UNIVERSITY OF SOUTHAMPTON

FACULTY OF MEDICINE

Human Development and Health

Physical activity among hospitalised older people: The feasibility and acceptability of a volunteer-led mobility intervention

by

Stephen Eu Ruen Lim

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ABSTRACT

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Physical inactivity among older inpatients is associated with worsening physical function and increasing dependence in activities of daily living. Studies have shown that interventions using paid staff to improve physical activity levels may reduce the risk of some of these harmful effects. However, few studies have explored the use of volunteers in this role. The aim of this study was to assess the feasibility and acceptability of using trained volunteers to encourage older inpatients to be physically active.

Physical activity levels of inpatients aged ≥ 70 years on three study wards receiving usual care were measured using two accelerometers. An evidence-based training programme for volunteers was developed with therapy colleagues. The volunteer-led activity sessions were implemented on the study wards with repeat measurement of physical activity. Finally, the acceptability of the intervention was assessed through interviews and focus groups among patients, volunteers, nurses and therapists.

42 participants (mean age 87.5 years, SD 4.6) receiving usual care had their physical activity measured. The median daily step count was 636 steps (IQR 298 – 1468), and the mean daily acceleration was 9.1milligravity (mg) (SD 3.3). 17 volunteers were recruited and volunteer retention at the end of the study period was 70% (12 volunteers). 310 activity sessions were offered to 50 participants and 230 sessions (74%) were completed. No adverse event was reported. 25 participants including patients, volunteers, nurses and therapists were interviewed. Findings from the interviews demonstrated that the intervention was well-received among patients, nurses and therapists.

Volunteers can be trained and retained to safely encourage older inpatients to be more active. Further research is required on the impact of the volunteer-led intervention on patient outcomes.

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DECLARATION OF AUTHORSHIP

I, Stephen Eu Ruen Lim

declare that this thesis entitled

Physical activity among hospitalised older people: The feasibility and acceptability of a volunteer-led mobility intervention

and the work presented in it are my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. Parts of this work have been published. Please see Appendix 20.

Signed:

Date: 28th October 2018

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John 3:27 A man can receive nothing, except it be given him from heaven.

Abbreviations

ADL	Activities of daily living
BMD	Bone mineral density
BMI	Body mass index
CCI	Charlson's comorbidity Index
CI	Confidence Interval
EMS	Elderly Mobility Scale
GDS	Geriatric Depression Scale
HELP	Hospital Elder Life Programme
ICC	Intraclass correlation coefficient
IQR	Interquartile range
MD	Mean difference
mg	milligravity
MMSE	Mini mental state examination
MRC	Medical Research Council
m/s	Metre per second
MVPA	Moderate vigorous physical activity
NHS	National Health Service
NPT	Normalisation Process Theory
SAM	StepWatch Activity Monitor
SD	Standard deviation
SE	Standard Error
SEM%	Percentage of standard error of measurement
SMLE	Standardised maximum likelihood estimate
SNAQ	Simplified Nutritional Appetite Questionnaire
TUG	Timed up and go test

Chapter 1: Introduction

1.1 Physical activity and its importance

This thesis brings together the evidence regarding the importance of physical activity among hospitalised older people. Hospitalisation has been identified as one of the significant points in the life of an older person where they are at an increased risk of functional decline. This can have a direct impact on the quality of life and well-being of older people, resulting in a decline in functional independence, and the potential loss of ability to self-care and increased risk of institutionalisation. Being physically active during hospital stay is important to ensure that the risks of the associated adverse effects are reduced.

1.1.1 Definitions

It is important that accurate terminology is used in the right context. In physical activity studies, terminologies such as exercise, mobility and physical activity are often used and reflect the type of intervention employed or outcome measure used. The following paragraphs serve to outline the key definitions of these commonly used terminologies.

Physical Activity

Physical activity is defined as any bodily movement produced by skeletal muscle that results in energy expenditure[1]. It encompasses all form of activities such as walking, leisure-related activity, recreational activity such as working out in a gym, and work-related activity[2]. In daily life, physical activity can be categorised by settings into occupational, sports, conditioning, household, or other activities. In research, physical activity is commonly viewed in its entirety and divided into categories of intensity such as light, moderate or vigorous intensity. This practical approach of subdividing physical activity into categories of intensity enables researchers to better understand physical activity levels among any given population.

Exercise

Commonly the term exercise is also used interchangeably to mean physical activity. However by definition, exercise tends to be planned, structured, repetitive and purposive in the sense that improvement or maintenance of one or more components of physical fitness is an objective. While it has a number of common elements with physical activity such as the involvement of skeletal muscles to produce bodily movement which results in energy expenditure, exercise is not synonymous with physical activity and is viewed as a subset of physical activity[1].

Mobility can be broadly defined as the ability to move oneself within community environments that expand from one's home, to the neighbourhood, and to regions beyond[3]. In the community, mobility may also include moving from one place to another by transportation means. However, in the context of research among older people in hospital, mobility is often used to describe the ability to walk, with or without aid. Like exercise, mobility is a subset of physical activity.

Based on the above definitions, it is clear that physical activity is a multidimensional construct and encompasses all aspects of activities which result in energy expenditure. Exercise and mobility are subsets of physical activity and are important outcome measures and interventions to consider in the study of physical activity among older people. In the following paragraphs, the importance of physical activity will be discussed in greater detail.

1.1.2 Importance of physical activity

Physical activity is important for healthy ageing and the quality of life of older people. The maintenance of physical activity enables older people to preserve and maintain their ability to carry out activities of daily living (ADL) such as bathing, dressing, eating and mobilising, which are fundamental for their independence and quality of life. The importance of physical activity for health has been demonstrated in a number of previous studies[4,5]. A recent meta-analysis of 18 studies, 15 of which were moderate to high quality, showed that sedentary behaviour was associated with increased risk of chronic diseases such as diabetes and cardiovascular disease[6]. Sedentary behaviour refers to activities that do not increase energy expenditure above the resting level (≤1.5 metabolic equivalent units) and includes activities such as sleeping, sitting and lying down[7]. Physical activity level (measured by accelerometry) was also found to be the strongest predictor of all-cause mortality in patients with COPD, in a prospective cohort study conducted in Germany[8].

1.1.2.1 Impact of physical activity on health outcomes

A study conducted by Schmidt et al found that older adults who achieve more than 5000 steps a day had a substantially lower prevalence of adverse cardio metabolic health indicators, including metabolic syndrome and elevated Framingham risk scores, than those achieving fewer steps[9]. Cross-sectional data from the Tasmanian Older Adult Cohort study (1014 adults aged 50-80 years) were used in this study. A study conducted in Germany measured the activity levels of 1271 participants aged ≥ 65 years and assessed mortality over a four year follow up period and found

that walking duration was inversely associated with mortality in community-dwelling older people[10].

A narrative review published in 2006, examined the role of physical activity and its associated health benefits[11]. The review found that regular physical activity was an important factor in the primary and secondary prevention of several chronic diseases such as cardiovascular disease, Type II diabetes, obesity, osteoporosis and depression. One randomised controlled trial included in the review recruited 98 community dwelling women aged 75 – 85 years to compare the effects of group-based exercise (resistance and agility training) on bone, as measured by dual-energy X-ray absorptiometry (DXA) and peripheral quantitative computed tomography (pQCT) [12]. Participants were randomised to one of three experimental groups: resistance training (n=32), agility training (n = 34), or stretching (sham exercise) (n = 32). At trial completion, the agility training group significantly increased cortical bone density by 0.5 ± 0.2% (SE) at the tibial shaft compared with a 0.4 ± 0.3% loss in the stretching group. The resistance training group significantly increased cortical bone density (1.4 ± 0.6%) at the radial shaft compared with a 0.4± 0.5% loss in the agility training group.

A more recent systematic review which included 43 randomised-controlled trials and 4320 participants (post-menopausal women) also showed a relatively small statistical significance, but clinically important effect of exercise on BMD[13]. Non-weight bearing high force exercises such as progressive resistance strength training for the lower limbs were found to be the most effective in improving neck of femur BMD (mean difference 1.03; 95% CI 0.24 – 1.82) compared to a control group, while the most important intervention for BMD at the spine was a combination exercise programme (MD 3.22; 95% CI 1.80 – 4.64)[13]. A systematic review conducted by Sherrington et al which included 54 randomised controlled trials showed that exercise as a single intervention can reduce the risk of falls, with a pooled rate ratio of 0.84 (95% CI 0.77-0.91)[14].

1.1.2.2 Impact of physical activity on cognition

Recent studies have also explored the beneficial effect of physical activity on cognition. A meta-analysis of 16 prospective studies calculated the pooled relative risk of dementia as 0.72 (95% CI 0.60-0.86) for the most physically active group, compared with the least active group[15]. The physical activity levels in theses studies were self-reported and included mobility, exercise and leisure and sports related activities, classified into categories of various intensities. The risk ratio for the highest versus the lowest reported physical activity group for each study was used in the analysis. A further meta-analysis for 15 prospective studies examined the association between physical activity (questionnaire-based measure of PA) and risk of cognitive decline in cognitively normal older adults[16]. The hazard ratio for cognitive decline over 1-12 years follow-up among

people with high levels of activity was 0.62 (95% CI 0.54-0.70). One study conducted in the US measured the physical activity levels of 6452 participants (mean age 69.7±8.5 years) for 4-7 consecutive days using an accelerometer and observed the incidence of cognitive impairment over an average of 3 years[17]. The study found a dose-response relationship between percentage of moderate-vigorous physical activity and cognitive function in older adults, with higher levels associated with a 36% lower risk of cognitive impairment and better maintenance of memory and executive function over time, particularly in white adults. These studies demonstrate that increased physical activity may have a role in reducing the risk of developing cognitive impairment among older people.

1.1.2.3 Impact of physical activity on well-being

Several studies have shown the beneficial effects of physical activity on emotional and psychological well-being. One study involving 176 older people aged ≥ 70 years demonstrated a positive correlation between physical activity energy expenditure and several outcomes of well-being including quality of life ($r = 0.24$, $p < 0.01$), subjective well-being ($r = 0.22$, $p < 0.01$) and physical self-perceptions ($r = 0.21$, $p < 0.01$)[18]. A systematic review conducted to explore the effects of regular physical activity on anxiety symptoms in healthy older adults which included seven studies (five randomised controlled trial, 1 cohort study and 1 cross-sectional) also found that regular physical activity including exercise and mobility may be effective in improving anxiety symptoms among older adults[19]. Antunes et al (n = 46, mean age 66.9 years) found that older people who took part in an aerobic fitness programme had significant decrease in depressive (Geriatric Depression Scale, $p < 0.05$) and anxiety (State-Trait Anxiety Inventory, $p < 0.001$) scores compared to control group[20].

These studies demonstrate the importance of physical activity in older people and its benefits on physical and mental well-being. While there has been a steady increase in the total life expectancy of the UK population over the past two decades[21], it is equally crucial to ensure that healthy life expectancy keeps pace with this increase. Independent living, good health and emotional well-being, and good quality of life are all important aspects of healthy ageing. With convincing evidence regarding the benefits of physical activity, there is great impetus for healthcare professionals to encourage older people to lead a physically active lifestyle.

1.2 Recommendations for physical activity in older people

The current recommended physical activity level for older adults age 65 years and older are 150 minutes a week of moderate intensity activity in bouts of 10 minutes or more plus muscle strengthening exercises on 2 days[22]. This is often expressed as 30 minutes of brisk walking or equivalent activity five days a week, although 75 minutes of vigorous intensity activity spread across the week, or a combination of moderate and vigorous activity are sometimes suggested[23]. In terms of step counts, this is equivalent to taking 6500-8500 steps per day[24]. However many people, especially those in older age groups, struggle to achieve this level of activity. Physical inactivity is a growing concern and has been acknowledged as a global health issue and is estimated to account for 6% of global deathts[25]. In the UK, a study conducted by the British Heart Foundation Health Promotion Research Group at Oxford University estimated the cost of physical inactivity to the NHS in 2013 to be in the region of £0.9 billion[26]. A physical activity survey conducted in England showed that 12.5 million people failed to achieve 30 minutes of moderate intensity of physical activity per week within a 28-day period in 2013[27].

Several studies have explored the activity levels older people in the community setting. In a study conducted in the UK, 238 community dwelling older people (age ≥65 years) from a single general practice wore an accelerometer to study their average daily step-counts and time spent in different physical activity levels[28]. Only 2.5% of participants achieved the recommended 150 minutes weekly of moderate intensity activity in bouts of 10 minutes or more. The study also showed that step count declined steadily with age. Another accelerometer-based study measured the physical activity levels of 1593 men (mean step count 4762 steps/day) and 857 women (mean step count 4470 steps/ day) age 70 -93 from 25 towns in the UK, and showed that with moderate vigorous physical activity (MVPA) defined as >1952 counts per minute, only 7% and 3% respectively achieved ≥150 minutes of MVPA in bouts of 10 minutes of more per week[29]. The prevalence of physical inactivity among older people in the community is well established and this phenomenon is also reflected in the hospital setting.

1.3 Physical activity of older people in the acute care setting

In the UK, it is estimated that 65% of patients admitted to hospital are older than 65 years. The proportion of inpatients who are 85 years or older has risen from 22% in 2002 to 25% in 2012 and this trend is expected to continue as the population ages and the absolute number of very old people increases[30]. The adverse effects of hospitalisation in older people are well recognised and

include increased frailty[31], functional decline[32], and development of disability in ADL[33]. It is estimated that between 30-60% of older people lose some independence in ADL as a result of hospitalisation[34]. A prospective cohort study conducted in New Haven, US involving 754 community dwelling older people (aged ≥70 years) found that illnesses and injuries leading to either hospitalisation or restrictions in ADL were important sources of disability, regardless of the presence of physical frailty[33]. The hazard ratio for the development of disability was 61.8 (95% CI 49.0 – 78.0) within a month of admission to hospital and 5.54 (95% CI 4.27 – 7.19) within a month of restricted activity. The study also found that falls-related admissions were most likely to lead to development of disability. Patients who develop disabilities in ADL are at an increased risk of other adverse outcomes such as increased mortality, admission to care home, reduction in health-related quality of life and greater use of healthcare services[35,36]. The reasons for the decline in function and development of disabilities are multifactorial. A clear understanding of the mechanisms underlying the disabling process is important as this will guide implementation of interventions to address the issues.

Previous studies have shown that increasing age, lower functional status before hospital admission, impaired cognitive status, depression and prolonged length of hospital stay are significant predictors of functional decline associated with hospital admission[37]. One other significant factor associated with functional decline during hospitalisation is low levels of physical activity[38]. A study in the US demonstrated that 45 previously independent older male inpatients, with a mean age of 74 years, typically spent only 43 minutes per day in an upright position i.e. standing or walking[39]. The study also showed that 83% of their hospital stay was spent lying in bed. A Danish study of 33 inpatients (mean age 82 years) reported that the average time spent standing or walking was 48 minutes over 24 hours[40]. A study conducted in the UK among 16 female patients (mean age 85 years) showed that during the office hours of 9am to 5pm, the median duration spent standing or walking was 25 minutes (IQR 15-36)[41]. Mudge et al conducted an observational study in a tertiary hospital in Australia, monitoring the time spent by patients doing various activities by using direct observation, over 4 observation periods (2 mornings [1000-1400] and 2 afternoons [1400-1800])[42]. The study found that among patients aged ≥ 65 years (n=67), only 8% (SD 8.5) of the observed time was spent in a standing position, walking or actively wheeling. A study conducted in an acute care for elders hospital unit in the US monitored the step count of 224 patients aged ≥ 65 years[43]. The median step count of older medical inpatient during the first 24 hours of their hospital stay was 478 steps and 846 steps in the last 24 hours. These studies demonstrate the prevalence of low levels of physical activity among hospitalised older people in general. There are currently no studies measuring the step count of older medical

inpatients in the UK. Further research is required to describe the activity levels of patient's representative of the patients in the National Health Service in the UK.

1.4 Measuring physical activity of older people in hospital

In order to explore the relationship between physical activity of hospitalised older adults and its association with various health outcomes, an accurate and reliable measure is necessary. I conducted a scoping review to search from existing literature, the tools and measures which are currently used to assess physical activity levels of hospitalised older adults and described their clinimetric properties and applications[44].

1.4.1 Literature review methods

1.4.1.1 Data Sources and Searches

An initial search of the Cochrane library and PROSPERO confirmed that no similar review was previously conducted. In August 2016, I conducted a literature search using four databases: Medline, Embase, AMED, and CINAHL. I designed the full search strategy including keywords and MESH terms, working together with a co-researcher (Appendix 2). Inclusion criteria for the review were: participants aged ≥ 65 years, any study which included measures of physical activity, studies involving acute medical inpatient setting, and published from 1996 onwards. Studies which specifically assessed the activity levels of surgical patients or patients with neurological conditions such as stroke or brain injury were excluded. Papers not meeting all of the inclusion criteria were excluded. Additionally, a manual search was conducted primarily from manufacturer websites for the characteristics, functionality and cost of the accelerometers included in this review. This review is registered on PROSPERO: CRD42015025278 (Appendix 3).

1.4.1.2 Study selection

One co-researcher and I conducted the initial search of the four databases individually. Titles of articles retrieved through the initial search were then screened independently for relevance prior to abstract review (Figure 1). Two other co-researchers and I independently reviewed the abstracts and articles selected by at least one co-researcher were included for full text review. One co-researcher and I reviewed the full texts and identified relevant studies for final analysis. Any disagreements were resolved through discussion. The references of selected articles were also screened for relevance.

1.4.1.3 Data extraction and Quality Assessment

I designed a data abstraction template and one co-researcher and I independently abstracted data from each paper with regard to study characteristics (participants' age, study setting, number of participants), physical activity outcome measure employed, and authors' comments regarding the devices. Additionally, data regarding the aim of the study, the duration of physical activity monitoring and controls or comparators used were also abstracted. Any disagreement during the data abstraction process was resolved through discussion with the third reviewer.

Working independently with one co-researcher, I assessed the quality of each paper using the Downs and Black study quality checklist[45]. The Downs and Black checklist is commonly used to assess health care intervention studies and is appropriate for both randomised and non-randomised studies. The overall study quality is assessed by 27 questions under the following sections: study quality (10 items), external validity (3 items), study bias (7 items), confounding and selection bias (6 items) and power of the study (1 item). The quality of the study is rated against a total score of 32, with 25 items scoring 0 or 1, 1 item scoring 1 or 2, and 1 item scoring 0 to 5. No cut-off point was specified by the authors of the checklist to determine if the study was low, moderate of high quality and the score for each study is provided in Table 1. No studies were excluded based on the quality of the paper.

1.4.1.4 Data synthesis and analysis

I analysed the studies based on the type of assessment of physical activity of hospitalised older people. For studies which utilised accelerometers, information such as the make and general description of the accelerometers, the outcome measures, the reported accuracy of the devices and its practical application were described.

Due to the heterogeneity of the studies, statistical pooling of data was not appropriate and the results were presented as a narrative synthesis of the methods currently used to measure physical activity of older acute medical inpatients.

1.4.2 Literature review results

The initial search identified 5855 articles after duplicates were removed. 159 articles were selected for abstract review. 127 articles were selected by three reviewers for full text review, and 17 studies met the inclusion criteria. Reference screening identified one additional article which met the inclusion criteria thus 18 papers were included in the final analysis (Table 1). The quality of the papers, which ranged from 9/32 to 21/32, is presented in Table 1.

1.4.2.1 Objective measures

15 studies employed objective measures to measure physical activity. 11 studies used accelerometers , including one study[46] which employed two different accelerometers. Four studies[43,47-49] used the StepWatch Activity Monitor, two studies[46,50] used the activPAL, two studies[39,51] used the AugmenTech Inc Pittsburgh accelerometer, and the other accelerometers used include the GENEActiv[46], Actiwatch-L[52], Tractivity[53] and Kenz Lifecorder EX 1-axial accelerometer[54]. Sample sizes for the accelerometer studies ranged from 8 to 287 participants. Four studies[42,55-57] used direct observation as a measure of physical activity with sample sizes ranging from 47 to 124 participants.

1.4.2.1.1 StepWatch Activity Monitor

The StepWatch Activity Monitor (SAM) is a water-resistant dual-axis accelerometer worn at the ankle, attached by a Velcro strap. It is suitable for continuous monitoring and its primary outcome measure is step count (calculated by the stride count multiplied by two). Stride count is recorded at one minute intervals synchronized to a 24-hour clock. The device is time-stamped and outcomes include the average step count and percentage of time spent at low (1-15 steps/minute), medium (16-40 steps/minute) and high (>40 steps/minute) activity. The activity level definitions can be modified to suit different participant characteristics. It has a typical battery life of seven years, which is not rechargeable. Of the four hospital studies which used SAM, only one study[47] tested its accuracy on one representative patient against direct observation and reported the device to be 99% accurate in step counting although the participant's gait speed was not reported. The SAM has previously been reported to be accurate in measuring step counts among community-dwelling older adults[58-60], and at slow gait speeds[61] down to 0.44 m/s, as well as in patients with gait abnormalities including muscular dystrophy[62], cerebral palsy[63], multiple sclerosis[64], stroke[65], and patients who require a walking stick to aid mobility[66]. It is reported to be well-tolerated by older patients[43].

1.4.2.1.2 activPAL

The activPAL is a single-axis accelerometer which is attached at the thigh using hydrogel pads. It can be waterproofed by wrapping medical grade adhesive around the device and attached to the thigh with a dressing, which allows continuous monitoring up to seven days. Based on thigh inclination and limb movement, the software can classify posture as sitting/lying, standing or walking. It is able to calculate step count and cadence. The output is time stamped which allows detailed analysis of the activity profile. This review identified one study which validated the use of activPAL in 14 older inpatients against video observation and reported it to be highly accurate in

classifying sedentary versus upright positions. However, the accuracy of activPAL in step counting was affected by slow gait speed (< 0.47m/s), and underestimated step counts by about 40%[50]. One study involving 21 older community-dwelling adults (mean age 71.9 ± 5.7) examined the accuracy of the activPAL in step counting using a treadmill and found the device to be accurate in measuring step counts with gait speeds ranging between 0.67m/s to 1.56m/s[67].

1.4.2.1.3 AugmenTech Inc. Pittsburgh wireless monitors

Two studies[39,51] utilised the AugmenTech Inc. Pittsburgh accelerometer. As this device is no longer manufactured, further description of the device is not relevant to the aims of this review.

1.4.2.1.4 GENEActiv

The GENEActiv is a waterproof, wrist-worn tri-axial accelerometer which produces raw data output that is time stamped. It contains a temperature sensor which enables researchers to determine wear time. The device allows continuous monitoring for a maximum of 7 to 45 days depending on the settings of the logging frequencies. By developing algorithms and with the use of analysis packages such as R, Matlab and Excel macro, raw data can be converted into clinically relevant outcomes such as body posture, sleep/wake measurements , and physical activity levels in terms of acceleration and metabolic equivalent of tasks (MET).

One study in this review used the GENEActiv to measure physical activity of older inpatients by analysing their time spent sitting/lying and standing[46]. Ten patients (mean age 76 years) admitted to hospital with COPD had two accelerometers, the GENEActiv and activPAL, worn continuously for 1-2 days, to examine their physical activity. Compared to the activPAL (mean time worn 22.25 hours), the GENEActiv (mean time worn 20.0 hours) underestimated patients' sitting and lying time by approximately 2.2 hours ($p<0.05$).

1.4.2.1.5 Actiwatch-L

This device which uses actigraphy technology, is wrist-worn and records movement-induced accelerations during one minute time periods. The most common clinical use of the Actiwatch-L is in evaluating sleep disorders and rest-activity rhythm disturbance. One study in this review used the Actiwatch-L to measure the rest-activity rhythm and light exposure of 10 older inpatients (mean age 81 years) admitted to an acute care unit[52] and reported that the device was well-tolerated by patients. Advances in accelerometer technology have led to further development of the device which has now been phased out and replaced by a new device, the MotionWatch 8. The MotionWatch 8 is a waterproof wrist-worn tri-axial accelerometer which allows continuous monitoring. It has been used to study physical activity levels of older adults in the community [68]

and it produces data in counts per minute which can be used to classify patients into sedentary, light and moderate vigorous physical activity.

1.4.2.1.6 Tractivity

One study used the Tractivity to measure ambulatory levels of hospitalised patients and included a subgroup of medical inpatients age ≥65.[53] The Tractivity is water-resistant and worn on the ankle secured by an ankle band with Velcro straps. The main outcome measure is step count, which is time-stamped, and the sensor memory allows up to 30 days of continuous monitoring. This study reported an unpublished sub-study on the Tractivity and found the device to have acceptable limits of agreement with the StepWatch Activity Monitor (+284 steps; 95% limits of agreement -911 – 343) in 20 hospital inpatients whose age and gait speed was not reported[53]. The Tractivity step counts also correlated highly with the nurses' documentation on a paper log of distance walked measured in feet (r = 0.76).

1.4.2.1.7 Kenz Lifecorder EX

This device is non-waterproof, and is worn at waist level just above either leg. It is able to record step counts and time spent in various levels of intensity. Using pre-entered data such as age, sex, height and weight, the device is also able to compute physical activity energy expenditure. The device is built with an internal memory which is capable of recording up to 200 days and has a battery life of 6 months. One study in this review used the Kenz Lifecorder EX 1 axial accelerometer to measure physical activity levels of 235 cardiac inpatients (mean age 74 years)[54]. It has also been used to measure step count and intensity of physical activity of community-dwelling older people (age range 60-78 years)[69]. However this accelerometer may be less accurate at slow gait speeds: in one study assessing the accuracy of pedometers using a treadmill, the Kenz Lifecorder EX, which was worn by 10 male subjects (mean age 33), underestimated actual step counts by about 10% at 0.9m/s but was found to be accurate at a gait speed of 1.1m/s and above[70].

1.4.2.1.8 Direct observation

Four studies[42,55-57] used direct observation alone to measure physical activity and two studies[47,50] used direct observation to validate or supplement the accelerometer data. Mudge et al (2008) measured patient activity on the ward by monitoring hallway ambulation[55]. Participants were observed for 2 to 3 hours periods at varying times in the morning and afternoon shift over a 7 day period. The frequency and time spent walking in the hallways were recorded. More recently, Mudge et al (2016) utilised a behavioural mapping protocol, where participants in each room were observed for 2 minutes before moving to the next room, with the sequence repeated in the

same order for 4 hours[42]. Observations were done by trained physiotherapy students with 2 observation periods between 10am to 2pm and 2pm to 6pm. Activities were classified as lying in bed, sitting in or on the bed, sitting on a chair, standing, actively wheeling, or walking.

Boltz et al used a previously developed tool, the Restorative Care Behaviour Checklist, which is an observational measure of patient involvement in activities such as bed mobility, transfers, ambulation, bathing, dressing, hygiene, eating, use of personal assistive devices, communication, and exercise[56]. Patients recruited in this study were observed over a 3 hour period on 3 separate occasions. Doherty-King et al utilised trained observers who shadowed 15 registered nurses each for two to three 8 hour periods. A hand-held computer tablet was used to collect data on the frequency and duration of patients' mobility events such as standing, transferring, walking by the bed space, walking to and from the bathroom, walking in the bay and walking in the hallway[57].

1.4.2.2 Subjective measures

Three studies [35,36,71] utilised subjective methods to measure the physical activity of older inpatients. All three studies interviewed nurses or patients regarding the frequency of mobility of patients over the past 24 hours. Brown et al developed an empirical scoring system for increasing levels of mobility , with a score of 0 for complete bedrest, 2 for transferring from bed to chair once, 4 for transferring ≥ twice, 6 for ambulation once with total assistance, 8 for ambulation ≥ twice with total assistance or once with partial or no assistance, 10 for ≥ twice with partial assistance, and a score of 12 for independent ambulation ≥ twice per day[35]. In this study, nurses looking after the patients were interviewed at baseline and on alternate days. An average score of 4 or less was classified as low level mobility, 4-8 was defined as intermediate and a score of 8 and above was considered as high mobility. Zisberg et al modified this scale with a change in scoring to 14 to take into consideration the distance mobilised by patients, classified by ambulation inside or outside their hospital room[36,71]**.** The sample sizes for the three studies ranged between 498-684 participants but the validity and reliability of this measure was not reported.

Figure 1. Flow diagram

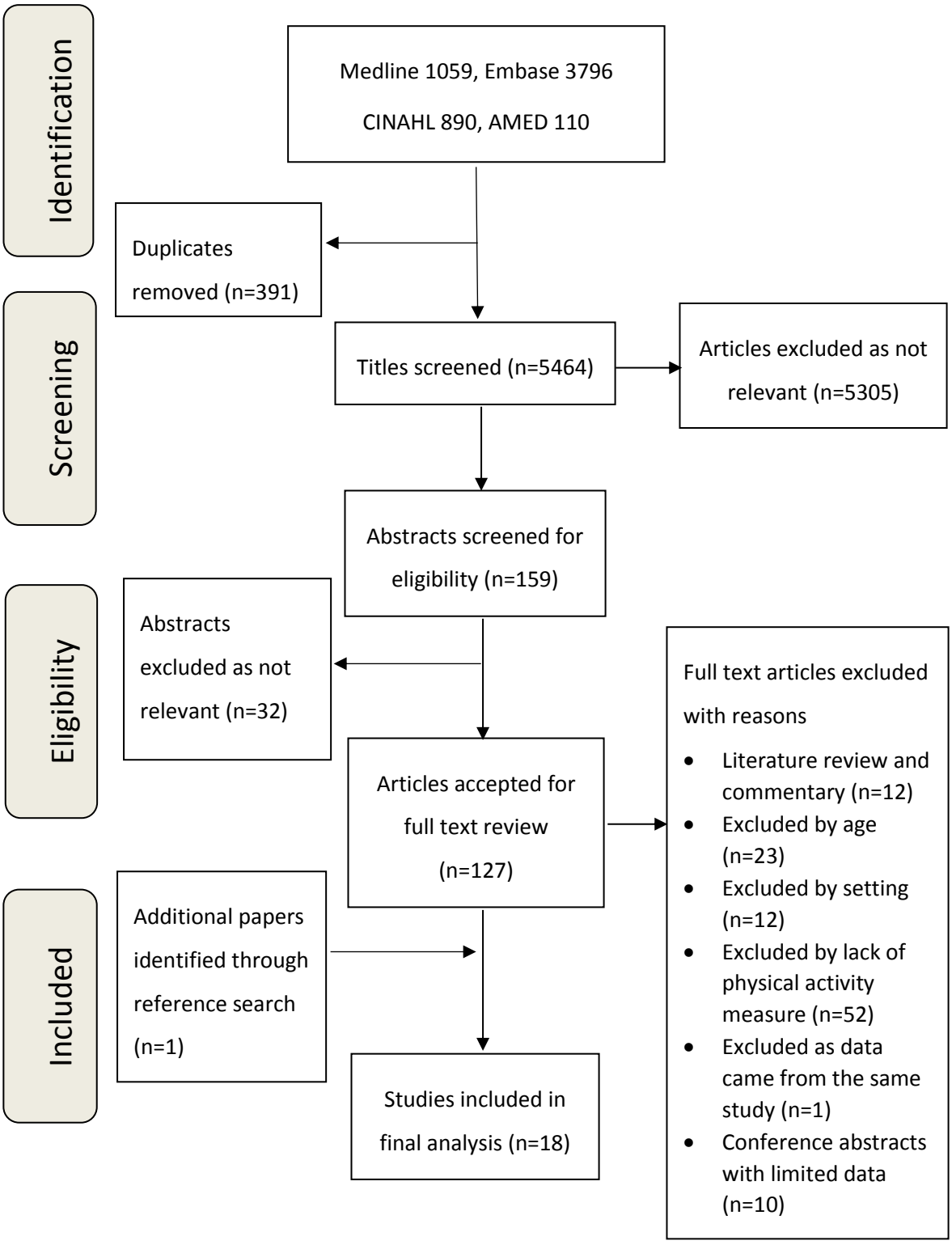


Table 1. Summary Table of Included Studies

	Author/ Year	Setting	No of pts	Mean age	Physical activity measure	Primary outcome	Validity or accuracy reported	Quality
	Objective measures							
1	Fisher 2010 [49]	University hospital, US	162	77.4	StepWatch Activity Monitor	Mean daily step count	Accuracy cited from other papers.[58,59,61]	12/32
2	Fisher 2011 (Sep) [48]	University hospital, US	198	76.9	StepWatch Activity Monitor	Mean daily step count	Not reported	12/32
3	Fisher 2011 (Jan) [47]	University hospital, US	239	76	StepWatch Activity Monitor	Mean daily step count	Accuracy cited from other papers.[58,59,61,63] Accuracy of SAM tested on 1 patient in this study showed 99% accuracy in step count.	12/32
4	Ostir 2013 [43]	University hospital, US	224	Age > 65, no mean given	StepWatch Activity Monitor	Mean daily step count	Accuracy cited from other papers.[49,58,61]	17/32
5	Taraldsen 2011 [50]	University hospital, Norway	14	84	activPAL, video recorded observation	Posture	High accuracy in classifying posture but high underestimation of step counts at gait speed < 0.47m/s	18/32
6	Rowlands 2014 [46]	Acute hospital, Australia	10	75.9	GENEActiv, activPAL	Posture	Validity of GENEActiv in measuring activity intensity[72,73] and activity type[74,75] cited. No previous study using GENEActiv to measure posture.	12/32

	Author/ Year	Setting	No of pts	Mean age	Physical activity measure	Primary outcome	Validity or accuracy reported	Quality
							GENEActiv underestimated sitting/lying time by about 130min ($p < 0.05$) compared to activPAL Validity of activPAL cited from other papers[76,77].	
7	Brown 2009 [39]	Department of Veteran Affairs Hospital	45	74	AugmenTech Inc accelerometer	Posture	Validity conducted and published in a separate paper.[78]	12/32
8	Pederson 2012 [18]	University Hospital, Denmark	48	84.7 (median)	AugmenTech Inc accelerometer	Posture	Cross-validation of algorithm conducted on 6 patients with level of correspondence ranging from 89.6% to 100% for all postures. Unable to differentiate between standing and walking	14/32
9	Vinzio 2002 [52]	Acute care unit, France	8	80.5	Actiwatch-L	Rest-activity times	Validity cited from other papers[79,80].	11/32
10	Izawa 2014 [54]	University Hospital Cardiac Inpatients, Japan	268	73.3	Kenz Lifecorder EX 1-axial accelerometer	Step count and energy expenditure	Validity cited from other papers[70,81].	14/32

	Author/ Year	Setting	No of pts	Mean age	Physical activity measure	Primary outcome	Validity or accuracy reported	Quality
11	Sallis 2015 [53]	Community Hospital, US	287	Age > 65	Tractivity	Step count	The authors report a comparison of the StepWatch and Tractivity, which showed high reliability of the Tractivity device (intraclass correlation = 0.99)	15/32
12	Mudge 2008 [55]	Tertiary teaching hospital, Australia	124	82.1	Direct observation	Time spent in various activities	Not applicable	21/32
13	Boltz 2012 [56]	Academic medical centre, US	93	80.8	Direct observation using Restorative Care Behaviour Checklist	Time spent in various activities	Not applicable	15/32
14	Doherty-King 2013 [57]	Veteran/ Teaching Hospital, US	47	76.6	Direct observation	Time spent in various activities	Not applicable	9/32
15	Mudge 2016 [42]	Tertiary teaching hospital, Australia	132	Age >65, no mean given	Direct observation, Behavioural mapping	Time spent in various activities	Physical activity levels estimated from behavioural mapping are similar to those identified by accelerometry.[16,82,83]	19/32

	Author/ Year	Setting	No of pts	Mean age	Physical activity measure	Primary outcome	Validity or accuracy reported	Quality
	Subjective measures							
1	Brown 2004 [35]	University Hospital, US	498	78.7	Mobility scale completed through interviewing nurses	Mobility level from 0-12 trichotomised in 3 mobility group: low, intermediate and high	Acknowledged that nurses may miss some mobility activity.	15/32
2	Zisberg 2011 [36]	Teaching hospital, Israel	525	78.9	Daily interview with participants using a mobility scale	Modified mobility index on a scale of 0-14.	Acknowledged that measure is subject to recall bias	17/32
3	Zisberg 2015 [71]	Teaching hospital, Israel	68	78.	4-6 interviews with participants during their hospital stay	Modified mobility index on a scale of 0-14.	Not reported	19/32

1.4.3 Discussion of the results of the literature review

This review has shown that objective methods using accelerometers were most commonly used among researchers investigating the physical activity levels of hospitalised older people. The outcome measures produced by accelerometers include step count, posture identification, physical activity energy expenditure and physical activity intensity. The variety of outcome measures reflect the multidimensional construct of physical activity, hence using one method of measurement can be difficult to fully capture its entirety. One of the benefits of using accelerometers is the continuous objective monitoring of physical activity. However, the review has shown the accuracy of the accelerometers in measuring step counts or posture vary across devices. The decision to use a particular device also depends on factors such as the aim of the study, the desired outcome measure, the duration of monitoring and the resources available including expertise to develop algorithms using statistical software for data analysis.

Only three studies tested the accuracy of the devices among older people in hospital. The activPAL was shown to be highly accurate in comparison to video observation in classifying postures but lacked accuracy in step counting at gait speed <0.47m/s[50]. The GENEActiv underestimated time sitting/lying by comparison with the activPAL[46]. In the study by Fisher et al in 2011, the SAM was found to be 99% accurate in step counting in one representative patient[47]. Older people in hospital are more likely to engage in lower intensity physical activity and have lower gait speed than their community-dwelling counterparts[84], hence it is important that the accuracy of the device is population-specific. This review has identified a lack of evidence for the validity of accelerometers specifically to measure physical activity among hospitalised older people.

The limited evidence available suggests that the SAM is the most accurate device currently available for measuring step counts of older inpatients and is reported to be well-tolerated. One disadvantage of the SAM is that it is unable to record non-walking related physical activity such as bed or chair-based exercises. The activPAL is the most accurate at classifying postures in studying the activity and sedentary behaviour of hospitalised older people. It does provide step counts but has been reported to be less accurate at slower gait speeds. The GENEActiv is able to measure physical activity intensity and also classify posture. The advantage of the GENEActiv is that it provides raw accelerometry data which allows researchers more flexibility to work with the data to produce a range of outcome measures.

Direct observation using a systematic approach of observing patients and coding their behaviour has benefits including elimination of the risk of recall bias. Additionally, contextually rich data

such as the types of activity, frequency and the physical and social environment in which the physical activity takes place can also be recorded[85]. Barriers to using direct observation include limitation of time and resources although the use of hand-held devices allows data to be entered and stored efficiently, making the data more manageable and easier to analyse. Video observation is useful for observing patients for a short period of time but is less practical for continuous monitoring.

The only subjective measure identified in this review was a score to classify patients into low, moderate and high mobility levels. The advantage of this method of measurement is its ease of use, requiring little resources, which may be relevant when studying a larger number of participants. However, it only provides an estimate of patients' physical activity level and is susceptible to recall bias as the information is dependent on participants to recall activities over the past 24 hours.

1.4.4 Limitations of this review

The search strategy was designed to include studies involving older general medical inpatients, hence studies limited to specific neurological conditions such as stroke and Parkinson's disease were excluded. The quality of the studies included was generally modest to poor, with scores ranging from 9 to 21 out of a total of 32. Of the 18 studies included, 11 studies had a score of less than 16 out of 32. However the aim of the review was to explore the methods of measurement in current practice and hence these studies were included.

1.4.5 Conclusions and relevance to this study

This review has identified and described the measures currently used to assess physical activity levels of older people in general medical wards in hospital. The seven accelerometers identified each have their own strengths and weaknesses. There are few validation studies looking specifically at the accuracy of these devices in measuring physical activity of hospitalised older people. Further population-specific validation studies are needed to determine which devices are most suitable for this group of patients to better inform researchers and clinicians who are interested in measuring physical activity levels of hospitalised older people.

Among the devices currently used in practice, the StepWatch Activity Monitor appears to provide the most accurate step count for older people with low gait speed or altered gait. Older people in hospitals are frailer and acutely unwell, with lower gait speed[86], hence the StepWatch Activity Monitor was chosen to measure the ambulatory activity of patients in this study. One disadvantage of the StepWatch Activity Monitor is its inability to measure non-walking activity

such as bed or chair-based exercises. In order to capture non-walking activity, an additional device, the GENEActiv was chosen to measure physical activity intensity of patients in this study, expressed as acceleration against gravity, with the unit measurement of milligravity (mg).

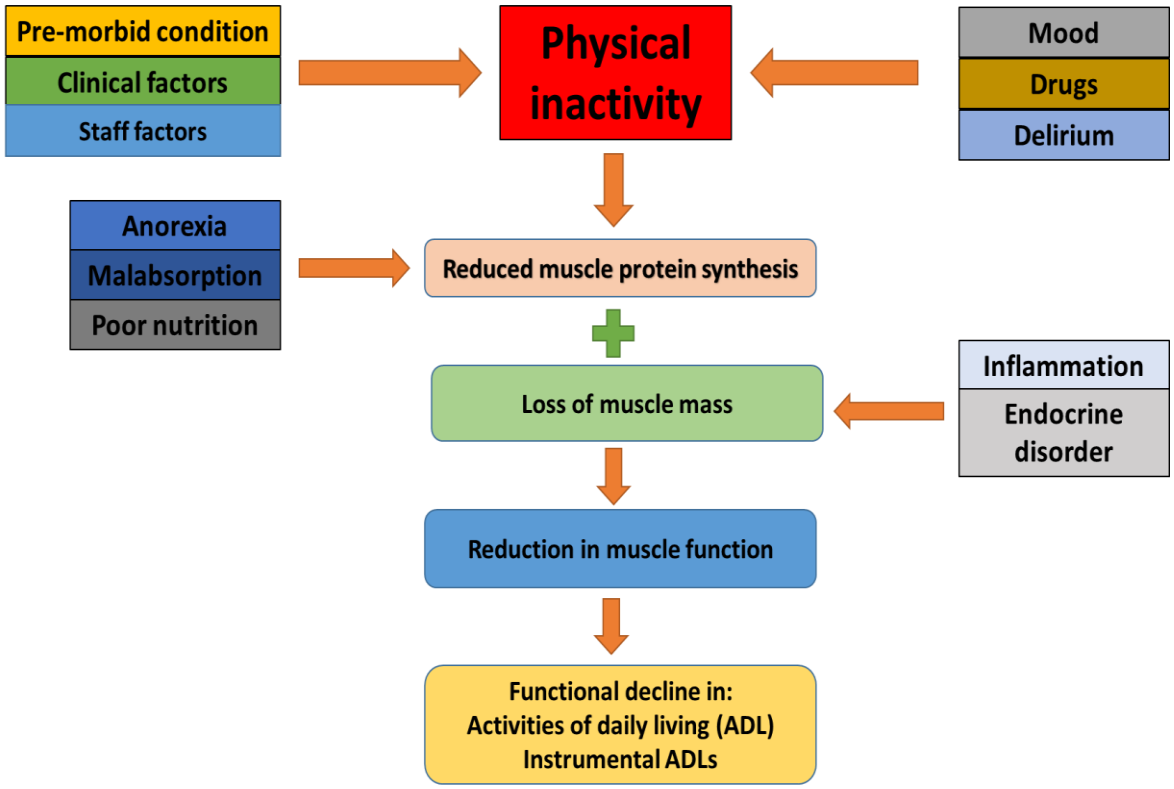
1.5 Adverse effects of low inpatient physical activity levels

Several studies have explored the association between low mobility in hospital and adverse outcomes. Brown et al conducted a prospective cohort study in a large teaching hospital in the US to determine the activity levels of older medical inpatients, classified as low, intermediate and high mobility levels, and to explore its associated adverse outcomes[35]. 498 older medical inpatients (mean age 78.7 years ± 6.1) were recruited and findings from the study demonstrated that patients with low (total bed rest or transferring from bed to chair up to twice a day) and intermediate (ambulation inside the room only) levels of mobility were associated with adverse outcomes (functional decline, new institutionalisation and death), in a graded fashion, even after controlling for multiple confounders, when compared with those with high (ambulation at least once a day outside the room, in addition to mobility inside the room) mobility. The low mobility group of patients had an adjusted odds ratio of 5.6 (95% Confidence Interval (CI) = 2.9 – 11.0) for decline in activities of daily living, 6.0 (95% CI = 2.5-14.8) for new institutionalization and 34.3 (95% CI = 6.3 – 185.9) for death.

