support intervention in the community.

APPENDIX ONE

One potential limitation of this study was that due to multiple variables entered into the statistical calculation it was possible that significant results would arise by chance. There are multiple techniques for adjusting for multiple comparisons, these include the Bonferroni correction and the technique of Benjamini and Hochberg.

The Bonferroni correction, which is widely used, is a very conservative method of correcting for multiple comparisons (http://en.wikipedia.org/wiki/Multiple_comparisons). It assumes that all variables tested are independent. However in our study most of the variables are dependant at some level with others, for example age and gender influence the likelihood of developing ischemic heart disease or congestive cardiac failure.

We therefore, after statistical advice, elected to use the method of Benjamini and Hochberg [336] to control for multiple comparisons. In brief, this method ranks variables according to their p-value and compares them with a calculated value (the BH value). If the BH value is higher than the original p-value then the result is taken as "true," while if the BH value is lower than the original p-value then the result is "false." It does not require the assumption of independence. Results are shown in Tables 38-41.

In this study the Benjamini-Hochberg analyses rejected most of the initially significantly variables as false, that is suggesting that they were positive due to chance when a large number of variables were included in the analysis. Both the combined outcome and the outcome of residential care admissions had no variables considered as "true" after the BH analysis. The outcome of hospital admissions had 2 variables remaining significant, gender and the Charlson index.

Table 38: Benjamini-Hochberg calculation for combined outcome

Variable	p-value	Rank	BH value	Outcome
CI	0.995	30	0.050	FALSE
GDS	0.960	29	0.048	FALSE
Benzodiazepines	0.923	28	0.047	FALSE
Gender	0.900	27	0.045	FALSE
IHD	0.874	26	0.043	FALSE
CCF	0.825	25	0.042	FALSE
OA	0.662	24	0.040	FALSE
OP	0.614	23	0.038	FALSE
Hearing	0.570	22	0.037	FALSE
Lives alone?	0.547	21	0.035	FALSE
COPD	0.536	20	0.033	FALSE
DM	0.483	19	0.032	FALSE
BP	0.410	18	0.030	FALSE
SR health	0.381	17	0.028	FALSE
UI	0.369	16	0.027	FALSE
Falls	0.304	15	0.025	FALSE
Vision	0.219	14	0.023	FALSE
CVA	0.214	13	0.022	FALSE
CRF	0.182	12	0.020	FALSE
AF	0.165	11	0.018	FALSE
3MS	0.125	10	0.017	FALSE
Age	0.122	9	0.015	FALSE
TUG	0.103	8	0.013	FALSE
Phone call-deteriorating	0.08	7	0.012	FALSE
Dementia	0.076	6	0.010	FALSE
FR	0.052	5	0.008	FALSE
SR QOL	0.042	4	0.007	FALSE
EFS	0.019	3	0.005	FALSE
FIM	0.007	2	0.003	FALSE
Admissions	0.003	1	0.002	FALSE

Table 39: Benjamini-Hochberg analysis for mortality

Variable	p-value	Rank	BH value	Outcome
Falls	0.969	31	0.050	FALSE
Depression	0.932	30	0.048	FALSE
Hearing	0.928	29	0.047	FALSE
UI	0.864	28	0.045	FALSE
CCF	0.820	27	0.044	FALSE
Age	0.802	26	0.042	FALSE
CI	0.754	25	0.040	FALSE
Dementia	0.708	24	0.039	FALSE
SR health	0.662	23	0.037	FALSE
OP	0.575	22	0.035	FALSE
CRF	0.530	21	0.034	FALSE
3MS	0.476	20	0.032	FALSE
IHD	0.416	19	0.031	FALSE
Vision	0.412	18	0.029	FALSE
TUG	0.407	17	0.027	FALSE
DM	0.320	16	0.026	FALSE
GDS	0.319	15	0.024	FALSE
AF	0.288	14	0.023	FALSE
Benzodiazepines	0.232	13	0.021	FALSE
BP	0.191	12	0.019	FALSE
OA	0.191	11	0.018	FALSE
Frail	0.188	10	0.016	FALSE
COPD	0.177	9	0.015	FALSE
SR QOL	0.152	8	0.013	FALSE
Married	0.089	7	0.011	FALSE
Phone call	0.081	6	0.010	FALSE
Gender	0.079	5	0.008	FALSE
FR	0.053	4	0.006	FALSE
FIM	0.032	3	0.005	FALSE
CVA	0.008	2	0.003	FALSE
Admission(s)	0.000	1	0.002	TRUE