A study in Israel utilised the same mobility classification as Brown et al (2004) to examine the association between mobility levels of hospitalised older people and functional outcome[36]. In this study (n = 525, mean age 78.9 ± 6 years), Zisberg et al (2011) found that in-hospital mobility was an important modifiable factor related to functional decline in older adults in immediate and short-term (1 month follow-up) functional outcomes. Among patients with low mobility levels, there was an associated worsening of basic functional status at discharge, with an adjusted odds ratio (AOR) of 18.03 (95% CI = 7.68 – 42.28), and at 1 month follow-up (AOR) = 2.00, 95% CI = 1.05 – 3.78). Another study conducted by Zisberg et al (2015) investigated the combined contribution of processes of hospitalisation and preadmission individual risk factors in explaining functional decline at discharge and at 1 month follow-up among older adults with non-disabling conditions[71]. In this study (n=684, mean age 78.9 ± 5.8 years), the authors conducted path analysis which demonstrated that low mobility in hospital (standardized maximum likelihood estimate (SMLE) = -0.48, $P < 0.001$) and suboptimal continence care (SMLE = -0.12, $P < 0.001$) were directly related to functional decline at discharge. McCullagh et al (n= 154, mean age 77 years ±7.4) explored the

association between mobility levels in hospital and length of stay and found that increased walking during hospital stay was associated with a shorter length of stay[87]. These studies demonstrate that low physical activity levels among older people in hospital are associated with multiple adverse outcomes including functional decline, prolonged hospital stay, increased risk of nursing home admission, and death. The mechanism behind physical inactivity leading to functional decline is complex and multifactorial[88]. To demonstrate the complex process of how physical inactivity may lead to functional decline, a theoretical model was developed based on existing evidence (Figure 2).

Figure 2 Theoretical model for the link between physical inactivity and functional decline



There are multiple factors which may contribute to reduction in physical activity among older inpatients. In a busy clinical setting, a lack of nursing and therapy staff to assist with mobility may contribute to low physical activity levels among patients. This is supported by a survey conducted by the Royal College of Nursing which reported that 59% of nurses felt that promoting mobility was one of the aspects of care reported to be most frequently neglected due to time pressures[89]. A lack of understanding of the importance of maintaining and increasing physical activity in

hospital among healthcare professionals may also be an important factor. In a UK study of 44 inpatients at an urban hospital, only 11% of the patients recalled receiving advice from any healthcare professional to stay physically active[90]. Similarly, another study reported that only 27% of respondents recalled being encouraged by hospital staff to exercise[91].

Other recognised factors contributing to inpatient sedentary behaviour include acute illness, delirium, physical restrictions such as urinary catheters and intravenous lines, poor nutrition, hostile environment, isolation, and deconditioning[32,92,93]. Medications such as neuroleptics and sedatives may also contribute to a reduction in physical activity levels. Barriers to increasing in-hospital mobility commonly described by patients, nurses and doctors were symptoms of weakness, pain and fatigue, and concern about falls[94]. In Ottawa Hospital, Canada, focus groups were conducted among researchers, educators and front-line staff members to determine barriers to mobilisation[95]. Environmental factors such as insufficient space in patient rooms, obstacles in the hallways, lack of designated exercise space, and lack of equipment were perceived barriers to mobility. Among staff members, other barriers to mobilising patients included lack of staff and time, too many competing new initiatives, lack of awareness of their role in mobilising patients, and low morale: 'things are never going to change'. Depression is also a common occurrence among hospitalised older inpatients[96]. Older inpatients with low mood are also less likely to be physically active and thus at risk of functional decline[97]. A combination of the above factors ultimately results in a reduction in physical activity levels among hospitalised older people.

Previous studies have explored the effects of bed rest on older people. Kortebein et al (2007) examined the effects of 10 days of bed rest in healthy older adults (n =12, mean age 67 ± 5 years) on skeletal muscle[98]. Participants were subject to 10 days of continuous bed rest except for toileting while consuming a eucaloric diet providing the recommended dietary allowance for protein (0.8g/kg of protein per day). Lean body mass was measured by dual-energy x-ray absorptiometry (DEXA) and findings from this study showed a loss of 1.5kg (CI -0.62 – -2.48, $P < 0.04$) in whole body lean mass in this group of patients after 10 days of continuous bed rest. Further work by Kortebein et al (2008) also showed that in patients who were subject to 10 days continuous bed rest, there was a reduction in isotonic knee extensor strength (-13.2 ± 4.1%, $p = 0.004$), stair-climbing power (Power = (Distance/Time) x Weight) (-14 ± 4.1%, $p = 0.01$) and a reduction in maximal aerobic capacity (VO_{2max}) by 12% ±4.5 ($p = 0.04$)[99]. Findings from these studies confirm the adverse effects of prolonged bed rest on muscle mass and function. While these findings cannot be directly extrapolated to chronically ill and frail older people, the pronounced effect of bed rest on patient's skeletal muscle is likely to be more substantial in

hospitalised older people given the physiological stress and catabolic state these patients are in due to acute illness and other factors associated with hospitalisation.

A study among 5063 community-dwelling older men and women age >65 years in the US explored the relationship between sarcopenia and disability in this population[100]. Using bioimpedance analysis, subjects were classified as having normal muscle mass, moderate sarcopenia or severe sarcopenia based on established disability-related skeletal muscle index thresholds[101]. Findings from this population-based study showed that severe sarcopenia was a modest independent risk factor for the development of physical disability. Given the high prevalence of sarcopenia among hospitalised older people (22 – 26%)[102-104], there is an increased vulnerability in the development of disability among this population[105,106]. Sarcopenia and frailty are examples of premorbid conditions shown in figure 2.

The loss of muscle mass during bed rest is likely to be driven by a reduction in muscle protein synthesis[98,107,108]. A study conducted by Volpi et al examined the response of muscle protein anabolism in healthy young (30 +/- 3 yr) and older (72 +/- yr) volunteers following administration of a simulated protein/carbohydrate mixed meal[109]. The study showed that muscle protein breakdown did not change in either age group. Moreover, an increase in muscle protein synthesis was observed in the young, but remained unchanged in the older subjects, leading to the conclusion that the response of muscle protein anabolism to amino acids and endogenous insulin (a potent anabolic stimulus) is impaired in healthy older adults due to unresponsiveness of protein synthesis. This finding suggest that anabolic resistance is a principal determinant of loss of muscle mass in older people.

Among hospitalised older people, several other factors can exacerbate the adverse effects of physical inactivity, resulting in functional decline. This include malnutrition[110], increased stress response (hypercortisolemia) secondary to the underlying injury or illness[107], and increased inflammatory response. These factors, combined with a decrease muscle protein synthesis ultimately results in accelerated loss of muscle mass. Importantly, studies have also shown that the loss of muscle mass associated with prolonged bed rest predominantly affects the lower body musculature[111-113], the functions of which are key for frail older people to maintain the ability to carry out important functional tasks such as bed transfers and mobilising.

Overall, these studies demonstrate the detrimental impact of low inpatient physical activity on hospitalised older peoples' functional outcomes, independence and mortality. What is more important is that this is potentially a modifiable risk factor and efforts must be made to encourage older people in hospital to remain active to reduce their risk of adverse outcomes.

1.6 Current evidence to improve inpatient physical activity levels

A study conducted in Switzerland involving 24 sedentary healthy volunteers (age 60 – 80 years) showed that an aerobic exercise programme, involving 16 weeks of supervised moderate intensity aerobic sessions in the gym, was associated with reduction in the loss of skeletal muscle mitochondria content, leading to the hypothesis that it may prevent ageing muscle comorbidities such as sarcopenia and insulin resistance[114]. In this study, the aerobic exercise programme involved engaging in at least three supervised sessions in the gym where participants could either bike, walk, run or row within their heart rate target range, with moderate intensity defined as 75% of the subjects' heart rate. There is also evidence to suggest that targeted exercise interventions in hospital may be beneficial to older inpatients. A systematic review was conducted in 2006, which included 7 randomised controlled trials and 2 controlled clinical trials to examine the effects of exercise on acutely hospitalised older medical patients[115]. Pooled analysis of multidisciplinary interventions that included exercise indicated a small significant increase in the proportion of patients discharged to their own home (Relative Risk 1.08, 95% CI 1.03 – 1.14) and a small reduction in acute hospital length of stay (weighted mean difference, -1.08 days, 95% CI -1.93 to -0.22 days).

A systematic review conducted to examine the efficacy of an early mobilisation protocol in hospitalised medical and surgical patients, found that among patients with deep vein thrombosis, older medical patients, and patients with lower-limb amputations, there was evidence of improved physical functioning, reports of less pain, enhanced well-being and/or lower length of hospital stay[116]. In the US, the impact of a nurse-driven mobility protocol on patient mobility was explored[117]. 51 medical inpatients with a mean age of 80 years were recruited to this study. The intervention involved nursing assistants walking patients three to four times a day, assisting patients to the chair for meals and bathroom or commode for toileting. As part of the mobility protocol, the nurse was directed to question orders for bed rest as well as routinely evaluate the necessity of obstacles to mobility such as urinary catheters. The intervention showed that patients were mobilised in the ward corridor earlier at 2.7 days, compared to the control group at 4.9 days ($p=0.07$). The frequency of ambulation in the corridor was also higher in the treatment group (3.1 episodes vs 2.4 for the control group) and they had a significantly shorter length of stay. (5 days treatment vs 8.7 days control; $P< 0.001$).

Said et al evaluated the feasibility of a randomised control trial of enhanced physical activity in older adults receiving in-hospital rehabilitation and demonstrated that the protocol was feasible[118]. Patients were randomised to receive usual care (n=25) or usual care plus additional physical activity delivered by a physiotherapist and physiotherapy assistant once or twice during

the weekday and twice during the weekend. The feasibility study found that physical activity targets were met on weekdays but not weekends. The protocol for the randomised control trial has since been published and the trial is currently ongoing and is yet to be reported[119]. Studies have also shown that implementing mobility interventions among hospitalised patients can increase inpatient mobility[120], reduce the risk of thromboembolism[121], and reduce overall hospital length of stay[122].

A randomised controlled trial involving 71 stroke patients conducted in Australia showed that an early mobilisation intervention may reduce depressive symptoms of stroke patients at 7 days post-stroke[123]. In this study, the intervention was delivered by a nurse and physiotherapist team for the first 14 days post-stroke or until discharge and patients were assisted to be upright and out of bed at least twice per day, in addition to usual care. A systematic review also reported that early physical rehabilitation care for hospitalised older people improved functional outcomes, and reduced the likelihood of discharge to nursing home[124]. These studies show that targeted interventions to improve patients' in-hospital mobility and physical function can be beneficial to older patients in maintaining their independence and reducing their length of stay in hospital, and may also have economic benefits.

Studies have shown that early mobilisation of hospitalised older people can result in positive outcomes including reduction in length of hospital stay[125] and reduction in admission to nursing homes[126]. A large multi-centre study examining the effectiveness of an early mobilisation intervention for hospitalised older people conducted by Liu et al demonstrated a reduction in median length of hospital stay of 3.45 days (95% CI -6.67, -0.23)[125]. Nonetheless, early mobilisation may not necessarily be appropriate in all clinical settings. A study conducted by the AVERT Trial Collaboration group examined the efficacy and safety of very early mobilisation of stroke patients within 24 hours of stroke onset[127]. Findings from this randomised controlled trial (n = 1054, median age 72.3 years, IQR 62.3 – 80.3) showed that fewer patients in the early mobilisation group had a favourable outcome (modified Rankin Scale scores of 0-2, which indicates no or minimum disability) at 3 months compared to patients in the usual care group. Subgroup analyses showed that patients with severe stroke and with intracerebral haemorrhage had reduced odds of favourable outcome by 3 months if treated with the very early mobilisation protocol. Findings from the well-designed study suggests that early mobilisation interventions must be administered to appropriate patients. Among hospitalised medical older people, current evidence suggests that early mobilisation can have many beneficial outcomes as discussed in the preceding paragraphs.

There is currently no evidence to suggest a dose-effect of mobility intervention frequency on health outcome measures. Frequency of mobility interventions from the above studies varied between three to four times per week up to four times per day. Nonetheless, the consistent message conveyed by these studies is the harmful effects of in-hospital sedentary behaviour and that an increase in physical activity in hospital may produce positive health outcomes as described.

Identifying changes in the hospital care process to encourage increased physical activity is important to prevent functional decline in older patients. Encouraging patients to increase physical activity levels in hospital requires multidisciplinary team working, involving doctors, therapists, nurses and other healthcare team members to create a culture in the hospital setting which promotes increased physical activity. Many physical activity intervention studies as described above, have employed paid staff such as nurses, nursing assistants and therapists to deliver the intervention. In the following sections, I will discuss about the valuable contributions that volunteers bring to healthcare organisations and explore the evidence regarding the use of volunteers to deliver physical activity interventions.

1.7 The role of volunteers in healthcare

1.7.1 Volunteering in Healthcare

Volunteering can be defined as an activity that is freely chosen, does not involve remuneration and helps or benefits those beyond an individual's immediate family[128]. Rather than a spontaneous help given to someone in an emergency situation, volunteering is typically proactive rather than reactive and entails some commitment of time and effort[129]. In England, it is estimated that up to 3 million people are involved in voluntary work within health and social care, both in the voluntary sector and within public services[130]. Approximately 1.9 million volunteers are involved in volunteering among older people. Volunteers are involved in a variety of roles including participation in planning, consultation, advice and research in health[131], service delivery[131,132], supporting clients through lifestyle changes[133,134], respite care and support[131,135], fundraising and administration[135,136] and much more[137]. In the Kings Fund report on volunteering in health and care in England, the most common settings for volunteer support were hospices, community settings and hospitals[137].

1.7.2 What motivates people to engage in voluntary activities?

Volunteers engage in various voluntary work for different reasons. Clary and Snyder explored what motivates individuals to volunteer and proposed six functions served by volunteering: values, understanding, enhancement, career, social and protective[138]. Table 2 is adapted from Clary and Snyder's work to further elaborate the six functions.

Table 2 Functions served by volunteering

Function	Definition
Values	The individual volunteers in order to express or act on important values like humanitarianism.
Understanding	The volunteer is seeking to learn more about the world or exercise skills that are often unused.
Enhancement	One can grow and develop psychologically through volunteer activities.
Career	The volunteer has the goal of gaining career-related experience through volunteering.
Social	Volunteering allows an individual to strengthen his or her social relationships.
Protective	The individual uses volunteering to reduce negative feelings, such as guilt, or to address personal problems.

*Adapted from Clary and Snyder 1999[138]

Individuals may volunteer for altruistic reasons and/or may have other motivations such as developing their social network, gaining new skills, and career development. Regardless of the underlying reason, volunteering can bring many benefits to the recipient as well as the organisation. The King's fund report highlighted some of the potential benefits to the recipients of volunteering such as improved wellbeing, reduced social isolation, improved disease management and acceptance, improved mental health, adoption of healthy behaviours, concordance with medical treatment and improved relationships with health care professionals[137]. There are also various benefits volunteering can bring to the organisation such as increasing quality in the

services or system, reducing healthcare costs, diversifying the health and social care workforce, provision of innovation and fresh perspectives to the organisation.

1.7.3 Benefits of volunteering

Studies have also shown that volunteering had very positive health and wellbeing outcomes for those who under took it[137]. Several studies have shown that older people who volunteer or still work, were found to be less depressed, had better cognitive functioning than those who did not engage in voluntary activities, as well as higher mental wellbeing and life satisfaction[139-145]. One study examined the association between volunteering and healthcare use and found that among 7168 participants (mean age 69, SD 9.8), participants who engaged in voluntary activities were more likely to use preventative healthcare services such as flu vaccine, cholesterol tests, mammograms, pap smears and prostate examination[146]. Volunteers were also more likely to have shorter hospital stays compared to non-volunteers (RR 0.62, 95% CI 0.52 – 0.76). Volunteering helps develop skills, connections and networks. It also contributes to avoiding boredom, and helps in keeping fit and healthy. Social interaction is an important aspect of volunteering and for many volunteers, this is one of the perceived benefits of volunteering. The volunteer can make new friendships, develop a more positive sense of self-worth, and gain an improved sense of community[131,135,147]. In one study, volunteering was also shown to be associated with reduction in mortality risk after 4 years ($\beta = 10.66$, $p < 0.001$) (odds ratio = 0.52, 95% confidence interval = 0.38 – 0.71), with the effect strongest for those who volunteered most regularly[148].

1.7.4 Complement or substitute

While volunteering may bring multiples benefits to the organisation, the volunteers and its recipients, there is potential for stress to emerge on the boundaries between professionalism and volunteerism. One common tension in a mixed workforce (paid and unpaid) setting is that paid workers may see volunteers as a threat to their own position in the organisation[149]. Particularly in circumstances where volunteers bring in valuable experience and credentials, paid staff may feel threatened in their job role[150]. Some evidence suggests that this might be more prominent among low-paid workers[151,152]. The tension between paid and unpaid staff can be observed in non-profit organizations, where volunteers are more intensely relied on, and often work alongside paid staff. This raises the question of whether volunteers complement or substitute the role of paid staff.

Voluntary work is considered complementary when paid and unpaid workers assume different tasks within the organizations. In circumstances where paid employees and volunteers perform similar duties such that volunteers can replace paid staff, this is said to be substitution[153]. The role

of volunteers are often diverse and not always distinct from paid workers' roles[154,155]. A survey conducted by Handy et al among 661 non-profit organisations in Canada showed that 25.5% of the organisations agreed that "some activities carried out by volunteers today were performed by paid staff in the past"[154]. 14.9% of the organisations also agreed that "there are worker/union concerns about volunteers replacing paid staff". On face value, it could be argued that in situations where volunteers and paid staff are performing the same functions, this represents de facto evidence of substitution. However, interestingly the survey also showed that 54.7% of the organisations agreed that "some activities that are carried out by paid staff today were performed by volunteers in the past". These findings suggests a more complex relationship between paid and unpaid staff rather than a binary concept of complementing or substituting. To describe the complex relationship between volunteers and paid staff, the authors of the study proposed a model of interchangeability of tasks among paid staff and volunteers that is influenced by organisational demand and volunteer labour supply. The substitutional and complementary role of volunteers differ depending on the nature of the organisation and the specific tasks to be performed[153].

Many NHS trusts have an established volunteer workforce who fulfil a number of important roles including serving in cafes, greeting patients and visitors, helping them with directions, and running other hospital-related services such as radio and books distribution, befriending services, and fundraising. In a report published by The King's Fund, a survey conducted among 95 hospital trusts in England showed that on average, acute trusts have 471 volunteers[156]. This equates to more than 78,000 volunteers across all acute trusts in England who are contributing more than 13 million hours per year. Volunteers are increasingly perceived as an integral part of the care team in hospital and play an important role in improving patient experience in hospital[130]. A large proportion of the voluntary roles offer help and support to the organisation and patients but increasingly there is awareness that volunteers can be involved in direct patient care when properly trained. The Southampton Mealtime Assistance Study (SMAS) has shown that trained volunteers were highly valued by patients and ward staff in their assistance at mealtimes[157]. In this study, volunteers were involved in direct patient care and examples of their role included encouraging patients to eat, opening packets and setting up the meal tray, cutting up food, helping guide the food to the patient's mouth and feeding patients.

In the acute hospital setting, as volunteers and paid staff members work more closely together, careful considerations must be made regarding the sensitive issue of complementing and substitution of roles. This is to ensure that the valuable contribution of volunteers is not undermined and paid staff members do not feel threatened in their job role. Good working relationship between paid staff and volunteers will only enhance the quality of care given to

patients. A survey conducted by the Institute for Volunteering Research among paid staff in a tertiary hospital in the UK explored the impact of volunteers on staff members[158]. 94% of respondents reported that they were satisfied with the quality of services provided by volunteers and 86% reported that they were satisfied with the quantity of services provided by volunteers. These findings suggest that majority of paid staff in the trust appreciated the work that volunteers do. Yet, there is still a minority of staff members who felt that volunteers were substituting the work of paid staff. 21.2% of respondents felt that volunteers took the place of paid staff within the trust. However, the fear of job substitution also resonates among volunteers as reflected in a quote from a volunteer who was interviewed as part of a report on volunteering in health and care by The King's Fund: '*Am I encouraging cuts in the NHS because I'm volunteering*?' Another volunteer was quoted to say: '*If it should be the case that volunteers are preferred to full-time staff and full-time staff lose their jobs, I am off, I am absolutely off*'. These studies highlight the importance of careful considerations being made within trusts to ensure the job role of volunteers serve to enhance the work that staff members do, rather than replace. The key question that needs to be asked when identifying a new role for volunteers is this: 'If the volunteer was unable to attend, would the core activities of the service cease?' If the answer to the question is yes, then it is clear that volunteers are replacing the roles which should be carried out by staff members.

In the acute hospital setting, physiotherapists and occupational therapists are skilled to assess and progress patients in their physical function and mobility. However, every staff member has the responsibility to encourage patients to be more mobile and active. Given that one of the commonly cited barriers to mobilising patients is the lack of staff and time, the use of volunteers in the role of promoting increased physical activity may help address this issue. One important contribution of volunteers to the healthcare setting is time. The time given to volunteering in a particular role, especially in roles which involve direct patient contact, may free up more nursing and therapy time to concentrate their resources on other aspects of clinical care. In the following section, I explore the use of trained volunteers to encourage older people in hospital to be more active.

1.8 Impact of volunteers on physical activity of older people in hospital

Whilst several studies have aimed to improve physical activity levels and mobility of patients in hospital[118,120-122,159], few studies have explored the use of trained volunteers to mobilise and promote physical activity in this setting. I co-authored a systematic review which was conducted to review current evidence regarding the use of volunteers to mobilise older people in hospital[160]. Two scientific studies and 3 reports on quality improvement initiatives were identified in the review.

The Hospital Elder Life Programme (HELP)

The Hospital Elder Life Programme is a model of care designed to prevent delirium and functional decline among hospitalised older patients[161-163]. The programme involves multidisciplinary staff and trained volunteers in the delivery of its protocols addressing six risk factors for delirium including orientation, therapeutic activities, early mobilisation, vision and hearing protocols, oral volume repletion and sleep enhancement. The early mobilisation protocol involves ambulation or active range of motion exercises performed three times daily. The programme has been demonstrated to be effective in preventing and managing delirium and functional decline across multiple sites[164] but the mobilisation protocol has been reported to be implemented less often and less completely than the other protocols (for example 84% for mobilisation protocol versus 96% for orientation protocol)[162]. It is also unclear to what extent volunteers have delivered the protocol rather than other health care professionals. Indeed a replication of the HELP programme in New Jersey omitted the early mobilisation intervention due to staffing limitations[165]. Similarly, a study in Taiwan which implemented the HELP programme on surgical wards employed staff members to deliver the interventions due to volunteer shortages[166].

In the UK, the principles of the HELP have been adopted in a delirium prevention study conducted by Young et al, which is currently ongoing[167,168]. The protocol for the randomised controlled feasibility trial published in 2015, described the intervention as a Prevention of Delirium Programme (POD) system of care[167]. The POD system of care included mobility as one of the aspects of care delivered and the study highlighted that the POD system of care could potentially be enhanced by the involvement of hospital volunteers. However, no clear description of the role of volunteers was provided.

Mobilisation of Vulnerable Elders in Ontario

The MOVE ON (Mobilisation of Vulnerable Elders in Ontario) project aims to improve the mobility of older inpatients to prevent functional decline[120,125]. The mobilisation protocol in this study involved the implementation of a progressive, scaled mobilisation of participants at least three

times a day as well as a mobility assessment and care pathway within 24 hours of admission. Two hospitals involved in this project were reported to be using volunteers in addition to paid staff, however the exact involvement of volunteers in the protocol was not detailed in the published literature[159].

The Footprints Walking Program

This program was implemented as a clinical quality improvement initiative in an acute hospital in the US with the aim to maintain mobility and prevent deconditioning during hospital stay[169]. 50 volunteers were trained to assist adult inpatients in walking sessions daily. The project outcome reported increased patient and staff satisfaction and reduced length of hospital stay. However, this programme was just one of many hospital-wide clinical service improvements and as such the outcome cannot be attributed solely to the volunteer-assisted mobilisation program.

ACTIVe Program – Aged Care Therapeutic interventions by Volunteers

The ACTIVe program involves the use of trained volunteers to provide 4 main interventions including meal assistance, mobility assistance, companionship and therapeutic activities[170]. This program was developed in one acute ward for older people at an Australian hospital with the aim of improving patients' experience and preventing functional and cognitive decline. Each volunteer provided a minimum of 4 hours per week of volunteer time to assist in the interventions. The mobility assistance protocol was not detailed in the report. The findings of the program include a reduction in the frequency of one to one nursing care required for patients at risk of falls and those with delirium, greater family involvement in patient care whilst in hospital as well as increased patient and staff satisfaction.

Mobility is Medicine

Mobility is Medicine is a pilot project that was implemented in 2011 on two acute care medical nursing units in a hospital in the US with the aim of creating a cultural change on the units and promoting the importance of patient mobilisation[171]. 5 volunteers were recruited and trained to independently mobilise patients deemed safe by the therapist or nurse, assist nursing and therapy staff to mobilise patients requiring more than one person assistance, and to prepare patients for planned mobilisation and exercise sessions. The intervention was not formally evaluated but the authors reported improvements in nursing documentation of patient mobilisation, patient reported mobilisation, and observed discussion of patient mobilisation by nursing staff in handover meetings as well as positive patient and staff perceptions of the programme.

The review demonstrated a lack of scientific studies examining the role of trained volunteers in encouraging older people in hospital to keep active. The best evidence comes from the HELP programme, a well-designed and evaluated clinical controlled trial. In this study, the aim of the intervention was delirium prevention and mobility was one aspect of a more complex care provided primarily by volunteers and but also by paid staff. Smaller quality improvement studies have demonstrated the feasibility of using volunteers to promote increased physical activity among older people with positive outcomes among patients and staff members.

1.9 Summary of the evidence

Several studies have shown that physical activity levels of older inpatients were low[35,47]. This is associated with poorer outcomes including a reduction in ADL and IADL scores, high risk of institutionalisation and increased mortality[36]. There is encouraging evidence to suggest that exercise or mobility interventions can improve patient outcomes[172]. However, all of these studies have used paid staff, including nurses, physiotherapists and occupational therapists, to deliver the interventions.

Volunteers play a huge role in contributing to the society. It is estimated that up to 1.9 million volunteers work among older people. Beyond the traditional roles of volunteering, such as fundraising, providing respite and support, administrative roles, and befriending services, there is increasing evidence that volunteers can be involved in direct patient care. The Southampton Mealtime assistance study has shown that volunteers can be trained to assist patients during mealtimes safely[157].

There is currently little evidence regarding the use of trained volunteers in delivering physical activity interventions. The best evidence came from the HELP study, a well-designed and evaluated clinical controlled trial which evaluated a multi-component intervention to prevent delirium among hospitalised older people[173]. Trained volunteers delivered six aspects of care: orientation, therapeutic activities, early mobilisation, vision and hearing protocols, oral volume repletion and sleep enhancement. The HELP programme has been shown to be effective in preventing delirium and reducing the risk of functional decline. However, the mobilisation protocol has been reported to be implemented less often and less completely than the other protocols. There is currently a lack of evidence on the use of trained volunteers in delivering physical activity intervention to older people in NHS hospitals.

1.10 Aims of the study

This study aims to explore the feasibility and acceptability of using trained volunteers to promote increased physical activity among older patients in hospital. The hypothesis is that it is feasible to train volunteers to carry out the intervention, and that the intervention will have a positive impact on the physical activity levels of older inpatients and may be beneficial in maintaining their physical function and prevent decline in ADL. Findings from this study will form the basis of a future controlled trial.

The specific objectives are:

1: To measure the physical activity levels of hospitalised older people using two accelerometers: the ankle-worn StepWatch Activity Monitor, and the wrist-worn GENEActiv,

2: To develop a training programme to enable volunteers to mobilise older people safely and promote bedside exercises for less mobile patients,

3: To implement the volunteer-led intervention on three study wards and to assess its feasibility, including recruitment, training and retention of volunteers, as well as patients' adherence to the intervention,

4: To determine if the use of trained volunteers to promote physical activity of older patients in hospital is acceptable to patients, nursing staff, therapists and volunteers, and

5: To perform cost-analysis for the volunteer-led intervention.

Chapter 2: Methods

2.1 Study design

Feasibility studies are used to determine whether an intervention is appropriate for further evaluation, to determine sample sizes for controlled trials and to assess whether or not the ideas and findings can be shaped to be relevant and sustainable[174]. In this prospective observational before and after study, the feasibility of using trained volunteers in an acute medical setting to promote increased physical activity among older people was assessed using both quantitative and qualitative measures. The feasibility study was conducted on three wards on the Medicine for Older People department, with no control ward. A control ward was not possible as there was only one male ward in the department, which was part of the three study wards. Data collected before the implementation of the intervention provided a description of usual care.

The first phase of this study was the measurement of baseline physical activity of patients on the three study wards. The second phase of the study involved developing and implementing the training programme for volunteers. The next phase of the study was the implementation of volunteer-led physical activity session on the three study wards. Finally, the acceptability of the intervention was assessed through interviews and focus groups to explore the views and experiences of patients, volunteers and healthcare professionals involved in this study. Statistical analysis was conducted to explore the effects of the intervention on several outcome measures including physical activity levels of older inpatients, physical function as well as receipt of care in hospital such as length of stay, discharge destination, and readmission within 1 month. As this was a feasibility study, it was not powered to show any statistical difference in the outcome measures. However, findings from this study will determine the sample size for a future trial. A cost-analysis was also conducted, costing the time of clinical staff involved in the designing and delivering of training for the volunteers.

Relevant stakeholders and key opinion leaders were engaged in the development of the study protocol and played an important role in the implementation the intervention. Further information regarding the involvement of key stakeholders can be found in section 2.6. The training programme and implementation of the intervention was informed by data from a survey of 92 older people[175] and a focus group conducted with volunteers which identified some barriers and facilitators to its implementation. Minor changes were made to the PowerPoint presentation for the volunteer training programme and some changes were made to the exercise sheets to make it clearer for the volunteers and patients.

2.2 Study population and setting

This study was conducted on three wards in the Medicine for Older People department at the University Hospital Southampton NHS Foundation Trust. Two of the wards were female and male wards respectively and the third ward provided care for female and male patients with complex discharge plans. The inclusion criteria for this study included patients aged 70 years and above, who were deemed appropriate by the medical team and therapists to receive a physical activity intervention by trained volunteers and were able to mobilise with or without a walking aid prior to hospital admission. The exclusion criteria were as follow: patients who were immobile prior to admission; patients who were in a side room for infection control reasons; palliative care patients; patients deemed inappropriate for the physical activity intervention by the medical or therapy teams and patients who were not able to provide valid written consent.

Eligible patients were introduced to the study by ward nurses and the therapy team and those who were interested in the study were approached by me for a more detailed explanation regarding the study. Information sheets were given to eligible patients and written informed consent was obtained from all patients who agreed to participate in the study. Upon recruitment, an entry was made in the medical notes to inform the medical team regarding the patient's participation in a research study. A copy of the information sheet and consent form were given to the participant and a copy of the patient information sheet and consent form were filed in the patient's medical notes. A formal letter was sent out to every consultant in the Medicine for Older People department prior to the commencement of the study to inform them about the potential recruitment of their patients to a research study and all consultants were in agreement for their patients to be considered for recruitment into the study.

2.3 Data collection for patient participants

An observational cross-sectional study was conducted to measure the physical activity levels of older people in hospital receiving usual care. 50 participants were recruited to have their physical activity levels measured using two accelerometers, the StepWatch Activity Monitor and the GENEActiv. Demographic data including age, marital status, smoking and alcohol history, usual residence, care received, medical history, and medications were recorded. Participants' physical function, cognition, mood and details regarding receipt of care were also recorded. A more detailed description of each measure is provided below.

2.3.1 Physical activity measures

2.3.1.1 StepWatch Activity Monitor

Based on the review of current literature, the StepWatch Activity Monitor was found to be the most accurate step counter among frail older people. Upon recruitment, participants were given the water-resistant accelerometer which was worn on their preferred ankle. Participants with significant peripheral oedema or peripheral vascular disease were not given the SAM.

The recording of step counts was set at 60 second intervals. Participants' gender, age, height and weight were entered into the device. To calibrate the device, a range of options under 4 categories (Quick Stepping, Walking Speed, Range of Speeds and Leg Motion) were available (Table 3). Participants' mobility were either observed or self-reported and the description which best describes each participant was selected by myself to tailor the sensitivity of the device individually.

Table 3. Device calibration options

Patient characteristics	Options available
Quick Stepping	• Yes • No
Walking Speed	• Fast • Slow • Normal
Range of Speeds	• Regularly engages in both extremes • Uses a moderate range of speeds • Rarely varies pace
Leg motion	• Fidgety and/or dynamic • Normal • Gentle and/or Geriatric • Severely Impaired

In both the pre-intervention and intervention phases, the SAM (Figure 3) was fitted on the ankle of each participant upon recruitment. In the intervention phase, the volunteer-led activity session would take place typically a day after the device is put on. The device was removed at the end of seven days, or upon discharge, if length of stay was less than seven days or if the patient was unable to tolerate it. The total number of steps taken by each participant over several days was calculated as a mean of the number of steps taken over a 24 hour period, expressed as mean daily step count. The total number of steps taken was divided by the number of valid 24 hour recordings. Recordings that had less than 24 hours were excluded as a calculation of the mean daily step count was not possible.

Figure 3. The ankle-worn StepWatch Activity Monitor

2.3.1.2 GENEActiv

Apart from mobilising around the wards, participants in the intervention group were also engaged in bed or chair-based exercises. In order to capture this, participants were given another device called the GENEActiv (Figure 4). The GENEActiv is a waterproof tri-axial accelerometer which is worn on the wrist. It provides raw data output that is time stamped. It contains a temperature sensor which enables researchers to determine wear time. In both the pre-intervention and interventions phases, the GENEActiv was fitted on the non-dominant wrist of each participant upon recruitment. In the intervention phase, the volunteer-led activity session would take place typically a day after the device is put on. The device was placed on the opposite wrist if the non-dominant wrist of the participant was injured or if there was presence of an intravenous cannula. The device was removed at the end of seven days, or upon discharge if length of stay was less than seven days or if the patient was unable to tolerate it.

Participants' activity levels were measured in terms of acceleration against gravity, with the unit measurement of milligravity (mg). Using the statistical software 'R' version 3.3.1 and Microsoft Access 2013, the raw data produced by the GENEActiv recording was converted into clinically

relevant outcomes to measure physical activity intensity defined as 40mg sustained for 1minute, 40mg sustained for 5minutes, and 40mg sustained for 10minutes, as well as mean daily acceleration. The programme designed to analyse the raw data was co-written by a statistician (Leo Westbury) and a colleague in the research department (Dr Richard Dodds) and was originally used in a study among community-dwelling older people[176]. For this study, Dr Richard Dodds has kindly offered the use of the programme to analyse the raw data from the GENEActiv accelerometer. He offered assistance in troubleshooting the programme as well as analysing the data.

In a study involving 7456 healthy community-dwelling adults (mean age 55.9 years, SD 6), the cut-off point used for moderate-vigorous physical activity was 100mg sustained for 10min[177]. In that study, the cut-off point of 100mg was chosen based on a study among 30 adults aged between 18 – 65 which showed that 100mg was equivalent to walking at 1.1m/s under laboratory settings[178], which is generally considered to moderate- vigorous physical activity[179]. In another study, 33 adults (mean age of 27.4 years, SD 5.9) were given the wrist-worn GENEActiv device and asked to perform 16 different sedentary to light activities ranging from lying flat on the back to walking at a self-paced free living walk around the room[180]. The mean acceleration for all sedentary behaviours which included lying and sitting down was 10.9mg (Standard Error (SE) of 0.4). The mean acceleration for walking at a self-selected paced in a free living environment was 110.9 (SE 5.6). There is currently no established cut-off for moderate-vigorous physical activity in older adults[177].

Figure 4 GENEActiv

2.3.1.3 Device acceptability

To determine the acceptability of both devices, participants were given a simple questionnaire to answer upon removal of the devices. Participants' feedback regarding the comfort of the each device and whether it interfered with their daily living were explored.

Figure 5 Device acceptability questionnaire

Participant ID:

1. Did you wear the StepWatch Activity Monitor?

   ❑ Yes ❑ No

2. Was the device comfortable to wear?

   ❑ Yes ❑ No

   If no, please explain:

3. Did you wear the GENEActiv?

   ❑ Yes ❑ No

4. Was the device comfortable to wear?

   ❑ Yes ❑ No

   If no, please comment:

5. Did the devices interfere with the following activities? (Yes/No)

StepWatch Activity Monitor		GENEActiv	
Washing		Washing	
Sleeping		Sleeping	
Dressing		Dressing	
Walking		Walking	
Personal hygiene		Personal hygiene	

2.3.1.4 Accuracy of the StepWatch Activity Monitor

To determine the accuracy of the SAM in measuring step count in this group of patients, 13 participants who were recruited to the study and were able to walk independently were given the SAM and were asked to walk for 40m and I observed and recorded their step count. This allowed comparison between observed and measured step count to determine the accuracy of the device. The SAM was then removed and a new device was put on for continuous monitoring.

2.3.1.5 Validation of the GENEActiv

There are currently no studies describing the bouts of acceleration of hospitalised older people. One study used the GENEActiv accelerometer to measure the physical activity levels of 10 older inpatients (mean age 76 years) but the outcome measure used was posture rather than acceleration[46]. Community studies as outlined in sections 2.3.1.2 have established a cut off for sedentary behaviour at 10.9mg and for moderate-vigorous activity, at 100mg. A validation study for the accuracy of the GENEActiv was not conducted as I did not have the required programming skills to rewrite or amend the original programme used to analyse the GENEActiv data. An arbitrary cut off of 20mg was chosen based on analysis of the baseline data which will be described in section 3.4. This study will provide a description of the pattern of activity undertaken by hospitalised older people measured in bouts of acceleration.

2.3.2 Physical function measures

The following section outlines the physical function measures which were included in this study. These measures are well validated clinically and together capture physical function, strength, functional ability and mobility.

2.3.2.1 Barthel Index

The Barthel Index (Appendix 4) is a measure of functional abilities and is commonly used in clinical and research settings[181]. It has been recommended by the Royal College of Physicians and British Geriatrics Society for routine use in the assessment of older people[182]. It measures activities of daily living including transfers, walking, stairs, toilet use, dressing, feeding, bladder control, bowel control, grooming and bathing, to give a maximum total score of 100. The inter-rater reliability of the Barthel Index was assessed in a study conducted by Richards et al (95 participants, median age 79 years, IQR 73 – 84) and found to be within acceptable boundaries (mean difference -0.25 with limits of agreement -3.22 to +2.27)[183]. One disadvantage of the Barthel Index is that is has a ceiling effect at hospital admission and hospital discharge[184]. Other tools have previously been used to measure functional abilities of hospitalised older people. One such example is the

Functional Independence Measure (FIM), which was designed to assess abilities to carry out activities of daily living using an 18 item 7-scale questionnaire[185]. It is commonly used in research and clinical settings particularly in rehabilitation settings. The FIM also suffers from a ceiling effect but has been reported to have a high interrater reliability (0.95) and test-retest reliability (0.95)[186]. Another available functional measure tool is the Katz Activities of Daily Living Scale. This tool was developed to measure treatment and functional changes in chronically ill and older people with six index measures: bathing, dressing, toileting, transfers, continence and feeding[187]. However, there is very little evidence regarding the validity and reliability of the Katz ADLs index[186].

The Barthel Index is one of the most widely used measure in research as well as in clinical practice. In a study comparing the frequency and patterns of use of the BI and FIM in stroke rehabilitation trials, Sangha et al found that BI was used more often that the FIM, and more frequently used in European studies as compared to the FIM, which was more widely used in North America[188]. The Barthel Index was used to measure participants' physical function as it is a widely used measure in research, with good validity and reliability. In UHS, the BI is also the measure of choice for clinicians and BI assessment is routinely performed by therapists. While there are some concerns about the reliability of Barthel Index particularly among patients with cognitive impairment[181], it is less applicable in this study as participants are expected to provide written consent to participate in the study and hence are likely to be more robust cognitively. Participants were asked regarding their abilities to perform each activity listed and were scored accordingly. A higher score indicates better functional abilities.

2.3.2.2 Elderly Mobility Scale

In order to capture the mobility aspect of participants' physical function, the Elderly Mobility Scale (EMS) was used an additional functional measure. The EMS (Appendix 5) was developed in 1994 to assess the functional mobility of frail older people in the acute care setting[189]. Seven items of assessment are included in the scale: moving from lying to sitting, sitting to lying, sitting to standing, standing, gait, timed walk (6 metres) and functional reach to give a total score of 20. A study conducted by Prosser et al among 66 patients with a mean age of 81.6 years ± 6.3 found significant correlation between the Barthel Index and EMS ($r= 0.787$ $p < 0.001$)[190]. Inter-rater reliability was also demonstrated on 19 patients with significant correlation between scores ($r = 0.88$, $p < 0.0001$). Participants were asked to perform all 7 tasks and were scored accordingly. The timed 6 metre walk was conducted along the ward corridors which were marked by stickers each one metre in length. A stopwatch was used to determine the time taken to complete the 6 metre walk, with the use of their usual walking aid. In the functional reach assessment, participants were stood upright in a neutral position with one arm raised at 90 degrees[191]. The assessor then

marked the starting position from the tip of the third finger on a piece of paper. Without using a walking aid as support, participants were asked to stretch forwards without taking a step forwards. The new position of the tip of the third finger was marked again on the same piece of paper and the distance measured between the two positions was the functional reach score. A score of 14 and above generally indicates that these patients are able to perform mobility manoeuvres alone and safely and are independent in basic activities of daily living. Scores of 10 – 13 generally indicate that patients are borderline in terms of safe mobility and independence in activities of daily living and may require help with some mobility manoeuvres. A score of less than 10 generally indicates that these patients are dependent in mobility manoeuvres and will require help with basic activities of daily living such as transfers, toileting and dressing.

An alternative measure of lower extremity function is the short physical performance battery (SPPB). SPPB was first described in 1994 by Guralnik et al and is a composite measure of walking speed, standing balance, and sit to stand performance[192]. Each task is scored out of 4, with a maximum score of 12 indicating highest level of function and a minimum score of 0 indicating poorest level of function. SPPB has previously been used in studies involving hospitalised older adults and has been shown to be a valid indicator of functional status of older inpatients[193-195]. A low SPPB is an independent predictor of length of hospital stay in this population and patients with poor SPPB scores at hospital discharge (0-4) had a greater risk of rehospitalisation or death (OR 5.38, 95% CI 1.82 – 15.9) compared to those with a SPPB score ranging from 8-12[196]. A systematic review conducted by Freiberger et al examined the validity and reliability of performance-based physical function measure in community-dwelling older people and reported that SPPB has the highest scores in reliability, validity and responsiveness among 11 other measures[197].

In this study, the EMS was chosen as a measure of mobility function as it is validated and commonly used in research among older people. The EMS was also chosen for pragmatic reasons, as it is less complex to perform compared to the SPPB, thus reducing the burden on participants in the data collection process.

2.3.2.3 Timed up and go test

The 'timed up and go' test (TUG) is a widely used clinical performance-based measure of lower extremity function, mobility and falls risk[198]. It is also commonly used in research as a functional measure among older people[199-202]. In this test, participants were seated on a standard chair with a seat height between 44 and 47cm. They were asked to stand up and walk a distance of 3 metres (marked on the floor) at a comfortable pace, turnaround, and then walk back to the chair and sit down. Participants were allowed to use their usual walking aid but no physical assistance was

provided. Participants who were unable to stand from a sitting position independently or unable to mobilise independently were scored as unable to complete the test. Using a stopwatch, the timing started at the command 'go' and stopped when the subject's back was positioned against the back of the chair after sitting down. A longer time taken to complete the test indicates poorer function. In the acute care setting, the value of the TUG lies in the inability to complete the task rather than the time recorded, in predicting falls risk[203]. The TUG has high inter-rater reliability among hospital in-patients[204] (Intraclass Correlation Coefficient (ICC) = 0.99) and community dwelling older adults[200] (ICC = 0.98).

2.3.2.4 Gait speed

Gait speed is a measure of functional ability, and has well-documented predictive value for major health-related outcomes including hospitalisation, nursing home placement, mortality, poor quality of life, physical and cognitive functional decline, and falls[205-207]. The measurement of gait speed is also a recommended test according to the European Working Group on Sarcopenia in Older People (EWGSOP) in the diagnosis of sarcopenia, in which a cut-off point of < 0.8m/s identifies a risk of sarcopaenia[208,209]. A systematic review conducted by Peel et al which included 48 studies (7000 participants in the hospital setting, mean age > 70 years) found that the mean gait speed for patients across the hospital was 0.58m/s (95% CI 0.49 – 0.67) and in the acute care setting, the mean gait speed was lower at 0.46m/s (95% CI 0.34 – 0.57)[210]. Along the ward corridor, a 4 metre distance was marked on the floor using stickers. From the word 'go', the time taken for each participant to walk 4 metres at a comfortable pace was recorded, using a stopwatch. Participants who were not able to mobilise independently with or without a walking aid were scored as unable to complete the test. Gait speed has been shown to have a high inter-rater reliability (ICC 0.91), with an absolute inter-rater reliability (percentage of standard error of measurement (SEM %)) of 7%[211].

2.3.3 Grip strength

Hand grip strength was measured using the Jamar dynamometer. Participants were sitting either on the chair or upright in bed, with shoulders adducted and neutrally rotated, elbow flexed at 90 ° and wrist neutrally rotated[212]. A demonstration was given to participants prior to the first test. Grip strength was then tested on both hands twice and the highest of the four scores was recorded as the final score for maximum grip strength. Studies have demonstrated associations between low grip strength and increased mortality, development of disability and prolonged hospitalisation[213]. Leong et al conducted a longitudinal population study involving 17 countries of varying income and sociocultural setting, measuring the grip strength of community-dwelling

adults (n=142861, aged 35 – 70 years) to explore the prognostic value of grip strength[214]. Findings from the study showed an inverse association between grip strength with all-cause mortality (hazard ratio per 5 kilograms reduction in grip strength 1.16, 95% CI 1.13 – 1.23), cardiovascular mortality (1.17, 95% CI 1.11 – 1.24), non-cardiovascular mortality (1.7, 95% CI 1.12 – 1.21), myocardial infarction (1.07 95% CI 1.02 – 1.11) and stroke (1.09, 95% CI 1.05 – 1.15). A study conducted by Beseler et al (50 participants, mean age 81.6 years old) also found a statistically significant relationship (p=0.009, OR = 1.14) of being in a higher category per 1 kilogram increase in grip strength) between grip strength and walking ability (measured by functional ambulation categories) in hospitalised frail older people[215]. The European Working Group on Sarcopenia in Older People (EWGSOP) has recommended a cut-off value of <30kg for men and <20kg for women in the diagnosis of sarcopenia[216]. More recent work by the Foundation for the National Institutes for Health Biomarkers Consortium Sarcopenia Project who conducted an analysis based on a pooled sample which included 26625 participants (mean age 75.2 years, SD 6.1) proposed a recommended cut-off point of <26kg for men and < 16kg for wean[217]. A study conducted by Dodds et al which combined 60803 observations from 49964 participants of 12 general population studies in Great Britain also suggested a lower cut-off point of <27kg for men and <16kg for women[218]. In this study, the cut-off point of <27kg for men and 16kg for women was used to identify patients with low grip strength. Grip strength has been shown to have a high inter-rater reliability (ICC 0.95), with an absolute inter-rater reliability (SEM %) of 8%[211]. Measurement of quadriceps strength is a possible alternative measure of muscle strength but was employed in this study as the equipment needed were cumbersome[208]. Previous studies have demonstrated strong associations between handgrip strength and lower limb muscle strength, with correlation coefficients varying from 0.70 to 0.72[208,216].

2.3.4 FRAIL scale

The FRAIL scale (Appendix 6) is a self-report measure of frailty which was proposed by the International Association of Nutrition and Aging and consists of five items: Fatigue, Resistance, Ambulation, Illnesses and loss of weight[219]. Each item is scored either zero or one, to give a total maximum score of five[220]. A score of zero indicates absence of frailty, one to two indicates prefrail state and three and above indicates frailty. A study conducted by Ravindrarajah et al (2929 men, mean age 60 years ± 11) among the European Male Aging Study Group explored the association between FRAIL scale and all-cause mortality[221]. The study demonstrated that men who were frail as defined by the FRAIL scale had an increased mortality risk compared to robust men (Hazard

ratio (HR) = 3.87; 95% CI 2.25 – 6.66). The FRAIL scale has also been validated for use among older women[222].

Several other measures of frailty are used in research among older people. One such example is the Fried Frailty scale. Fried et al defined frailty as a clinical syndrome in which three or more of the following criteria were present: unintentional weight loss, self-reported exhaustion, weakness (grip strength), slow walking speed and low physical activity[223]. A study among 5317 community-dwelling older people using the above frailty phenotype showed that the measure was independently predictive of incident falls, worsening mobility, hospitalisation and death[223]. A study by Bieniek et al examined the use of Fried frailty index among older inpatients (n = 500, mean age 79 years) and found that completion of all five Fried frailty assessment criteria was possible in only 65% of studied patients[224]. Another commonly used frailty scale is the Clinical Frailty Scale (CFS). In a study by Rockwood et al, the 7-point CFS was used to measure frailty of 2305 older patients who were followed up for 5 years to determine its ability to predict death or need for institutional care[225]. The study found that each 1 category increment in the CFS scale significantly increased the medium-term risks of death (21.2% within about 70 months) and entry into an institution (23.9%). The updated version of the CFS consists of a 9 point scale ranging from 'Very Fit to 'Terminally Ill'[226]. The CFS is a very simple and practical way of stratifying frailty but the disadvantage of the CFS is observer subjectivity. Both the Fried frailty scale and CFS are commonly used in research and clinical practice[227].

In this study, the FRAIL scale was used as one of the measures of frailty among participants as it is a validated and objective measure of frailty which is very simple to perform and reflects the participants' views.

2.3.5 Mini Mental State Examination

The Mini Mental State Examination (MMSE) is a well-known measure of cognitive function (Appendix 7). The MMSE is divided into two sections. The first section covers orientation, memory and attention, and requires verbal responses only, with a maximum score of 21. The second section tests subjects' ability to name, follow verbal and written commands, write a sentence spontaneously and copy a complex polygon, with a total score of 9. With a maximum score of 30, a higher score indicates better cognition. The MMSE was first published in 1975 by Folstein et al as a practical method of grading cognitive status by clinicians[228]. Since then, it has been widely used clinically and in research to assess cognition[229,230]. A score of 23 and below is generally accepted as an indication of possible underlying cognitive impairment, with a sensitivity of 0.63 and specificity of 0.96[231,232]. Bowie et al examined the inter-rater reliability of the MMSE by

preparing a sample set of responses to the items in the MMSE to give a correct score of 20[233]. 40 healthcare professionals who were experienced in old-age psychiatry were asked to administer the test and received the same set of responses. The mean score obtained for the 40 assessments was 18.5 (95% CI 17.2 – 19.2). The study demonstrated a higher than expected inter-rater variability.

A more recent measure of cognitive function is the Montreal Cognitive Assessment (MoCA). The MoCA is a 30-point test which was developed by Nasreddine et al as an alternative tool to detect mild cognitive impairment (MCI) and consists of the following domains: attention and concentration, executive functions, memory, language, visuo-contructional skills, conceptual thinking, calculations and orientation[234]. A study by Trzepacz et al explored the relationship between the MoCA and MMSE for assessing MCI in older adults[235]. The study participants consisted of 219 healthy control (HC), 299 MCI, and 100 Alzheimer's disease (AD). Using ≥ 24 as a cut point for MMSE, 99.5% of HC participants had scores ≥ 24 while 98.3% of participants with MCI had scores ≥ 24. Among participants with AD, 21% of participants had a MMSE score of ≥ 24. Using ≥ 23 as a cut-off point for MoCA, 87.7% of HC had scores ≥ 23 and 65.9% of participants with MCI had scores ≥ 23. Only 7% of participants with AD had a MoCA score of ≥ 23. When the cut-off of ≥ 17 was applied for MoCA, 96.3% of subjects with MCI had a score of ≥ 17 and 48% of participants with AD had scores of >17. The correlation coefficients between tests were high for all subjects (0.84) and AD dementia (0.86) but lower for MCI (0.6) and HC (0.43). This study demonstrates the advantage of MoCA over MMSE in detecting cognitive impairment in the earlier stages.

Nasreddine et al who developed the MoCA, proposed a practical approach to evaluating patients with cognitive complaints by using the MMSE as an initial screening tool[234]. Subjects with a normal MMSE score (≥ 26) should then be given the MoCA test to assess for abnormal MoCA score. The MMSE is one of the most commonly used measurement tool in research and in clinical practice[236] and is simple and brief to administer and as such was chosen to be used as a measure of cognitive function in this study.

2.3.6 Geriatric Depression Scale

The Geriatric Depression Scale (GDS) was first designed by Yesavage et al in 1982 with 30 questions as a screening tool for depression among older people[237]. Since then, a shorter version of the GDS which contains 15 questions (GDS-15) (Appendix 8) was developed and has been widely used in research[238-240]. A systematic review which included 42 studies reported the GDS-15 to have 80.5% sensitivity and 75% specificity in detecting depression among older people[238]. The

Methods

GDS-15 was used to assess the mood of participants and responses for each question was limited to yes or no. For each 'Yes' answer to questions 2, 3, 4, 6, 8, 9, 10, 14 and 15, a score of 1 is given. For each 'No' answer to questions 1, 5, 7, 11 and 13, a score of 1 is given. The total score was calculated and a score of 0 – 4 indicate no depressive symptoms, 5-9 indicate mild depressive symptoms and 10-15 indicate moderate to severe depressive symptoms[238-240]. The GDS-15 has been shown to have high inter-rater reliability (ICC 0.94)[241].

Another commonly used measure of mood in older people is the Hospital Anxiety and Depression Scale (HADS)[242]. This 14 item scale (with scores of 0 to 3) was developed by Zigmond and Snaith in 1983 to identify and quantify the two most common forms of psychological disturbances in medical patients[243]. The HADS has no items relating to somatic symptoms, which may confound the diagnosis of depression in patients who also have physical illness, and thus may be more applicable to be used in the acute medical settings[244]. At the suggested cut-off point of 11 to identify major depressive disorder, the HADS was able to exclude this condition with high specificity of 0.92 but with lower sensitivity of 0.56. The depression subscale of HADS (HADS-D) has previously been reported to have reduced sensitivity in the context of older inpatient settings[245]. Campbell et al conducted a study to compare the performances of GDS-15 and the HADS-D among older people (n = 972, mean age 73.8) with varying cognitive profiles and found that the HADS-D classified fewer participants with depressive symptoms as compared to the GDS[246]. 5.1% of the cohort were identified as having depressive symptoms with HADS-D while 9.3% were classified by the GDS-15 as having depressive symptoms. The study found that the measurement discordance was more common in the healthy control group than the Alzheimer's disease group. To explain this finding, the authors proposed that among cognitively impaired subjects, depressive illness are likely to be more common. Conversely subjects who are cognitively intact are less likely to display depressive symptoms and thus occupy more of a 'middle ground' on the continuum from non-depressed to depressed and it is likely that it is within this 'middle ground' of participants that both measures fail to agree.

The GDS has been shown to be a simple and accurate tool in diagnosing major depressive episodes among older adults, particularly among patients without cognitive impairment. A systematic review conducted by Dennis et al which included 14 studies found that the GDS was the most widely evaluated measure to detect depression among older people in hospital[247].

In this study, participants are required to provide valid consent and thus are less likely to be cognitively impaired. As the GDS appears to be more sensitive in detecting depressive symptoms among older inpatients compared to HADS and more widely used in research among older

people, it was thus chosen to be the measure of choice for assessing depressive symptoms in this study.

2.3.7 Charlson Comorbidity Index

The Charlson comorbidity index (CCI) was initially developed to classify comorbid conditions which might alter the risk of mortality for use in longitudinal studies[248]. It consists of 17 comorbidities with two subcategories for diabetes and liver disease. Frenkel et al conducted a prospective cohort study to determine if CCI predicted short and long term mortality among acute hospitalised individuals (n = 1313, mean age 77.8 ± 7.9 years)[249]. The study found that participants with a CCI of five or more had higher 3 month (odds ratio (OR) 3.6, 95% CI = 2.1 – 6.4), 1 year (OR 7.1, 95% CI = 4.2 – 11.9), and 5 year (OR = 52.4, 95% CI = 13.3 – 206.4) mortality than those with a CCI of zero. Further work on the CCI led to the development of the age-adjusted CCI, which was used in this study[250] (Appendix 9). The comorbidity score is calculated based on the presence and severity of active comorbidities as listed in the questionnaire. Age score is calculated by scoring 1 point for every decade of age over 40 years and the total score is calculated by adding the comorbidity and the age score. The inter-rater reliability of the CCI is reported to be moderate to good, with an ICC of between 0.74 and 0.95[251,252].

Another commonly used comorbidity index is the Geriatric Index of Comorbidity (GIC)[253]. In a prospective cohort among 444 older inpatients (mean age 85.3), the ability of six comorbidity indices (Charlson index, cumulative illness rating scale, index of coexistent diseases, Kaplan scale, geriatrics index of comorbidity and chronic disease score) to predict adverse hospitalisation outcomes were compared[254]. In the multiple logistic regression analysis performed, the GIC was found to be the best predictor of death during hospitalisation, accounting for 24% of the variance in this outcome (adjusted odds ratio: 4.34, CI: 3.92 – 9.52).

The CCI was chosen as the comorbidity index of choice as it is widely used in research among older people, thus allowing more comparison with other research studies. It is a well validated and reliable measure of comorbidity[251,252,255-257]. Data collection on active comorbidities were conducted by reviewing participants' medical notes.

2.3.8 Simplified Nutritional Appetite Questionnaire

Poor appetite is a common problem among older people[258] and may lead to worsening health outcomes[259]. The Simplified Nutritional Appetite Questionnaire (SNAQ) was used to measure the appetite of participants (Appendix 10). It consists of four questions focusing on the subject's appetite, taste, meal frequency and how quickly they feel full. Each response ranges from a score

of 1 to 5, giving a total score of 20. A higher score indicates better appetite and poor appetite was defined as a score of <14. The SNAQ has previously been used in the acute care setting and one study involving 179 female patients (mean age 87 ± 4.7 years) demonstrated that a low SNAQ score was found to be associated with an increased risk of hospital acquired infection (OR 3.53, 95% CI 1.48 – 8.41) and with increased risk of death at six months (HR 2.29, 95% CI 1.12 – 4.68)[260]. An alternative tool commonly used to assess nutritional status of older inpatients is the Mini Nutritional Assessment (MNA). The MNA consists of several measurements including: anthropometric measurements (weight, height, and weight loss), global assessment (six questions related to lifestyle, medication, and mobility), dietary questionnaire (eight questions related to number of meals, food and fluid intake, and autonomy of feeding), and subjective assessment (self-perception of health and nutrition)[261]. A score of ≥ 24 indicates adequate nutrition, 27 to 23.5 indicates at risk of malnutrition and a score of < 17 indicates protein-calorie malnutrition. This scoring was shown to have 96% sensitivity, 98% specificity, with a predictive value of 97%. Although the MNA offers a more thorough nutritional assessment, it takes considerably more time to complete than the SNAQ, adding to the burden of data collection in this group of older unwell patients. The SNAQ was thus chosen as the measure of choice to assess participant's appetite and risk of malnutrition.

2.3.9 EuroQol EQ-5D-3L

The EuroQOl EQ-5D (Appendix 11) was developed by the EuroQol Group which at its initiation, consisted of a network of international multidisciplinary researchers from Finland, Netherlands, Norway, Sweden and the UK[262]. Its primary aim was to develop an instrument which measures non-disease specific health-related quality of life. The EuroQol EQ-5D-3L has since been widely used in research among older people[263-265] and is also a useful tool for cost-effectiveness analysis[266]. The questionnaire consists of two parts, the first of which contains 5 items: mobility, self-care, usual activity, pain/discomfort and anxiety/depression. Participants were asked to indicate which statements best describes their own health state and based on their responses, they were given a score ranging from one to three for each question. In the second part of EuroQol ED-5D, participants were asked to rate their own health state on a scale ranging from zero being the worst imaginable health state to 100 which represents their best imaginable health state.

Another commonly used quality of life measure is the 36-Item Short Form Health Survey (SF-36). The SF-36 consists of 36 questions addressing eight health dimensions: vitality, physical functioning, bodily pain, general health perceptions, physical role functioning, emotional role functioning, social role function and mental health[267]. Hayes et al examined the suitability of the

SF-36 for use among older adults in hospital outpatient and general practice settings and reported that the questionnaire was reasonably quick to complete, with a median completion time of 8 minutes[268]. 32% of outpatients and 10% of general practice patients, consisting predominantly of older adults aged ≥ 75 years with poor physical or mental health scores, were unable to complete the questionnaire. Parker et al conducted a prospective observational study to examine the use of SF-36 among older patients receiving health care[269]. The response rate by interview administration of the questionnaire was only 77.4% (164 of 212). Logistic regression analysis revealed that self-completion, cognitive dysfunction, disability and age were all independently associated with poor overall response rates. Factors such as cognitive dysfunction, disability and advanced age are common among hospitalised older people and thus render it less suitable for use in this setting. The EuroQol ED-5D was chosen as the questionnaire of choice in this study as it is widely used in research among older people and well-validated[270,271]. It will be presented as a descriptive measure of participants' health profile, and as a measure of overall self-rated health status[272].

2.3.10 Receipt of care

Outcome measures reflecting participants' receipt of care in hospital such as length of hospital stay, discharge destination, and readmission to hospital in one month, were recorded. Hospital related complications including development of pressure sore and thrombosis were also documented. To determine the number of inpatient venous thromboembolic event, several exclusion criteria were applied to differentiate cases where thromboembolism was the cause of admission. Patients who presented with clear symptoms such as warm erythematous unilateral leg swelling, shortness of breath associated with chest pain which was sharp in nature and/or patients where thromboembolism was the primary diagnosis on admission were excluded as having had an inpatient thromboembolic event. Patients who were treated with a different primary condition and subsequently found to have deep vein thrombosis or pulmonary embolism were considered to have had an inpatient venous thromboembolic event. Data collection for these outcome measures was conducted by reviewing participant's clinical notes, the electronic discharge summary and the patient administration system.

2.4 Data collection for volunteers

I designed a data collection sheet (Appendix 12) to collect basic demographic information from the volunteers such as age, ethnicity, previous volunteering experience and educational attainment. Details regarding the recruitment of volunteers are described in Section 2.7.1. Upon recruitment, volunteers were given the volunteer profile proforma, identified only by a study ID number, and completed the data collection sheet at their own convenience. As part of the feasibility study, the number of volunteers identified, recruited, trained, and then completed the competency assessment and delivered the intervention were recorded. The retention of volunteers was also assessed. Other information include the frequency and duration of their activity, and type of activity conducted with patient. This provided data on the practicality of recruiting and training volunteers and the frequency of training sessions needed to sustain a steady workforce of trained volunteers who are able to carry out the physical activity intervention.

2.5 The intervention – Theoretical framework

The field of implementation science was borne out of a desire to address challenges in translating evidence-based practice into routine care in health care and other areas of professional practices[273]. The three overarching aims of theoretical approaches used in implementation science are to: describe and/or guide the translational process of research into practice, understand and/or explain the key factors which determines implementation outcomes, and evaluate implementation. Theories and frameworks provide a systematic and efficient approach in synthesising and generalising findings across various settings within implementation science[274,275]. Several implementation theories have been developed or adapted by researchers in the implementation science sphere. Examples of implementation theories include: Implementation Culture[276], Absorptive Capacity[277], and Organizational Readiness[278]. Another example of an implementation science theory is the COM-B (Capability, Opportunity, Motivation and Behaviour)[279]. The COM-B model proposes that motivation energizes and directs behaviour, and capability and opportunity were necessary conditions to allow behaviour to occur, given sufficient motivation. The following section describes the theoretical framework that was chosen for this study.

The conceptual framework for this study was based on the MRC framework of complex interventions[280] and Normalisation Process Theory (NPT).[281,282] The MRC framework identifies key

stages in the implementation of an intervention including the development, piloting, evaluation, reporting and implementation of an intervention. It is widely used and probably one of the most commonly used framework in intervention studies in healthcare. The focus of this study was to develop and pilot an intervention that would help promote increased physical activity among older inpatients.

The intervention proposed in this study, of using trained volunteers to increase physical activity among older inpatients, had several key dimensions which may influence its effectiveness. The key groups of people that played an important role in the development and delivery of this intervention were the occupational therapists and physiotherapists (therapy team), nurses, and volunteers. The therapy team were the main healthcare professionals formally trained to assess and work with patients to improve their mobility and physical function. Nursing staff were closely involved in the day-to-day care of patients and played an important role in promoting physical activity. I led the development of the training programme for the volunteers, working with the therapists to ensure that the key aspects of patient safety, mobility and exercise techniques were taught, and that the trained volunteers were competent and safe in delivering the intervention. I piloted the training programme for volunteers and minor changes were made based on the feedback from volunteers and training staff. The physical activity intervention was evaluated by assessing: the feasibility of using trained volunteers, including their recruitment, training, and retention, the acceptability of using trained volunteers, established through qualitative interviews, and its impact on physical activity levels and other outcome measures.

There is often a problematic gap between research evidence and implementation of practice[283] and Normalization process theory (NPT) was developed to address the observed difficulty of implementing and integrating new treatment modalities and ways of organizing care in health service settings. In this study, the NPT was chosen as the theoretical framework of choice to develop and evaluate the intervention. The NPT provides a set of sociological tools to understand and explain the social processes through which new or modified practice of thinking, enacting, and organizing work are operationalized in healthcare and other institutional settings[281]. The use of an implementation theory is useful as it helps researchers identify, describe and explain important elements of the implementation process[282]. The three core problems which the theory is concerned with are: implementation (bringing of a practice or practices into action), embedding (routine incorporation of practice or practices into everyday work of individuals and groups) and integration (reproduction and sustainability of a practice or practices among the social matrices of an organization or institution). NPT was used in the development of the study protocol, the implementation of the training programme for the volunteers as well as the intervention on the wards. The online NPT toolkit was used to assist in critically thinking through the processes and

challenges which may arise in implementing and integrating an intervention in a complex health care setting[284]. NPT was chosen as the framework that underpinned this study as it was systematic in its approach, easy to understand and provided a proven framework to evaluate the implementation process of this study. The online toolkit available for this implementation theory also made the application of NPT at various stages of this study more convenient and practical. The NPT is also widely used in healthcare research[285-287]. Combining the MRC framework and NPT in this study provides a more theory-driven and comprehensive approach in the implementation of the intervention.

There are four components to consider when using NPT to develop a complex intervention.

I. Coherence: meaning and sense-making.
II. Cognitive participation: this explores the likelihood of all participants (patients and health care professionals) being committed and engaged with the intervention.
III. Collective action: the consideration of the work that participants do to make the intervention function.
IV. Reflexive monitoring: which involves participants appraising or reflecting on the intervention.

Table 4 describes how NPT was used to inform the development of the volunteer training programme and Table 5 describes how NPT was used in the implementation of the volunteer-led intervention in the clinical setting. To determine the acceptability of the intervention, the interview schedules to be used for interviews and focus groups among patients, volunteers, nurses and therapists were also underpinned by NPT.

Table 4 Use of NPT in developing the training programme for volunteers

NPT components	Questions to consider within the NPT framework	NPT analysis
Coherence i.e. meaning and sense making by participants	Is the intervention easy to describe? Does it have a clear purpose for all relevant participants? What benefits will the intervention bring? Will it fit with the overall goals and activity of the organisation?	Development of training programme for volunteers to safely mobilise older people or encourage exercise activities *Volunteers*: To ensure competency of volunteers, their own safety and the safety of patients *Therapy team*: To ensure high quality and relevant training is provided A well-developed training programme will ensure that volunteers are well prepared to deliver the physical activity intervention and the training programme can be repeated to ensure a steady supply of trained volunteers are available This will ensure high quality care is provided to patients, ensuring patient safety, and with the aim of improving patients' health outcomes
Cognitive participation i.e. commitment and engagement by participants	Are target user groups likely to think it is a good idea? Will they see the point of the intervention easily? Will they be prepared to invest time, energy and work in it?	Volunteers and ward staff are likely to appreciate the importance of proper training prior to delivering the physical activity intervention Issues regarding health and safety of volunteers and patients are important, which will be addressed during the training programme Having adequate training and preparation will allow the volunteers to deliver the physical activity intervention safely and confidently. Thus, volunteers are likely to engage with the training programme

NPT components	Questions to consider within the NPT framework	NPT analysis
Collective action i.e. the work participants do to make the intervention function	How will the intervention affect the work of user group?	Ensure volunteers' competency in delivering the physical activity intervention, which in turn ensures patient safety
	Will it promote or impede their work?	The training will prepare volunteers for any potential adverse events, and how to react and respond in those situations
	How compatible is it with existing work practices?	Volunteers must be willing to offer half a day of their time to be trained, after which they will be able to work independently
	What impact will it have on division of labour, resources, power and responsibility between different professional groups?	Therapist who are involved in providing the training will have to take time out of routine clinical work. Their time involved will be remunerated. The therapy team will need to dedicate time and labour to help design and deliver the training programme and support the volunteers on the wards. The research team will also be trained to deliver the training programme.
Reflexive monitoring i.e. participants reflect on or appraise the intervention	How are users likely to perceive the intervention once it has been delivered?	Volunteers will be encouraged to reflect and provide feedback, to help improve the training programme
	Is it likely to be perceived as advantageous for patients and staff?	The training programme will prepare a group of competent volunteers who will be equipped to promote increased physical activity levels of older inpatients. This is hypothesised to be beneficial to patients and would complement the work of the therapy team and nurses in mobilising older people or encouraging exercise
	Will it be clear what effects the intervention has had?	The effect of the training programme will be evaluated through the feedback received from the volunteers. The frequency and nature of the volunteers' physical activity intervention will be recorded Interviews will be conducted with volunteers to explore their thoughts on the training programme as well as the physical activity intervention

NPT = Normalisation Process Theory; i.e. = id est (equivalence in meaning)

Table 5 The use of Normalization Process Theory in the implementation of intervention

NPT components	Questions to consider within the NPT framework	NPT analysis
Coherence i.e. meaning and sense making by participants	Is the intervention easy to describe? Does it have a clear purpose for all relevant participants? What benefits will the intervention bring? Will it fit with the overall goals and activity of the organisation	The use of trained volunteers to encourage older inpatients to be physically active by walking or performing bedside exercises *Patients*: To prevent sedentary behaviour in hospital and its associated harmful effects *Therapy team*: To complement the work of therapists in patients' physical rehabilitation from acute illness *Nurses:* To assist nurses in encouraging patients to be more active. *Volunteers:* The volunteers are main driver in this intervention to promote increased physical activity among older inpatients. Reduce the harmful effects of sedentary behaviour in hospital. Improve adherence to therapists' advice of performing exercises. The intervention also carries a social aspect to it, where patients can interact with the volunteers during the sessions. Studies have shown that higher activity levels in hospital is associated with shorter length of hospital stay and better patient outcomes. The potential benefits of the intervention are in line with the goals and aims of the organisation.
Cognitive participation i.e. commitment and engagement by participants	Are target user groups likely to think it is a good idea? Will they see the point of the intervention easily?	Patients are likely to engage with the intervention as there are clear benefits to their health and physical function. The aim of the intervention which is to promote increased physical activity can be easily appreciated through the activity sessions.

NPT components	Questions to consider within the NPT framework	NPT analysis
	Will they be prepared to invest time, energy and work in it?	*Patients*: Patients are likely to be keen to improve or maintain their physical function and this may motivate them to participate in the activity sessions. *Therapy*: The intervention will complement the work of the therapists and may free up more therapists time to focus on patients who need more help. Main investment of time and energy would be in the training of volunteers. *Nurses*: The intervention will help support the nurses in their role in encouraging patients to be more active
Collective action i.e. the work participants do to make the intervention function	How will the intervention affect the work of user group?	*Patients*: Patients who engage with the intervention are likely to be physically more active. Therapists: The main role of the therapy team is to provide training and support on the wards. Nurses: The role of the nurses is to ensure that patients are medically well and able to participate in the intervention and to provide support to volunteers on the wards
	Will it promote or impede their work and how compatible is it with existing work practices?	The volunteer-led intervention is likely to promote and complement the work of the therapy team and nurses in encourage mobility. Therapy: Therapist who are involved in providing the training will have to take time out of routine clinical work. Their time involved will be remunerated. Nurses: There will be minimal addition to clinical work apart from ensuring that patients are well enough to participate in the intervention.

NPT components	Questions to consider within the NPT framework	NPT analysis
Reflexive monitoring i.e. participants reflect on or appraise the intervention	How are users likely to perceive the intervention once it has been delivered? Is it likely to be perceived as advantageous for patients and staff? Will it be clear what effects the intervention has had?	Patients, volunteers, nurses and therapists will be interviewed to determine the acceptability of the intervention. The intervention will help promote increased physical activity levels of older inpatients. This is hypothesised to be beneficial to patients and would complement the work of the therapy team and nurses in mobilising older people or encouraging exercise. The effect of the intervention will be monitored through various outcomes including number of steps taken by patients before and after the introduction of the intervention and several other outcomes associated with receipt of care in hospital. The effects of the intervention will also be explored in the interviews with key stakeholders

2.6 Development of the intervention

2.6.1 Engagement with the therapy team

In March 2015, I started the ground work of designing the intervention and developing the study protocol. An initial meeting was held with the Head of Therapies of University Hospital Southampton NHS FT together with a few other senior occupational and physiotherapy colleagues. The idea of using trained volunteers to mobilise older inpatients was discussed, including my proposed plan to conduct a feasibility and acceptability study to formally evaluate this. The plan for the study was very well received by the senior therapy team, who were very supportive of the idea. A band 7 physiotherapist was allocated to work with me to co-design the training programme to ensure that the mobility and exercise protocol were appropriate.

After the initial meeting, the therapists disseminated the idea about the proposed study to the rest of their colleagues in the Medicine for Older People department during their weekly therapists' meeting. Informal conversations were also held on the wards by myself with other therapy colleagues to gain a rough idea of what the therapy team felt about the study. A formal meeting with the therapy team was then arranged to present the proposed intervention. Anonymised questions were encouraged to be submitted before the meeting to ensure that the therapy team were able to voice their opinions and concerns freely. The presentation was attended by therapy assistants, occupational therapists and physiotherapists of varied seniority. Overall, the proposed intervention was well-received by therapy colleagues. The main concerns that some therapists had included: the level of training given to volunteers to address medical emergencies, the substitution of volunteers for workforce among lower banded therapy assistants and patient safety in the event of falls and syncope. These were valid concerns and were addressed accordingly during the meeting. As volunteers are not medically trained, part of their training was to know when to call for help in any situation where they feel uncertain or where there is potential harm to them or the patient. To prevent volunteers from mobilising patients who are medically unwell, part of the mobility protocol before any patient contact was to confirm with the nurse looking after the patient that they are safe and well enough to participate with the activity session. Volunteers were also given training on how to safely mobilise patients and what to do in the event of an adverse incident such as a fall. From a governance perspective, volunteers were legally covered by the trust as long as they perform within the remit of their training. The therapy team were also reassured that the volunteer's role was to complement the services provided by the therapy team rather than substituting lower banded therapists. The benefits of having mobility volunteers included promoting the maintenance of functional levels among patients who have been discharged by therapy, as well as encouraging patients to perform extra

exercises prescribed by the therapy team. Following the formal meeting with the rest of the therapy team and after the open discussion about the study, there was strong support from therapy team with regards to the volunteer-led mobility intervention.

2.6.2 Engagement with the voluntary services

A meeting with the voluntary services was held to discuss about the proposed intervention of training volunteers to mobilise patients. The voluntary services have been very engaged with the Academic Geriatric Medicine department from our previous work of training volunteers as mealtime assistants. The proposed idea was well received by the voluntary services team and plans were made to recruit new volunteers to this role. The opportunity was also extended to existing volunteers to be trained as mobility volunteers. This was advertised through volunteer leaflets, dissemination of information through e-mails, and adverts on the voluntary services notice board. As it was a feasibility study and the aim was to train up to 15 volunteers, further recruitment drive beyond the routine methods were not needed as it was felt that the constant flow of new volunteers would be sufficient to meet our requirement for this study. The usual method of recruitment of hospital volunteers included adverts on the trust website, social media and booths at public-facing hospital events.

The role of the voluntary services includes: recruitment of volunteers, managing the administrative aspects of volunteering including occupational health checks and disclosure and barring services checks, and promoting the new volunteering role. Volunteers who were interested to find out more about the study were referred to me and those who were keen to participate were invited to attend the training sessions. The hospital voluntary services have about 1000 volunteers registered with them and have volunteers in various departments in the hospital with a variety of roles. Having an established voluntary services that is engaged is a key factor in determining the success of this intervention.

2.6.3 Engagement with the medical and nursing team

To engage with nursing colleagues, a 3 page document (Appendix 13) was design to provide a brief outline of the study. The document was sent to the ward managers of the study wards and disseminated via e-mail to all nursing staff on the wards. Informal conversations were also held on the wards to promote the study and to receive informal feedback regarding the intervention. Overall, the study was well received by the nursing team and nurses looked forward to the intervention phase of the study.

Methods

During the development of the protocol, the proposed intervention was also presented at departmental teaching sessions for medical staff members. The meetings were attended by junior doctors, consultants and specialist nurses. Throughout the study period, 2 presentations were held yearly to update the medical team regarding the progress of the study. Consultants in the Medicine for Older People department were also contacted through e-mail to seek their consent for their patients to be recruited to the study. All consultants gave their consent for their patients to be involved in the study.

2.6.4 Engagement with Patient and Public Involvement

A survey was conducted among older inpatients, nursing home residents and at lunch club meetings to gather the views of older people regarding the use of volunteers in the fundamental care of older inpatients[175]. The survey was conducted by another colleague prior to the development of the study protocol. Among the 92 respondents (age 60 – 99 years), 74% of them were female. 45% of the respondents had experience of hospital volunteers and all spoke highly of their input. Most participants felt that volunteers could be trained to help with inpatient mobility. Their main reservations were the training given to volunteers and interaction with staff members.

A PPI representative (PPIR) was recruited through the NIHR CLAHRC Wessex to provide input into the study protocol. The PPIR reviewed the study protocol, commented on the intervention, and reviewed key documents such as the lay summary, and patient and volunteer information sheets. The PPIR also attended research departmental meetings and provided input when the study was discussed. The study protocol was also submitted to an external PPIR for a further review. The PPIR reviewer commented that the research aims were simply expressed and very clear to understand and felt that the research was worthwhile, not only in terms of cost-savings to the NHS but more importantly the possible benefits to the patients. The main concerns raised were around the recruitment, training and support of the volunteers to ensure that the patients are not adversely affected by the proposed intervention. A key aspect of this feasibility study was to develop a training programme that is robust to ensure that volunteers are well-prepared for their role to safely encourage older patients in hospital to be more active.

Summary

Engagement with key stakeholders including PPI, the therapy team, nursing team, voluntary services and the medical team early on during the development of the study protocol prepared the ground work for the study. Engaging with the Head of Therapies and other senior members of the therapy team ensured commitment and engagement from a management perspective and

this was disseminated down to the clinical team. Organising a meeting to present the study to the rest of the therapy team was an important step in this study. This allowed concerns from the therapy team to be raised and discussed and it gave me the opportunity to formally present the proposed intervention to the team. It was also crucial to engage with nursing staff at an early stage and the information provided to them gave them an overview of the study and informed them of their role in supporting volunteers during the study period. One important advantage that the research team had was good rapport and previous collaboration with the voluntary services in developing volunteers. This ensured that as new ideas were proposed, the voluntary services were keen to engage and provide support. Further development of the study was built on the foundation established with key stakeholders.

2.7 Development of the training programme

The mobility protocol and training programme (Appendix 14) for the volunteers were developed based on existing literature of in-hospital mobility programmes as described in Section 1.9, and the clinical expertise of senior hospital therapists and geriatricians who acted as clinical champions.

The lead therapist from Medicine for Older people department, a band seven physiotherapist, was assigned to work with me on the research project. Input from the therapy team ensured that all the important aspects of mobilising older people were covered in the training programme. I worked closely with the therapy team to determine the appropriate chair and bed-based exercises to be used in this study to help maintain or improve muscle strength and physical function of older people (Appendix 15). The exercise sheets were piloted on a few patients on the wards and received positive feedback. Key aspects of the training programme included the importance of physical activity in hospital, health and safety aspects of the intervention, the range of mobility and exercise interventions and how to deal with potential complications. Other aspects of the training related to the importance of good communication and accurate documentation.

2.8 Delivery of the training programme

2.8.1 Recruitment of volunteers

All volunteers were recruited through the hospital volunteer services. Existing volunteers who had a different role in the Trust and were interested in participating in this study were referred to me by the hospital volunteer services team. Volunteers who were new to the trust were briefed about the research project at induction and were given the opportunity to speak to me directly during the interview sessions to find out more about the study. Volunteers who were interested in participating were then invited to attend the training programme at an agreed date. Participant information sheet was given to each volunteer and written informed consent was obtained prior to the commencement of the training programme.

2.8.2 Volunteer training

The targeted number of volunteers per training session was between 4-6 volunteers. The aim was to train 15 volunteers to deliver the intervention. A half day training programme was provided for the volunteers which included a mix of classroom-based teaching sessions and a practical session. The training sessions were led by myself and supported by a band seven physiotherapist. The training session was held in a meeting room opposite the therapy gym in the Medicine for Older People department. This allowed equipment to be conveniently brought over to the meeting room during the training day so that the volunteers can familiarise themselves with the various walking aids and equipment. Tea, coffee and light refreshments were provided during the training sessions.

The presentation began with an introduction of the study and the importance of encouraging older inpatients to be more active. Volunteers were then introduced to their role and informed about what was expected of them. General guidelines were provided such as hand hygiene, importance of speaking to nursing staff prior to every activity session with patients, guidance on their interaction with patients and importance of documentation. Volunteers were also taught to pay attention to their own safety at all times, with attention to appropriate footwear, clothing, and posture. Volunteers were taught to stop the activity session and inform staff members if they felt uncomfortable at any point during the intervention. Important aspects of patient safety such as ensuring that patients have appropriate walking aid and footwear, steps to take to reduce risk of falls, and how to respond when a patient falls or becomes unwell, were taught. Further information regarding this is available in the training programme in Appendix 14. Volunteers were taught to go through a pre-intervention checklist prior to each activity session. The mobility and

exercise protocols were taught and volunteers also received training on how to respond in the event of an adverse incident such as a fall. Other aspects of the training include the importance of communication and documentation. During the training session, volunteers were encourage to ask questions to clarify any issues they were unclear with.

Volunteers had the opportunity to familiarise themselves with their role through role play during the training session. Volunteers took turns in pairs, with one as a patient and the other as the volunteer delivering the intervention, to practice carrying out the mobility and exercise protocols. Feedback was given by myself and the band 7 therapist to help address any issues and to ensure that the mobility and exercise interventions were delivered accurately. Once they were comfortable with their role, the training day concluded with a practical assessment on the wards. This would be their first patient contact and patients were informed that this was the volunteers' first real patient contact in their training as a mobility volunteer. After the training day, volunteers were allocated specific days where they would come in and deliver the intervention under close supervision. The competency assessments were carried out over several sessions. Each volunteer had to be signed off as competent before being able to deliver the intervention independently.