Table 40: Benjamini-Hochberg analysis for residential care admission

Variable	p-value	Rank	BH value	Outcome
Benzodiazepines	0.882	31	0.050	FALSE
BP	0.876	30	0.048	FALSE
CCF	0.800	29	0.047	FALSE
OP	0.724	28	0.045	FALSE
OA	0.715	27	0.044	FALSE
CI	0.659	26	0.042	FALSE
IHD	0.632	25	0.040	FALSE
GDS	0.612	24	0.039	FALSE
COPD	0.604	23	0.037	FALSE
Gender	0.589	22	0.035	FALSE
CVA	0.528	21	0.034	FALSE
UI	0.521	20	0.032	FALSE
Depression	0.509	19	0.031	FALSE
DM	0.493	18	0.029	FALSE
Falls	0.441	17	0.027	FALSE
Hearing	0.371	16	0.026	FALSE
SR health	0.354	15	0.024	FALSE
Lives alone?	0.329	14	0.023	FALSE
Age	0.323	13	0.021	FALSE
FR	0.315	12	0.019	FALSE
Vision	0.307	11	0.018	FALSE
AF	0.277	10	0.016	FALSE
CRF	0.264	9	0.015	FALSE
3MS	0.112	8	0.013	FALSE
Phone call-	0.094	7	0.011	FALSE
Dementia	0.083	6	0.010	FALSE
TUG	0.078	5	0.008	FALSE
EFS	0.048	4	0.006	FALSE
Admission(s)	0.043	3	0.005	FALSE
FIM	0.040	2	0.003	FALSE
SR QOL	0.029	1	0.002	FALSE

Table 41: Benjamini-Hochberg analysis for hospital admissions

Variable	p-value	Rank	BH value	Outcome
Falls	0.953	30	0.050	FALSE
Benzodiazepines	0.897	29	0.048	FALSE
Dementia	0.841	28	0.047	FALSE
Depression	0.819	27	0.045	FALSE
3MS	0.739	26	0.043	FALSE
DM	0.689	25	0.042	FALSE
GDS	0.624	24	0.040	FALSE
CVA	0.623	23	0.038	FALSE
Phone call	0.572	22	0.037	FALSE
TUG	0.505	21	0.035	FALSE
AF	0.501	20	0.033	FALSE
UI	0.482	19	0.032	FALSE
Age	0.461	18	0.030	FALSE
FR	0.432	17	0.028	FALSE
SR health	0.394	16	0.027	FALSE
BP	0.389	15	0.025	FALSE
COPD	0.353	14	0.023	FALSE
SR QOL	0.232	13	0.022	FALSE
Vision	0.220	12	0.020	FALSE
OA	0.192	11	0.018	FALSE
FIM	0.174	10	0.017	FALSE
Hearing	0.154	9	0.015	FALSE
IHD	0.128	8	0.013	FALSE
OP	0.116	7	0.012	FALSE
Married	0.110	6	0.010	FALSE
CRF	0.035	5	0.008	FALSE
EFS	0.029	4	0.007	FALSE
CCF	0.007	3	0.005	FALSE
CI	0.005	2	0.003	TRUE
Gender	0.001	1	0.002	TRUE

APPENDIX TWO

Receiver-operated curves (ROC) were plotted for each of the models developed in phase two. The best fitting model was that for predicting residential care admission. ROC curves were also plotted for the combined outcome of either death or residential care admission and of further hospital admissions. The ROC curve for the combined outcome was significantly predictive, using a cut-off value of 27.45 points it gave a sensitivity of 92%, p=0.004. In contrast the model of further hospital admissions was not significant. These ROC curves shown in Figure 16 and Figure 17. The co-ordinates of the curve for the combined outcome are shown in Table 42.