2.8.3 Pilot training session

A seminar room on the Medicine for Older People department was used to conduct the training session. The seminar room was situated across from the therapy gym which enabled easy access to common equipment that is normally available on the wards. The first two and a half hours of the training session consisted of a PowerPoint presentation, designed to provide the theoretical basis of the research and the intervention.

Volunteers were then separated into pairs for a role play session. Once the volunteers were comfortable with their role and understood what was expected of them, they were brought to the wards individually for their first contact with patients, supervised by me and a band seven physiotherapist. Feedback from the pilot study was very positive and apart from a slight alteration to the PowerPoint presentation, it was deemed appropriate to continue with the same format of training.

2.9 Delivering the physical activity intervention

2.9.1 Patient recruitment

The process of recruiting participants for the intervention phase of this study is as described in Section 2.2. The aim was to recruit 50 participants in the intervention phase. Patients from the three study wards who met the inclusion criteria were approached. Written consent was obtained from patients who were interested in participating in the study.

2.9.2 Intervention

Participants received physical activity sessions led by trained volunteers twice a day on weekdays during their stay in hospital. The mobility level of each participant was determined by a therapist's assessment or through an assessment by the nursing staff and researcher. Participants who were physically independent and functionally at baseline were not referred to the therapy team in line with standard practice. These participants were assessed by the nursing staff and myself. Patients who were deemed safe to mobilise independently by the therapists or nurses, with or without a walking aid, were mobilised by trained volunteers for up to 15 minutes each session. (Figure 6) Patients who required assistance to transfer or mobilise, or patients who were bed-bound were encouraged by the volunteers to carry out bed or chair-based exercises twice daily. During their hospital stay, patients may fluctuate in their clinical condition or physical function. Prior to each physical activity intervention session, volunteers were instructed to confirm with the ward nurses that the patient was able to participate in the intervention.

Patients who were recruited to the study were given a physical activity chart (Appendix 16) located in a folder on the ward. The physical activity chart included patient's mobility status, and recommended intervention as determined by the therapy team and myself. This informed the volunteers on whether patients were suitable to be mobilised, and at what distance, or if they were suitable only for chair or bed-based exercises. After each physical activity session, volunteers documented the physical activity completed by each patient on the physical activity sheet. This enabled patients' adherence to the intervention to be monitored and analysed.

Figure 6 An example of a mobility session in progress

2.9.3 Volunteer activity

The trained volunteers were allocated a regular time each week based on their availability, to carry out the intervention. At the start of each session, volunteers would refer to the research folder located on the ward to identify patient participants that had been recruited to the study by checking the activity prescription sheet. Once the patients had been identified, the volunteers would approach the nurse in charge or the nurse looking after the patients to ensure that the patients were safe and well enough to participate in the intervention. Participants who were recruited into the study had a magnet bearing the study logo placed beside their name on the patient's board to aid identification of patients. (Figure 7)

Figure 7 A picture of the study logo

SoMoVe

Before entering each ward and before and after each patient contact, volunteers observed hand hygiene protocols. The identity of each patient was confirmed verbally and also by checking the wristband. Volunteers would then offer to take the patient for a walk or go through bedside exercises. Patients who provided verbal consent then proceeded to have walking or bedside exercises. Patients who declined to participate in the activity session were asked the reason for their refusal. Each activity session, including refusals, were documented in the activity prescription sheet. Based on the documentation on the activity prescription sheet, the total number of activity sessions, including adherence to the activity sessions were recorded.

2.10 Quantitative data analysis

Data collected was double entered into a secured database for analysis. Statistical analysis was conducted using the statistical software SPSS version 22. Descriptive statistics -median (IQR); mean (SD); number (%) - were used to analyse the numbers of volunteers recruited, trained and retained, as well as the type and duration of their activity, and patients' adherence to the intervention. Analysis of the above outcome measures was used to develop an assessment of the feasibility of this study.

To determine the accuracy of the SAM in step counting in this group of patients, the mean absolute difference between the observed and measured step counts of 13 participants was calculated. Bland-Altman analysis was also used to determine the level of agreement for both the observed and measured step count.

Descriptive statistics were used to characterise participants in the pre-intervention and intervention phase of the study. This included their physical activity levels as measured by the SAM and GENEActiv, physical function levels as measured by TUG, gait speed, Barthel Index, EMS and cognition as measured by MMSE. Other basic demographics presented included age, Charlson Co-morbidity Index, number of medications, smoking history, home situation and social package, Geriatric Depression Score and quality of life score. The distribution of each outcome measure was assessed for normality and described using parametric or non-parametric statistics as appropriate.

Analysis of intra-daily activity levels was also conducted to provide a description of the activity levels of patients throughout the day. This analysis helped identify periods of sedentary behaviour during patients' hospital stay and provided a guide to suitable timings for the intervention to be conducted.

In the intervention phase, the total number of activity sessions were presented, including the type of activity (mobility/exercise) and the number of instances where patients declined participation. The reasons for refusal to participate in the activity session were also presented.

2.10.1 Comparison between the characteristics of pre-intervention and intervention participants

Comparison in the mean daily step count, as measured by the SAM, in the pre-intervention and intervention group was conducted to determine if the intervention resulted in an increase in the physical activity levels of older inpatients. As this was a feasibility study, no power calculation was conducted and hence the study was not powered to demonstrate a statistical significance in this outcome measure. Similar comparisons were made using the outcome measure produced by the GENEActiv. As part of the feasibility study, I explored the use of both devices and their responsiveness to the intervention.

2.10.2 Correlation studies and regression analysis

To explore the associations between physical activity levels and other variables, bivariate correlation studies were conducted between mean daily step count and several dependent variables including age, Barthel Index, Elderly Mobility Scale, gait speed, TUG, grip strength, FRAIL scale, Charlson co-morbidity index, number of medications, smoking history, BMI, MMSE, GDS, and SNAQ. These correlations were described separately for male and female participants to explore gender differences. Similar analyses were conducted between the above independent variables and mean daily acceleration.

Previous studies have shown that factors such as age, obesity, smoking status and mood were predictors of physical activity levels among older people[288-291]. A study conducted by Walsh et al showed among 9442 independently living older white women (mean age 72 years), those who were depressed (Geriatric Depression Score > 5) were less likely to take up walking as a form of exercise[288]. Among 601 community-dwelling older adults (mean age 76.8, SD 8.7), age was shown to be inversely associated with physical activity, as measured by the Physical Activity Scale for the Elderly. Gender, polypharmacy and health status have also been shown to be associated with physical activity[292-294]. A study conducted by Morie et al among 82 community-dwelling older men (mean age 74 years, SD 5.3) showed that physical function measures such as gait speed and short physical performance battery were positively associated with physical activity as measured by triaxial accelerometers[295]. Outcomes variables were included in a multiple regression model based on evidence from existing literature. The outcome variables chosen to be included in the

multivariate regression model were age, body mass index, smoking pack years, Geriatric Depression Scale, gender and gait speed. Multiple regression studies were also conducted between the mean acceleration, as measured by the GENEActiv, and the outcome measures as mentioned above.

2.10.3 Cost analysis

Analysis was performed to determine the cost of implementing the intervention on the study wards. Analyses were also conducted to determine the cost of training one volunteer, which was used to estimate the cost of rolling out this study on a typical ward on Medicine for Older People department as well as across the whole department, which consists of 6 wards.

The unit cost for healthcare professionals were obtained from the published figures by the Personal Social Services Research Unit in 2016[296]. Potential cost savings were calculated based on any reduction in length of hospital stay. Cost of hospital stay was calculated based on the published document by the Department of Health, National schedule of reference costs[297].

2.11 Acceptability of training programme and physical activity intervention

Quantitative and qualitative research methods often play an important role in implementation studies. It helps answer the same questions by combining results from different sources in a complementary fashion[298]. Quantitative methods help measure the intervention and/or implementation outcomes while qualitative inquiry helps in the understanding of processes, both of which are important to determine the success of the implementation of any intervention[299]. As implementation research occurs in the real world setting, participants' experience and perceptions of the implementation are key factors which can determine the success or failure of any implementation. To determine the acceptability of the intervention in a complex system like the NHS, qualitative research methods were applied to allow key stakeholders to express their views and voice their opinion regarding the intervention.

2.11.1 Qualitative research in healthcare

Qualitative research aims to study phenomena and events in their natural settings by collecting data through various methods including interviews, observation and analysis of documents[300]. It was first used by sociologists and anthropologists in the early twentieth century as a method of

inquiry[301]. The goal of qualitative research is the development of concepts which helps us understand social phenomena in the natural settings, giving due emphasis to the meanings, experiences, and views of all the participants[302]. In the context of healthcare, qualitative research is invaluable in enabling researchers to better understand what really matters to patients, identify barriers to quality improvement in service delivery and explain why improvement does or does not occur[300]. By exploring the experiences and viewpoint of the people involved, the complexity inherent to quality improvement in the healthcare setting can be better understood[300].

2.11.2 Approaches in qualitative research

Qualitative research includes a wide range of philosophical approaches and methodology found within different research disciplines[303]. The aims and goals of the research, its environment, the characteristics of research participants, the researchers' beliefs about the nature of the social world (ontology) and the nature of knowledge and how it can be acquired (epistemology) are some of the determining factors on which approach is used[303]. A few examples of approaches commonly used in qualitative research include grounded theory, ethnography, phenomenology, and narrative research and discourse analysis. Table 6 provides a broad overview of some of the theories, although the list is by no means exhaustive.

Table 6 Traditions and approaches in qualitative research

Research tradition	Disciplinary origins	Aims
Ethnography	Sociology, anthropology	Understanding the social world of people being studied through immersion in their community to produce detailed descriptions of their culture and beliefs.
Phenomenology	Philosophy/Sociology	Understanding the 'constructs', concepts or ideas people use in everyday life to make sense of their world. Uncovering meanings contained within conversation or text.
Grounded theory	Sociology	Developing 'emergent' theories of social action through the identification of analytical categories from the data and the relationships between them.
Discourse analysis	Sociology	Examining the way knowledge is produced within different discourses and the performances, linguistic styles and rhetorical devices used in particular accounts.
Narrative research	Sociology, social history, literary criticism	Analysing what a narrative reveals about the person and their world. Studying the way people tell stories and the structure of narratives.

Ethnography is grounded in a commitment to the first-hand experience and exploration of a particular social or cultural setting on the basis of (though not exclusively by) participant observation[304]. It is based on an epistemology which says that culture can be known through their cultural and social settings. Phenomenology aims to explore and describe the meaning people attach to a particular phenomenon, concept or idea, which helps them make sense of their social world[305]. Grounded theory[306,307], which is one of the best known qualitative approaches, aims to generate theories which explains social processes or actions through analysis of data from participants who have experienced them[303]. The application of grounded theory is varied and the term is often used loosely to describe a broader inductive research strategy[308,309]. Discourse analysis focuses on the way knowledge is produced within different discourses. One of the fundamental principles of discourse analysis is that language is not just a purely descriptive medium used to convey information about the real world but that language actually shapes the real world, and our views of it[310]. Narrative research focuses on the exploration of individual lives and their experiences through various means including the analysis of people's writings or biographies and also by analysing the way they tell stories and how they structure their narratives[311].

Despite the diversity of approaches, many authors would counsel against 'epistemological determinism'[303]. Having a good understanding of the range of approaches available is very helpful but the application of the approaches should take into consideration the research design, aims and questions. Jennifer Mason presents the case eloquently for a less stringent adherence to a particular approach:

> *I have emphasized that you do not have to choose whether you are an ethno methodologist or a psychoanalyst necessarily, but that you do have to be cognizant of the different takes on crucial matters of ontology and epistemology that different approaches imply. It is how you handle these matters that counts more than whether you can claim to be a card-carrying member of a particular doctrine. You may do this by selecting a range of methods and data sources, and approaching them in ways which you can justify as being complement, or, if you wish, by a more doctrinaire following of the conventions of a particular approach. Whatever you choose to do, my view is that there is a great deal to learn by investigating and thinking about a range of ways of generating data in relation to your research questions, rather than assuming too readily that one particular method is the only way[312].*

Mason puts across a clear argument that the approach used in qualitative research should be carefully considered in the context of the research question and aims, and a less stringent application of the traditional research doctrines may at times be suitable depending on factors as discussed. In the following section, I aim to outline the approach which I adopted in this study.

2.11.3 Application of qualitative research methods

Qualitative methods have traditionally been used in research interested in developing social theories and exploring social structures, behaviours and cultures. However, they are now commonly utilised in applied settings and play an important role in the development and appraisal of social policies[313]. Ritchie proposes that the applications of qualitative research methods can be broadly classified as outlined in Table 7.

Table 7 Functions of qualitative research

Classification	Explanation	Examples
Contextual	Describing the form or nature of what exists	• What perceptions of politics do young people hold? • What does it mean to be a grandparent? • How does racism manifest itself?
Explanatory	Examining the reasons for, or associations between, what exists	• Why does homelessness occur? • Why do people 'decide' not to have children? • What are the underlying factors leading to racism?
Evaluative	Appraising the effectiveness of what exists	• What factors contribute to the successful resettlement of people who are homeless? • What are the psychological consequences of youth detention schemes? • What are the needs of different ethnic groups in responding to health promotion programmes?
Generative	Aiding the development of theories, strategies or actions	• The nature of social structures that lead to 'workless' households. • Changing conceptions of family and family relationships. • The role of religious conflict in newly developing racial tensions.

*Adapted from Ricthie and Ormston. "The Applications of Qualitative Methods to Social Research" Qualitative Research Practice. London: Sage, 2013.

Evaluative research

In this study, qualitative research was applied to evaluate the acceptability of the intervention to various stakeholders. Evaluative research is concerned with issues surrounding how well does it work, a question that is central to much policy related investigation[313]. The aim is to identify factors which may contribute to a successful or unsuccessful implementation of an intervention by exploring its processes and outcomes. The broad distinction in evaluative research is between formative and summative modes of inquiry[303]. Formative evaluations are designed to gather information that may help change or improve a particular intervention or programme whereas summative evaluations are concerned about the impact of the intervention or programme on specific outcomes.

In exploring the acceptability of the intervention to relevant stakeholders, the principles of evaluation research were broadly adhered to. Formative evaluation can be defined as a rigorous assessment process designed to identify potential and actual influences on the progress and effectiveness of implementation efforts[314]. Acknowledging the inherent complexity of implementing an intervention into routine clinical practice, I set out to appraise and understand the barriers and facilitators of the implementation process by focusing of the processes and outcomes of the intervention.

Normalisation Process Theory

The evaluation of the intervention was underpinned by Normalisation Process Theory (NPT). The development of Normalisation Process Theory was originally based on grounded theory-building techniques with the aim of addressing the observed difficulties of implementing and integrating interventions in healthcare settings[281]. My approach in the evaluation of the intervention was mainly inductive, with the aim of exploring data generated through interviews and focus groups through the lens of NPT. NPT was used as the framework in the analysis of data but an open mind was also reserved for any other emergent themes. Further details regarding the analysis of data can be found in section 2.12.

2.11.4 Interviews and focus groups

In qualitative research, data can be acquired using various tools such as: interviews and focus groups, observations, documentations and audio or visual records[315]. Interviews are commonly used in qualitative research and involve verbal communication between the researcher and the participant face to face, or through other means such as telephone or video conferencing. The aim of research interview is to explore the views, experiences, beliefs and/or motivations of

individuals on specific matters[316]. Interviews can provide a deeper understanding of a particular social phenomena compared to information collected through quantitative methods such as questionnaires[317]. The three fundamental types of research interviews are structured, semi-structured, and unstructured[318].

Types of interviews

Structured interviews are verbally administered questionnaires where a list of predetermined questions are asked with very little or no variation from the questionnaire and with no scope for further questions to clarify responses or elaborate on a particular issue[319]. They are structured like those in a job interview, where the employer asks the same set of questions for consistency[320]. The interview is considered to be structured where the interviewer follows a specific set of questions in a predetermined order with a limited number of response categories[321]. The benefit of structured interviews is that it is easy to administer and replicate, with less time needed to complete and thus typically allow for a larger number of participants in studies which employ this method. The disadvantage of this method is that a stringent adherence to the interview schedule or questionnaire may prevent in-depth questioning to help better understand a particular phenomenon.

On the contrary, unstructured interviews are conducted on the basis of no preconceived theories or ideas and are performed with little or no organisation[322]. They are sometimes referred to as discovery interviews. It typically starts with an opening question and progresses based primarily upon the initial response[316]. It is often used in circumstances where significant depth is required, for example in a new subject area where little is known. The strength of unstructured interviews is in the ability to go in depth with interviewees to better understand a particular phenomenon[323]. It allows for the interviewer to probe and seek clarification and allows the interviewee to steer the direction of the interview. Unstructured interviews can be very time consuming to conduct and the vast data generated also requires considerable amount to time to analyse in detail. As there is little guidance to steer the interview, the interviewer must have the ability and skills to establish rapport with interviewees and know when to probe or how to progress the interview. The other disadvantage of unstructured interviews is that it is costly to employ interviewers with significant experience or train new researchers with the needed skills to conduct the interview successfully.

Semi-structured interviews have a particular focus, but are flexible in order based upon the direction of the participant's responses[320]. It consists of several key open-ended questions that help define the areas explored but allows the interviewer or interviewee to expand and diverge with the aim of pursuing or developing an idea with more depth[324]. The flexibility of this

approach, as compared to structured interviews, allows for elaboration of participant responses and potential discovery of new information which may not have previously been thought of by the interviewer. Interview schedules or guides are used to explore participant responses in a more systematic and comprehensive way, while keeping the interview focused on the desired line of action[325]. This is in contrast to an unstructured interview where there is no pre-determined questions to guide the interview. Rather than using hand written notes during interviews, audio-recording is typically used to allow the interviewer to focus on the interview content and verbal prompts and also enables a 'verbatim transcript' of the interview to be generated[326]. Semi-structured interviews can be used in an individual interview setting or with a larger group of interviewees. The following section will discuss in greater detail the concept of focus groups.

Focus groups

Focus groups are a form of group interview that capitalises on communication between research participants in order to generate data. It is widely employed to examine people's experiences of disease and of health services[327]. They are used for generating information on collective views, and the meaning that lie behind those views[316]. A focus group consists of participants who are guided via a facilitated discussion, initiated by a set of open-ended questions[328]. The role of the facilitator is to steer the participants back to the focus group questions or go along with the direction of participant responses, based on the research question. Each focus group is a single entity and not an interview with distinct individuals, and thus not to be used as a quick way to collect data from several participants in one go[329].

The key to a successful focus group is interaction among participants[330]. The facilitator plays an important role in facilitating discussion and eliciting participation from all members of the group, while maintaining an appropriate direction guided by the research question. Group dynamics is also an important factor in focus groups. Careful consideration ought to be made regarding the composition of a focus group to get the best quality of discussion. The interviewer should take into consideration factors such as the mix of age , gender, and social professional status of participants and consider how these may impact on the dynamics of the group[316,331]. Participants may be selected based on common or diverse characteristics, depending on the research question[328]. Group size is also an important factor in determining the quality of the discussion. The generally proposed group size ranges from between 6 to 10 participants[319,328,332]. A smaller size may impact of the breadth of data collected and a large group may be too difficult to moderate and participants may feel frustrated at the lack of opportunity to speak[333].

Individual interviews vs focus groups

There are strengths and weaknesses in both focus groups and individual interviews, and one may be more suitable than the other depending on the setting and the desired outcome of the interview[316]. One advantage of focus groups is that group processes can often help people explore and clarify their views in ways that would be less easily accessible in a one to one interview[334]. It allows individuals to build on each other's ideas and generate a group narrative to help understand group norms, meanings and processes. It also provides context about relations of participants in a particular setting. The interpersonal and interactive nature of focus groups allows them to produce information that might not be gathered in an individual interview setting[332,335]. This allows the generation of a wider range of views or ideas as compared to individual interviews.

Nonetheless, there are some challenges with focus groups. There may be situations where some participants in a focus group feel unable to express themselves freely in fear of repercussion[316]. Participants may also feel uneasy with each other and thus inhibited in freely expressing their feelings and opinions. There is also a risk that the group discussion can be dominated by an outspoken individual. Careful selection of group size and composition as well as having a skilled facilitator are all important factors to mitigate some of the above challenges[336]. Focus groups can also be more difficult to schedule as invited participants have to agree on a date and time to meet and can be more time consuming compared to individual interviews.

The strength of a one to one interview is in the ability to explore individual accounts of a particular phenomenon in greater detail compared to a more 'surface' data produced from focus groups[337]. It allows issues that are more sensitive or personal to be explored as respondents may feel embarrassed sharing personal experiences in a group setting, in particular where the group consists of interviewees whom they are less familiar with[332]. It may offer more insight into a respondent's personal thoughts, feelings and world view[338,339]. Individual interviews may also be appropriate when exploring subjects or issues with low prevalence or in circumstances were respondents are hard to recruit. The challenge of individual interviews is that the attention is focused on one person and thus interviewees may be less forthcoming compared to being in a group situation where the attention is directed to many. Individual interviews also lack stimuli in discussion and idea generation as compared to focus groups.

Ultimately, objectives drive design. The decision to utilise individual interviews or focus groups, or both, depends on the research question and objectives. The methods employed should aim to generate the highest quality data to answer the research question. In this study, the process of implementing the intervention on the wards involves interaction and communication between

multiple groups of healthcare professionals. The collective commitment and engagement of key stakeholders are important factors which would determine the success or failure of the implementation process. The following sections outline how participants were selected to be interviewed and whether individual interviews or focus groups were used.

2.11.5 Purposive sampling

Key stakeholders were selected by purposive sampling to share their thoughts and views regarding the implementation of the volunteer-led activity sessions on the wards, through interviews and focus groups. The technique of purposive sampling is widely used in qualitative research for the identification and selection of information-rich cases for the most effective use of limited resources[298,340]. Two key considerations that guide sampling methods in qualitative research are appropriateness and adequacy[341,342]. The aim of sampling in qualitative research is not to count opinions or people but to explore the range of opinions and different representations of an issue[343]. The key stakeholders for the intervention were volunteers, patients, nurses and therapists. The success of the implementation relies on these four groups of people working together in a cohesive manner. Several selection criteria were chosen for each group of participants to be interviewed and this will be discussed separately in the following sections. The rationale behind the selection criteria was to achieve a sample that was inclusive of the demographic structure of the population being studied, and also sufficiently diverse for comparative analysis to be undertaken[303].

The interviews took place from the fourth month onwards after the start of the intervention to ensure that it was well-embedded. The number of interviewees per group varied and data collection ceased once data saturation was achieved. The general principles of data saturation include: no new coding, no new data, no new themes and the ability to replicate the study[344,345]. Rather than emphasising the size of the sample, the aim was to ensure there was adequate depth in the data collected, both in terms of quantity and quality[346,347]. Recruitment of participants for interviews was stopped once no new codes or themes emerged during the data analysis process. The interview schedules are shown in Appendix 17.

Patients

The objective of the intervention was to improve patient outcomes and thus the views of patients regarding the intervention were crucial. Individual interviews were chosen as the method of choice for data collection among patient participants to explore their personal experiences of the intervention. Focus groups was not a suitable choice of data collection for patients as the logistical arrangement required to organise patient participants, including those who were less mobile or

acutely unwell to meet in a meeting room, was neither practical nor safe. Patients were interviewed from four months onwards after the commencement of the intervention to ensure that it was embedded into routine clinical practice. Patients who received at least two activity session were approached and invited to be interviewed individually. To ensure a wide range of views were included in the interviews, participants were selected to ensure equal distribution of male and female patients, with representation from patients with higher and lower physical function and a representative age range. Written consent for participating in the interview was obtained. The interviews were held, with patient's consent, by the bedside behind closed curtains.

Volunteers

Focus groups were chosen as the method of choice to collect data among volunteers. The shared experience of volunteers in delivering the intervention was felt to be best explored through a group setting. Discussions among volunteers are likely to generate a wider perspective of the implementation process and may provide insight into the group narrative on their experiences in their interaction with healthcare professionals and patients. A focus group was conducted four months after the commencement of the intervention to gather the views and experiences of trained volunteers regarding their progress with the intervention. Feedback from volunteers helped address any potential barriers or challenges which volunteers faced on the wards. The selection criteria for interviews for volunteers included participants from different age groups, with differing length of volunteering experience, and a mix of gender. As most of the volunteers had different availability throughout the week due to personal or work commitments, individual interviews were conducted if a date and time for focus groups could not be agreed on. Written consent for the interview was included in the initial recruitment process. The focus groups and interviews were conducted in a meeting room in the hospital.

Nurses

One of the key stakeholders in this study were the nursing staff. Good interaction and communication between the volunteers and healthcare professionals were important factors for the smooth-running of the intervention. Nursing staff played an important role in identifying patients, providing help and supporting volunteers and patients. Focus groups were conducted among nurses to gain their views on the physical activity intervention and their interaction with volunteers. Some of the topics that were explored included barriers and facilitators to the intervention, perceptions of the intervention and suggestions for facilitating its sustainability in hospital settings. Nurses who had interactions with the volunteers during the period of the study were approached individually and those who were keen to participate were invited to the focus

group. Nurses with a mix of length of time in healthcare service and different seniority, ranging from healthcare assistants to ward sisters, were selected to ensure a wide range of views were included in the interviews. Separate interviews were conducted for junior and senior nurses to prevent junior nurses feeling inhibited in expressing their views in the presence of their senior colleagues. The focus groups were conducted in a meeting room in the hospital. Written consent was obtained from nursing staff was participated in the focus group. Nursing staff work on shift patterns and are often allocated breaks throughout the day. Given the possible difficulties in arranging an agreed time for nurses to attend focus groups, individual interviews were employed as an alternative approach for practical reasons if a date and time for focus groups could not be agreed on.

Therapists

The therapy team were one of the main contributors to this study. Their involvement in the study included working with me on the development of the training programme, training the volunteers, identifying suitable patients and providing support to volunteers on the wards. Focus groups were conducted with the therapy team to explore their views and thoughts regarding the intervention and to identify facilitators and barriers to the implementation of the intervention. The role of the volunteer in this intervention was designed to complement the work of the therapy team, hence valuable input would be gained from these focus groups to ensure successful implementation of the intervention in routine clinical practice. Therapists with a wide range of experience and seniority, ranging from therapy assistants to senior therapist, were invited to be interviewed to ensure a broad range of views and input. The focus groups were conducted in a meeting room in the hospital. Written consent was obtained from therapists who participated in the focus groups.

2.12 Qualitative data analysis

The framework approach was applied in the analysis of data. The framework approach is a method of managing qualitative data analysis which was developed by the National Centre for Social Research in the 1980s to manage data through a process of summarisation, resulting in a series of themed matrices[313]. It is a common approach of managing qualitative data in healthcare research and allows data to be managed and analysed systematically[348-350].

The initial stages of the framework approach bears many similarities to thematic analysis in that the emphasis is on the identification of recurring and significant themes. The process of identifying a theme is an interpretive process in which data are systematically searched for patterns to provide an illuminating description of the phenomenon[348,351]. The Framework method provides guidance to adhere to which produces highly structured outputs of summarised data and is useful where multiple researchers are working on the same project[349]. The rigour of the analytical processes and the credibility of the findings are enhanced as it this method of analysis that allows in depth exploration of data while maintaining an effective and transparent audit trail[313,348]. It is not aligned to a particular epistemological or philosophical approach but rather it is a flexible tool that can be utilised with diverse qualitative approaches that aim to generate themes. The stages of the framework approach as described by Richie and Lewis[313] are as described in Table 8 and were adhered to in the analysis of the data, with some minor adaption as described below.

Table 8 Procedure for analysis

Stage 1	Transcription	The audio recording was transcribed verbatim.
Stage 2	Familiarisation with the interview	This process involves listening and re-listening to the audio recording and reading the transcript to familiarise with the interview.
Stage 3	Coding	After familiarisation, the transcript was read line by line and codes or labels which were descriptive of the interpretation were noted down. Examples of code can include emotions, values, behaviours, incidents or structures.
Stage 4	Developing a working analytical framework	The four key components of normalisation process theory were used as the analytical framework. Transcripts were also analysed to explore other emerging themes.
Stage 5	Applying the analytical framework	The framework was then applied by indexing subsequent transcripts using the existing categories and codes.
Stage 6	Charting data into the framework matrix	A matrix was generated using the analytical framework and data was summarised and 'charted' into the matrix.
Stage 7	Interpreting the data	This process involves the analysis of the data to generate concepts, ideas, and impressions, to help gain a better understanding of the acceptability of the intervention.

Coding qualitative data

The terminology 'coding' is often used to refer to both the data management and the abstraction and interpretation processes[303]. For example in grounded theory, coding can be divided into three basic types : open, axial and selective coding[352]. The definition of each these three basic codings are as follow: Open coding is described as a brainstorming approach, axial coding is the act of relating concepts/categories to each other and selective coding is the process of integrating and refining categories. Other authors use terms such as first cycle coding (indexing, sorting) and second cycle coding (categorisation and classification)[353]. The aim of coding is to provide the analyst a formal system of organising the data, uncovering and documenting additional links within and between concepts and experiences described in the data[354]. The codes act as tags or labels to help catalogue key concepts embedded within the raw data[355].

The audio-recordings were transcribed verbatim by an administrative colleague within the research department. I double-checked the transcripts against the audio recording to ensure that it was done accurately. To familiarise myself with the interview, I listened to the audio-recording several times while reading the transcripts. After the familiarisation process, I read the transcript line by line and assigned codes to categorise the data. To help decide which theme each code should be assigned to, I developed several key questions for each of the four NPT themes: Coherence, Cognitive Participation, Collective Action and Reflexive monitoring, to help with this process (Table 9). These questions were not designed to be exhaustive but served as a useful reminder of what the key concepts of the four themes were. I kept an open mind for codes which may not fit into any of the four themes. Microsoft Word was used in the coding and analysis process, as well as data management. Comments were added to each quote indicating its code and theme. A worked example of the coding process is shown in Appendix 18. The example was taken from a focus group conducted among volunteers. Data was then organised according to their themes and codes, and charted onto a matrix (Appendix 19). After organising the data on the matrix, I began the data interpretation process. Codes were analysed to generate concepts and ideas to determine the acceptability of the intervention, and to identify facilitators and barriers to the implementation process. I completed the coding process individually and discussed my findings with a fellow colleague with extensive qualitative research background. We went through the matrix together, exploring each code and its quotes to ensure that the data interpretation process was robust.

Table 9 Key considerations for NPT themes

NPT framework	Questions
Coherence	• Do patients, volunteers and staff members have a shared understanding of the importance of being physically active in hospital? • Do the volunteers appreciate the importance of the training provided? • What are the perceived benefits of the intervention on patients, staff members and the organisation? • Does the volunteer-led physical activity intervention fit with the overall goals and activity of the organisation?
Cognitive participation	• Will volunteers be prepared to invest time, energy and work in the training as well as the intervention? • Do patients, volunteers and staff members see the value of the volunteer-led intervention in encouraging older people to walk or exercise during their stay in hospital? • Will patients, volunteers and staff members be prepared to invest their time to work on it?
Collective action	• How will the training of volunteers and intervention affect the work of user groups and how compatible is it with existing work practices? • What is the impact of the intervention on labour, resources and responsibility of staff members? • Are stakeholders working together to achieve the same goals?
Reflexive monitoring	• What do the volunteers think of the training? • What do the user groups think of the intervention? • Has the intervention benefited patients, staff members and volunteers, and are the benefits easily appreciated?

2.13 Ethical considerations

An important aspect of the study was to develop a high quality training programme to ensure that volunteers were trained and competent to perform their tasks. As volunteers were not clinically trained to be aware of patient's clinical deterioration, before any intervention, volunteers were instructed to confirm with the duty nurses that patients were safe to be mobilised or participate in exercise interventions. As clinical conditions of hospitalised patients may fluctuate from time to time, this prevented unwell patients being mobilised or involved in exercises inappropriately. Volunteers were also trained to seek the help of other healthcare professionals in the event of any uncertainty or adverse events.

A potential hazard of mobilising patients in hospital is the risk of falls. However, previous studies have shown that exercise and mobility interventions among hospitalised older people were not associated with increased adverse outcomes including falls. A randomised controlled trial conducted in a tertiary hospital in Canada in 2003 studied the feasibility of performing resistance exercise on acutely hospitalised older people (N=39, mean age= 82) and found no adverse health effects related to the intervention[356]. Another randomised controlled trial published in 2006, conducted in a tertiary hospital in Australia among hospitalised older people (N=180, mean age 82.4 years) showed no associations between falls and exercise interventions which included mobility ($p=0.437$)[357]. Nonetheless, in the training programme volunteers were taught how to deal with potential adverse events such as falls, dizziness and weakness by ensuring the safety of the patient and themselves, and getting help from healthcare professionals as soon as possible. This study was supported by the professional and clinical governance leads for nursing, therapy and medical staff in Medicine for Older People.

Participant information was safely stored to ensure patient confidentiality. Data collected did not include any personal details such as the name or address of patients, to ensure anonymity, and instead coded numbers were allocated to patients. Focus groups and interviews were conducted in a private meeting room to ensure confidentiality. Patients could opt to have the interview done by the bedside if that was preferred. All transcripts were identified by a study ID number only and no personally-attributable quotes were included in any reports.

Ethical approval was granted by the South East Coast – Surrey Research Ethics Committee (REC reference: 15/LO/2091) and the Health Research Authority. (Appendix 1)

Chapter 3: Physical activity levels of older people in hospital

In this chapter, findings from the pre-intervention phase are described. This phase of the study was designed to define the population studied and describe their physical function and physical activity levels. As there was no control group during the intervention phase, findings from the pre-intervention phase formed a baseline for comparison against the intervention phase findings.

3.1 Validation of the StepWatch Activity Monitor

A sub-study was conducted to determine the accuracy of the SAM in step counting in this patient group who I anticipated would walk slowly. 13 participants (7 male, mean age 86.3 years) who were recruited to the pre-intervention phase of this study, and were able to mobilise independently wore the SAM and had their step count manually recorded by me through direct observation as they walked along the ward corridor for 40 metres. The mean absolute percentage between the observed and measured step counts was calculated with the formula below:

$$\text{Mean absolute percentage error} = \frac{100}{n}\sum\left(\frac{(Observed\ step\ count - SAM\ measured\ step\ count)}{Observed\ step\ count}\right)$$

The median gait speed was 0.53 metre/second (m/s) (IQR 0.14 – 0.79). The calculated mean absolute percentage error between the observed and SAM measured step count was 8.6% (SD 10.5). Figure 8 shows the scatterplot between the observed and measured step counts. Bland-Altman analysis demonstrated good level of agreement between both measures (mean difference = -8.23 steps; 95% CI -17.99 – 1.53) (Figure 9). The analysis showed that the SAM tended to miscalculate between an overestimation of 18 steps and an underestimation of 1.5 steps in this patient group with low gait speed. This sub-study demonstrated that the SAM was sufficiently accurate in step counting among older inpatients and was suitable to be used in this study.

Figure 8 Plot of observed and measured step counts

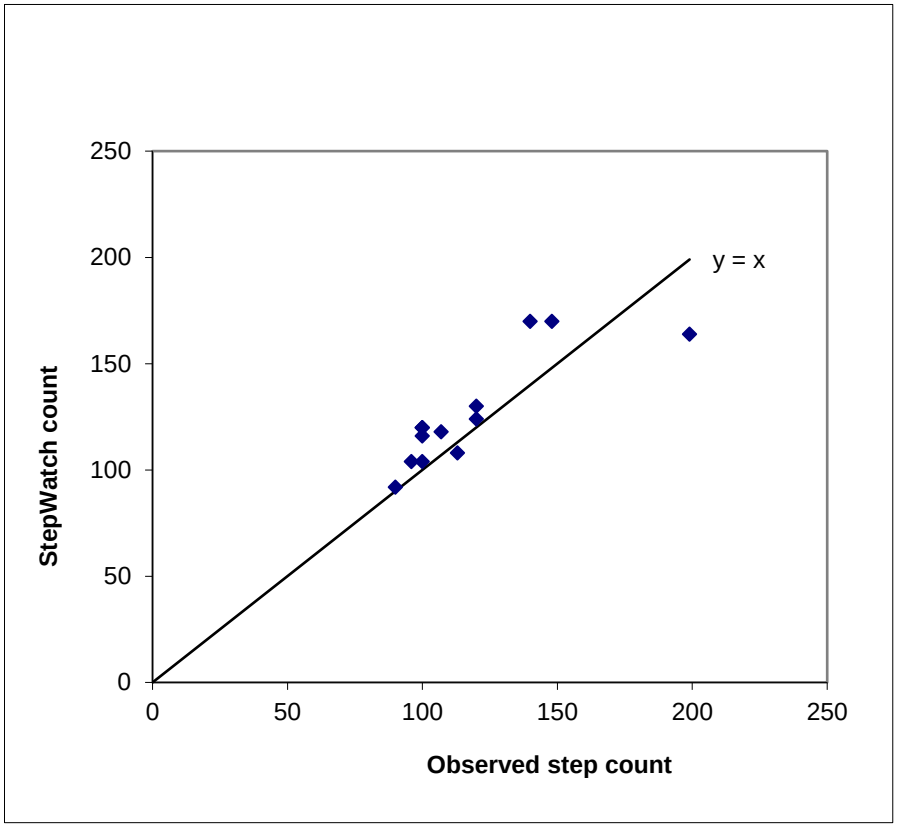
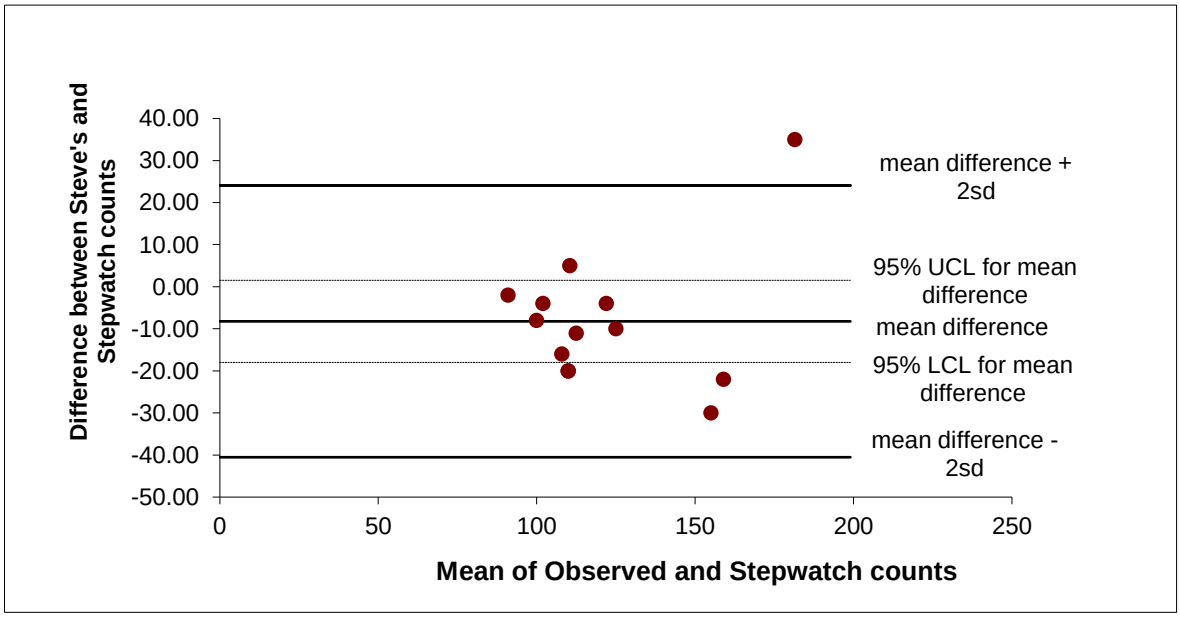


Figure 9 Bland-Altman analysis: comparison of mean difference



UCL= Upper confidence limit; LCL = lower confidence limit; SD = standard deviation

3.2 Baseline characteristics

50 participants (25 male, 25 female) were recruited from three study wards for the baseline assessment of physical activity levels. 67 patients who met the inclusion criteria were initially approached and 17 (25%) patients declined to participate in the study. Participants' mean age was 87.2 years (SD 4.6). The baseline characteristics of the participants are shown in table 10. The mean age for male (87.1 years, SD 4.8) and female (87.3 years, SD 4.5) participants were similar. Male participants were more likely to be married (48%) while the majority of the female participants were widowed (68%). 56% of the male participants were living with friends or family while 60% of the female participants were living alone. 33.3% of the female participants received formal help with personal care while 92% of the male participants received no help with personal care. A higher proportion of male participants (76%) were ex-smokers compared to female participants (44%). The median smoking pack years for male participants was much higher at 11 years (IQR 0 – 47.5) compared to female participants (0.5 years, IQR 0 – 5). Charlson comorbidity index, number of medications and BMI scores were similar between male and female participants.

Table 10 Characteristics of participants in the pre-intervention phase

	Total (n = 50)	Men (n = 25)	Women (n = 25)	p value
Age	87.2 (SD 4.6)	87.1 (SD 4.8)	87.3 (SD 4.5)	0.86
Marital status:				
Single:	3 (6%)	2 (8%)	1 (4%)	0.015
Married:	14 (28%)	12 (48%)	2 (8%)	
Divorced/Separated:	5 (10%)	2 (8%)	3(12%)	
Widowed:	26 (52%)	9 (36%)	17 (68%)	
Cohabitating:	1 (2%)	0	1 (4%)	
Usual residence:				
Living alone	26 (52%)	11 (44%)	15 (60%)	0.028
Living with friends or family	21 (42%)	14 (56%)	7 (28%)	
Residential/Rest home	3 (6%)	0	3 (12%)	
Nursing home	0	0	0	
Care received:				
Community nursing team	6 (12.2%)	3 (12%)	3 (12.5%)	0.65
Sitting service				
Formal	2 (4.1%)	0	2 (8.3%)	0.23
Informal	2 (4.1%)	1 (4%)	1 (4.2%)	
No	45 (91.8%)	24 (96%)	21 (87.5%)	
Meal provision				
Formal	14 (28.6%)	5 (20%)	9 (37.5%)	0.34
Informal	19 (38.8%)	10 (40%)	9 (37.5%)	
No	16 (32.7%)	10 (40%)	6 (25%)	
Personal care				
Formal	9 (18.4%)	1 (4%)	8 (33.3%)	0.012
Informal	1 (2%)	1 (4%)	0	
No	39 (79.6%)	23 (92%)	16 (66.7%)	
Shopping				
Formal	3 (6.1%)	2 (8%)	1 (4.2%)	0.14
Informal	37 (75.5%)	16 (64%)	21 (87.5%)	
No	9 (18.4%)	7 (28%)	2 (8.3%)	
Cleaning				
Formal	16 (32.7%)	6 (24%)	10 (41.7%)	0.40
Informal	25 (51%)	14 (56%)	11 (45.8%)	
No	8 (16.3%)	5 (20%)	3 (12.5%)	
Smoking history:				
Never	18 (36%)	6 (24%)	12 (48%)	0.062
Ex-smoker	30 (60%)	19 (76%)	11 (44%)	
Current smoker	1 (2%)	0 (0%)	1 (4%)	
Median Pack years	3 (IQR 0 – 27.5)	11 (IQR 0 – 47.5)	0.5 (IQR 0 – 5)	0.018
Charlson comorbidity Index	7 (IQR 6 – 9)	7 (IQR 6 – 9)	7 (IQR 5 – 8.5)	0.14
Number of medications				
0 – 5 medications	14 (28%)	9 (36%)	5 (20%)	0.45
6 – 10 medications	22 (44%)	9 (36%)	13 (52%)	
>10 medications	14 (28%)	7 (28%)	7 (28%)	
Body Mass Index				
<18.5	3 (6%)	1 (4%)	2 (8%)	0.50
18.6 – 25	27 (54%)	13 (52%)	14 (56%)	
>25	20 (40%)	11 (44%)	9 (36%)	

n = number of participants; SD = standard deviation

3.3 StepWatch Activity Monitor

3.3.1 Ambulatory activity

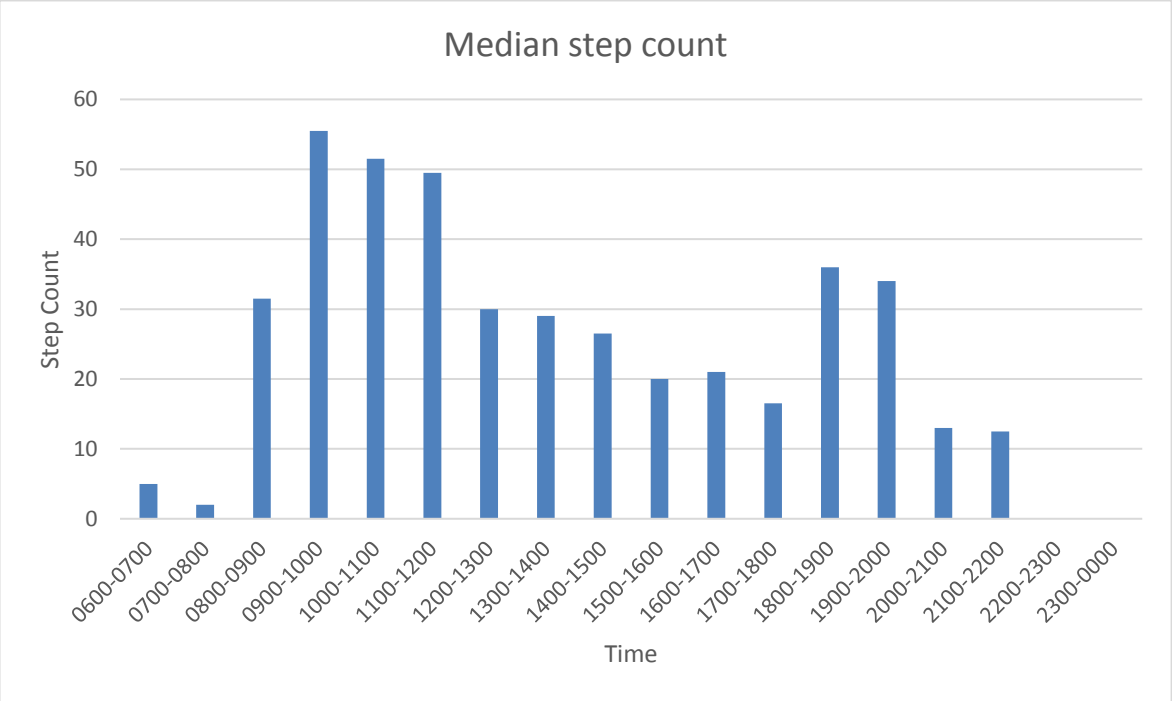
42 participants (21 males, mean age 87.5 years, SD 4.7) had at least 24 hours of step count recording (Table 11). The median wear time for the SAM was 4 days (IQR 2 – 6.8 days). The median daily step count for the pre-intervention participants was 636 steps per day (IQR 298 – 1468). The median daily step count for male participants (764 steps) was higher than the female participants (542 steps), although this difference was not statistically significant (p = 0.29). Intra-daily activity analysis demonstrated two peaks of ambulatory period throughout the day between the hours of 8am to 12pm and a lower one between 6pm to 8pm (Figure 10). Analysis of ambulatory activity during night time was also conducted. 33 participants (79%) were ambulant between the hours of 10pm and 6am, with a median step count of 94 steps (IQR 36 – 289 steps) during this period.

Table 11 Pre-intervention daily step count

	Total (n = 42)	Male (n = 21)	Female (n=21)	p value
Median daily step count (IQR)	636 (298 – 1468)	764 (328 – 2248)	542 (249 – 1290)	0.29
SAM median wear time in days (IQR)	4 (2 – 6.8)	5 (2 – 7)	4 (2 – 5)	0.36

n = number of participants; IQR = Interquartile range

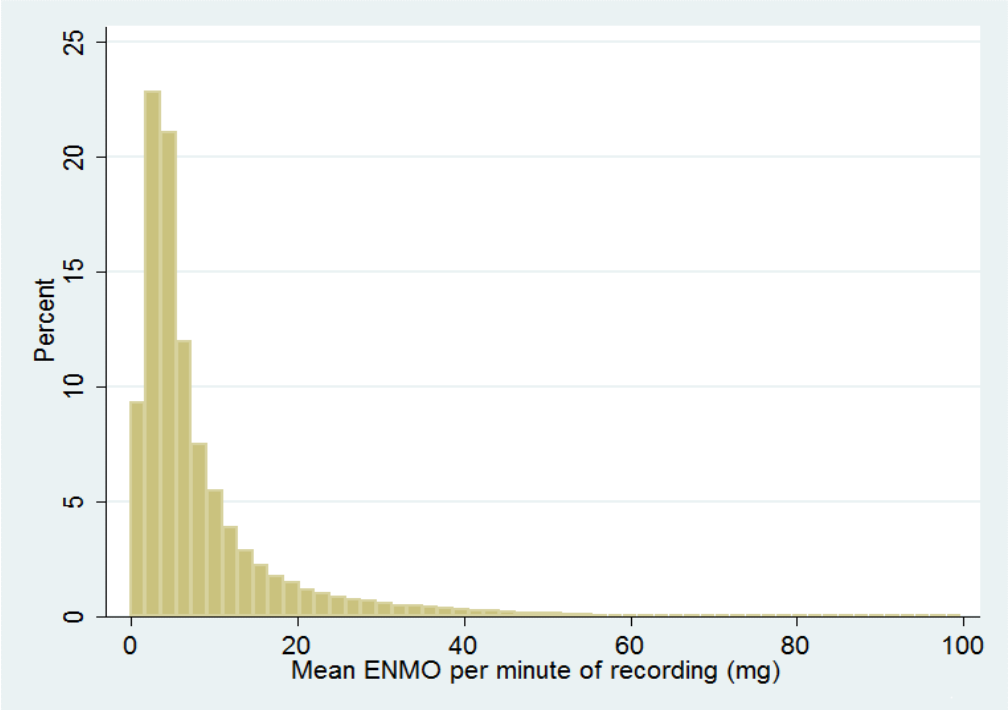
Figure 10 Ambulatory activity between 6am and 10pm



3.4 GENEActiv

In my initial analysis, 40mg was chosen as the cut-off point for sedentary behaviour based on a study conducted by Charman et al which defined sedentary behaviour as (0 – 40mg) among a group of community-dwelling older adults (n = 58, mean age 79 years)[358]. However, I found that the median time spent by patients at 40mg for 1 min was only 7.9min (IQR 3.8 – 27.6) and 29 participants (69%) did not achieve 40mg sustained for 5 minutes. Further analysis of the mean acceleration per minute across all participants showed that the top 10% of activity was ≥19.9mg (Figure 11). Based on these findings, 20mg was chosen as the cut-off point for sedentary behaviour of older inpatients in this study.

Figure 11 Mean acceleration per minute across all participants



ENMO = Euclidean Norm Minus One (acceleration); mg = milligravity

42 participants (22 female, mean age 87.5 years, SD 7.8) had valid GENEActiv recordings for a minimum of 24 hours (Table 12). The median device wear time was 5.8 days (IQR 2.9 – 7). Analysis of the GENEActiv recordings showed that among this patient group, patients spent a median time of 57 minutes (IQR 29 – 112) at 20mg sustained at 1 minute, 11 minutes (IQR 2 – 40) at 20mg sustained at 5 minutes and 4 minutes (IQR 0 – 25) at 20mg sustained at 10 minutes. The mean daily acceleration of the whole sample was 9.1mg (SD 3.3). There was statistically significant difference ($p = 0.009$) between the mean daily acceleration of male (10.4mg, SD 3.6) and female (7.9mg, SD 2.6) participants. Intra-daily activity analysis demonstrated that the mean acceleration from 12am to 6am was 5.9mg ± 2.1, from 6am to 12pm it was 10.2mg ± 4.1, from 12pm to 6pm it was 10.8mg ± 4.5 and from 6pm to 12am it was 8.8mg ± 3.2 (Table 13). Figure 12 shows the comparison of hourly activity levels measured by the SAM and the GENEActiv.

Table 12 Physical activity levels measured by GENEActiv

	Total (n = 42)	Male (n = 20)	Female (n = 22)	p value
Minutes of activity (20mg) at 1 minute bouts	57 (IQR 29 – 112)	93 (IQR 11 – 142)	33 (IQR 25 – 60)	0.012
Minutes of activity (20mg) at 5 minutes bout	11 (IQR 2 – 40)	27 (IQR 11 – 96)	2 (IQR 0 – 15)	0.001
Minutes of activity (20mg) at 10 minute bouts	4 (IQR 0 – 25)	15 (IQR 4 – 61)	0 (IQR 0 – 6)	0.001
Mean acceleration per 24 hours (mg)	9.1mg (SD 3.3)	10.4 (SD 3.6)	7.9 (SD 2.6)	0.009
Median GENEActiv wear time (days)	5.8 (IQR 2.9 – 7)	7 (IQR 4.9 – 7)	3.9 (IQR 2.7 – 6.1)	0.019

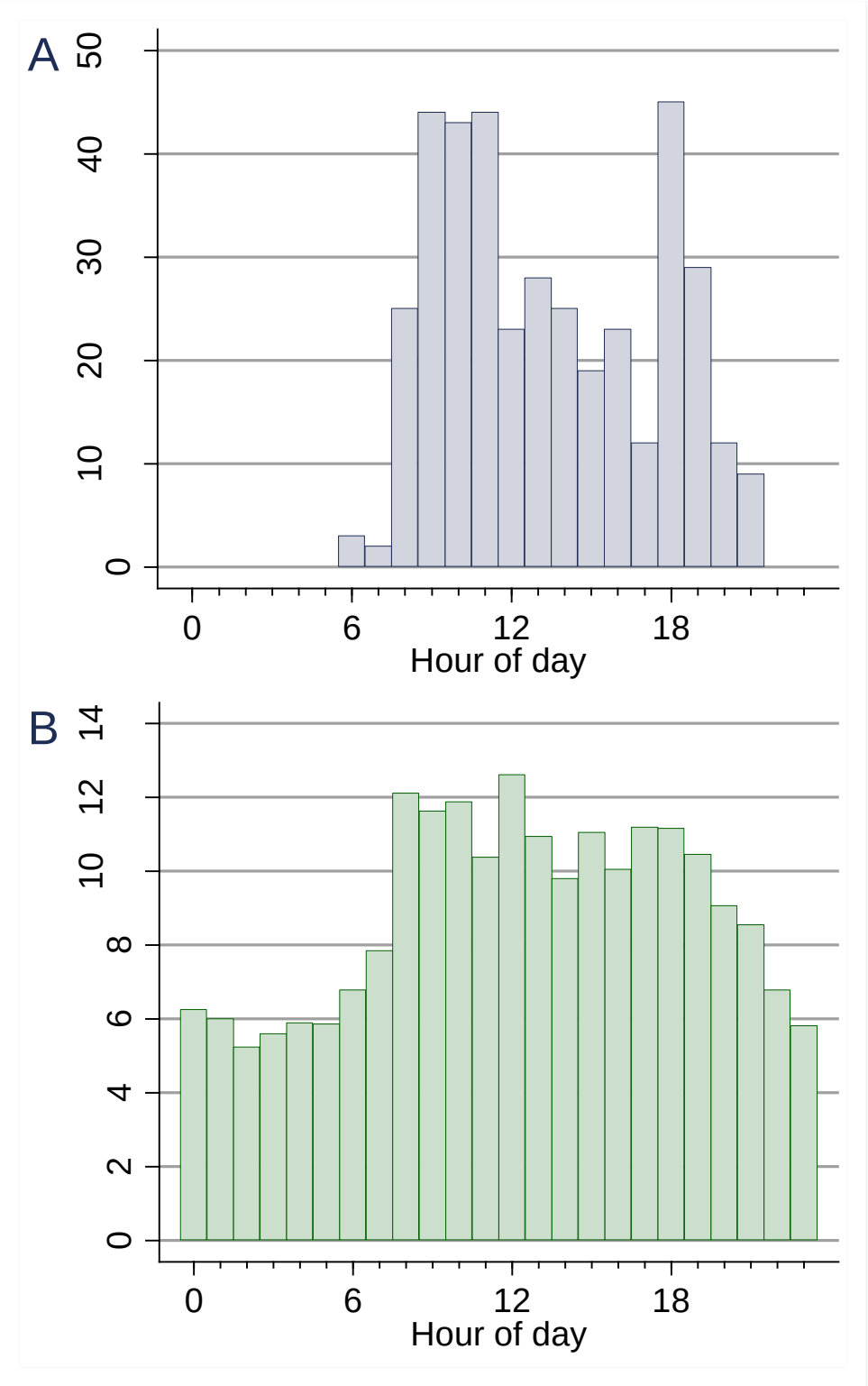
n = number of participants; mg = milligravity; IQR = Interquartile range

Table 13 Intra-daily activity analysis with the GENEActiv

	12am – 6am	6am – 12pm	12pm to 6pm	6pm – 12am
Mean acceleration (mg)	5.9	10.2	10.8	8.8
SD	2.1	4.1	4.5	3.2

mg = milligravity; SD = standard deviation; am = morning; pm = evening

Figure 12 Step count and wrist acceleration by hour of day



3.5 Determining the suitability of both devices to patients

23 participants (14 male, 9 female) completed the device suitability questionnaire upon removal of the devices (Table 14). 22 participants wore both the SAM and the GENEActiv and one participant wore only the GENEActiv due to venous eczema on both legs. Four out of 22 participants (18%) who wore the SAM reported that the device was uncomfortable to wear. The device was well-tolerated during the day but all four participants reported that it was uncomfortable to wear during sleep time. 22 of 23 participants who wore the GENEActiv reported that the device was comfortable to wear and did not interfere with their activities of daily living. One participant reported that both devices were uncomfortable and wanted them to be removed without giving any specific reasons.

Table 14 Device acceptability table

		Yes	No	Missing
1.	**Was SAM comfortable to wear?**	17	5	1
2.	**Did the SAM interfere with the following activities?**			
2a.	Washing	0	21	2
2b.	Sleeping	4	17	2
2c.	Dressing	0	21	2
2d.	Walking	0	21	2
2e.	Personal Hygiene	0	21	2
3.	**Was the GENEActiv comfortable to wear?**	22	1	0
4.	**Did the GENEActiv interfere with the following activities?**			
4a.	Washing	0	22	1
4b.	Sleeping	0	22	1
4c.	Dressing	0	22	1
4d.	Walking	0	22	1
4e.	Personal Hygiene	0	22	1

3.6 Physical function

3.6.1 Barthel Index

46 participants had their Barthel Index recorded (Table 15). Four participants had missing data. The median Barthel Index was 77. Male participants had a higher median Barthel Index (80) compared to female participants (72).

3.6.2 Elderly Mobility Scale

Scores for the Elderly Mobility Scale (EMS) were categorised into three categories: 0 – 9 indicated patients were fully dependent, 10 – 13 indicated patients were borderline in their physical function and were very likely to require some assistance and scores ≥ 14 indicated functional independence. 42 participants had their EMS recorded. Data was missing for eight participants. 23 participants (54.8%) were classified as independent and 19 participants (45.2%) were classified as borderline or fully dependent in their mobility. The median score for male participants was 15.5, which was higher than female participants (12), although this difference was not statistically significant ($p = 0.27$).

3.6.3 Timed up and go test

21 participants (55.2%) had their Timed up and go test measured. 17 participants (10 female) were unable to complete the task. 12 participants did not have their TUG measured. The median TUG time was 27.2 seconds(s). Male participants had a better median TUG time (20.6s, IQR 18.4 – 47.1) compared to female participants (32.4s, IQR 6.5 – 19.8). A longer time taken to complete the test indicates poorer physical function.

3.6.4 Gait speed

25 participants (59.5%) had their gait speed measured whilst 17 participants (10 female) were unable to mobilise independently and hence gait speed was not measured. Eight patient had missing data. The median gait speed was 0.55m/s (IQR 0.35 – 0.72). Male participants had a faster gait speed (0.63m/s, IQR 0.4 – 0.82) compared to female participants (0.48m/s, IQR 0.21- 0.62), although the difference was not statistically significant ($p = 0.18$). The median gait speed for both male and female participants were below the cut-off score 0.8m/s which indicates a risk of sarcopenia[208,209].

3.6.5 Grip strength

43 participants had their grip strength measured. 40 participants (93%) were right-handed and three participants (7%) were left-handed. Seven patients did not have their grip strength recorded. The mean grip strength for male participants was 23.7kg and 13.8kg for female participants. The mean grip strength for both male and female participants were below the cut-off value of <27kg for men and <16kg for women, which is used in the diagnosis of sarcopenia. 16 (70%) male participants had grip strength < 27kg and 13 (65%) female participants had grip strength below 16kg.

3.6.6 FRAIL scale

46 participants had their FRAIL scale recorded. 18 participants (39.1%) were classified as being frail, 20 participants (43.5%) were classified as being pre-frail and eight participants (17.4%) had a normal score. 82.6% of the participants were either frail or in a pre-frail state based on their FRAIL scale score. Four participants had missing data.

Table 15 Physical function of pre-intervention participants

(Median)	Total	Male	Female	P value
Barthel Index (IQR)	77 (54 -90) N = 46	80 (58 – 91) N = 24	72 (49 – 89) N = 22	0.33
Elderly Mobility Scale (IQR)	14.5 (7 – 19)	15.5 (7 – 20)	12 (6 – 18)	0.27
Score 0 – 9 (%)	16 (38.1%)	7 (31.8%)	9 (45%)	
Score 10 – 13	3 (7.1%)	1 (4.5%)	2 (10%)	
Score ≥ 14	23 (54.8%)	14 (63.6%)	9 (45%)	
	N = 42	N = 22	N = 20	
Timed up and go test (s)	27.2 (20.1 – 45.9) N = 21	20.6 (18.1 – 47.1) N = 13	32.4 (25.2 – 44.3) N = 8	0.24
Gait speed (m/s)	0.55 (0.35 – 0.72) N = 25	0.63 (0.4 – 0.83) N = 15	0.48 (0.21 – 0.62) N = 10	0.18
Grip strength# (kg)		23.7 (SD 7.2)	13.8 (SD 3.9)	0.001*
< 27kg		16 (70%)		
< 16kg			13 (65%)	
		N = 23	N = 20	
Frail scale				
Not frail	8 (17%)	4 (17%)	4 (18%)	0.54
Pre-frail state	20 (44%)	11 (46%)	9 (40%)	
Frail	18 (39%)	9 (38%)	9 (40%)	
	N = 46	N = 24	N = 22	

IQR = Interquartile range; N = number of participants; % = percentage; s = seconds; m/s = metre per second; # = mean; kg = kilogram; SD = standard deviation; * = statistically significant

3.7 Cognitive function

3.7.1 Mini Mental State Examination

48 participants had their MMSE score recorded (Table 16). The median MMSE score was 25.5 (IQR 22 – 27). Male participants had a higher median MMSE score (27, IQR 23.5 – 27) compared to female participants (22, IQR 20 – 28), however this difference was not statistically significant (p = 0.219). Participants were also categorised into two categories: no cognitive impairment (scores of ≥24) and possible underlying cognitive impairment (scores of ≤ 23). A higher proportion of male participants (76%) had no cognitive impairment compared to female participants (43.5%).

3.7.2 Geriatric Depression Scale

The scoring for GDS was classified into three groups: no depressive symptoms (0 – 4), mild depressive symptoms (5 – 9) and moderate to severe depressive symptoms (10 – 15). 25 participants (52%) had a normal score, 19 participants (39.5%) were classed as having mild depressive symptoms and four participants (8.3%) were classed as having moderate to severe depressive symptoms. Data on GDS was missing for two participants.

Table 16 Cognitive function of pre-intervention participants

Median	Total (n=48)	Male (n=25)	Female (n=23)	P value
Mini-mental state examination (IQR)	25.5 (22- 27)	27 (23.5 – 27)	22 (20 – 28)	0.22
No cognitive impairment	29 (60%)	19 (76%)	10 (44%)	
Possible underlying cognitive impairment	19 (40%)	6 (24%)	13 (56%)	
	N = 48	N = 25	N = 23	
Geriatric Depression Scale (IQR)	4 (3 – 6)	4 (3 – 7)	4 (3 – 6)	0.45
No depressive symptoms	25 (52%)	13 (52%)	12 (52%)	
Mild depressive symptoms	19 (40%)	9 (36%)	10 (44%)	
Moderate to severe depressive symptoms	4 (8%)	3 (12%)	1 (4%)	
	N = 48	N = 25	N = 23	

N = number of participants; IQR = Interquartile range; % = percentage

3.7.3 Simplified Nutritional Appetite Questionnaire

47 participants had their SNAQ score recorded (Table 17). The median SNAQ score for all participant was 14 (IQR 13 – 15). The male and female participants had similar SNAQ score of 14 (IQR 14 – 16) and 14 (13 – 15) respectively. A score of <14 indicates poor appetite. Three participants had missing data.

Table 17 SNAQ score – Pre-intervention

	Total (n = 47)	Male (n = 24)	Female (n = 23)	p value
Median (IQR)	14 (13 – 15)	14 (14 -16)	14 (13 – 15)	0.10
Poor appetite	16 (32%)	5 (20%)	11 (44%)	
Good appetite	41 (62%)	19 (80%)	12 (48%)	

n = number of participants; IQR = Interquartile range; % = percentage

3.7.4 EuroQol-5D-3L

47 participants had their EuroQol-5D-3L score recorded (Table 18). Each category of the quality of life score is presented individually. Across all five categories including mobility, self-care, usual activities, pain/discomfort, and anxiety/depression, there were no statistically significant difference in the responses from male and female participants. Participants were also asked to rate their health state on a scale of 0 (worst imaginable health) to 100 (best imaginable health). The median score for health state was 52.5 (IQR 50 – 73.75). The median score for male participants was higher (60, IQR 47.5 – 70) than the score for female participants (50, IQR 50 – 75), but this was not statistically significant (p = 0.74). Three participants had missing data.

Table 18 EuroQol-5D-3L score – Pre-intervention

Mobility	Total (n = 47)	Male (n = 24)	Female (n = 23)	p value
No problems	7 (14.9%)	4 (16.7%)	3 (13%)	0.58
Some problems	35 (74.5%)	16 (66.7%)	19 (82.6%)	
Confined to bed	5 (10.6%)	4 (16.7%)	1 (4.3%)	
Self-care				
No problems	23 (48.9%)	12 (50%)	11 (47.8%)	0.89
Some problems	22 (46.8%)	10 (41.7%)	12 (52.2%)	
Unable to wash or dress	2 (4.3%)	2 (8.3%)	0	
Usual activities				
No problems	13 (27.6%)	7 (29.2%)	6 (26.1%)	0.33
Some problems	20 (42.6%)	7 (29.2%)	13 (56.5%)	
Unable to perform usual activities	14 (29.8%)	10 (41.7%)	4 (17.4%)	
Pain/Discomfort				
No pain or discomfort	17 (36.2%)	11 (45.8%)	6 (26.1%)	0.25
Moderate pain or discomfort	29 (61.7%)	12 (50%)	17 (73.9%)	
Extreme pain of discomfort	1 (2.1%)	1 (4.2%)	0	
Anxiety/Depression				
Not anxious or depressed	30 (63.8%)	15 (62.5%)	15 (65.2%)	0.87
Moderately anxious or depressed	13 (27.7%)	7 (29.2%)	6 (26.1%)	
Extremely anxious or depressed	4 (8.5%)	2 (8.3%)	2 (8.7%)	
Health state today				
Median	52.5	60	50	0.74
IQR	50 – 73.75	47.5 - 70	50 – 75	

n = number of participants; IQR = Interquartile range

3.8 Receipt of care

The median length of stay was 15.5 days (Table 19). Male participants had a higher length of stay (17 days) compared to female participants (15 days), although the difference was not statistically significant (p = 0.915). 35 participants (70%) were discharged back to their usual residence. 11 participants (22%) were discharged to another hospital for further rehabilitation. There was one new residential/rest home admission and one new nursing home admission compared to pre-admission residence status. Four participants (8%) had either a deep vein thrombosis or a pulmonary embolism. No participants had pressure sores. 15 participants (30%) were re-admitted to hospital within a month. There were no statistically significant difference in outcome measures for receipt of care between male and female participants.

Table 19 Receipt of care – Pre-intervention

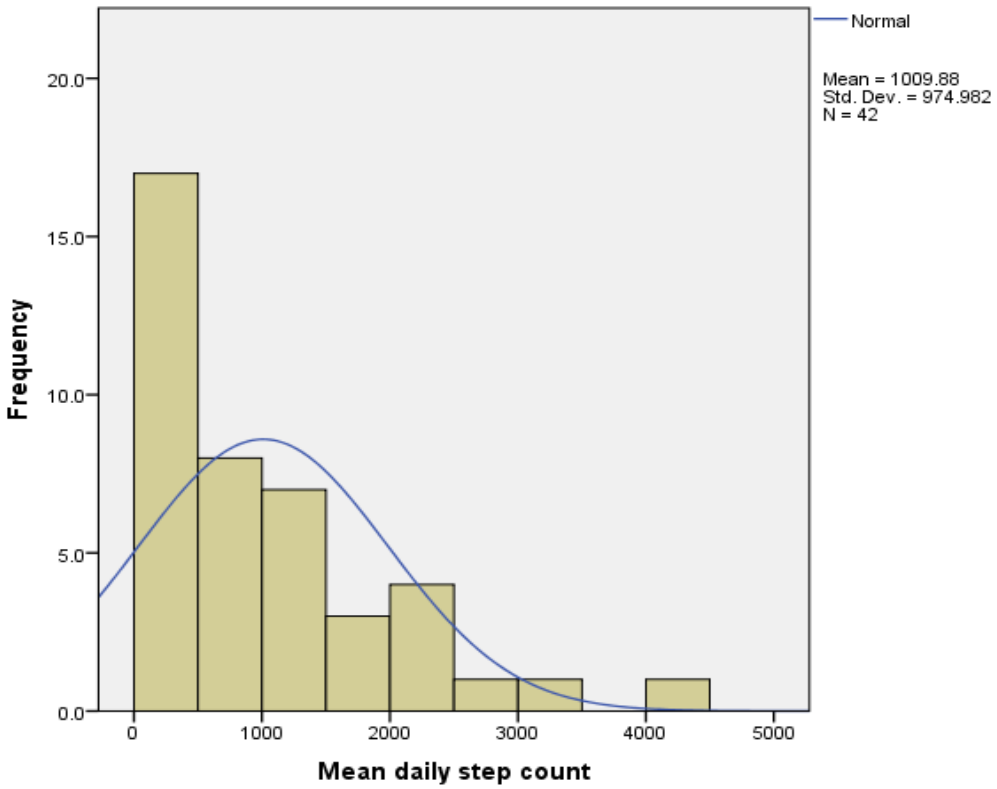
	Total	Male	Female	p value
Length of stay (median)	15.5 (IQR 8 – 22.5)	17 (IQR 8 – 22)	15 (IQR 7.5 – 26)	0.92
Discharged to usual residence	35 (70%)	17 (68%)	18 (72%)	0.76
Discharge destination:				
• Private home living alone	18 (36%)	7 (28%)	11 (44%)	0.22
• Private home living with relatives or friends	16 (32%)	11 (44%)	5 (20%)	
• Residential/Rest Home	4 (8%)	1 (4%)	3 (12%)	
• Nursing Home	1 (2%)	1 (4%)	0	
• Another hospital	11 (22%)	5 (20%)	6 (24%)	
New package of care offered	8 (16%)	3 (12%)	5 (20%)	0.70
New package of care accepted	7 (14%)	3 (12%)	4 (16%)	0.68
New informal care arranged	2 (4%)	1 (4%)	1 (4%)	
Community nursing	18 (36%)	9 (36%)	9 (37.5%)	0.91
Sitting service:				
Formal	13 (26.5%)	5 (20%)	8 (33.3%)	0.25
Informal	1 (2%)	0	1 (4.2%)	
No	35 (71.4%)	20 (80%)	15 (62.5%)	
Meal provision:				
Formal	24 (49%)	11 (44%)	13 (54.2%)	0.51
Informal	16 (32.7%)	9 (36%)	7 (29.2%)	
No	9 (18.4%)	5 (20%)	4 (16.7%)	
Personal care:				
Formal	20 (40.8%)	9 (36%)	11 (45.8%)	0.48
Informal	0	0	0	
No	29 (59.2%)	16 (64%)	13 (54.2%)	
Shopping:				
Formal	11 (22.9%)	5 (20.8%)	6 (25%)	0.59
Informal	26 (54.2%)	12 (50%)	14 (58.3%)	
No	11 (22.9%)	7 (29.2%)	4 (16.7%)	
Cleaning:				
Formal	19 (39.6%)	9 (37.5%)	10 (41.7%)	0.95
Informal	19 (39.6%)	10 (40%)	9 (37.5%)	
No	10 (20.8%)	5 (20.8%)	5 (20.8%)	
Community therapy	16 (32.6%)	7 (28%)	9 (37.5%)	0.33
Deep Vein Thrombosis/ Pulmonary Embolism	4 (8%)	3 (12%)	1 (4%)	0.60
Pressure sore	0	0	0	
Readmission in 1 month	15 (30%)	8 (32%)	7 (28%)	0.76

n = number of participants; IQR = Interquartile range

3.9 Correlation studies

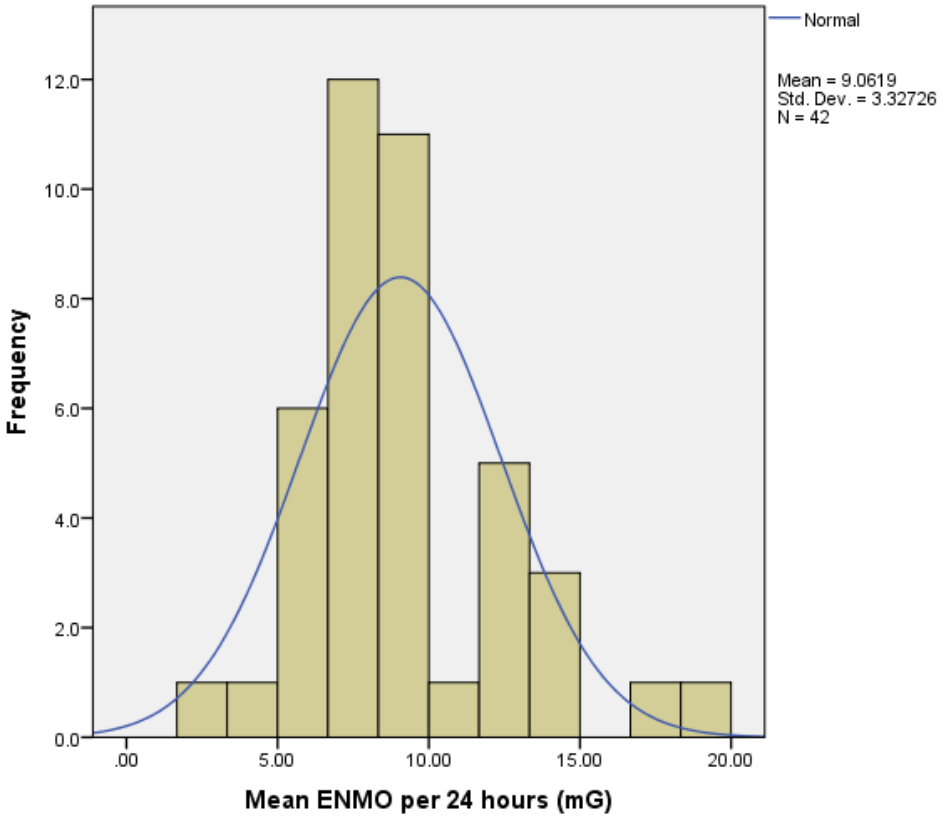
Bivariate correlation analysis was conducted between physical activity levels (mean daily step count and mean daily acceleration) and other variables including age, Barthel Index, Elderly Mobility Scale, gait speed, timed up and go test, number of medications, smoking pack years, BMI, mini mental state examination, Geriatric Depression Scale, grip strength, Charlson comorbidity index and simplified nutritional appetite questionnaire (Table 20 and 21). The mean daily step count was not normally distributed (Figure 13) while the mean daily acceleration data were normally distributed (Figure 14). Data from grip strength, Charlson comorbidity index and SNAQ were normally distributed and the rest of the variables were not normally distributed. Spearman's rank correlation was used for non-parametric variables and Pearson's correlation was used if one of the variables was normally distributed. Kruskal-Wallis analysis was used for categorical variables.

Figure 13 Histogram of mean daily step count



n = number of participants; std dev = standard deviation

Figure 14 Histogram of mean daily acceleration



ENMO = Euclidean Norm Minus One, which represents acceleration; mg = milligravity; n = number of participants; Std Dev = standard deviation

3.9.1 Mean daily step count

Across both gender, Barthel Index (r = 0.54, p = 0.001), Elderly Mobility Scale (r = 0.71, p = 0.001), and gait speed (r = 0.57, p = 0.007) had statistically significant positive correlation with mean daily step count while timed up and go test (r = - 0.57, p = 0.014) was found to have a statistically significant negative correlation with mean daily step count (Table 20).

Among male participants, age (r = -0.46, p = 0.037) and years of smoking (r = -0.49, p = 0.029) were found to have statistically significant negative correlation with mean daily step count while Elderly Mobility Scale (r = 0.66, p = 0.003) was found to be positively correlated with mean daily step count with statistical significance.

Among female participants, Barthel Index (r = 0.728, p = 0.001) and Elderly Mobility Scale (r = 0.78, p = 0.001) were shown to have positive correlation with mean daily step count with statistical significance. TUG (r = -0.86 p = 0.014) had statistically significant negatively correlation with mean daily step count among female participants.

Table 20 Correlation between step count and co-variates

	Male	Female	Total
Age[a]	n = 21 r = -0.46 p = 0.037*	n = 21 r = 0.03 p = 0.89	n = 50 r = -0.25 p = 0.11
Charlson comorbidity Index[a]	n = 21 r = -0.07 p = 0.78	n = 21 r = -0.17 p = 0.47	n = 42 r = -0.75 p = 0.64
Number of medications[a]	n = 21 r = 0.17 p = 0.46	n = 21 r = -0.36 p = 0.11	n = 42 r = -0.04 p = 0.79
Smoking pack years[a]	n = 20 r = -0.49 p = 0.029*	n = 21 r = 0.17 p = 0.45	n = 41 r = -0.13 p = 0.44
Body Mass Index[a]	n = 21 r = -0.19 p = 0.40	n = 21 r = -0.19 p = 0.42	n = 42 r = -0.17 p = 0.30
Barthel Index[a]	n = 20 r = 0.43 p = 0.06	n = 20 r = 0.73 p = 0.001**	n = 40 r = 0.54 p = 0.001**
Elderly Mobility Scale[a]	n = 18 r = 0.66 p = 0.003**	n = 17 r = 0.78 p = 0.001**	n = 35 r = 0.71 p = 0.001**
Gait speed[a]	n = 12 r = 0.40 p = 0.20	n = 9 r = 0.78 p = 0.014*	n = 21 r = 0.57 p = 0.007**
Timed up and go test[a]	n = 11 r = -0.41 p = 0.22	n = 7 r = -0.86 p = 0.014**	n = 18 r = -0.57 p = 0.014*
Grip strength[a]	n = 19 r = 0.20 p = 0.41	n = 19 r = 0.17 p = 0.49	n = 38 r = 0.21 p = 0.21
Mini Mental State Examination[a]	n = 21 r = 0.13 p = 0.57	n = 21 r = 0.11 p = 0.63	n = 42 r = 0.13 p = 0.41
Geriatric Depression Scale[a]	n = 21 r = 0.05 p = 0.83	n = 21 r = -0.20 p = 0.38	n = 42 r = -0.06 p = 0.71
Simplified Nutritional Appetite Questionnaire[a]	n = 20 r = -0.51 p = 0.02	n = 21 r = -0.1 p = -.67	n = 41 r = -0.29 p = 0.07

* Correlation is significant at the 0.05 level; ** Correlation is significant at the 0.01 level
n = number of participants; r = correlation co-efficient; a = Spearman correlation

3.9.2 Mean daily acceleration

Across both genders, gait speed (r = 0.68, p = 0.001) and grip strength (r = 0.34, p = 0.034) were found to be positively correlated with mean daily acceleration with statistical significance (Table 21). Among male participants, gait speed (r = 0.73, p = 0.011) positively correlated with mean daily acceleration with statistical significance and Geriatric Depression Scale score (r = -0.48, p = 0.048) was negatively correlated with mean daily acceleration with statistical significance. Among female participants, no statistically significant correlation was found between mean daily acceleration and the other variables.

Table 21 Correlation between mean daily acceleration and co-variates

Pearson's correlation	Male	Female	Total
Age[a]	n = 25 r = -0.37 p = 0.11	n = 25 r = -0.05 p = 0.83	n = 25 r = -0.20 p = 0.20
Charlson comorbidity Index[b]	n = 25 r = -0.22 p = 0.34	n = 25 r = -0.20 p = 0.38	n = 50 r = -0.14 p = 0.40
Number of medications[a]	n = 25 r = -0.13 p = 0.57	n = 25 r = -0.22 p = 0.32	n = 50 r = -0.21 p = 0.18
Smoking pack years[a]	n = 20 r = -0.13 p = 0.59	n = 22 r = -0.12 p = 0.58	n = 42 r = 0.04 p = 0.79
Body Mass Index[a]	n = 25 r = -0.03 p = 0.89	n = 25 r = 0.18 p = 0.41	n = 50 r = 0.09 p = 0.56
Barthel Index[a]	n = 24 r = 0.26 p = 0.28	n = 22 r = 0.19 p = 0.41	n = 46 r = 0.26 p = 0.10
Elderly Mobility Scale[a]	n = 22 r = 0.31 p = 0.23	n = 20 r = 0.25 p = 0.51	n = 42 r = 0.28 p = 0.11
Gait speed[a]	n = 21 r = 0.73 p = 0.011*	n = 20 r = 0.58 p = 0.08	n = 41 r = 0.68 p = 0.001**
Timed up and go test[a]	n = 20 r = -0.57 p = 0.09	n = 18 r = -0.13 p = 0.76	n = 38 r = -0.41 p = 0.09
Grip strength[b]	n = 23 r = 0.18 p = 0.48	n = 20 r = 0.22 p = 0.34	n = 43 r = 0.34 p = 0.034*
Min Mental State Examination[a]	n = 25 r = -0.10 p = 0.66	n = 23 r = -0.21 p = 0.35	n = 48 r = -0.05 p = 0.75
Geriatric Depression Scale[a]	n = 25 r = -0.45 p = 0.048*	n = 23 r = 0.32 p = 0.15	n = 48 r = -0.15 p = 0.36
Simplified Nutritional Appetite Questionnaire[b]	n = 24 r = -0.16 p = 0.53	n = 23 r = -0.19 p = 0.30	n = 47 r = -0.05 p = 0.75

* Correlation is significant at the 0.05 level; ** Correlation is significant at the 0.01 level

n = number of participants; r = correlation co-efficient; a = Spearman correlation; b = Pearson's correlation

3.9.3 Summary of correlation analysis

3.9.3.1 Mean daily step count

When male and female participants were included in the correlation analysis, Barthel Index (r=0.54, p=0.001), Elderly Mobility Scale (r=0.71, p=0.001) and gait speed (r=0.57, p = 0.007) were shown to have positive correlation with mean daily step count with statistical significance. Timed up and go test (r=-0.57, p=0.014) was negatively correlated with mean daily step count with statistical significance.

Separate analysis of the male sample showed that Elderly Mobility Scale (r=0.66, p=0.003) had statistically significant positive correlation with mean daily step count. Age (r=-0.46, p=0.037) and smoking pack years (r=-0.49, p=0.029) were shown to be negatively correlated with mean daily step count with statistical significance.

Correlation analysis of the female sample showed that Barthel Index (r=0.73, p=0.001) and Elderly Mobility Scale (r=0.78, p=0.001) were positively correlated with mean daily step count with statistical significance while Timed Up and Go test (r=-0.86, p=0.014) had statistically significant negative correlation with mean daily step count.

3.9.3.2 Mean daily acceleration

Correlation studies conducted on both male and female participants showed that gait speed (r=0.68, p=0.001) and grip strength (r=0.34, p=0.034) had positive correlation with mean daily acceleration with statistical significance.

Separate analysis of the male sample showed that gait speed (r=0.73, p=0.011) was positively correlated with mean daily acceleration with statistical significance while Geriatric Depression Scale score (r=-0.48, p=0.048) had a statistically significant negative correlation with mean daily acceleration.

Correlation analysis among the female sample yielded no statistically significant correlation, although gait speed was shown to have a high correlation coefficient of 0.58 with a p value of 0.08, approaching statistical significance.