Figure 16: ROC curve for Combined Outcome
　　　N=65 people

ROC Curve for Combined Outcome

AUC 0.71 (95% CI 0.58-0.83) p=0.004
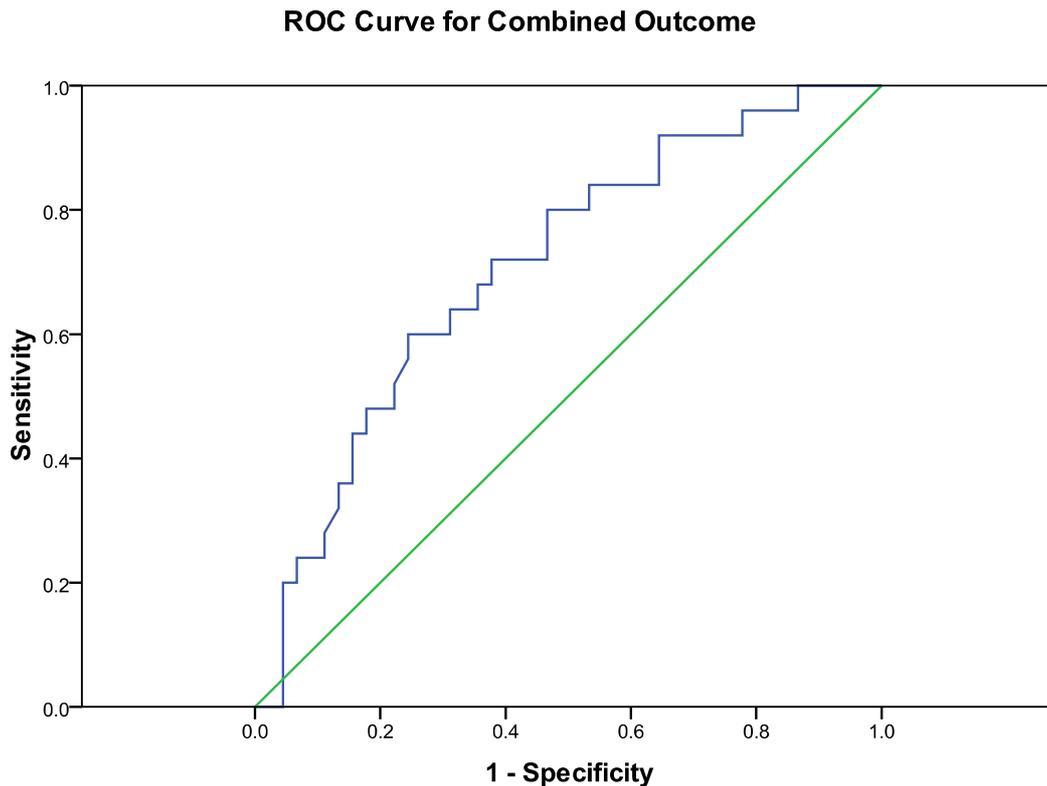
Table 42: Co-ordinates of the curve for the combined outcome

This table shows the sensitivity and specificity for different cut-off values of the ROC curve. The cut-off value of 27.45 points is highlighted, and was chosen for a good sensitivity of 92% and moderate specificity.

Positive if Greater Than or Equal To[a]	Sensitivity	1 - Specificity
2.500	1.000	1.000
7.950	1.000	.978
14.750	1.000	.956
18.050	1.000	.911
19.900	.960	.867
21.550	.960	.844
23.900	.960	.800
24.850	.920	.778
25.500	.920	.756
26.950	.920	.667
27.450	.920	.644
27.850	.880	.644
28.950	.840	.622
30.200	.840	.533
31.150	.800	.511
31.450	.800	.489
32.350	.800	.467
33.300	.760	.467
33.850	.720	.422
34.700	.680	.378
35.050	.640	.356
36.650	.600	.311
38.150	.600	.244
39.100	.560	.244
40.100	.520	.222
40.500	.480	.222
42.500	.440	.178
43.350	.360	.156
43.750	.320	.133
44.000	.280	.111
44.900	.240	.067
45.200	.200	.067
46.850	.160	.044
48.250	.120	.044
48.850	.080	.044
49.300	.040	.044
50.150	.000	.044
52.150	.000	.022
54.700	.000	.000