3.10 Regression analysis

3.10.1 Mean daily step count

Six independent variables were chosen to be included in the multivariate regression model to predict physical activity levels, based on existing literature: age, body mass index, smoking pack years, Geriatric Depression Scale, gender and gait speed. Three functional measures, Barthel Index, gait speed and timed up and go test, had statistically significant correlation with mean daily step count in the correlation analysis conducted for both male and female participants. However, as all three variables are measures of physical function and were significantly correlated with each other (Table 22), a multiple regression analysis using all three variables was not possible due to multicollinearity. As the mean daily step count was not normally distributed, logarithmic transformation was conducted on mean daily step count to produce a normally distributed dependent variable (Figure 15). Simple linear regression was conducted on all three variables and gait speed had the highest R^2 value (0.36) and was thus selected as the functional outcome measure to be included in the regression model. Forced entry approach was applied in the regression model. The regression model showed that the six variables used to predict mean daily step count explained 35.1% of the variance in mean daily step count among this patient group (p = 0.008) (Table 23).

Table 22 Correlation table for EMS, Gait speed, Barthel Index and TUG

	Gait speed	Barthel Index	Timed up and go
Gait speed	1		
Barthel Index	r = 0.37 p = 0.07	1	
Timed up and go	r = -0.82 p < 0.001**	r = -0.48 p = 0.027*	1

* Correlation is significant at the 0.05 level; ** Correlation is significant at the 0.01 level

r = correlation co-efficient

Figure 15 Histogram of Log transformed mean daily step count

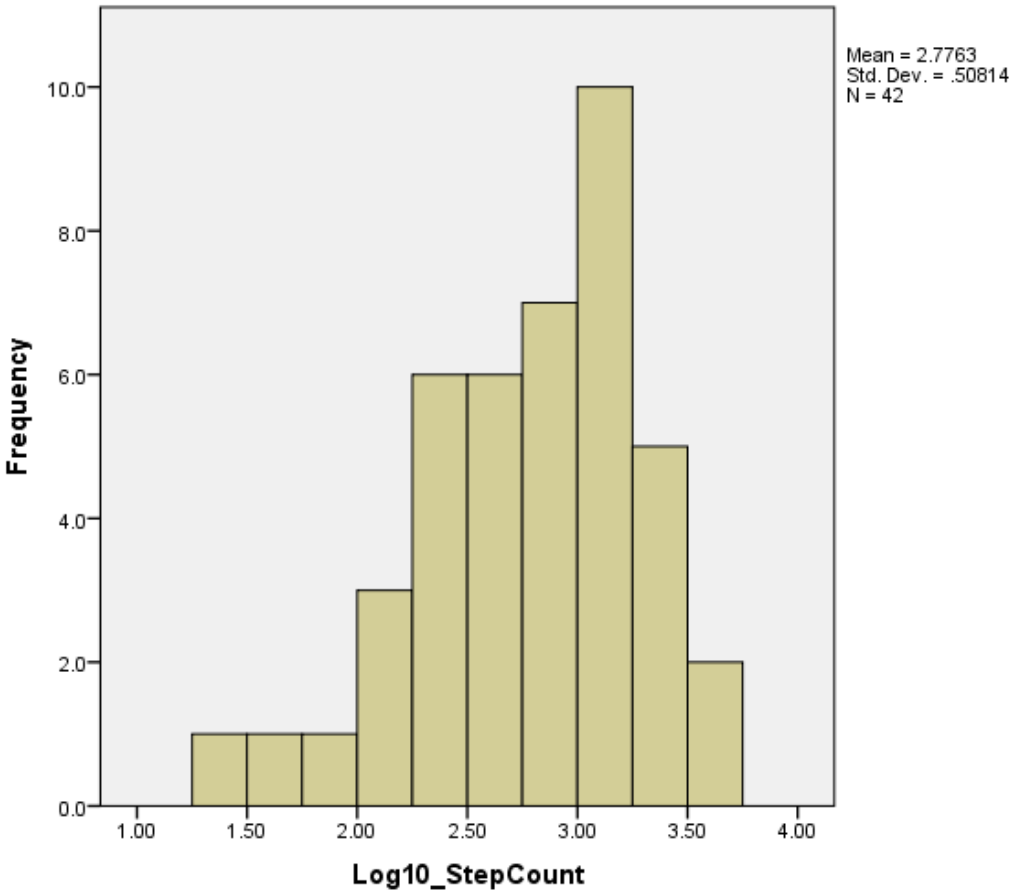


Table 23 Multivariate regression model for mean daily step count

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.593[a]	.351	.249	.36126	.351	3.428	6	38	.008

a. Predictors: (Constant), BMI (kgm-2), Gait speed, Gender, Age, Pack years, Geriatric Depression Scale

b. Dependent Variable: Log10_StepCount

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.026	1.177		3.419	.002
	Gait speed	.911	.230	.581	3.962	.000
	Gender	-.006	.112	-.007	-.054	.957
	Age	-.016	.012	-.187	-1.380	.176
	Pack years	.002	.003	.072	.530	.599
	Geriatric Depression Scale	.027	.022	.183	1.227	.227
	BMI	-.006	.015	-.053	-.378	.708

3.10.2 Mean daily acceleration

The same six independent variables (age, body mass index, smoking pack years, Geriatric Depression Scale, gender and gait speed) were chosen to be included in the multivariate regression model to predict physical activity levels as measured by mean daily acceleration (Table 24). Mean daily acceleration was normally distributed and thus log transformation was not needed for this variable. Forced entry approach was applied in the regression model. The regression model showed that 36% in the variance of mean daily acceleration can be explained by these six independent variables. (P = 0.005)

Table 24 Regression model for mean daily acceleration

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.600[a]	.360	.264	3.044182	.360	3.750	6	40	.005

a. Predictors: (Constant), BMI (kgm-2), Gait speed, Pack years, Gender, Age, Geriatric Depression Scale

b. Dependent Variable: Mean acceleration

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.026	1.177		3.419	.002
	Gait speed	.911	.230	.581	3.962	.000
	Gender	-.006	.112	-.007	-.054	.957
	Age	-.016	.012	-.187	-1.380	.176
	Pack years	.002	.003	.072	.530	.599
	Geriatric Depression Scale	.027	.022	.183	1.227	.227
	BMI	-.006	.015	-.053	-.378	.708

3.10.3 Summary of multiple regression analysis

An a priori model was developed based on existing literature to predict physical activity levels as measured by daily step count and daily acceleration. Regression analysis showed that age, gender, gait speed, smoking pack years, body mass index, and Geriatric Depression Scale accounted for almost 35% in the variance of mean daily step count in this patient group. The same variables also accounted for 36% in the variance of mean daily acceleration in this patient group. In both models, gait speed was shown to be the best predictor of mean daily step count and mean daily acceleration.

3.11 Summary of findings from the pre-intervention phase

Findings from both accelerometers agree with previous studies regarding the sedentary behaviour of hospitalised older people[39,47], demonstrating a median daily step count of 636 in this patient group, with a mean daily acceleration of 9.1mg, where <10.9mg would indicate sedentary behaviour. Participants in this study were able to provide valid written consent and were thus likely to represent a more robust cohort of patients compared to the general older medical inpatients. Therefore the activity levels of the general older medical inpatients is expected to be lower than the findings from this study.

The SAM was found to be an accurate measure of step count among frail older inpatients with low gait speed. However participants found the wrist-worn GENEActiv to be more comfortable compared to the ankle-worn SAM. Only 4% of the respondents reported that the GENEActiv was uncomfortable to wear compared to 22% for SAM.

Findings from the regression analysis demonstrated that age, gender, gait speed, smoking pack years, body mass index, and Geriatric Depression Scale accounted for 35% of variance in mean daily step count and 36% of variance in mean daily acceleration in this patient group. Gait speed was shown to be the best predictor of mean daily step count and mean daily acceleration.

Chapter 4: Feasibility of the volunteer-led Intervention

In this next chapter, findings from the recruitment and training of volunteers will be presented. I will then present my findings from the intervention phase, including participant characteristics, outcome measures, correlation studies and cost analysis.

4.1 Volunteer recruitment and training

The intervention phase commenced on the first week of August 2016 and data collection continued till the end of April 2017 (9 months). Volunteers were recruited through the hospital voluntary services. Members of the public would approach the hospital voluntary services to express interest in volunteering and applicants were processed to ensure that they cleared occupational health and disclosure and barring service checks. New volunteers were then invited to attend the volunteer induction day held at the hospital.

At the registration and induction day for the volunteers, I gave a 10 minute presentation regarding the research study to describe the opportunity available to volunteers to participate in this study as a mobility volunteer. Volunteers who wanted to find out more about the study were given the opportunity to speak to me in a small group setting. Those who were interested were invited to receive training on a day convenient for them. The training sessions were conducted by myself, supported by a senior physiotherapist. Following the classroom-based training, I supervised each volunteer during the initial activity sessions, to assess their performance and to sign them off as competent. Volunteers who had been signed off as competent received a mobility volunteer t-shirt and a badge from the voluntary services, and were deemed safe to carry out the activity sessions independently.

Five classroom-based training sessions were conducted and 17 volunteers attended the training. Details regarding the training session were previously described under section 2.7.2. The first training session was held at the end of July 2016 (Figure 16) and by the end of August 2016, seven volunteers were trained to carry out the intervention on the wards. However, due to the retirement of the volunteer services manager and an operational change implemented by the new manager, there was a delay in recruiting new volunteers. Only one volunteer was trained between September 2016 and January 2017. A further 9 volunteers were recruited and trained in February and March 2017. The first training session was piloted and feedback from volunteers was very positive. The format of subsequent training days remained the same with minor changes made to the PowerPoint presentation to improve the presentation and to clarify terminologies.

Feasibility of the volunteer-led Intervention

Volunteer retention

The attendance for each training session ranged between one and six volunteers. 16 volunteers had their competencies signed off. One volunteer attended the training but did not continue with her competency assessment as she felt that the role as a mobility volunteer did not suit her. Over the period of the intervention, four volunteers dropped out: three due to health reasons (chronic back pain, dizziness, renal stones) and one due to logistical issue, where she had to remain back in Kent after her house purchase in Southampton fell through. Volunteer retention over the 9 month period was 70%. The volunteer-led intervention continued on after the 9 month study period as part of the trust's service improvement programme. A year since the commencement of the intervention, 11 volunteers continued to be actively involved in providing mobility and exercise session to patients. This represents an annual volunteer retention rate of about 65%.

Figure 16 Example of the volunteer training session

4.2 Volunteer profile

16 volunteers (median age 32 years; IQR 17 – 62) completed the volunteer questionnaire. The volunteer who did not continue with her training did not return the volunteer questionnaire. Half of the volunteers were students, all of whom were aspiring to a career in healthcare and felt that participating in this study as a mobility volunteer would give them first-hand experience of interacting and communicating with patients (5 A-Level students and 3 university students). The majority of the volunteers were female (75%) and white British (75%). 12 volunteers had previous volunteering experience (75%) but only 9 (56.3%) had previous experience in healthcare. The volunteers profile is shown in Table 25.

Table 25 Volunteer profile

Age (years) Age range (years)	Mean: 36.1 (SD 20.6) 17 – 66	
Gender	Male: Female:	4 (25%) 12 (75%)
Marital status	Single: Married: Divorced/Separated:	10 (62.5%) 5 (25%) 1 (6.3%)
Employment	Full time employment: Part-time employment: Retired: Student: Not declared:	1 (6.3%) 3 (18.8%) 3 (18.8%) 8 (50%) 1 (6.3%)
Ethnicity	White British: British – Asian: British – Black: European: Not declared:	12 (75%) 1 (6.3%) 1 (6.3%) 1 (6.3%) 1 (6.3%)
Previous volunteering experience	Yes: No:	12 (75%) 4 (25%)
Previous experience in healthcare or as a carer	Yes: No:	9 (56.3%) 7 (43.8%)
Educational attainment	GCSE/O-level: A-level or equivalent: College or university: Other:	7 (43.8%) 4 (25%) 3 (18.8%) 2 (12.5%)

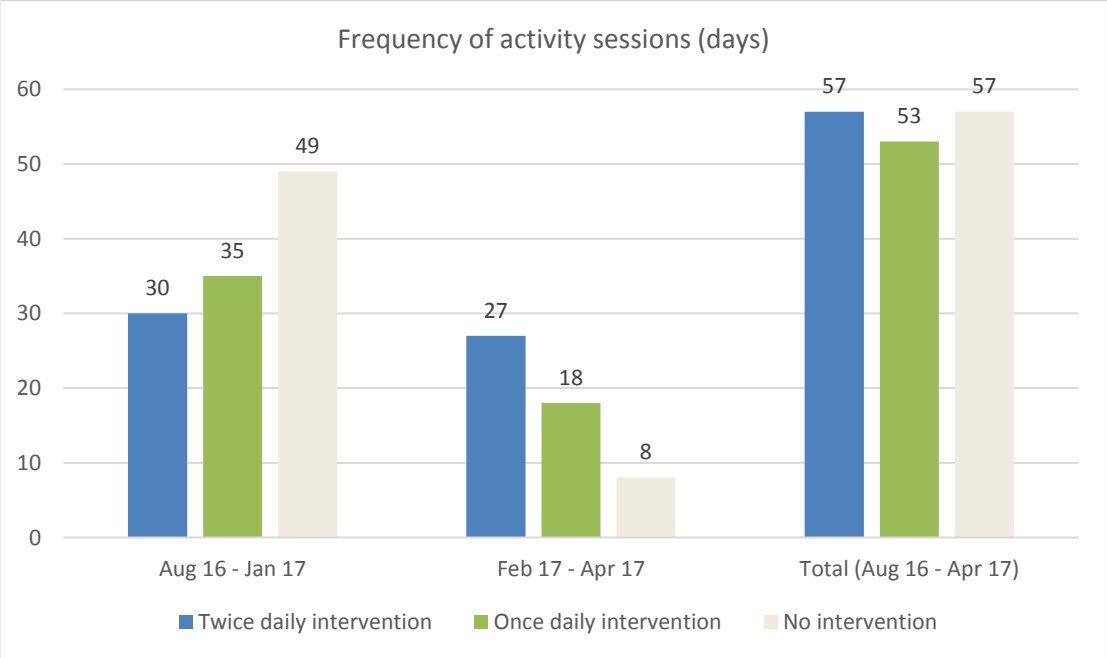
SD = standard deviation; % = percentage

4.3 Volunteer activity

During the intervention phase which took place over 9 months, 16 volunteers provided activity sessions on 167 days. The median number of intervention days provided by volunteers was 6 (IQR 4 -11). Between August 2016 and January 2017 (6 months), the intervention continued daily apart from a three week planned break during the Christmas and New Year period. During this six month period, there was a total of 114 days where the intervention was ongoing. Participants received at least once daily volunteer-led intervention for 65 days (57%) and the remaining 49 days (43%) were left unfilled due to the delay in recruitment of volunteers. Twice daily interventions occurred on 30 days (26%) and once daily intervention occurred on 35 days (31%) during this period.

Between February 2017 and April 2017 (3 months), there were 53 intervention days. Recruitment of participants continued during this period apart from a one week planned break during the Easter holidays. During this period, twice daily interventions occurred on 27 days (51%) and once daily intervention occurred on 18 days (34%), and 8 days (15%) left unfilled. The improvement in the number of activity sessions during this 3 months was due to new recruitment of volunteers mid-February 2017 and in the first week of March 2017.

Figure 17 Volunteer activity



4.4 Physical activity during the intervention phase

Patients on three acute medical wards were referred to me by therapists and nurses to determine if they were suitable to participate in the study. Written consent was obtained for patients who agreed to participate in the study. Participants in the study were assigned to receive either chair-based exercises, bed exercises or mobility sessions. Participants' mobility levels were determined by the ward therapists and those who were functionally independent received mobility sessions. Participants who needed assistance with mobility performed bedside exercises. The prescription of activity was done by myself or the ward therapist. The prescription was specific and detailed each patient's recommended walking distance or exercises, the need for mobility aid, and any other comments specific to the participants such as: 'Avoid left leg exercises due to pain', or 'Patient may need encouragement and motivation'. Mobility sessions were confined to the ward area for safety reasons. Participants were encouraged to walk based on their abilities, which would range from walking around the bed space to walking several laps along the ward corridors. Exercises took place by the patient's bedside and were done individually rather than group-based. Participants were encouraged to exercise within their pain-free range of movement.

4.4.1 Participant characteristics in the intervention phase

50 participants with a mean age of 86 years (SD 5.1) were recruited to the intervention phase of the study (Table 26). 61 patients who meet the inclusion criteria were approached and 11 (18%) patients declined participation. Baseline characteristics between male and female participants in the intervention phase were broadly similar. A higher proportion of male participants had informal meal provision compared to female participants ($p=0.009$). Male participants were more likely to be married compared to female participants, who were more likely to be widowed ($p<0.001$). Table 27 shows the comparison between participants' characteristics in the pre-intervention and intervention group. Characteristics in both groups were broadly similar. The only statistically significant difference in characteristic between both groups was meal provision ($p = 0.049$). A higher proportion of participants in the intervention group (56%) received no support for meal provision compared to the pre-intervention group (32.7%).

Table 26 Intervention phase participants' characteristics

	Total (n = 50)	Male (n = 26)	Female (n = 24)	p value
Age	86.2 (SD 5.1)	85.5 (SD 4.6)	86.9 (SD 5.9)	0.35
Marital status:				
Single:	3 (6%)	3 (11.5%)	0	0.001*
Married:	21 (42%)	15 (57.7%)	6 (25%)	
Divorced/Separated:	4 (8%)	4 (15.4%)	0	
Widowed:	22 (44%)	4 (15.4%)	18 (75%)	
Cohabitating:	0	0	0	
Usual residence:				
Living alone	21 (42%)	8 (30.8%)	13 (54.2%)	0.19
Living with friends or family	27 (54%)	16 (61.5%)	11 (45.8%)	
Sheltered accommodation	1 (2%)	1 (3.8%)	0	
Nursing home	1 (2%)	1 (3.8%)	0	
Care received:				
Community nursing team	4 (8%)	1 (3.8%)	3 (12.5%)	0.29
Sitting service				
Formal	0	0	0	
Informal	0	0	0	
No	49 (98%)	25 (100%)	24 (100%)	
Meal provision				
Formal	8 (16.3%)	2 (8%)	6 (25%)	0.009*
Informal	13 (26.5%)	11 (44%)	2 (8.3%)	
No	28 (56%)	12 (48%)	16 (66.7%)	
Personal care				
Formal	9 (18%)	4 (16%)	5 (20.8%)	0.24
Informal	2 (4%)	2 (8%)	0	
No	38 (77.6%)	19 (76%)	19 (79.2%)	
Shopping				
Formal	4 (8%)	4 (16%)	0	0.016*
Informal	31 (62%)	12 (48%)	19 (79.2%)	
No	14 (28%)	9 (36%)	5 (20.8%)	
Cleaning				
Formal	17 (34.7%)	7 (28%)	10 (41.7%)	0.60
Informal	16 (32.7%)	9 (36%)	7 (29.2%)	
No	16 (32.7%)	9 (36%)	7 (29.2%)	
Smoking history:				
Never	23 (46%)	11 (42.3%)	12 (50%)	0.37
Ex-smoker	26 (52%)	15 (57.7%)	11 (45.8%)	
Current smoker	1 (2%)	0 (0%)	1 (4.2%)	
Median Pack years	2.5 (IQR 0 – 20)	11 (IQR 0 – 48)	0.5 (IQR 0 – 14)	0.39
Charlson comorbidity Index	8 (IQR 7 – 9)	7.5 (IQR 7-9)	8 (IQR 7 – 9)	0.53
Number of medications				
0 – 5 medications	16 (32%)	8 (30.8%)	8 (33.3%)	0.98
6 – 10 medications	21 (42%)	11 (42.3%)	10 (41.7%)	
>10 medications	13 (26%)	7 (26.9%)	6 (25%)	
Body Mass Index				
<18.5	3 (6%)	3 (11.5%)	0	0.13
18.6 – 25	25 (50%)	12 (46.2%)	13 (54.2%)	
>25	22 (44%)	11 (42.3%)	11 (45.8%)	

n = number of participants; SD = standard deviation; * $p < 0.05$

Table 27 Participants characteristics from the pre-intervention an intervention group

	Pre-intervention (n = 50)	Intervention (n = 50)	p value
Age	87.2 (SD 4.6)	86.2 (SD 5.1)	0.26
Marital status:			
Single:	3 (6%)	3 (6%)	0.52
Married:	14 (28%)	21 (42%)	
Divorced/Separated:	5 (10%)	4 (8%)	
Widowed:	26 (52%)	22 (44%)	
Cohabitating:	1 (2%)	0	
Usual residence:			
Living alone	26 (52%)	21 (42%)	0.08
Living with friends or family	21 (44%)	27 (54%)	
Sheltered accommodation	0	1 (2%)	
Residential home	3(6%)	0	
Nursing home	0	1 (2%)	
Care received:			
Community nursing team	6 (12.2%)	4 (8%)	0.51
Sitting service			
Formal	2 (4.1%)	0	0.06
Informal	2 (4.1%)	0	
No	45 (91.8%)	49 (98%)	
Meal provision			
Formal	14 (28.6%)	8 (16.3%)	0.049*
Informal	19 (38.8%)	13 (26.5%)	
No	16 (32.7%)	28 (56%)	
Personal care			
Formal	9 (18.4%)	9 (18%)	0.84
Informal	1 (2%)	2 (4%)	
No	39 (79.6%)	38 (77.6%)	
Shopping			
Formal	3 (6.1%)	4 (8%)	0.41
Informal	37 (75.5%)	31 (62%)	
No	9 (18.4%)	14 (28%)	
Cleaning			0.10
Formal	16 (32.7%)	17 (34.7%)	
Informal	25 (51%)	16 (32.7%)	
No	8 (16.3%)	16 (32.7%)	
Smoking history:			0.64
Never	18 (36%)	23 (46%)	
Ex-smoker	30 (60%)	26 (52%)	
Current smoker	1 (2%)	1 (2%)	
Median Pack years	3 (IQR 0 – 27.5)	2.5 (IQR 0 – 20)	
Charlson comorbidity Index	7 (IQR 6 – 9)	8 (IQR 7 – 9)	0.06
Number of medications			0.84
0 – 5 medications	14 (28%)	16 (32%)	
6 – 10 medications	22 (44%)	21 (42%)	
>10 medications	14 (28%)	13 (26%)	
Body Mass Index			0.92
<18.5	3 (28%)	3 (6%)	
18.6 – 25	27 (44%)	25 (50%)	
>25	20 (28%)	22 (44%)	

n = number of participants; SD = standard deviation; * $p < 0.05$

4.4.2 Patients' adherence to intervention

310 activity sessions were offered to participants and 230 sessions (74%) were completed. 29 participants (58%) participated in mobility and exercise sessions and 21 participants (42%) completed exercises only. The reasons why 80 of the activity sessions were not completed are shown in Table 28. No gender difference was observed in terms of adherence to intervention: male (77.8%), female (71.6%).

Table 28 Reasons why activity sessions declined

	Reasons	Number (%)		Reasons	Number (%)
1.	Clinical reasons eg: nursing care, bedside or away from bedside investigations	16 (20%)	**6.**	Participants asleep	5 (6%)
2.	Tiredness	15 (19%)	**7.**	Visitors present	5 (6%)
3.	No reason given or documented	15 (19%)	**8.**	Pain	3 (4%)
4.	Feeling unwell	14 (18%)	**9.**	Going home	1 (1%)
5.	Participant wanted to rest	6 (7%)			

The commonest reason for non-adherence to activity sessions was due to clinical care given to patients, which included personal hygiene, washing, investigations and engagement with other healthcare professionals. Other common reasons included reports of tiredness (18.8%) and feeling unwell (18.8%). Interestingly having visitors present was among the reasons why activity sessions did not take place, which may explain the finding of low ambulatory activity levels during visiting hours.

4.4.3 StepWatch Activity Monitor

44 participants had their ambulatory activity recorded (Table 29). The median device wear time was 3 days (IQR 1 – 5.25). The median daily step count was 912 (IQR 295 – 1824. This represented a 43.4% increase in step count compared to participants from the pre-intervention group (636 steps per day), however the difference was not statistically significant (p = 0.55). Among female participants, the step count increase compared to pre-intervention participants was higher at 72.9% (p = 0.12), compared to male participants (15.7%, p = 0.95).

Table 29 Physical activity measure in the pre-intervention and intervention group

	Pre-intervention (n = 42)	Intervention (n =44)	p value
Median daily step count (IQR)	636 (298 – 1468)	912(295 – 1824)	0.28
SAM median wear time in days (IQR)	4 (2 – 6.8)	3 (1 – 5.25)	0.79
Minutes of activity (20mg) at 1 minute bouts	57 (IQR 29 – 112)	79 (IQR 37 – 127)	0.26
Minutes of activity (20mg) at 5 minutes bout	11 (IQR 2 – 40)	31 (IQR 5 – 49)	0.08
Minutes of activity (20mg) at 10 minute bouts	4 (IQR 0 – 25)	11 (IQR 2 – 29)	0.25
Mean acceleration per 24 hours (mg)	9.1mg (SD 3.3)	9.7mg (SD 3.3)	0.30
Median GENEActiv wear time (days)	5.8 (IQR 2.9 – 7)	3.5 (IQR 1 – 6)	0.85

N = number; IQR = Interquartile Range; SAM = StepWatch Activity Monitor; mg = milligravity

4.4.4 GENEActiv

44 participants had valid GENEActiv recording (Table 29). The mean daily acceleration for participants in the intervention phase was 9.7mg. Compared to the pre-intervention participants, this difference was not statistically significant. Participants spent a median time of 79 minutes (IQR 37 – 127) at 20mg sustained at 1 minute, 31 minutes (IQR 5 – 49) at 20mg sustained at 5 minutes and 11 minutes (IQR 2 – 29) at 20mg sustained at 10 minutes. Mean acceleration among pre-intervention participants was 9.1mg (p = 0.35). Separate analysis among male (p = 0.73) and

female (p = 0.14) participants showed no statistically significant improvement in mean daily acceleration between pre-intervention and intervention participants. A separate analysis was conducted for patients in both the pre-intervention and intervention phase who were very ambulant (mean daily step of ≥ 3000, n = 8), and the mean daily acceleration was 13.9milligravity (SD 5.1).

4.5 Physical function

4.5.1 Barthel Index

50 participants had their Barthel Index score recorded (Table 30). The median Barthel Index score was 80 out of 100. There was no difference of statistical significance between the Barthel Index of the pre-intervention (77, IQR 54 – 90) and intervention participants (p = 0.52).

4.5.2 Elderly Mobility Scale

47 participants had their Elderly Mobility Scale (EMS) score recorded. The median EMS score was 16 out of 20. The was no statistically significance difference between the EMS score of the pre-intervention (14.5, IQR 7 – 19) and intervention participants (p = 0.69).

4.5.3 Timed up and go test

26 participants completed the Timed up and go (TUG) test. The median time taken to complete the TUG test was 32.3 seconds(s). There was also no statistically significant difference between the TUG scores between the pre-intervention (27.2s) and intervention participants (p = 0.73).

4.5.4 Gait speed

29 participants had their gait speed recorded. The median gait speed for participants in the intervention phase was 0.45s. Compared with the pre-intervention participants (0.55m/s), participants in the intervention phase had a slower gait speed, but the difference was not statistically significant (p = 0.54).

4.5.5 Grip strength

40 participants had their grip strength measured. The mean grip strength for male participants was 22.4kg while the mean grip strength for female participants was 13.9kg. There was no significant difference (p=0.74) in the mean grip strength for participants in the pre-intervention (male: 23.7kg; female: 13.8kg) and intervention phase.

4.5.6 FRAIL scale

49 participants had a FRAIL scale score recorded. 20 participants (40.8%) were classified as being frail, 29 participants (59.2%) were classified as being pre-frail and no participants had a normal score. The proportion of participants in the intervention phase who were classified as (pre-frail or frail) was significantly higher (p=0.001) than participants in the pre-intervention group (normal: 8; pre-frail state: 20; Frail: 18).

Table 30 Physical function of pre-intervention and intervention participants

(Median)	Pre-intervention	Intervention	P value
Barthel Index (IQR)	77 (54 -90) N = 46	80 (58 - 92) N = 50	0.53
Elderly Mobility Scale (IQR)	14.5 (7 – 19)	16 (7 – 19)	0.69
Score 0 – 9 (%)	16 (38.1%)	14 (30%)	
Score 10 – 13	3 (7.1%)	7 (15%)	
Score ≥ 14	23 (54.8%)	26 (55%)	
	N = 42	N = 47	
Timed up and go test (s)	27.2 (20.1 – 45.9) N = 21	32.3 (21.5 – 45.6) N = 26	0.73
Gait speed (m/s)	0.55 (0.35 – 0.72) N = 25	0.45 (0.26 – 0.71) N = 29	0.54
Grip strength# (kg)	M: 23.47 (SD 7.2) F: 13.8 (SD 3.9) N = 43	M: 22.4 (SD 7.7) F: 13.9 (SD 6.9) N = 40	0.74
Frail scale			
Not frail	8 (17%)	0	0.001*
Pre-frail state	20 (44%)	20 (41%)	
Frail	18 (39%)	29 (59%)	
	N = 46	N = 49	

IQR = Interquartile range; N = number of participants; % = percentage; s = seconds; m/s = metre per second; # = mean; kg = kilogram; SD = standard deviation; M = male, F = female; * = statistically significant

4.6 Cognitive function

4.6.1 Mini-mental state examination

50 participants had their mini-mental state examination (MMSE) score recorded (Table 31). The median MMSE score was 26.5 (IQR 22 – 28). Participants were also categorised into 2 categories: no cognitive impairment (scores of ≥24) and possible underlying cognitive impairment (scores of ≤ 23). No statistically significant difference in MMSE was found between the pre-intervention and intervention phase participants (p = 0.76).

4.6.2 Geriatric Depression Scale

49 participants completed the Geriatric Depression Scale (GDS) assessment. 27 participants (55.1%) had a normal score, 16 participants (32.7%) were classed as having mild depressive symptoms and six participants (12.2%) were classed as having moderate to severe depressive symptoms. There was no statistically significant difference in GDS score between the pre-intervention (No depressive symptoms: 25, Mild depressive symptoms: 19, Moderate to severe depressive symptoms: 4) and the intervention phase participants (p = 0.70).

Table 31 Cognitive function of intervention participants

Median	Pre-intervention	Intervention	P value
Mini-mental state examination (IQR)	25.5 (22- 27)	26 (22- 28)	0.76
No cognitive impairment	29 (60%)	35 (70%)	
Possible underlying cognitive impairment	19 (40%)	15 (30%)	
	N = 48	N = 50	
Geriatric Depression Scale (IQR)	4 (3 – 6)	4 (3 – 8)	0.70
No depressive symptoms	25 (52%)	27 (55%)	
Mild depressive symptoms	19 (40%)	16 (33%)	
Moderate to severe depressive symptoms	4 (8%)	6 (12%)	
	N = 48	N = 49	

N = number of participants; IQR = Interquartile range; % = percentage

4.6.3 Simplified Nutritional Appetite Questionnaire

49 participants completed the Simplified Nutritional Appetite Questionnaire (SNAQ) (Table 32). There was no significant difference in SNAQ score between pre-intervention (median score 14) and interventions participants (p=0.98).

Table 32 SNAQ - Intervention

	Pre-Intervention (n = 47)	Intervention (n = 49)	p value
Median (IQR)	14 (13 – 15)	14 (12 - 16)	0.98
Poor appetite	16 (32%)	19 (39%)	
Good appetite	41 (62%)	30 (61%)	

n = number of participants; IQR = Interquartile range; % = percentage

4.6.4 EuroQol-5D-3L

50 participants had their EuroQol-5D-3L score recorded (Table 33). Participants were also asked to rate their health state on a scale of 0 (worst imaginable health) to 100 (best imaginable health). The median score for health state was 50 (IQR 50 – 75). Across all six categories of the EuroQol-5D-3L, they was no statistically significant difference between pre-intervention and intervention participants.

Feasibility of the volunteer-led Intervention

Table 33 EuroQol-5D-3L - Intervention

Mobility	Pre-intervention (n = 47)	Intervention (n=50)	p value
No problems	7 (14.9%)	8 (16%)	0.42
Some problems	35 (74.5%)	40 (80%)	
Confined to bed	5 (10.6%)	2 (4%)	
Self-care			
No problems	23 (48.9%)	28 (56%)	0.92
Some problems	22 (46.8%)	17 (34%)	
Unable to wash or dress	2 (4.3%)	5 (10%)	
Usual activities			
No problems	13 (27.6%)	16 (32%)	0.54
Some problems	20 (42.6%)	24 (48%)	
Unable to perform usual activities	14 (29.8%)	10 (20%)	
Pain/Discomfort			
No pain or discomfort	17 (36.2%)	19 (38%)	0.51
Moderate pain or discomfort	29 (61.7%)	25 (50%)	
Extreme pain of discomfort	1 (2.1%)	6 (12%)	
Anxiety/Depression			
Not anxious or depressed	30 (63.8%)	30 (60%)	0.75
Moderately anxious or depressed	13 (27.7%)	17 (34%)	
Extremely anxious or depressed	4 (8.5%)	3 (6%)	
Health state today			
Median	52.5	50	0.91
IQR	50 – 73.75	50 – 75	

n = number of participants; IQR = Interquartile range

4.7 Receipt of care

The median length of stay for participants in the intervention phase was 15 days (Table 34). There was no significant difference between the median length of stay between participants in the pre-intervention (15.5 days) and intervention phase ($p = 0.84$). Participants in the intervention phase were more likely to have no formal meal provision compared to pre-intervention participants ($p = 0.036$).

Feasibility of the volunteer-led Intervention

Table 34 Receipt of care comparison between pre-intervention and intervention participants

	Pre-intervention	Intervention	p value
Length of stay (median)	15.5 (IQR 8 – 22.5)	15 (IQR 7 – 28)	0.84
Discharged to usual residence	35 (70%)	34 (68%)	0.83
Discharge destination:			
• Private home living alone	18 (36%)	14 (28%)	0.35
• Private home living with relatives or friends	16 (32%)	20 (40%)	
• Residential/Rest Home	4 (8%)	4 (8%)	
• Nursing Home	1 (2%)	1 (2%)	
• Another hospital	11 (22%)	8 (16%)	
• Patient died	0	3 (6%)	
New package of care offered	8 (16%)	7 (14%)	0.78
New package of care accepted	7 (14%)	6 (12%)	0.77
New informal care arranged	2 (4%)	0	0.09
Community nursing	18 (36.7%)	12 (24%)	0.17
Sitting service:			
Formal	13 (26.5%)	12 (24%)	0.46
Informal	1 (2%)	0	
No	35 (71.4%)	38 (76%)	
Meal provision:			
Formal	24 (49%)	20 (40%)	0.029
Informal	16 (32.7%)	9 (18%)	
No	9 (18.4%)	21 (42%)	
Personal care:			
Formal	20 (40.8%)	20 (40%)	0.50
Informal	0	1 (2%)	
No	29 (59.2%)	29 (58%)	
Shopping:			
Formal	11 (22.9%)	12 (24%)	0.40
Informal	26 (54.2%)	21 (42%)	
No	11 (22.9%)	17 (34%)	
Cleaning:			
Formal	19 (39.6%)	19 (38%)	0.11
Informal	19 (39.6%)	12 (24%)	
No	10 (20.8%)	19 (38%)	
Community therapy	16 (32.6%)	8 (16%)	0.10
Deep Vein Thrombosis/ Pulmonary Embolism	4 (8%)	2 (4%)	0.40
Pressure sore	0	0	
Readmission in 1 month	15 (30%)	9 (18%)	0.16

n = number of participants; IQR = Interquartile range

4.8 Associations between physical activity levels and receipt of care variables

Bivariate correlation analysis was conducted to determine if there was any association between physical activity levels (daily step count and daily acceleration) and length of hospital stay. In the pre-intervention group, no significant correlation was found between daily step count and length of stay (Table 35). However, in the intervention phase, daily step count was found to be negatively correlated with length of stay, and this association was statistically significant. When the sample was analysed as a whole, daily step count was found to be negatively correlated with length of stay, with statistical significance. Mean daily acceleration was also found to be correlated with length of stay with statistical significance among the intervention phase participants (Table 36).

Table 35 Correlation between mean daily step count and length of stay

	Pre-intervention	Intervention	Whole sample
Length of stay	N = 42 R = 0.04 P = 0.81	N = 44 R = -0.50 P = 0.001	N = 86 R = -0.25 P = 0.019

Table 36 Correlation between mean daily acceleration and length of stay

	Pre-intervention	Intervention	Whole sample
Length of stay	N = 42 R = -0.01 P = 0.98	N = 44 R = -0.34 P = 0.024	N = 86 R = -0.20 P = 0.06

4.9 Cost analysis

4.9.1 Cost to implement the intervention on the study wards

I conducted five training sessions, with a band seven therapist as a co-trainer. Apart from the 3 hour group training sessions, each volunteer had further 4 hours of competency assessment conducted by me, before being signed off as competent. Below are the calculations for the cost of training the volunteers.

Figure 18 Cost of volunteer training

Cost per hour for a band seven therapist: £55

Cost per hour for a medical registrar: £50

Cost of travel and food per volunteer per day: £15

Cost to train 16 volunteers:

((£50 + £55) x 3 hours x 5 training sessions) + (4 hours x 16 volunteers x £50) + (16 x £15) = £5,015

Cost to train 1 volunteer:

£ 5,015 ÷ 16 = £313.44

The total cost of training the volunteers was estimated to be about £5,015, and the cost to train a volunteer was about £313.44. The venue for the training sessions was located in the hospital and as such did not incur extra cost. Stationary and photocopying cost were also at a minimal and were not included in the cost analysis.

4.9.2 Optimal cost

To calculate the optimal cost (Figure 19) of training a volunteer, the number of volunteers per group session was estimated to be six, which would be the ideal group size to deliver the classroom-based training, ensuring that volunteers were given adequate time to practice and ask questions. Calculations were made to determine the cost of using band four, five, six and seven therapists to conduct the group training session and competency assessment. Whilst it would be more cost-effective to have a lower banded therapist conducting the training, the main benefit of having a more experienced therapist conducting the training is that it increases the likelihood that the training delivered is robust and safe. Once the volunteer training programme is well-developed, lower banded therapists could be trained to take on the role of the trainer.

Figure 19 Optimal cost to train 1 volunteer

Cost per hour for a band 4 therapist: £30

Cost per hour for a band 5 therapist: £34

Cost per hour for a band 6 therapist: £45

Cost per hour for a band 7 therapist: £55

Cost of travel and food per volunteer per day: £15

Cost to train 1 volunteer:

Band 4 therapist: ((3 hours x £30) ÷ 6 volunteers) + (4 hours x £30) + £15 = £150

Band 5 therapist: ((3 hours x £34) ÷ 6 volunteers) + (4 hours x £34) + £15 = £168

Band 6 therapist: ((3 hours x £45) ÷ 6 volunteers) + (4 hours x £45) + £15 = £217.50

Band 7 therapist: ((3 hours x £55) ÷ 6 volunteers) + (4 hours x £55) + £15 = £262.50

The optimal cost for training a volunteer is predicted to range from £150 to £262.50 depending on the banding of the trainer. The decision to employ different bandings of therapist depend on several factors. While it may be more cost-effective to have a lower banded therapist to conduct the training, a therapist with higher qualification and more experience may be preferable as the trainer has the overall responsibility of delivering high quality training and ensuring that the volunteers are adequately prepared for their role and are safe and competent to deliver the intervention.

4.9.3 Cost to implement the intervention across the department

The Medicine for Older People department in the University Hospital Southampton NHS FT comprises of six wards. To estimate the cost of implementing the study across the department for a year, the retention rate of volunteers (70%) was taken into consideration (Section 4.1). To deliver the activity sessions twice daily during the weekdays, each ward would require 10 volunteers to carry out the intervention.

Figure 20 Cost to implement the intervention across the whole department

Calculation based on a band 4 trainer

6 wards x 10 volunteers per ward x £150 per volunteer x 100% ÷ 70% (retention rate) = £12857.14

Calculation based on a band 7 trainer

6 wards x 10 volunteers per ward x £262.50 per volunteer x 100% ÷ 70% (retention rate) = £22,500.00

The cost of implementing a twice-daily volunteer-led mobility or exercise session across the whole Medicine for Older People department is estimated to range from £12,857.14 to £22,500.00, depending on the banding of the trainer (Figure 20). In this study, the cost of rooms for the training sessions were free. A future controlled trial will need to take into consideration the cost of booking rooms for training and other activities.

4.10 Adverse events

After each activity session, volunteers would document on the activity prescription sheet on how the session went and if there were any adverse events. Analysis of the activity prescription sheet showed that there were no adverse events reported, such as falls or injuries related to the activity sessions. This is a very positive finding which suggests that with adequate training and accurate activity prescription for patients, volunteers can safely encourage older inpatients to walk or exercise.

4.11 Summary of findings from the intervention phase

This study has demonstrated that it was feasible to recruit and train volunteers to encourage older inpatient to remain active, with a 70% retention rate over a period of 9 months. There was a delay in the recruitment of volunteers halfway through the study due to the retirement of the voluntary services manager and the appointment of a new successor who introduced new processes in recruiting volunteers. While this had an impact on the number of activity sessions received by participants, it was a reflection of real life scenario where changes in hospital personnel or key stakeholders may happen and may have an impact on any implementation of intervention. However, 4 months after the appointment of a new voluntary services manager, recruitment of mobility volunteers resumed with no concerns.

Participants' characteristics between the pre-intervention and intervention group were broadly similar and hence comparisons between both groups were deemed appropriate. The intervention has showed some positive signal towards improvement in physical activity levels (improvement in step count by 43%) and a trend towards shorter length of hospital stay and reduction in one month hospital readmission. These findings must be interpreted cautiously as this study was not powered to show statistically significant difference in these outcome measures. However, these findings are encouraging and should be further explored in a larger controlled trial.

Correlation studies also demonstrated a negative correlation between mean daily step count and length of hospital stay, with statistical significance ($P < 0.02$). This finding agrees with a previous study conducted by McCullagh et al demonstrating that a 50% increase in step count was associated with a 6% shorter length of stay among older medical inpatients (mean age 77 years, n = 154)[87].

Very importantly, no adverse events occurred during the intervention period, such as falls or patients being unwell due to the intervention. Findings from this chapter demonstrates that volunteers can be trained to safely deliver the intervention to encourage older inpatients to be active.

Chapter 5: Acceptability of the intervention

In this chapter, the findings from the qualitative interviews will be reported and discussed. Six patients, six volunteers, six nurses and seven therapists were recruited by purposive sampling to determine the acceptability of the intervention. For patient participants, there was a balanced mixture of male and female patients, patients with varying age range (82 – 96 years) and varied physical function at baseline. All patients were interviewed individually. Three volunteers attended the focus group and two volunteers were interviewed individually. Among the volunteers interviewed, there was a wide range of age group represented (17 – 62 years), with differing background in volunteering experience (no experience to 9 years' experience). Three nurses attended a focus group and three other nurses were interviewed individually. The interviews included nurses with wide range of experience (5 weeks to 20 years), seniority (final year student nurse to matron) and included both male and female nurses. Seven therapists were interviewed in two separate focus groups (1st focus group: 3 therapists, 2nd focus group: 4 therapists). Among the therapists interviewed, there was a wide range of experience (6 months to 19 years) and seniority (band 3 to band 7) represented.

In the first instance, I attempted to organise focus groups for volunteers and staff members. However, as noted above, several volunteers and staff members were interviewed individually due to the difficulty in finding an agreed time for focus groups to be held as each individual had differing availability. Recruitment of participants was discontinued after data analysis showed no generation of new data. Table 37 to 40 shows the participants' profile across the four groups of participants interviewed.

Acceptability of the intervention

Table 37 Profile of patient participants interviewed

Participants	Age	Gender	Functional status before admission	Intervention received
P01	94	Female	Independent with activities of daily living. Once a week cleaner.	Mobility
P02	92	Female	Independent with activities of daily living. Walks with a stick and able to drive. No carers	Chair exercises
P03	91	Male	Able to walk about 45 metres with a walking stick. No carers.	Mobility
P04	82	Male	Self-caring, able to walk 20 yards without oxygen supplement. No package of care	Chair exercises
P05	83	Male	Able to walk about 5-10 meters with a Zimmer frame. Has four times a day package of care.	Chair exercises
P06	96	Female	Independent with activities of daily living. Able to walk about 100 yards with a stick. No carers.	Mobility

Table 38 Profile of volunteers interviewed

Participants	Age	Gender	Experience in volunteering
V01	38	Male	8 months
V02	62	Female	15 months
V03	62	Female	9 and a ½ years
V04	62	Female	No previous experience
V05	17	Female	No previous experience
V06	17	Male	No previous experience

Table 39 Profile of nurses interviewed

Participants	Banding/ Seniority	Gender	Job Role	Years of experience
N01	8a	Male	Matron	20 years
N02	7	Female	Ward A manager	16 years
N03	7	Female	Ward B manager	18 years
N04	6	Male	Ward A Charge nurse	20 years
N05	4	Female	Healthcare Assistant Ward B	3 years
N06	Final year nursing student	Female	Nursing student Ward A	5 weeks

Table 40 Profile of therapists interviewed

Participants	Banding/Seniority	Gender	Job Role	Years of experience
T01	7	Female	Lead physiotherapist	7 years
T02	5	Female	Occupational Therapist	5 years
T03	5	Female	Physiotherapist	2 years
T04	7	Female	Senior physiotherapist	19 years
T05	4	Female	Therapy technician	11 years
T06	5	Female	Physiotherapist	6 months
T07	4	Female	Therapy technician	4 years

The four key components of Normalisation Process Theory: coherence, cognitive participation, collective action and reflective monitoring, were used as the main themes to analyse the data. In my analysis of the data, I kept an open mind to allow for any other potential emerging themes. All codes fitted into one of the themes and no new themes emerged throughout the data analysis process. The findings will be presented thematically.

5.1 Theme I: Coherence

Coherence can be defined as the sense-making work that people do individually and collectively when faced with the problem of operationalising some set of practices[359]. In relation to this study, it involves the patients, volunteers, nurses and therapists, building a shared understanding of the objectives of the proposed intervention. It also involves them appreciating the importance and value of the intervention and its potential benefits. Under this theme, several key concepts were derived through the interviews, which will be presented individually.

5.1.1 Sedentary behaviour of older people in hospital

The main aim of this study was to define the problem of sedentary behaviour in hospital and to explore the feasibility of using volunteers to encourage patients to be more active. Findings from the pre-intervention phase were consistent with previously published literature regarding the sedentary behaviour of older people in hospital. Staff members were aware of the issues surrounding sedentary behaviour among older inpatients, as highlighted in the following quotes.

> *I think the activity levels of patients are quite poor to be perfectly honest. You have patients coming in and whilst they're in hospital they tend to sit on their bed, lie on bed or down by the bedside with a minimal amount of movement.* ***(T04)***

> *If they can walk out to the bathroom and the nursing staff know that they can do it, then they might do that but, at the most that's it. Isn't it?* ***(T07)***

> *I think the activity levels of patients were quite low. Personally I do feel they were not as good as they are now. There's more going on now with the mobility volunteers than there was before.* ***(N04)***

Staff members were aware that the current activity levels were unsatisfactory and more effort was needed to encourage patients in hospital to be more active. This is an important finding as it would motivate staff members to work towards improving the activity levels of older inpatients.

> *Something has got to change. You've got to get them out.* ***(N03)***

It needs to be improved. We used to have more activities, particularly in Medicine for Older People. The plan was to get a room especially for more activities so patients could be brought round but that never happened. And I think over the years it's always been a plan, but obviously the wards are too busy. ***(N02)***

5.1.2 Importance of being physically active

Physical inactivity in hospital can result in many adverse effects as described in section 1.5, which demonstrated the evidence by which being physically active may reduce the risk of some of these adverse effects. One of the key concepts that emerged from the data was that patients, staff members and volunteers all demonstrated awareness regarding the importance of being physically active in hospital.

I think it's a matter of keeping the body mobile which is the important thing. I've been in hospital now six times with pneumonia and fortunately, and luckily for me, I'm physically fit I can get out of bed every day. Yeah, so to get somebody mobile I think is half the way to getting them better ***(P04)***

Well I think it's very necessary because you do sit about a lot. It keeps your muscles active ***(P03)***

*I think it's important. For somebody like me, who's physically fit. Just sitting here is not doing me any good (****P04)***

It made me think how important exercise is. Because if she'd been doing keep fit for 40 years and she was so fit. She was the best of all the people I've been to at doing the exercises. So it made me think that well, you know, it just shows how important exercise is. ***(V03)***

Acceptability of the intervention

> *I think it's really important to stay active and try and maintain that baseline that they've got. If somebody only walks 10 metres at home, they can get them to walk 10 metres here, which is all they need to do then I think that's really important to try and maintain that level, at that baseline. I think it's really important.* ***(N04)***

5.1.3 Barriers to being physically active

Although all key stakeholders were aware of the importance of being physically active in hospital, yet many challenges and barriers to encourage and motivate patients to be more active were raised. Identifying these barriers was important as it may help in the future planning of interventions to address this issue of sedentary behaviour among patients. Table 41 shows a list of the barriers to mobility identified through the interviews. These barriers can be broadly classified into three main factors: clinical, staff and patient factors.

Table 41 Barriers to mobility

	Barriers to mobility	Factors
1	Ward environment	Clinical factors
2	Medical reasons and patient acuity	Clinical factors
3	Lack of staff members	Staff factor
4	Lack of time from healthcare professionals	Staff factor
5	Lack of encouragement from staff members	Staff factor
6	Lack of awareness of the importance of mobility	Staff, patient and family member factors
7	Misperception of the responsibility of mobilising patients	Staff and patient factors
8	Fear of falls	Patient factors

5.1.3.1 Ward Environment

One of the commonly raised barriers to mobilising patients was ward environment. Due to clinical demand, there are no common areas or day rooms and as such patients have nowhere to walk to, which reduces their incentive to mobilise.

> *Most hospitals across the country got rid of their day rooms and places where you can go to. Everything nowadays is either clinical or office or their bedroom which means they've got nowhere to go to.* ***(N01)***

> *Yeah you can get somebody up get them dressed get them all looking lovely but where are they going? Because you know I don't think I'd particularly want to get up and get dressed if I was only going to be sat right in that chair and next to the bed anyway* ***(N02)***

> *We've also lost a lot of wash up facilities. When I started we used to have little cubicles which just had a sink and a shower and people would go and sit in there behind the door and just do their own little wash and that was the reason for them to get out of bed and walk to the bathroom.* ***(N03)***

> *They don't know where they can go, what they can do.* ***(T01)***

Being in an unfamiliar or foreign environment may also discourage patients from mobilising beyond their bed space as they feel less confident.

> *Sometimes it's more of a confidence thing as well. You're in an alien environment, there's lots going on. It's a new environment to them isn't it, because it's not their own home? You've got bells, buzzers, and people moving in and out. Doctors in and out, nurses in and out, you've got a whole plethora of people and different things going on. And it's confusing. I mean it's bad enough sometimes going in as a member of the team with all the different things that disorientate you, so I can understand why people actually feel safe within their bed space* ***(T04)***

> *It's also from them being in an unusual environment and not then progressing and challenging themselves because, especially if they've come in with a fall, it's an increased risk isn't it on the ward.* ***(T04)***

The location of the wards was raised as a barrier by one of the patients, which prevented him from venturing further while walking,

> *Maybe it's because we're old people on the G level of the hospital. Yeah, and they may not feel it totally practical to go walking downstairs or something like that. But you know if I was on a lower floor I would want to go out, wander out, without a shadow of a doubt.* ***(P04)***

This issue of ward location was also raised by one of the nursing staff as a barrier to mobility.

> *We are six storeys up so patients will find it difficult to go downstairs. A lot of our patients are dementia sufferers; they do have confusion, UTIs, that kind of thing. It's all well and good saying 'yeah they're mobile and independent they can go downstairs' but it's mentally as well, would they be able to get themselves back? Would they know where they were?* ***(N05)***

5.1.3.2 Medical reasons and patient acuity

Another barrier to mobility was patient acuity. Nursing staff reported that they often have to prioritise tasks that were more urgent clinically and hence mobilising patients was often neglected. Other medical reasons were also highlighted by patients and nursing staff.

> *So for me it's the same as what they've said, but it's just that perfect storm that patients are sicker that they used to be. Which means that the rehab and the niceties of moving, and that kind of social thing's gone in place of more intensive care focus.* ***(N03)***

And also the dependency you know. I know when I started training there was very very few patients that needed 45 minutes to feed and I know there was only an occasional one. But a lot of them do need a lot more assistance and a lot of patients are now coming in from nursing homes where they're a lot more dependent prior to coming into hospital ***(N01)***

Plus there's the added pressure from the tissue viability side. People aren't supposed to be in chairs for longer than, oh I'd say 2 hours. So if you get someone out in their clothes and then you virtually have to put them back, and people will be: 'I don't want to get rid of my clothes so I get back in my pyjamas'. In which case you get back and forth and it's a lot of effort for people who are often not well. ***(N03)***

From my personal point of view I would be delighted to be doing an awful lot more, like I used to be, if it wasn't for my, my lungs now. Only my breathing. That's the only thing that limits my mobility. ***(P04)***

5.1.3.3 Lack of staff

Interlinked with the factors of higher patient acuity and lack of time, staff members raised the issue of insufficient staff members on the wards to promote increased physical activity among patients. A few staff members discussed previous initiatives to encourage patients to mobilise which came to a halt due to staffing issues.

We did have the group exercise class that we had running for a few months. 2 or 3 months I think. That had been okay but then again staffing has been the issue, because you need to have the proper staffing to support the number of patients to actively participate in, in the group session ***(T05)***

We've tried quite a few times to do, like chair exercises in groups. And as (name) says it, they keep coming up against obstacles like the timing, and not having the staff. ***(T07)***

Unfortunately with 28 patients there are only so many members of staff you can spare to be taking them off the ward every day. It's just not possible ***(N05)***

*The staff members are now less than they were in terms of numbers (**N03)***

5.1.3.4 Lack of time

The issue of lack of time to mobilise patients was brought up by several nursing staff during the interviews. Due to increased clinical demands, nursing staff reported that they were not able to encourage patients to mobilise.

*In as much as we'd love to say that the nurses would have time to sit and chat and reminisce, and giving them that thing that makes them want to get up and do. It's, you know, we're dealing with reality, nurses do not have time to do that anymore. All those days are gone and unless they reopen convalescence homes and units that they used to have when I started, which was the place where you could do it because you had more time. **(N03)***

*Normally once the physios have finished, that's when any physical therapy finishes. With the best will in the world the nurses just haven't got that level of time to carry out ongoing plans for people that they have really in hospital. Yes time is a major issue at the moment, yeah. **(N04)***

5.1.3.5 Lack of encouragement from staff members

Another barrier to mobility identified was the lack of encouragement from staff members to motivate patients to be more active. One senior staff nurse commented on the lack of experience and awareness from junior nurses regarding the importance of encouraging patients mobilise.

*Also in terms of probably experience and world experience more than anything. So that they, they wouldn't think of the whole picture of the patient getting about doing that because it's about task. It's about doing the observations, doing the wash, doing the IV antibiotics, that's it. They don't think actually this is a person, and we have left them in bed for three days in a row. **(N03)***

Other nursing staff participants felt that apart from the therapy services, there was a lack of encouragement from other healthcare professionals to motivate patients to be more active.

> *So I think it depends on that relationship you've got with the Therapy Team. But apart from that there's not really anything is there though?* ***(N02)***

> *Sometimes with our patients when they get to a certain level and we discharge them from Therapy, they then don't have the stimulation from the Therapists going in there and saying 'come on we're getting them up, we're getting them mobilising. They don't have that encouragement.* ***(T04)***

5.1.3.6 Lack of awareness among patients and family members

Several staff members raised the issue of the lack of awareness among patients regarding the importance of keeping active during their hospital stay.

> *I think there's still quite a big culture though that 'I'm in hospital I need to stay in bed because I'm poorly'. And even if these patients are medically fit they're still like 'no, I'm poorly, I'm in hospital I need to stay in bed'* ***(T07)***

> *Patients don't necessarily want to get up either* ***(N01)***

A staff member commented that family members of patients also lacked awareness in terms of the benefits of keeping active in hospital.

> *On the flip side though you do also get some of the relatives who say 'no my mother can't possibly get out of bed they're too sick' or too poorly and it's about kind of the education that actually… getting up, getting moving is going to help you get better quicker than staying in bed for goodness knows how long.* ***(T01)***

5.1.3.7 Misperception of responsibility to mobilise patients

Several therapists voiced their concerns regarding the misperception that mobilising patients is the physiotherapists' responsibility. This misperception was felt to be common among healthcare professionals.

> *I think it's the Healthcare Professionals. So you will hear people on the wards saying to the patients 'oh no wait till the Physio comes to get you up'… No you won't!* ***(T01)***

> *I think a lot of it is a cultural thing from some of the nursing team. The fact that the Physios and the Therapists have to walk them.* ***(T04)***

This misperception was also felt to be among patients. Rather than taking the initiative to motivate themselves to mobilise, the therapists reported that some patients would only mobilise if the physiotherapist came along to encourage them.

> *When a patient's discharged from physio sometimes they think that's it. They don't bother. If they're able to walk out of the door they don't bother to continue walking. They assume that it's a Physio that must come and walk them.* ***(T03)***

> *Mostly all our patients would need that extra bit of encouragement 'come on let's get you out now' which mostly would be coming from Therapists* ***(T05)***

5.1.3.8 Fear of falls

Falls are a common reason for hospital admission among older people. Patients who fall are likely to have less confidence in their mobility due to their fear of falling[360]. The psychological trauma after a fall was raised by interviewees as a reason why patients might be reluctant to mobilise in hospital.

With the patient group that we've got in Medicine for Older People, they do need a lot of encouragement. Some of them who have been admitted with falls would need that reassurance, because after the falls their confidence level gone down. So that would be a factor of why they would stay in bed ***(T05)***

I think those that need more assistance to move, where that person is more challenging, if they're walking with two, and that type of thing. It often doesn't happen because of that high risk of falling and fear of falling and the fear of injury and that type of thing as well for the more complex patients. ***(T01)***

5.1.4 Suggestions to improve inpatient mobility levels

Several suggestions were given by staff members on how inpatient mobility levels could be improved. I have classified these suggestions under three headings: education, team working among multidisciplinary team and implementing activities for patients.

Education

One of the key aspects of promoting change in the ward culture is to educate both healthcare professionals and patients regarding the importance of keeping active in hospital.

I think we need to be educating ward staff, nurses, in as much as possible in that actually they can get patients out of bed and that when patients come into hospital there's no reason why they shouldn't be getting their baseline or asking the patient. For most of the time, they would ask us to get that information or get patients up when they're actually mainly the first port of call. And they could ask the patients themselves or family members to get that information, not mainly necessarily down to us all the time. There may only be one of us per ward, when they're obviously a lot of nurses. And we're not here all the time; nurses are there all the time and they could be asking for this information when patients come in. Not leaving it for us to do. ***(T03)***

Acceptability of the intervention

> *I feel like the, the nursing staff just need a bit more confidence about it and education to feel confident to get those patients up so they don't have to wait for us to get them up and assess them or walk to the bathroom. They could just, they could just do it.* ***(T07)***

One therapist felt that education was also needed among patients to raise awareness of the importance of being physically active during their hospital stay.

> *And the generation that we've got coming through in Elderly Care at the moment, I think there's a lot of education we need to do there because they don't have that knowledge. And actually it, it's very prevalent in the younger generation as well, that they come into hospital and think 'that's it I don't need to do anything'.* ***(T04)***

Team working among healthcare professionals

A senior therapist commented that better patient care could be achieved with better team working among healthcare professionals.

> *I think a lot of that could be achieved by better joint working in terms of working with the MDT, to actually upskill people to increase their confidence. Um, with a whole manner of tasks really, because it can work on both ways. Like I mean there's so much we can learn from our nursing colleagues about the sort of things we can do for patients when we're with them as well so it works both ways* ***(T01)***

Implementing activities on the wards

Several nursing staff suggested that a way to encourage patients in hospital to be more active could be by having more activities on the wards. One suggested that having an activity co-ordinator on the wards may help engage patients in more meaningful activities and may give them a purpose to mobilise to a communal area.

If we had somebody on one unit who would do activities, then actually they could go round to those patients that really need encouragement and do something, you know, to actually do it with them ***(N02)***

It's like they do in Care Homes don't they when they have the activities co-ordinators. What do they do? The get the patients into Day Room don't they? And they do stuff like Bingo or, you know the things that…. But it's just obviously having the person to do it with. ***(N02)***

5.1.5 The value of volunteers

Through the interviews, it was evident that staff members felt that more could be done to encourage patients to be more active during their hospital stay. Staff members appreciated the value of having volunteers to help encourage patients to mobilise. The volunteers were felt to be able to address some of the barriers of mobilising patients such as: lack of encouragement, lack of time and insufficient staff members.

And they've (the volunteers) probably; they've got more time really to spend with those patients whereas we're sometimes pushed for how long we've got to do the assessment with that patient. Actually they've got more time to spend with the patients whether getting them up and doing the exercises. ***(T02)***

And the other great thing they can do is when they do the chair and bed exercises, because a lot of our patients for whatever reason will need prompts to do those chair and bed exercises. And with the best will in the world we don't have the scope in our service to go round and do those with every patient that we would like to do, because we have to be so focused on the discharges and that type of thing, but the exercises, they shouldn't be overlooked at all. So having volunteers that can come in and prompt that, is brilliant ***(T01)***

I think volunteers play a vital role within the hospital generally. You know, I think they play a vital role, definitely. Talking about time before, we should have time but we haven't and they, that's the role they've been playing which is very much, a very vital support role to us I think. ***(N04)***

Staff members also felt that the volunteers played an important role in the care of older people and felt that they were very much part of the team.

> *I think it's useful; it's an asset to the team. I consider them as part of the team. They're an asset to the team. Anyone who comes in and provides that extra bit of service, it's a good thing.* ***(N04)***

> *They're not running round trying to do observations and notes and care plans and this and that with us. So they've got that time to be able to say 'shall we go for a walk round the ward'. 'Shall we go for a walk downstairs?' 'Shall we get in the chair?' How about we go outside for a little while?' They are brilliant because they can get people out* ***(N05)***

Volunteers were also able to appreciate the value of their role as mobility volunteer. They were able to appreciate the potential benefits that the patients might receive through the intervention.

> *I think it's a very useful role because patients in the hospital don't often get the opportunity to exercise and having Mobility Volunteers means that they are getting something else that should be part of their normal life anyway. Even while they're at the hospital. I think the intervention will encourage the patients to mobilise more, because they aren't too strenuous. Although some of the patients are quite old, it does give them the idea that there are other ways to exercise rather than just the standard running or being exhausted so it shows them that there are other ways to keep fit* ***(V04)***

> *I mean it does make you think about, just generally, when patients are admitted that, how much encouragement are they actually given to think about moving? Because often, we've often found, I know they move patients from the bed to the chair, but it's those other little things that that might not be too risky which we could encourage people to do.* ***(V02)***

5.1.6 Summary of Theme I: Coherence

Under this theme, I explored how patients, volunteers, nurses and therapists made sense of the intervention individually and collectively. An important element of sense-making is that key stakeholders understand the aims and expected benefits of the intervention. The healthcare professional demonstrated awareness of the problem of sedentary behaviour among older inpatients and felt that improvement was needed. Patients and volunteers also showed understanding regarding the importance of being physically active. Several barriers to mobilising older inpatients were raised through the interviews. Several factors were inter-related, such as higher patient acuity, lack of time and lower number of staff members. These findings were consistent with published literature showing that due to increased clinical and time pressure, mobilising patients was one of the aspects of patient care that was often neglected[89].

The use of trained volunteers to encourage patients to mobilise addresses some of the barriers to mobility raised by healthcare professionals: lack of time, lack of staff members and lack of encouragement given to patients. Staff members appreciated and valued the time offered by volunteers to help improve care given to patient. Importantly, feedback from nurses showed that volunteers were seen as 'part of the team', working together to provide better care for patients. Volunteers were also able to appreciate the importance of their role and the benefit it may bring to patients, which would be a source of motivation for their participation in this voluntary role.

Overall, the key stakeholders in the intervention demonstrated coherence with the concept and the implementation of the volunteer-led intervention to encourage older inpatients to be more active. In the next theme, I will discuss my findings on how patients, volunteers and staff members legitimise their beliefs by committing to ensure that the intervention is carried forwards.

5.2 Theme II: Cognitive participation

Cognitive participation is the relational work that people do to build and sustain a community of practice around a complex intervention[284]. It involves participants and stakeholders believing that it is right for them to be engaged with and contribute to the intervention, and actively putting in the effort to contribute in their role. In the process of implementing an intervention in a complex environment like the NHS, one of the key aspects which would determine the success of the implementation is the willingness of stakeholders to drive the intervention forwards. When key stakeholders have 'bought in' to the idea and concept behind the intervention and are able to appreciate its value, then they are more likely to be prepared to invest time and energy to make the intervention a success. Through the interviews the views of key stakeholders were explored to determine how engaged and committed they were to the implementation of the intervention.

5.2.1 Patient commitment

There were many positive experiences described by patient, demonstrating their willingness to participate in the mobility and exercise sessions. Feedback from patients also demonstrated that they enjoyed the activity sessions and felt that they benefitted from it.

> *It's not a drag. I think it's a jolly useful exercise to do* ***(P02)***

> *So when the gentleman, whoever, comes to give me a few exercises I welcome it. I'm now able to go, to walk to the toilet myself with this, which has given me freedom if you like. Yeah, rather than tethered to the bed.* ***(P04)***

> *Well just the thought that I want to be more fit and able to get back to walking again.* ***(P02)***

Patients' commitment in participating with the intervention was also demonstrated through some of the feedback given by the volunteers and staff members. There were occasions were patients who were not part of the study also expressed interest in participating with the exercise sessions.

I think quite a lot of the patients really like that. In fact they're quite excited when you come round and like to have a bit of a chat they say 'oh, you coming round tomorrow'. ***(V01)***

It's generally a pleasant experience because most patients are willing to do it. ***(V04)***

And there was one gentleman that wanted to do the exercises with us in the other bed. He was watching. ***(V05)***

I think I've seen a positive aspect as well. When you are actually in the bay and someone comes in, one of the volunteers and they're mobilising and going through exercises. Other patients are trying to join in the exercises that they're going through. And then, quite often you hear people saying 'oh I wish someone would come and give me a walk. I wish I could get up and walk'. Or 'Mr so and so is doing very well, when are they going to come and see me?' So there is a lot of engagement from them, which I find really nice. ***(T04)***

However, there were also a few instances where participants were not willing to engage with the volunteers in the activity sessions, as expressed by some volunteers. Nonetheless, it was felt that majority of the patients were willing to participate with the activity sessions.

Some of them, some of the patients can be challenging, because they're resistant to do the actual exercise or do anything full stop. ***(V02)***

I mean when I first started I was seeing mainly ladies, and they seemed very very keen and the men weren't so bothered. But now, I'm seeing mainly men and they seem much happier. I suppose it varies from the patient to patient ***(V05)***

5.2.2 Volunteer commitment

One of the cornerstones of the intervention, which could determine the success or failure of its implementation, is the volunteers. Interviews with the volunteers showed that they were committed to their role and were motivated to encourage patients to mobilise or exercise and to improve their mobility.

> *I had parents, elderly parents that have had mobility problems I understood what was needed. And I just thought I could help in that way. Well I like to hope that I'm helping them remember to do the exercises so I'm hoping I make a difference* ***(V05)***

> *There are a number of older people who could probably, rather than be just sat in their chairs, be encouraged to actually do some form of movement. Not necessarily everything that we've got, but some form of movement just to keep their circulation going and all those sorts of things.* ***(V02)***

One therapist also reported that the volunteers were very engaged with what they were doing.

> *So I've found them (the volunteers), I've met a few different ones and actually each person that I've met has been really sort of engaged, with what they're doing* ***(T01)***

Volunteers also showed commitment in delivering the intervention safely. Through the interviews, the volunteers demonstrated that patient safety was always in the forefront of the minds.

> *The other aspect is making sure they can safely get on the bed. And, or if they want to get off the bed that they can safely get off the bed. I would go to a member of the nursing staff to say whoever it is wants to get back into their chair, is that okay? Or get them to do it, because I'd hate for them to have a fall.* ***(V02)***

It was a bit worrying with one of the patients I was with and she sort of shuffled forward in the chair so that she could do the exercises easier and I thought 'oh I hope she's safe'. I mean she was. She knew what she was doing but I felt a bit worried. Is she going to shuffle forward a bit too much? ***(V03)***

5.2.3 Staff commitment

The proposed intervention was very well-received among staff members. Both nursing and therapy staff members showed enthusiasm about the volunteer-led activity sessions and were keen to ensure that patients were encouraged to be more active during their hospital stay.

I love it. Personally. I think it's a brilliant idea. For the patients there are so many benefits to it. **(T01)**

They are actively thinking of trying to facilitate patients to get moving in Medicine for Older People and I think having the mobility volunteer intervention come up has been a very very good idea. There are loads of people would benefit from it. It's a very very good study and, if it can be rolled out to everybody that is appropriate, it would be good. ***(T05)***

I can't see any other option other than bringing in volunteers because they are going to be the person that's free to do it. ***(N03)***

5.2.4 Summary of Theme II: Cognitive participation

Findings under this theme suggest that both therapists and nurses were supportive of the idea of using trained volunteers to encourage patients to be more mobile. Healthcare professionals felt that the intervention would benefit patients and were keen for the intervention to be implemented. Volunteers were also motivated in their role and were committed to ensuring that the intervention was delivered safely. The majority of the patients were positive about the activity sessions however there were a few patients who were less motivated to participate. As described in section 4.4.2, adherence to the intervention was 74%, with clinical reasons (20%), tiredness (19%) and feeling unwell (18%) being the main three reasons why patients declined participation.

5.3 Theme III: Collective action

Collective action is the operational work that people do to enact a set of practices. One of the determinants of the success of implementing a complex intervention is the interaction and integration of stakeholders in carrying out the work together. This theme explores how volunteers and healthcare professionals work together in implementing the intervention in everyday setting. It also explores how the intervention impacts on the workload and resources of healthcare professionals.

5.3.1 Supportive staff members

The volunteers reported positive experiences of working with staff members. They found the staff members supportive and helpful and were working together with them in actively encouraging patients to participate with the activity sessions. Volunteers also felt adequately supported in their role.

> *I think once I went to a patient and he was feeling quite tired but there was a member of staff there, a nurse or somebody and, and that person sort of encouraged him and got him going. So I suppose sometimes you can get a bit of help from other staff, you know, from staff that might be there.* ***(V03)***

> *If I needed help I'd ask a nurse and they've always been very helpful. Yes I know that you are here. I have had a problem before and I have asked a nurse whether I could do something No, I think I am adequately supported, yes.* ***(V05)***

> *Very positive I think. I think they've been, they've been always happy to sort of help. When I've approached them they've always been very supportive. They've been very approachable and always been very proactive sort of thing: 'yeah, yeah that'll be good yeah'. Particularly as I said, surprisingly perhaps, particularly physio staff and the therapy technicians, they have been very helpful. Yeah they're always very helpful.* ***(V01)***

I've worked more with the nurses and I would say that it's a pleasant experience. They're willing to help you if you don't know what you're doing, or where to go, so they'll direct you. Also if you're having difficulty locating a patient they can help you find them as well. ***(V04)***

5.3.2 Working well with busy staff members

Implementing an intervention in a busy clinical setting can present its own challenges. However, the volunteers felt that they were able to work well with staff members despite the busy ward setting. Volunteers were understanding and were aware that on occasions, nurses may have more urgent medical issues to deal with and may not be able to engage with them immediately. While at times volunteers may struggle to find a nurse to speak to, on the whole they felt that it was not a significant problem.

That's the thing isn't it? Cos we have to balance that knowing that it may be that the nursing staff might actually have a medical issue that they have to deal with which is far more important than us trying to get a patient to do some exercises. ***(V02)***

There was one senior nurse that I was asking whether a patient was okay to do the exercises with me. She was so busy she said 'well you'll have to walk along with me you know' so I had to, you know, rush along with her while I was asking her what I was asking ***(V03)***

Occasionally you, it's a problem to find a nurse because they're all so busy, but on the whole I haven't had any problems ***(V05)***

5.3.3 Encouragement given to patients to mobilise

Feedback from patients was also positive and they felt that the volunteers and staff members were working together and actively encouraging them to be more active.

Acceptability of the intervention

*From what I've seen, they're quite good at encouraging people in hospital to be more active**.*** ***(P01)***

Well I've taken part in this research and I find that they, the staff that know what they're doing will obviously encourage me. ***(P02)***

5.3.4 Compatibility with other volunteering roles

Feedback from volunteers suggests that their role as a mobility volunteer complemented their other volunteering roles in the hospital. Previous experience of volunteering in the hospital gave the volunteers more confidence as they were familiar with how the wards operate. Another volunteer expressed that having multiple roles was helpful to her as she could move from one volunteering role to the next. The volunteer who was also a mealtime assistant would normally encourage patients to mobilise mid-morning to lunch time and would then move on to help out with the meal times.

Yeah I think, I think so. I think it depends on whether you do other, other volunteering roles and therefore you're used to particular systems ***(V02)***

Yeah, because, because I come from the far side of the city, I'm not going to come here every day of the week just to do a couple of hours, and so I do all my volunteering on one day. So I'm here all day on Tuesdays to do all my different volunteering roles. ***(V03)***

5.3.5 Impact on work pattern

In the interviews, nurses and therapists were asked how the intervention had impacted on their resources and work pattern. Overall, staff members felt that the intervention had a positive impact on their work in providing care for patients. The therapy team had the added responsibility of providing a therapist to assist me in training the volunteers and that had a slight impact on their workload. However, they also felt that the intervention may have reduced their workload by reducing the number of patients who were re-referred to them. Re-referrals were for patients who have previously been discharged by therapists as they were back at their baseline physical function but subsequently deteriorated in function during their hospital stay.

I think the biggest impact was the initial stages with the training. To be honest, I think because we've, we've got to be so careful to safeguard our patients. You've got to make sure the training is spot on and that people are safe to be doing what they're doing on the wards. So I think the biggest investment was the training side of things ***(T01)***

On a day-to-day basis, the impact on us….. Doesn't take much time up out of us at all, the most it will take is 'oh, shall we refer to SoMoVe? Let's put that on the board'. It takes a minute ***(T01)***

I think we get less re-referrals. So previously people would just be sat there and they'd just be waiting for a package of care which could take weeks or months sometimes, and they wouldn't be walking out to the bathroom because nurses didn't have the time or whatever. So their mobility would get worse again. We'd have to pick them up and we'd have to do all the assessments and everything all over again. Whereas, because they (the volunteers) have been going in and keeping them ticking over, I don't think…. We've had a few but not, not that many. ***(T07)***

I think they (volunteers) fitted really well generally, you know. They're not; they don't come in sort of strange times of the day. They're always here in the afternoons or mornings, no problem at all. ***(N04)***

5.3.6 Summary of Theme III: Collective Action

In summary, both nurses and therapists have shown that they were supportive of the intervention and were actively encouraging patients to participate with the intervention. No negative comments regarding the intervention was raised through the focus groups and interviews. They were helpful and supportive to the volunteers and worked well together even during busy times. Volunteers and staff members interacted and integrated well and played their part to ensure that the patients received the intervention.

Importantly, the staff members felt that the intervention had a positive impact on their workload. For the therapists, there was an initial increase in workload as they provided a therapist to assist me in the training of volunteers. However they have also reported that since the introduction of the volunteer-led intervention, it appeared that the number of patients re-referred back to them had reduced, which in turn reduced their workload and allowed them to focus their resources on other patients. These findings were really positive and demonstrated that both the staff members and volunteers were working well together to achieve the same goal of encouraging patients to be more active in hospital. In the next theme, I will discuss the findings from the appraisal of the effectiveness and usefulness of the intervention.

5.4 Theme IV: Reflexive monitoring

Reflexive monitoring is the appraisal work that people do to assess and understand the ways that a new set of practices affect them and others around them. Within this theme, I explored the views and experiences of patients, volunteers and staff members on the effectiveness and usefulness of the intervention. I also explored the challenges and barriers that they faced and identified factors that would facilitate the smooth running of the intervention. Suggestions were also sought on how the intervention could be modified or improved to ensure that the intervention can be successfully implemented on a larger scale.

5.4.1 Reflections on the training programme

The volunteers reported that the training programme was very useful as it adequately prepared them for their role as a mobility volunteer on the wards. They found the role-play session provided during the training day very useful and the close supervision on the wards for their competency assessment helped to build their confidence in carrying out their role independently.

> *I thought it was pretty good. Especially the bit where we actually pretended to be a patient or we had somebody pretending to be a patient, and go up and have a go, going through perhaps standing, walking, that was good. A good sort of beginning to how to approach, the safety aspects, and also the courtesy aspects of going up to the patients and I thought, I thought that, that was good. That was good, useful, very useful.* ***(V01)***

> *I would say the training programme was quite thorough because I had at least 3 or 4 training sessions so I could get used to as many different kinds of scenarios I may be presented with. And I think that was really useful because it's quite easy to forget things, but doing the training over and over again helped to cement things in my head* ***(V04)***

> *With supervision of course which was another bonus as well because then you start to feel a bit more confident when you approach somebody making sure things are correct and remembering all the different sections we were taught* ***(V01)***

Acceptability of the intervention

The volunteers also gave a few suggestions on what could be improved in the training programme. One volunteer suggested some minor changes could be made to the exercise sheets to ensure that the exercises were clearly labelled. I adapted the exercise sheets following the suggestion to ensure the exercise sheets were clear to patients and volunteers. Another volunteer suggested that video recordings of the exercises could be of help to refresh their memory on the actual movement of each exercise.

> *I was thinking on the handouts that you gave us with the pictures of the exercises it could say on there, I think one of them is arm flexion, and I can't remember, and there are different terms for it. And on the activity prescription sheet for the patient, it says those different terms but it could actually be written clearly on the exercise sheets* ***(V03)***

> *Perhaps a little video, I mean we have all the sheets with the exercise, with all the different forms of exercises on. That's good for the reminder, although I look at them and keep thinking 'oh what's this one'. If you had a little video, which sort of said 'this is what we want the patients to do'… And so for me to actually see that particular movement over, I could make sure that I was getting the patient to do it, to actually get the best benefit out of it.* ***(V02)***

5.4.2 Challenges of the intervention

To better understand how the implementation of the intervention could be improved, I explored the challenges and barriers that stakeholders experienced during the implementation process. Identifying barriers to the intervention is an important step in appraising the effectiveness of the intervention as it will help guide future implementation studies. Table 42 shows the lists of challenges identified through the interviews.

Table 42 Challenges and barriers to implementation

	Challenges and barriers	Factors
1.	Finding the right nurse on busy wards	Clinical factors
2.	Space limitation	Clinical factors
3.	Frequent patient transfers	Clinical factors
4.	Physical restrictions	Clinical factors
5.	Staff awareness of the programme	Staff factor
6.	Lack of appreciation from staff members	Staff and volunteer factor
7.	Inconvenient timing	Volunteer factor
8.	Intimidating environment	Volunteer factor
9.	Patient availability	Patient factor
10.	Patient expectation	Patient factor

5.4.2.1 Finding the right nurse on busy wards

Prior to each activity sessions, volunteers were required to speak to staff members to ensure that patients were safe to participate. One of the challenges raised was the issue of looking for the nurse that is looking after the patient. Nurses were often busy with other clinical work or behind curtains. Although this may present some difficulty to the volunteers, they were willing to wait to speak to the right nurse to ensure that patients were safe to participate. As highlighted in section 5.3.2, volunteers showed understanding and consideration to work alongside busy staff members.

> *I think, I don't know about the others, sometimes I actually find the person who's in charge of that particular bay, just to make sure that that person is fit, and it's actually okay to do the exercise, that's the most challenging thing to actually do. To find that person so before you start off doing anything, that you've actually checked.* ***(V02)***

Well because of the different shifts which people do, you might not speak to the same person for a particular bay both the weeks. So I just sort of find the nurses just to double check, just to make sure this particular patient hasn't had some major medical issue overnight ***(V03)***

5.4.2.2 Space limitation

Some volunteers struggled with space limitation, particularly for patients who were sitting right against the wall in the bays or patients who were less mobile in the armchairs. Several arm exercises were difficult to achieve accurately as the space surrounding the patient was limited which prevented full abduction of upper limbs.

There's some of the exercises if you've got a patient sat in their armchair, and they don't want to move in their armchair, there are some exercises which can be difficult for people to actually do, because there isn't the space… Yes, that's, that's a difficulty too, some of the exercises. ***(V02)***

Well I suppose that's one way it could be improved, what we've just been talking about, if the patient could be move to a part of the bay where there was a bit more space. Not just sitting next to their bed. ***(V03)***

5.4.2.3 Frequent patient transfers

During their hospital stay, patients may be moved to different wards for various reasons. The volunteers found it a challenge to locate patients who have been moved to a different ward to continue the intervention with them. Bed moves were often determined by ward nurses and bed managers based on demand for beds and on occasion patients recruited to the study were moved to a different ward within the hospital. Volunteers would visit the patient on a different ward to continue with the activity sessions.

*Most important thing I had to deal with was just locating the patient. Because between one intervention and the next the patient can be moved to a different ward, so that's the only thing (**V04)***

5.4.2.4 Physical restrictions

Another challenge that volunteers faced was doing exercises with patients who were on intravenous drips. Patients who were on an intravenous drip were reluctant to move their arm to prevent disrupting the administration of medicine or fluids.

*I've just realised it's always a problem when you've got a patient who's actually on a drip. I got one patient the other week, before he got hooked up to the drip. So I got him to do all of his exercises, do all the arm ones, all the arm exercises before they hook you up on the drip. I sort of challenged him to try and do some exercises otherwise they end up doing one armed exercises. **(V02)***

5.4.2.5 Staff awareness of the intervention

The second barrier that was raised was regarding staff awareness of the intervention. Meetings were organised with the therapy team prior to the commencement of the study to introduce the intervention to them. Ward managers were also informed about the study and a circular e-mail about the study was sent to the ward managers to be distributed to all the nursing staff on each ward. Each study ward was also given a folder where further information regarding the study was accessible. Additionally, when patients were recruited to receive the intervention, the nurse looking after them were briefed about the study too. Despite this, feedback from the interview showed that some nurses were unaware of the study.

*I'm not too sure as to what information has been provided to the nursing staff and medical staff, about the role of the, the mobility volunteers to make sure they're aware that we're just not somebody else who has a blue t-shirt and has come along to, but we're there actually for a particular purpose. **(V02)***

Well the immediate ones that come to mind are the fact that the staff, nice as they are, can't really tell you, how to use the different bits of equipment and things to help you to start walking again. They're very good, but if they knew a bit about the research themselves they'd know what you were working towards. I think that would be helpful ***(P02)***

Like I said to you earlier, it's almost like nobody really knows about this project on the wards. It's almost done covertly so I don't know if anybody's even noticed that they're doing the exercises with the patients. That's the only thing. So whether or not if they got more involved, then actually that would really encourage the staff that are on the ward as well. ***(N02)***

5.4.2.6 Lack of appreciation for the volunteers

Another barrier to the intervention that may impact on its implementation is the lack of appreciation from the staff members for the mobility volunteers. Some nurses perceived that the mobility volunteers were a bonus to the wards, helping out with less essential things, rather than being a regular member on the ward.

They're (the volunteers) there in the background. I don't think I know what their names are and what day they come. ***(N01)***

I think it is more difficult to measure the mobility volunteers because they're coming in almost to do a nice thing whereas the Mealtime Volunteers are coming in to do an essential part of the day. But that comes back to I think the staffs' mentality that they won't necessarily think of getting somebody walking, that it is something that they need to do. They'll get them up to walk if they need the toilet. But I don't think they think 'well I've got a spare 5 minutes let me go and get (name) up because actually I know she hasn't walked for a bit'. So because of that, I don't think they will pick up that Mobility Volunteers are any different than 'Pat the dog' or something or League of Friends or Cake Concert. They'll know it's a volunteer thing, but they'll see it as a bonus and not something that if the volunteers are there, that they will do. ***(N03)***

One volunteer mentioned that she could not recall being thanked by the nurses for the work she had done with the patients, but took the helpful and supportive attitude of the nursing staff as appreciation. As described in section 5.3.1, most of the volunteers felt that they had good working relationship with the nurses and felt supported by them.

> *About any healthcare professional that has said to me… No I'm just trying to see whether I've had any healthcare professional say to me 'thanks for' 'that was good I saw Mr or Mrs whatever or saw her do that'. I can't nod my head and say 'yes'. I don't think anyone's actually said 'thank you' to me, but I just take it in their attitude to sort of being helpful I suppose I pick that as appreciation really* ***(V02)***

5.4.2.7 Inconvenient timing

One volunteer who provided the activity sessions in the mornings and afternoons found that it was more challenging to get patients to participate during the afternoons. Interestingly, findings from the pre-intervention observational study showed that activity levels started to decline after lunch towards to evenings. Afternoons appear to be the time where more encouragement was needed to be given to patients to motivate them to mobilise.