Positive if Greater Than or Equal To[a]	Sensitivity	1 - Specificity

Figure 17: ROC curve for Hospital Admissions
    N=65 people

ROC Curve for hospital admissions

AUC 0.60 (95% CI 0.46-0.73) p=0.17
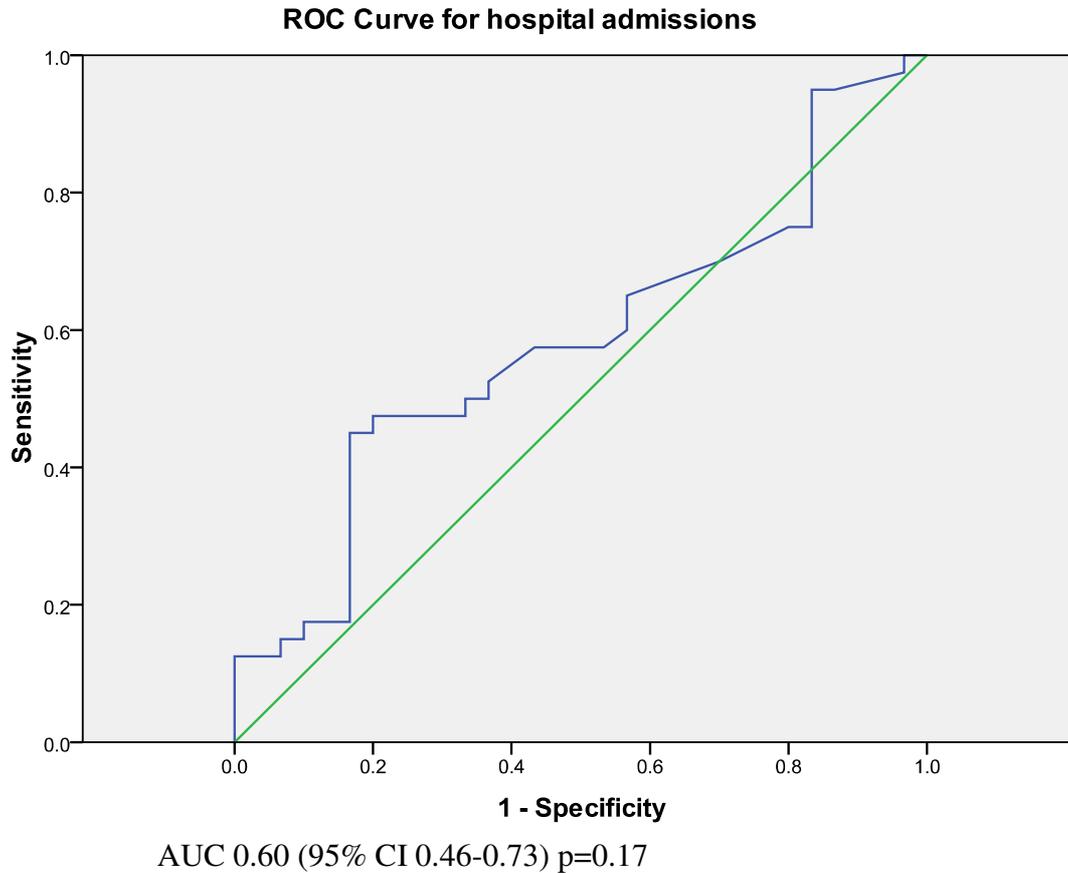
In addition to testing the models I wished to explore whether the models added any value to the measurement of either function (FIM) or frailty (EFS) alone. ROC curves were therefore plotted for the FIM and EFS alone. These were not significantly predictive of any of the outcomes. These are shown in Figure 18-23.

Figure 18: Predictive Value of FIM for combined outcome
    N=65 people

ROC Curve for the combined outcome
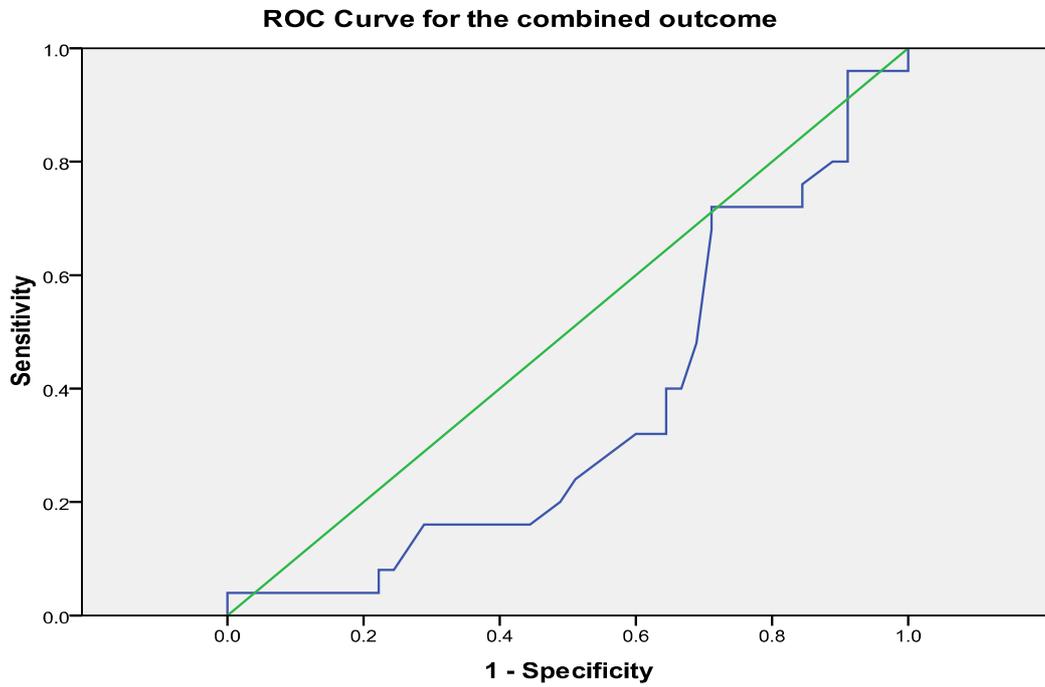
Figure 19: Predictive value of EFS on combined outcome
    N=65 people

ROC Curve for the Combined outcome
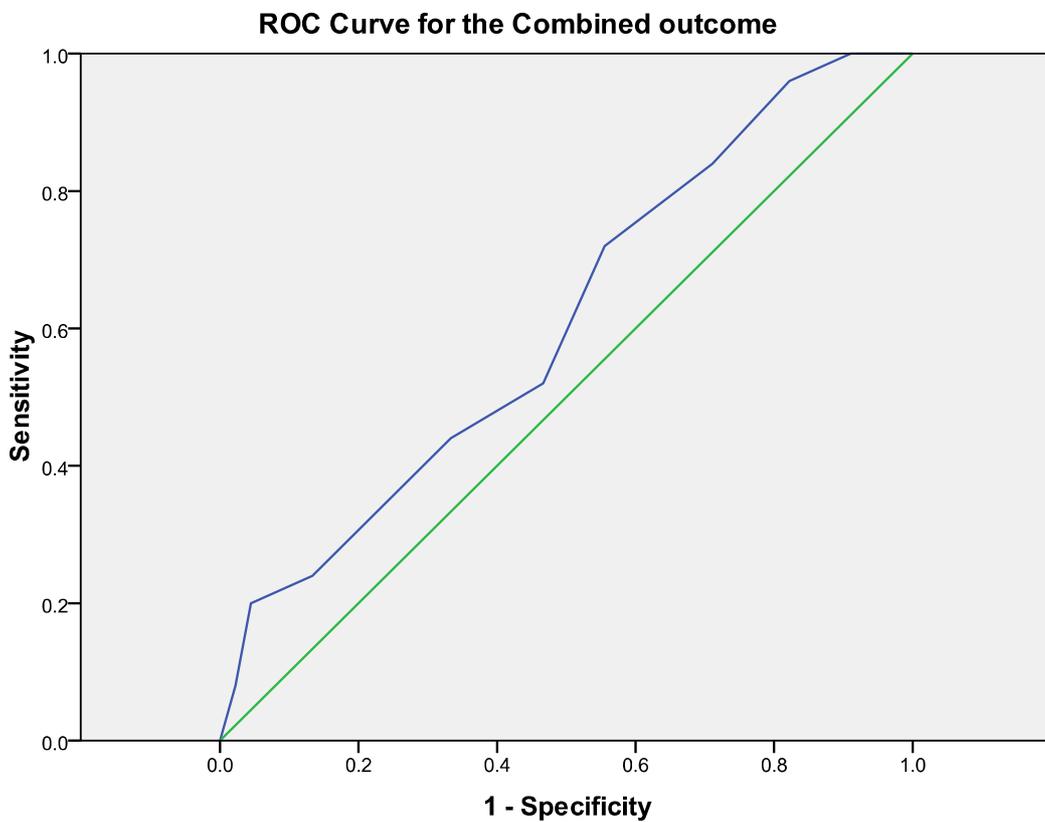
Figure 20: Predictive value of FIM on residential care admission
   N=65 people
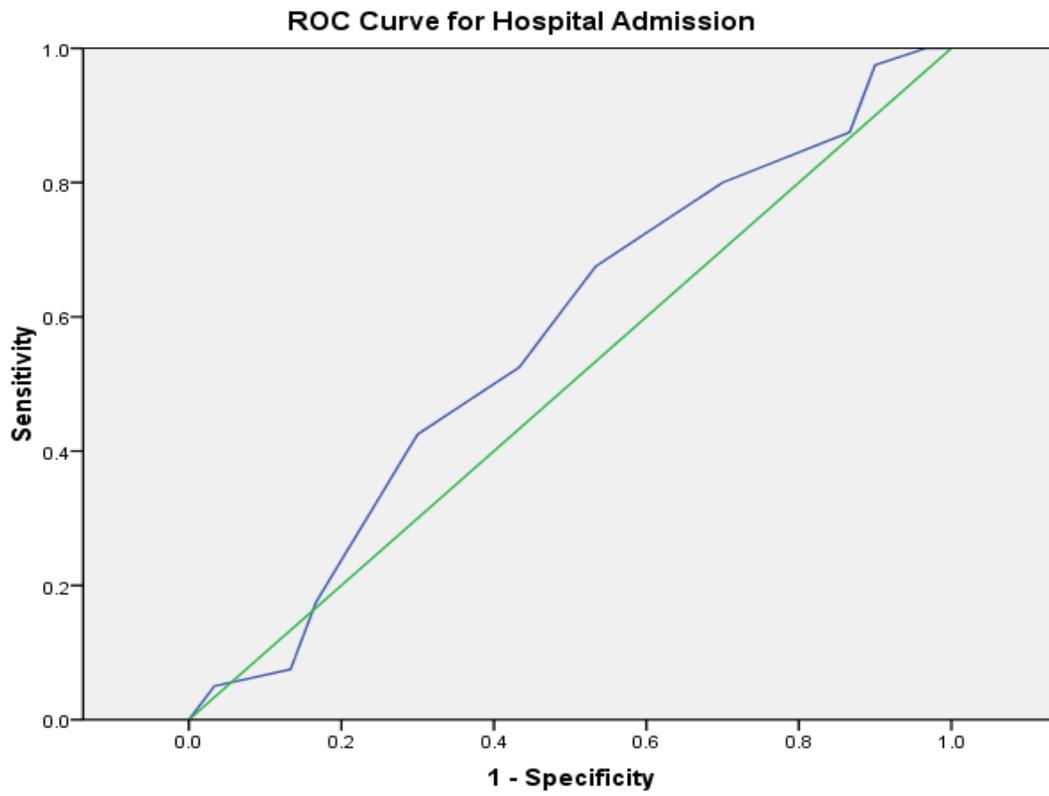
**Figure 21: Predictive value of EFS for residential care admission**
   N=65 people
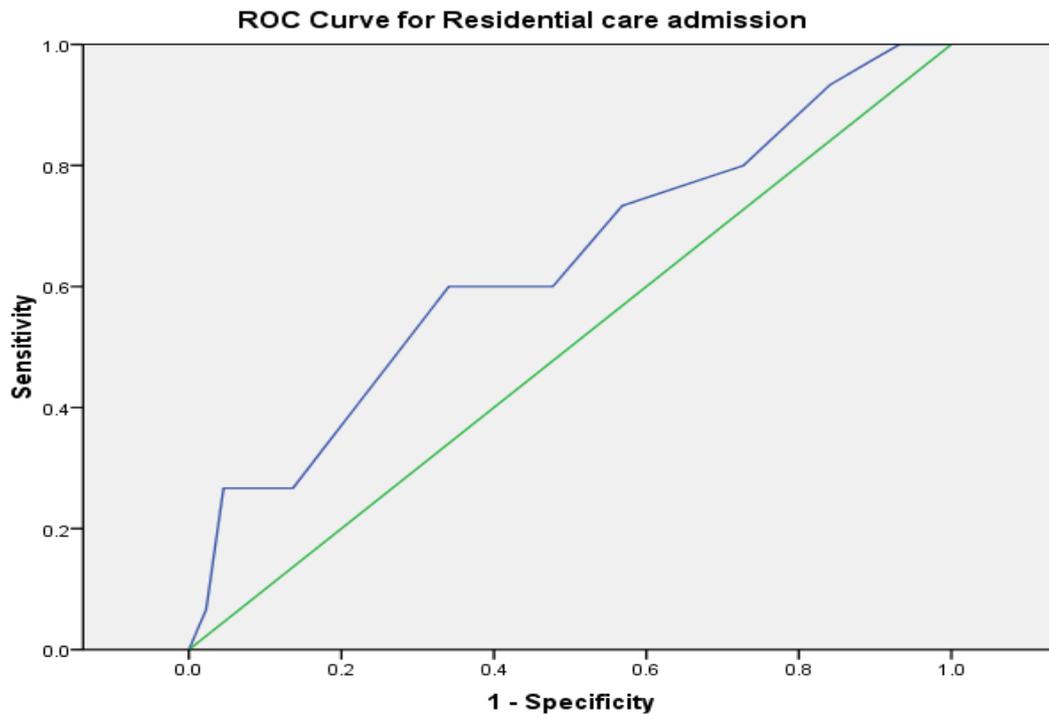
Figure 22: Predictive value of FIM for hospital admission
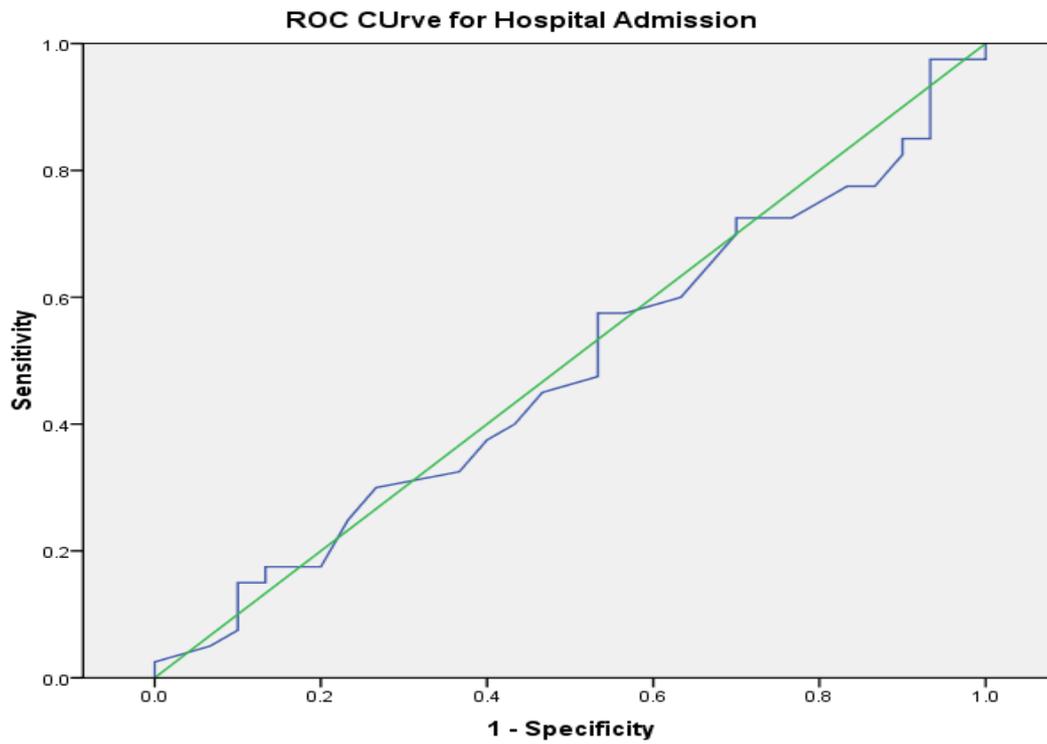
Figure 23: Predictive value of EFS for hospital admission
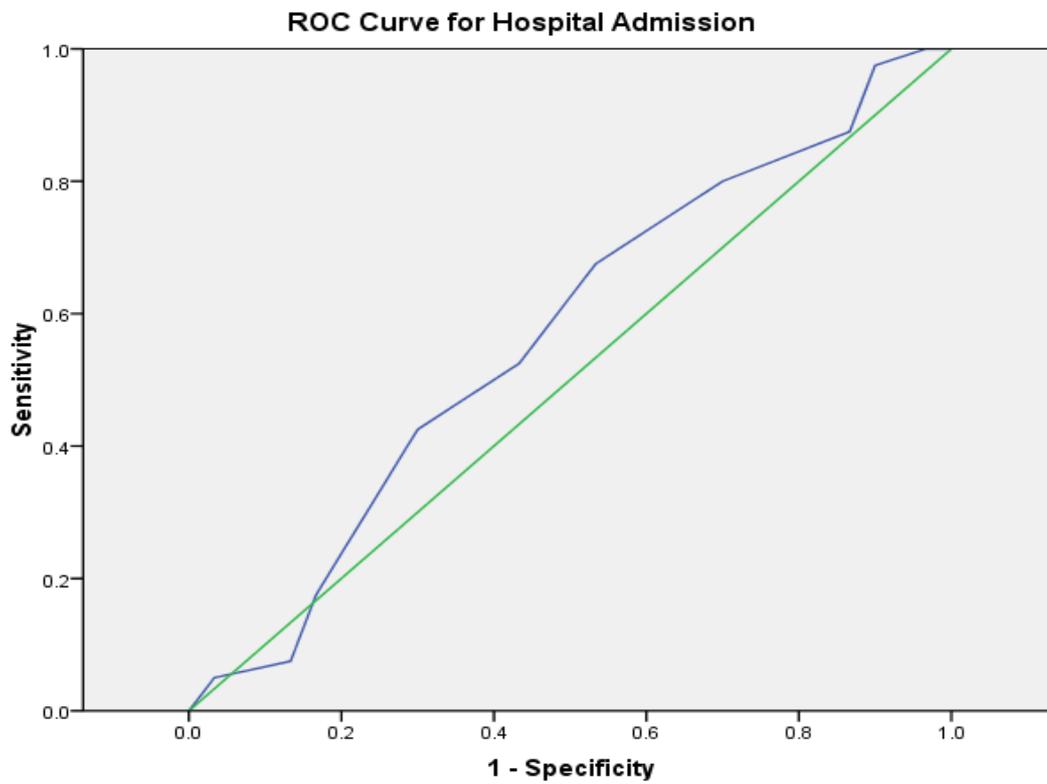
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