> *I think it's more challenging, from what I've heard here, since I changed from doing both shifts just doing the afternoon shifts. It is more challenging in the afternoon. This is because not only that people get a bit tired after, but also they've had a big lunch and they don't like doing much and then sometimes you've got rest periods on wards and that sort of thing so it's quite a difficult judgement call as to when's the best actual time to go. I think, at the moment, sort of between 1 and 2 half past two seems to be a good time. Because some people you do get 'oh I've just had lunch' and that sort of thing. But then if you come back a little bit later on I say 'I'll try again in half an hour, see how you feel in half an hour'. Often they'll be like… 'Okay, we'll do it then'. But then other people, you want to catch them before they have a rest on the bed, because once they're in the bed they don't want to get out, do they?* ***(V01)***

5.4.2.8 Intimidating environment

One of the volunteers commented that the wards can be an intimidating environment for someone who is new to it. This is an important finding to note to reassure new volunteers that similar thoughts may be going through other volunteers' minds and that with time and familiarity with the role, things would improve.

> *Sometimes it can be quite intimidating going into a place where everyone knows what they're doing* ***(V04)***

5.4.2.9 Patient availability

On several occasion, the activity sessions did not take place due for several reasons such as patient tiredness, patient asleep or being away from the wards. There were several other documented reasons, which were presented in section 4.4.2, under patients' adherence to intervention.

> *I don't have that happen very much but last week actually one person was fast asleep and somebody else was behind the blue curtains so I spent most of the time going backwards and forwards between the two to see if one had woken up or to see if the curtains had been opened again.* ***(V03)***

> *I had an empty bed, I don't know where the patient was.* ***(V02)***

5.4.2.10 Patient expectation

Patients' expectations on what the volunteers could do for them was identified as a challenge. In one particular instance, the patient was dependant on staff members to stand her up and the volunteers were doing chair-based exercises with her. She was hoping that the volunteer could help her move and transfer from bed to chair, which was beyond the volunteer's remit. Volunteers were taught how to verbally coach patients who were independently mobile to transfer and get out of bed and were taught not to physically help patients. Patients who needed assistance to transfer had to be assisted by nursing staff before the chair-based exercise could take place.

I think it may help if the volunteers knew how to help people who are disabled or, or lying in bed or something, helping get up and how to stand and how to stand and how to manage properly. But I mean, that's only my opinion. The woman that came was very nice and did the exercises alright but, she didn't know how to help me get up or do anything you know. ***(P02)***

5.4.3 Facilitators of the intervention

There were also many positive experiences shared by stakeholders which were important facilitators to the implementation of the intervention. These facilitators, as shown in Table 43, were identified through the interviews and provide an insight as to how successful the implementation process has been.

Table 43 Facilitators of the intervention

	Facilitators	Factors
1.	Perceived benefits: Staff members	Staff factor
2.	Staff appreciation	Staff factor
3.	Perceived benefits: Volunteers	Volunteer factor
4.	Convenient timing	Volunteer factor
5.	Confidence in the volunteers	Volunteer factor
6.	Positive experiences: Volunteers	Volunteer factor
7.	Volunteers seen as non-medical personnel	Volunteer factor
8.	Social aspect of the intervention	Patient and volunteer factors
9.	Perceived benefits: Patients	Patient factor
10.	Positive experiences: Patients	Patient factor
11.	No adverse events	Patient, volunteer and staff factors

5.4.3.1 Perceived benefits: Staff members

Several benefits of the intervention to therapy team and nursing staff were raised in the interviews. Nurses felt that the volunteers freed up their time to do more urgent care. The therapy team felt that they could reallocate their resources to work on patients who needed more help while the volunteers worked with the more stable patients. It helped in maintaining patients' functional baseline and prevented re-referrals to the therapy team. The therapy also reported that having the volunteers on the wards helped change the perception that the therapy team are the only people who should be mobilising patients.

> *It frees up time for us to do more critical care. The acuity of patients coming through now is a lot higher. We're tied up a lot more.* **(N04)**

> *It frees staff members up as well. You've then got a volunteer to sit and go through exercises and walk with them, that frees up a potential 10 – 20 minutes to half an hour where you can actually be treating a patient clinically and progressing them in another direction. From a purely therapy perspective, that really helps as well. But it helps with the fact that they're not going back downhill again and they're maintaining what level they are.* ***(T04)***

> *Then it might show, like we talked about, the attitude that the Physio is the get up and go people, because the nurses can see that the volunteers are getting them up as well aren't they. So it's showing the nurses that anyone can do it. You don't have to have the physio manual handling skills to keep these patients' mobility up.* ***(T03)***

> *I suppose it might decrease the amount of people getting re-referred to us if they are still getting up and walking.* ***(T03)***

5.4.3.2 Staff appreciation

Overall, both the therapists and nursing staff were very appreciative of the work that the mobility volunteers did and gave very positive feedback about them. The volunteers were professional and friendly and were very good at encouraging patients to be more active. The volunteers interacted well with staff members and had good rapport with patients.

I have seen them around and as you say they're always professional and generally friendly ***(T07)***

It's all been really good. Ever since it got started it's been brilliant yeah. Well I came past the other day and there was somebody in there doing leg exercises on the bed. Brilliant. Well that's very good, that's fantastic. ***(N04)***

I met one. It was a young gentleman who was lovely. Went in, he was bubbly, he was obviously happy to be there and, he clearly wanted to do well. He introduced himself to the ladies in the room and introduced himself to the members of staff who were there and he got them up moving. Talking about what they wanted to do, where they wanted to go and he was really positive. And there was no negative vibe, it was all very positive. 'No, come on we can do this' and 'right come on we're going to do this next' and he was, he was really good actually. He was nice. ***(N05)***

They would come onto the ward; they were kind of well-recognised on the ward now. The staff knew who they are. They would stop and have a chat. Sometimes if they're, certainly if they're like with for example a patient that I've been seeing, and referred on to SoMoVe, I will often sort of have a chat with the patient and the volunteer at the same time to see how things are going. That's been great cos it sort of allows us to sort of keep a bit of a peripheral approach of what's going on and so that's been brilliant ***(T01)***

5.4.3.3 Perceived benefits: Volunteers

Volunteers enjoyed their role and felt that the intervention has also benefitted them. Apart from verbally encouraging the patients to do the exercises, volunteers would sometimes do it together with the patients and felt that they too benefited from the exercises. They also enjoyed interacting with patients and staff members and for some, the interaction has helped them build confidence.

I mean I don't know about you, but I go through the exercises, apart from bed exercises. I'll sit in the chair and do all the exercises. Just to make sure that I'm actually… yeah just the demonstration, well not only the demonstration but… it keeps me active… it keeps me supple. Benefits of doing the exercises. I get the benefit as well by actually doing some. ***(V02)***

I think patient contact and the interaction with the staff that work on the wards are the things I enjoy most in my role. The intervention provides an avenue to actually speak to staff because I have to ask for their permission first. So it's just like, it just develops confidence. ***(V04)***

You get to know the patients a bit more, and that's nice as well because you've got that sort of connection with them. ***(V01)***

5.4.3.4 Convenient timing

An important factor in the implementation of the intervention was the timing of the intervention. Volunteers and patients felt that the timings of the volunteers visit were appropriate. Volunteers were also flexible in their approach and were willing to return to the patients at a different time if patients were not feeling up to mobilising at a particular time.

I think the time that I do it is good. It's 11 o'clock so it's before lunch. You know as a mealtime assistant I notice that quite often, patients after they've had their lunch, they just want to have a rest or go to sleep. So I think doing it before lunch is good time isn't it. ***(V02)***

*I think it's quite a good time because it's not too close to lunch or dinner so they're willing to like mobilise (****V04)***

*Well, they came when nothing was happening. Now whether they noticed that****,*** *or whether they've asked the doctors or asked the nurses when, is a case of... if the patients' got nothing to do any time will do as far as I'm concerned.* ***(P04)***

They were alright; I worked it in without any problems. They were always very willing to go away and come back another time. ***(P02)***

5.4.3.5 Confidence in the volunteers

Patients and staff members also expressed confidence in the volunteers. This demonstrates that the volunteers were adequately trained and were carrying out their role competently and safely. For patients who were mobile with an aid, volunteers were careful in ensuring that the patients had the right frame and at the right height, prioritising patient's safety.

It's done with people who really know what they're doing, what to suggest, and what exercises you need to do in order to improve your mobility. ***(P02)***

*And occasionally it's been you know, 'Is that the right height for that person to use the frame', but actually that's really showing the fact they're risk assessing them. They're making sure that the walking aid that they're using is the most appropriate for the patient. Which is really a safety awareness and I'd much rather someone came and said 'is that frame the right height' 'is that Mr so and so's frame, I can't find, it's different from yesterday'? I've taken 5 minutes out to say 'yes that's the right frame; it's the right height off you go, carry on'. And that shows quite a lot of, the fact that they've taken on the safety aspects of it****. (T04)***

5.4.3.6 Positive experiences: Volunteers

Five of the six volunteers interviewed also reported that they were enjoying what they did and did not feel unappreciated by patients or staff members. Only one volunteer reported that she could not recall being thanked by any staff members. The enjoyment of their role in helping others is a source of motivation for the volunteers to continue in their role and a key factor which promotes volunteer retention.

Yes, I'm enjoying it. Just to see them getting up and walking is, is so vital to them for when they get home. ***(V05)***

They (staff members) don't make me feel unappreciated ***(V04)***

And those (patients) who don't want to they just, they aren't rude or anything they just, they just don't feel like mobilising at that particular time. Which is perfectly understandable? ***(V04)***

5.4.3.7 Volunteers seen as non-medical personnel

Staff members also felt that volunteers were able to break down some of the boundaries between patients and healthcare professionals as they were viewed as non-medical people. Someone who is non-medical or not in a uniform may create a less formal atmosphere for patients, and therefore patients were perceived to be more likely to engage and participate with the intervention.

I think it's good because actually by bringing in volunteers you break down some of the boundaries as well, so it's not seen as someone medical coming to see them. ***(T04)***

I feel it works very well now. The patients, they don't see it as physiotherapy. They see it as um... They (physiotherapists) come across as a little bit threatening maybe? If they see a physiotherapy they can feel a little bit that they 'must do this, they've got to do it'. But when somebody comes up: 'I would just like to help you do', 'oh okay'. So they seem more positive and more sort of accepting of it. ***(N04)***

*It's nice to have volunteers come in. It's a fresh face, someone different, someone new, and they all come in and they might be recognised by one of the patients. The patient associates that person with 'right we're getting up, we're going to something now'. 'I'm not just going to sit here and have my observations done and take medication and wait for visitors, I'm going to get up and go somewhere now because that person's come in to see me' (****N05)***

5.4.3.8 Social aspect of the intervention

Although the main aim of the volunteer-led intervention was to promote increased physical activity among older inpatients, one key aspect of the intervention was the social interaction between patients and volunteers. Rather than being regimented in their approach, volunteers were able to communicate and build rapport with patients. Social interaction with patients can help prevent them from feeling socially isolated or feeling bored during their hospital stay.

> *Yes. Especially if they come and talk to somebody first. Communication, I'm a great one for communication and not via electronic devices. It's somebody to talk to, somebody like me who doesn't get many visitors. Its funny when I'm home I get visitors all the time. Haven't seen one since I've been here, but there we go. Yes, just by talking, and if they can keep encouraging the patient to try a few mobile exercises, it can only be good.* ***(P04)***

> *Because you have the time for the social aspect. It's so boring being in hospital and to actually have somebody who is completely different and doing, not actually medical staff, a volunteer who'll just chat away and doing things with them.* ***(V02)***

> *And it's somebody to talk to as well. I know they're not there primarily for that but they can have a chat about what they would normally do and they can talk to them and build up a good rapport with them* ***(N04)***

> *The social interaction that they are getting as well, that really plays a vital role as well* ***(T05)***

5.4.3.9 Perceived benefits: Patients

Feedback from patients, volunteers and staff members suggests that the volunteer-led intervention had several benefits to the patients. Patients felt that they were encouraged and motivated to be more active during their hospital stay. Patients who were not part of the study also indirectly benefited from the intervention by joining in with the exercises and were motivated to be more active. A therapist also reported that patients appeared to be in a better mood having received the intervention, and saw a psychological benefit of the intervention to patients.

Talking, communicating with them and encouraging them to, even if they don't feel like doing exercises. To do one or two is better than nothing at all. Keeping the body, keeping the legs nimble, keeping the arms nimble. ***(P04)***

I think, even other patients when they see other people walking around and getting benefit of the volunteering, they become interested. And on the ward people sort of try to join in, like when we're sat down doing the exercises. So I think it does kind of promote this idea of moving around and getting a bit of exercise. It's something also for people to do in hospital cos a lot of them when they're sat in the bay are sat there quite bored ***(V01)***

And actually you can tell the difference as well, from a physical point of view, actually having that one-on-one time from somebody who is not from the hospital team per se, makes them feel really quite valued. And you might have somebody who's been quite low mood, the volunteer's been in and when they leave they've got a smile on their face and they're like 'oh tomorrow I'm going to walk a little bit further' or they carry on with their exercises once the volunteers have gone as well. So that's a huge benefit from a psychological aspect as well. ***(T04)***

So we do sometimes get people saying: 'You haven't seen me in three days, I'm not doing anything 'etc. etc. So the SoMoVe project come along, they actually feel like they're doing something. It may not be getting up and walking down the corridor, but at least they're having some physical input ***(T07)***

5.4.3.10 Positive experiences: Patients

Throughout the interview, the patients were very complimentary about the volunteers and the work they did. They felt encouraged and were motivated to be more active. A few therapists reported that they received very good feedback about the volunteers from the patients too.

I think it's lovely. And I think they're lovely people to do it. ***(P01)***

They were very patient ***(P03)***

It's great to do some exercises with somebody. ***(P04)***

We've had very good feedback on some of the patients that have been on the study, and when we do come and see them they would report to us 'oh I've done this with so and so' or something fantastic, and they are a lot more confident within themselves and say 'so what are we going to do now?' So they are already tried to initiate therapy ***(T05)***

Oh we've got a patient on G9 at the minute who said 'I love doing these exercises because I feel much more flexible since the volunteers started coming'. He rants about it all the time and he obviously likes it ***(T07)***

5.4.3.11 No adverse events

During the intervention phase, no adverse events were reported by patients, volunteers or nurses. During the initial implementation stages, several staff members had concerns about how volunteers were able to determine if patients were well enough to participate and what would happen if patients deteriorated during the activity sessions. However, volunteers were trained to only engage with patients once they had been given approval by staff members that the patients were medically fit to participate with the activity sessions. They would only do what was prescribed on the activity prescription sheet. Furthermore volunteers were trained to call for help in emergency situations for example in the case of a falling patient. However, throughout the intervention, no patients suffered any adverse events due to the intervention.

I think because it was voiced, when it was kind of first becoming a thing that we were going to trial it, about how the volunteers would know whether or not they were medically well enough to receive the treatment on that particular day. About how they would know if they were pushing them too far etc. Just because they haven't had training and they hadn't had previous knowledge and things. As I say I, don't think we've ever, never had any problems. If they have any concerns, they would step back and talk to you or us ***(T07)***

> *Not that, not that I've been made aware of. I think there have been a few incidences where patients have sort of become, not medically fit and not medically appropriate to do the intervention. But where the volunteers are always checking with us or the nursing staff before they go in and do it, that hasn't actually had an effect on the patients as such (**T01)***

5.4.4 Suggestions to improve the intervention

Several suggestions were given by patients, volunteers and staff members on the things that could be improved. Table 44 presents the lists of suggested changes and their quotes.

Table 44 Suggestions to improve the intervention

Suggestions	Quotes
Group exercises	• I think group exercise would be a good way of getting more people to do the exercises for the time given. You get quite a few patients then. **(V01)** • Perhaps group exercises **(P03)**
Working with student nurses	• We could have student nurses too as well. Actually it could be part of their placement to actually spend a bit of time in here if you have this room with a volunteer to actually man it if you like. **(N02)**
Opt out basis	• I don't know if there's a kind of opt out, as opposed to opt in, that everyone should be partaking in mobility activities. The volunteers have a list of everyone, the only people that are taken off of it are, or the nurses take off cos they're not clinically well enough. So that rather than people having to be referred in, you're referred out**. (N03)**
Implementing on other wards	• Especially somewhere like Trauma and Orthopaedics, like your Orth geriatrics. Like your hip fracture rehabs would benefit massively from this. Having somebody that can go through those chair exercises with them daily. **(T01)** • If anything it's expanding the role. Making it sort of more often, more of them. More of them would be absolutely brilliant. You could have 2 or 3 of them based on a ward, on every single ward. I think it would be a massive asset to the team**.** They could follow through on anything that physio's put in place or the OT's put in place whichever. Yeah I think why not? The more the merrier **(N04)**
Greater variety of exercises	• From my point of view perhaps a greater variety. First visit on the patient, if the same volunteer is coming to the same patient then the patient will know who the guy is and keep a record of exercises done and try and introduce some new ones. For instance, like standing up**.** From a sitting position, most important when somebody's at home **(P04)**
Improving methods of referring patients	• I don't know, maybe like getting the senior nurses, to refer patients in as well **(T07)** • And then it could be like potentially maybe a note on the therapy databases that we have where we collect all the information about the patients' home, just a little note saying 'is this patient suitable for the SoMoVe potentially'? **(T07)**

5.4.5 Summary of Theme IV: Reflexive monitoring

The effectiveness and usefulness of the intervention was appraised under this theme. Overall, volunteers felt prepared and equipped for their role. This was reflected in the confidence that patients and staff members had in them. The training programme also addressed all the important aspects of mobilising patients and volunteers were conscientious about putting patient safety at the forefront. No adverse events occurred during the intervention phase. Volunteers also demonstrated good team working with staff members and felt that they were well supported and appreciated by them. Apart from the physical benefits, social interaction was highlighted by all stakeholders as one of the key benefits of the intervention.

Several challenges and facilitators to the intervention were identified through the interviews. These factors were categorised into clinical factors, staff factors, volunteer factors, and patient factors. Addressing some of the modifiable factors in future implementation studies may help ensure a more successful implementation.

To determine the acceptability of the intervention to all stakeholders, their views and experiences were explored in depth. Analysis of their responses in this systematic way has allowed me to come to the conclusion that the intervention was acceptable to patients, volunteers, nurses and therapists. Many positives to the intervention where highlighted and all stakeholders were keen for the intervention to be implemented.

Chapter 6: Discussion

This thesis has explored the feasibility and acceptability of training hospital volunteers to encourage older people in hospital to remain physically active through mobility and exercise interventions. In the following sections, I will discuss my findings in the following order: literature review, observational study before intervention, findings from the intervention phase, feasibility and acceptability of the intervention, and summary of the clinical relevance of these findings.

6.1 Literature review of volunteer involvement in mobilising hospitalised older people

A literature review was conducted which showed little published evidence regarding the use of trained volunteers in encouraging hospitalised older people to mobilise. Most of the studies used healthcare professionals such as therapists and nurses to deliver the physical activity interventions[117,118,124]. The best evidence regarding the of use of volunteers to mobilise older inpatients came from a large study in the US, the Hospital Elder Life Program (HELP)[161,173]. The HELP programme consisted of a comprehensive patient-care initiative that was delivered by an interdisciplinary team which included Geriatricians, nurses, therapists and volunteers, with the aim of preventing delirium. The role of volunteers in the HELP programme was to carry out the core interventions which included orientation, therapeutic activities, early mobilisation, vision/hearing, oral volume repletion, feeding assistance and sleep enhancement protocols[162]. The mobilisation protocol has been reported to be implemented less often and less completely than the other protocols (for example 84% for mobilisation protocol versus 96% for orientation protocol)[162]. It is also unclear to what extent volunteers have delivered the protocol rather than other health care professionals. A replication of the HELP programme in New Jersey omitted the early mobilisation intervention due to staffing limitations[165].

The application of HELP principles in a delirium prevention study conducted in the UK by Young et al highlighted the potential use of volunteers in their model of care (Prevention of Delirium Programme, POD)[167]. However the roles of the volunteers were not clearly described[167]. A qualitative study conducted prior to the development of the POD system of care explored the views of staff members, patients and volunteers regarding delirium and delirium prevention[168]. One of the major challenges identified in the implementation process was the ability to secure volunteer engagement. The study identified a lack of clear systems for supporting volunteers, including their purposeful integration into routine patient care. Moreover, whilst the concept of volunteer involvement was considerably well-received by staff members, they considered

practices such as nutrition, fluid intake and mobilisation as central to delirium prevention and as such, felt that staff members needed to be actively involved in those aspects of care.

There is currently a lack of studies exploring the use of volunteers in the National Health Service in the UK to encourage older inpatients to mobilise[361]. This PhD study explored some of the knowledge gaps in the implementation of a volunteer-led intervention to encourage hospitalised older people to be more active. Some of these issues include the practical aspects of recruiting, training and retaining volunteers, as well as examining the acceptability of the intervention to patients, volunteers and staff members. These findings will be discussed in the following sections: 6.4 (feasibility) and 6.5 (acceptability).

6.2 Physical activity levels of older people in hospital: results from the observational study

I conducted a literature review which showed that the StepWatch Activity Monitor (SAM) was the most appropriate measure of ambulatory activity among older people with slow gait speed. In order to capture non-walking physical activities such as bed and chair-based exercise, the wrist-worn GENEActiv was also used as a measure of physical activity.

6.2.1 StepWatch Activity Monitor

Findings from the pre-intervention observational study showed that the median daily step count for this group of older people (n = 42, mean age 87.5) in hospital receiving usual care was 636 steps, which was very low. This finding agrees with previous published work by Ostir et al who examined the ambulatory activity of 224 older people in hospital in the US aged ≥65 years, and found that patients took 478 steps during the first 24 hours of their hospital stay and 846 steps in the last 24 hours[43]. Previous studies examining the step count of hospitalised older people were conducted in the US, Norway, Japan and Ireland[43,47-50,54,362]. A study conducted in the US by Fisher et al examined the mean daily step count of 239 hospitalised older people (mean age of 76.6 years, SD 7.6) using the StepWatch Activity Monitor and found that the mean daily step count was 740 steps[47]. A separate analysis among patients older than 75 years of age showed that the mean daily step count was 590 steps. Another study in Japan conducted by Izawa et al examined the differences in daily in-hospital physical activity and geriatric nutritional risk index (GNRI) in older cardiac inpatients[54]. Among older inpatients (mean age 79.3 years, SD 4.2) with high GNRI, the mean daily step count was 3424 steps (SD 1538) and among older inpatients (mean age 80.1

years, SD 4.9) with low GNRI, the mean daily step count was 2470 steps (SD 1260). The findings from this study are very interesting and show a much higher step count compared to studies conducted in the US and the findings from my study. The study published by Izawa et al did not include any physical activity intervention and the ward setting included patients with acute myocardial infarction, heart failure and surgical patients who underwent coronary artery bypass grafting and valve replacement. Description of the usual care on the cardiac wards was not provided in the paper however it is possible that the higher daily step count could be due to a more comprehensive therapy given to patients undergoing cardiac rehabilitation. Patients who received surgical interventions were also likely to be physically more robust as they were deemed appropriate for surgery. Cultural differences such as patient and family expectations of mobility could also be a possible explanation however this has not been previously explored.

It has been suggested that for older adults (age > 65 years) and patients living with disability or chronic illness, the recommended daily step count should be 4600 steps per day[363]. Using this as a guideline, none of our participants achieved this step count. The highest step count recorded was 4300 per day by one participant and only one other participant took more than 3000 steps per day. Both participants were men and were independently mobile since admission. The participant who had a mean daily step count of 4300 steps was functionally independent prior to admission and had only a few co-morbidities including hypertension and osteoarthritis, with a reasonably high MMSE score of 27/30. The other participant who took more than 3000 steps was also functionally independent prior to admission and had a MMSE score of 27/30. However, he had more co-morbidities than the previous participant, which included Type II Diabetes Mellitus, previous myocardial infarction, previous TIA and chronic kidney disease. Step activity from both participants showed that they were active throughout the day with no observable peak activity in any particular time of the day.

The pattern of intra-daily ambulatory activity is a novel finding. Peak ambulatory periods were between the hours of 8am to 12pm and 6pm to 8pm. The higher ambulatory period in the morning is likely to be due to patients getting ready for the day and nursing interventions in aiding personal care and hygiene, as well as therapy intervention. There were many reasons that could account for periods of low ambulatory activity in the afternoon such as the introduction of rest periods for patients during the afternoons and visiting hours. A general observation on the wards noted in my field notes was that visitors tended to sit by patients' beds during visiting hours rather than taking them out for walks. This may explain the low step count during visiting hours and should prompt a change in healthcare professionals' approach by encouraging visitors to take patients away from the bedside to mobilise around and beyond the wards. Towards the evening there was a slight peak in activity again which was likely to be related to patients using the

washroom and preparing themselves for rest time at night. An interesting finding in this study was that patients were reasonably mobile overnight, with a median step count of 94 steps during the hours of 2200 to 0600. In the clinical environment, this is roughly equivalent to the number of steps needed to get to the toilet and back to their bed space. This gives an insight to the disturbance of patients' sleep overnight in hospital.

6.2.2 GENEActiv

Recordings from the GENEActiv demonstrated that the physical activity levels of older people receiving usual care in hospital, as measured by acceleration against gravity, was very low. The mean daily acceleration for male and female participants in the pre-intervention phase was 10.4mg and 7.9mg respectively. The mean acceleration when male and female participants were analysed together was 9.1mg. A study conducted by Bakrania et al among 33 adults with a mean age of 27.4 years showed that the mean acceleration of sedentary behaviours such as lying and sitting in various positions was 10.9mg[180]. The mean acceleration for other usual household activity such as washing dishes was 58.5mg and walking at a self-paced speed was 110.9mg. Given the younger mean age of participants in the study by Bakrania et al, the findings are unlikely to be representative of an older population, but may provide some comparison to help understand the clinical relevance of the mean acceleration achieved by participants in this study. Findings from this study confirmed the sedentary behaviours of older people in hospital. To my knowledge, there is currently no published data on the mean acceleration of hospitalised older people as measured by GENEActiv. One study conducted by Rowlands et al used the GENEActiv to measure postures of 10 hospitalised older people (mean age 75.9, SD 9.7) to determine sedentary behaviour and found that the mean time spent in a lying or sitting position was 20 hours (SD 2.6)[46].

This study proposes a lower cut-off point of < 20mg to define sedentary behaviour (sleeping, lying and sitting activities) among hospitalised older people. In a previous study by Charman et al, the cut-off point of <40mg was used to define sedentary behaviour among community-dwelling older people (n = 58, mean age 79 years) [358]. However, when analysis was performed using the cut-off of 40mg, I found that the median time spent by patients above this cut-off point sustained at 1 minute was only 7.9 minutes (IQR 3.8 – 27.6), and 29 participants (69%) did not achieve 40mg sustained for 5 minutes. As hospitalised older people are likely to be frailer than their community-dwelling counterparts and thus more likely to engage in lower intensity physical activity, there is valid reason to propose a lower cut-off point. Analysis was performed to determine the mean acceleration per minute across all participants and found that the top 10% of activity was ≥ 19.9mg. Further analysis was conducted using 20mg as the cut-off point for sedentary behaviour.

The median time spent by participants above 20mg sustained at 1 minute duration was 57 minutes (IQR 29 – 112), and 11 minutes (IQR 2 – 40) sustained at 5 minutes duration. This finding appears to be consistent with existing literature. A study by Bodilsen et al showed that older inpatients (n = 30, mean age 82.7) spent 48 minutes (IQR 36 – 90) per day standing or walking[364]. A similar study in the US by Brown et al showed that the median time spent walking or standing by older inpatients (n=45, mean age 74.2 years) was 43 minutes[39]. In the context of defining sedentary behaviour among hospitalised older people, the pragmatic use of 20mg as a cut-off point appears to be reasonable. Future studies involving a larger cohort of patients may be required to validate this finding.

The analysis of hourly mean acceleration across 24 hours showed very little variation in activity levels throughout the day. The minimum mean hourly acceleration was 5.5mg (at 3 am) and the maximum was 12.5mg (at 12pm). Participants also spent a median time of 57 minutes (IQR 29 – 112) above 20mg sustained at 1 minute, and a median time of 4 minutes (IQR 0 – 25) above 20mg sustained at 10 minutes. These findings suggest that the majority of physical activity performed by older inpatients were at a lower intensity and over a very short period of time. Thus, hourly analysis of acceleration may be less informative and performing minute-by-minute analysis of activity data may yield more beneficial findings. A better understanding of patients' activity patterns may be helpful from a clinical perspective. Given that older inpatients often engage in low intensity activities over a short period of time, this may have implications on the interventions and exercises that clinicians prescribe as considerations should be made about how much and how long patients are able to manage.

The use of the wrist-worn accelerometer, GENEActiv has its limitations. There is a lack of studies validating its use among hospitalised older people. In this study, a cut-off point of < 20mg was chosen to define sedentary behaviour based on preliminary analysis of the data. As described above, although the use of < 20mg to define sedentary behaviour appears to agree with findings from other studies in terms of time spent in non-sedentary activity, this is merely exploratory and future studies are required to validate the use of this cut off point. Another disadvantage of wrist-worn device is that it does not measure lower extremity function. A study by Clarke et al explored the validity of a triaxial accelerometer, Axivity AX3, for use in older populations[365]. The device was mounted on both the wrist and on the thigh of each participant, who then completed a series of standardised activities. The study found moderate correlation ($r = 0.69$, $P < 0.001$) between wrist-mounted and lower-limb mounted AX3 counts, with poorer correlations when walking aids were in use. Findings from this study suggests that wrist-worn devices may be less accurate particularly among functionally impaired older patients who require the use of a walking aid. The lack of improvement in mean daily acceleration among participants in the intervention group compared

to baseline participants in this study, could be a reflection of the inaccuracy of the device in measuring activity particularly in this group of patients who are acutely unwell, a high proportion of whom would require a mobility aid. In future studies, a body-worn or lower limb worn accelerometer, like the SAM, may be a more appropriate device for this patient group.

6.2.3 Accuracy of the SAM and device acceptability

I examined the accuracy of the SAM in measuring step counts of 15 older people compared with direct observation and found that the SAM was accurate in measuring step count even in this patient group with low median gait speed (0.53m/s; IQR 0.14 – 0.79), with a mean absolute percentage error of 8.6%. Among the accelerometers used to measure step count of hospitalised older people which were identified in my systematic review[44], the SAM has been shown to be the most accurate device. The activPAL[50] had an absolute percentage error of 40% at gait speed <0.47m/s and the Kenz Lifecorder EX[54] was found to miscalculate steps by 10% at gait speed <0.9m/s. The disadvantage of the SAM was that it was less well-tolerated than the GENEActiv overnight. 21.7% (5/23) of the participants reported that the SAM was uncomfortable to wear in bed compared to 4.3% (1/23) of participants who felt that the GENEActiv was uncomfortable. Previous studies have also shown that wrist-worn devices were generally more user acceptable[366,367]. Individual reports from research participants which were documented in my field notes suggested that wrist-worn devices were more tolerable than ankle-worn devices as users were used to the idea of wearing a watch. 80% (4/5) of the participants who reported that the SAM was uncomfortable also reported that the device interfered with their sleep. One solution to improve compliance with the SAM would be to allow participants to remove the device just before they go to bed and to put it on as soon as they wake up. The disadvantage of this is that ambulatory activity overnight will not be recorded and it would also depend on each participant to remember to put the device on again, both of which factors might affect the accuracy of step counting.

6.2.4 Factors associated with physical activity

An a priori model was developed based on existing literature to predict physical activity levels as measured by daily step count and daily acceleration. Regression analysis showed that age, gender, gait speed, smoking pack years, body mass index, and Geriatric Depression Scale accounted for almost 35% in the variance of mean daily step count in this patient group. The same variables also accounted for 36% in the variance of mean daily acceleration in this patient group. In both models, gait speed was shown to be the best predictor of mean daily step count and mean daily acceleration. Gait speed is a commonly used outcome in research[206] and has been shown to be a

predictor of adverse outcomes including falls, institutionalisation, development of disability and mortality[205,210,368]. The cut-off used for gait speed as part of the diagnostic criteria for sarcopenia proposed by the EWGSOP is ≤ 0.8m/s[208,369]. As a quick screening tool, patients are asked to walk a distance of 4 meters at a comfortable pace and those who take more than 5 seconds to complete the task (i.e. <0.8m/s) are at an increased risk of sarcopenia. It is a simple and inexpensive bedside test that is helpful in the comprehensive assessment of older people and had been previously described as the sixth vital sign[370]. Patients who have lower gait speed are more likely to be physically inactive and may thus need more encouragement or therapy input to promote higher activity levels.

6.3 Findings from the intervention phase

6.3.1 Impact of intervention on physical activity levels

During the intervention period, the activity sessions took place on 110/167 (66%) of the planned days. On days where the activity sessions took place, participants had twice daily intervention on 52% of those days and just once on the remainder. Although the intervention took place approximately 2/3 of the time, there was a trend towards improvement (+43%) in the step count of participants in the intervention phase (median daily step count of 912) compared to the pre-intervention participants (median daily step count of 636), although this difference was not statistically significant (p = 0.554). A further controlled trial that is adequately powered is required to examine the impact of the volunteer-led intervention on older inpatients' daily step count. The trend towards increased step count in the intervention group could suggest that older patients in hospital are not too unwell or fatigued to improve their activity levels and with the right encouragement, there is potential for patients to increase their physical activity levels.

Interestingly, the GENEActiv findings showed very little difference (+6.5%) in the mean daily acceleration among the intervention phase participants (9.7milligravity) compared to the pre-intervention participants (9.1 milligravity). This may be due to the fact that even during periods of activity or mobility, older inpatients would move at a lower acceleration. A separate analysis was conducted for patients in both the pre-intervention and intervention phase who were very ambulant (mean daily step of ≥ 3000, n = 8), and the mean daily acceleration was 13.9milligravity (SD 5.1). The small increase in mean daily acceleration even among patients who were more active suggests that mean daily acceleration may not be a suitable measure of inpatient physical activity levels and that minute-by-minute analysis of accelerometer data may yield more

beneficial results. Another possible explanation of the lack of improvement in mean daily acceleration could be due to the lack of accuracy of wrist-worn accelerometers in measuring physical activity levels particularly among patients who mobilise with walking aids. Among hospitalised older people, a high proportion of patients would mobilise using a walking aid and thus wrist-worn accelerometers are less useful in this setting. The median time spent by participants in the intervention phase above 20mg sustained at 1 minute duration was 79 minutes (IQR 37 – 127), and 31 minutes (IQR 5 – 49) sustained at 5 minutes duration. The median time spent in activity was higher than the pre-intervention phase participants, who spent 57 minutes (IQR 29 – 112) above 20mg sustained at 1 minute duration and 11 minutes (IQR 2 -40) above 20mg sustained at 5 minutes duration. However, these differences were not statistically significant.

6.3.2 Impact of intervention on receipt of care

Length of hospital stay

Participants in the intervention phase had a slightly shorter length of hospital stay (15 days) compared to pre-intervention participants (15.5 days), however the difference was not statistically significant. The small reduction in length of hospital stay could be due to chance as this was not a randomised controlled trial but rather two convenience samples. However, previous studies have shown that an increase in physical activity levels in hospital is associated with a reduction in length of hospital stay. De Morton et al conducted a pooled analysis of seven randomised controlled trials and 2 controlled clinical trials to explore the impact of exercise on hospitalised older people and found that a multidisciplinary intervention which included exercise was associated with a small reduction in acute hospital length of stay (-1.08 days, 95% CI -1.93 to -0.22 days)[115]. A recent study by McCullagh et al in 2016, explored the associations of average daily step count in hospital with physical performance and length of stay among older medical inpatients and found that a 50% increase in step count was associated with a 6% shorter length of stay[362]. The trend towards reduction in length of hospital stay among participants who received the volunteer-led intervention is consistent with findings from published literature. A larger controlled trial that is adequately powered will be required to demonstrate the impact of the intervention on the length of stay of hospitalised older in patients.

Readmission in 1 month

Readmission to hospital is commonly used as an outcome measure in healthcare-related reports and research studies because of its impact on patient outcomes and cost implications[371,372]. In this study, there was a 12% reduction in 30 day readmission although the difference was not statistically significant (p = 0.16). Blunt et al conducted a retrospective analysis of 82 million routinely collected data from NHS hospitals in England between 2004 to 2010 to determine the number of 30 day readmissions and performed an exploratory classification of readmissions using simple rules relating to International Classification of Disease diagnostic codes for both admission and readmission[373]. The classifications were hypothesised by the authors with the advice of six senior consultant from five specialities (trauma and orthopaedics, care of the elderly, renal medicine, clinical pharmacology and emergency medicine). Findings from this study suggested that less than 30% of readmissions fell into the 'potentially preventable' category. van Walraven et al published a meta-analysis of 16 studies which reported on the proportion of 30 day urgent readmissions that were deemed avoidable and found that only 23.1% (95% CI 21.7 – 24.5) of 30 day urgent readmission were classified as avoidable[374]. These findings suggest that the cause of readmissions is only partially influenced by quality of care and a majority of the readmission were unavoidable. Similarly, the conclusion can be drawn that some aspects of care could be improved to reduce the proportion of 30 day hospital readmissions. A systematic review conducted by Garcia-Perez et al examined the risk factors for hospital readmissions among older people and found that morbidity and functional disability were the most common risk factors in this population[375]. Encouraging hospitalised older people in hospital to stay active may reduce the risk of functional decline which may in turn reduce their risk of hospital readmission.

Thromboembolism

Venous thromboembolism (deep vein thrombosis and pulmonary embolism) is associated with a significant increased risk of mortality[376]. The incidence of venous thrombosis increases sharply with age and age-specific risk factors of thrombosis such as endothelial dysfunction, increased co-morbidities and frailty are important contributing factors[377]. Immobility in hospital is also recognised as an important risk factor for the development of venous thromboembolism among older inpatients[378]. As such, the use of thromboembolic events as an outcome measure can be useful to explore the impact of the intervention on important patient outcomes.

In the pre-intervention phase, two participants had inpatient venous thromboembolic events while in the intervention phase; only one participant had an inpatient venous thromboembolism. While there was a reduction in the number of thromboembolic events, this difference was not statistically significant.

Pressure sore

The development of pressure sores is a direct consequence of immobility. There were no participants with pressure sores in both the pre-intervention and intervention arm and hence no demonstrable difference in this outcome.

Overall, there was a trend towards increased physical activity, reduction in length of hospital stay and 30 day readmission. While none of these differences were statistically significant, these were encouraging findings.

6.3.3 Efficacy of the intervention

The impact of the volunteer-led intervention on physical activity levels and receipt of care measures could have been affected by several factors. During the intervention phase, there were 57 days out of 167 planned days (34%) where no volunteers were available to carry out the intervention. The lower number of volunteers during the start of the intervention period were largely due a change in the volunteer services manager. The new manager initiated a new recruitment process for volunteers, which took about 4 months to implement. This resulted in a delay in providing new volunteers who could potentially be recruited and trained as mobility volunteers. A constant supply of volunteers who are ready to be trained to deliver the intervention throughout the study period is likely to result in increased frequency of mobility intervention, which may potentially increase physical activity levels. A change in key stakeholders can have a significant impact on the implementation of an intervention. In this study, a change in volunteer services manager resulted in a delay in the recruitment and training of volunteers and thus less activity sessions were carried out. This, however, is a true reflection of the challenges of implementing changes in a complex healthcare setting like the NHS.

Secondly, the intervention could potentially have been more efficacious if the exercises were designed to be more intensive and volunteers were trained to push patients harder to ensure that they achieve greater benefits of the exercise and mobility sessions. Current evidence suggests that progressive resistance exercises can improve strength and functional outcomes among older people[379-381]. In future studies, the use of weights or resistance bands could be considered to increase the intensity of the exercises. Considerations should also be made regarding the volunteer training programme, to include training on how volunteers can, within a safe limit, increase the intensity of the exercises and push patients a little harder during the activity sessions. However in the context of this study, as it was a feasibility and acceptability study, patient safety was of primary concern. The chair and bed exercises included in the intervention were mainly exercises used for patients receiving usual care, as recommended by the therapy

team. Volunteers were also trained to strictly adhere to the exercises and mobility plan prescribed by therapists to ensure patient safety. The trade-off of a cautious approach in delivering the activity intervention may have been that the intervention was less efficacious. This study has shown that it is safe for volunteers to deliver exercise and mobility intervention to acutely unwell older people in hospital. A future study could potentially explore exercises with greater intensity to ensure maximum benefits of the volunteer-led exercise and mobility intervention. One approach would be to introduce exercises of varying degree of intensity (i.e. Level I, II and III). Patients could then be progressed gradually to increase the level of intensity as appropriate.

6.4 Feasibility of the intervention

Feasibility of recruiting volunteers

17 volunteers were recruited and 16 volunteers completed the training and competency assessment. 12 volunteers continued till the end of the study, and the retention rate for volunteers in this study was 70%. A previous study published by Roberts et al examined the feasibility of using volunteers to assist older inpatients during meal times and reported a volunteer retention rate of about 60%[157]. In this study, there were valid reasons for volunteers discontinuing their role, which were largely unavoidable, such as ill health (3 volunteers), feeling unsuited to the role (1) and a logistical issue (1).

The recruitment of volunteers was staggered and there was an unexpected delay in the recruitment process due to the retirement of the volunteer services manager. The transition of having a new volunteer services manager and a change in the way volunteers were recruited and interviewed meant that for a period of five months from September 2016 to January 2017, only one volunteer was recruited and trained. This impacted on the number of interventions that were offered to participants. However, this demonstrates the true challenges of implementing an intervention in a complex healthcare setting like the NHS, where a change in key stakeholder or personnel can have an impact on the implementation process. However, as soon as the new manager settled into her role, the process of recruiting volunteers was smooth.

Half of the volunteers (8/16) recruited to this study were students (5 A-Level students, and 3 university students). All of the students who participated in this study were interested in a future career in healthcare as doctors or therapists. Volunteering as a mobility volunteer presented them an invaluable opportunity to gain some experience in healthcare as well as the opportunity to work with patients. Students are a great resource in the context of volunteering[382]. Interestingly, a study by Handy et al suggested that students who were motivated by resume building were more likely to invest fewer hours and volunteer in an episodic way compared to

students who volunteer for altruistic reasons[383]. As the intervention period for this study was only 9 months, a future study with a longer intervention period may be helpful to explore the retention rate of student volunteers.

Training of volunteers

Feedback regarding the training sessions for the volunteers was explored through focus groups and interviews. The training sessions were well-received by volunteers. Volunteers felt that the training and competency assessments adequately prepared them for their role. One of the aspects of the training that the volunteers felt was particularly helpful was the opportunity to practice with one another during the training sessions. This was a closed environment which allowed volunteers to practice on one another and not feel embarrassed if mistakes were made. One volunteer commented:

I thought the training was pretty good. Especially the bit where we actually pretended to be a patient or we had somebody pretending to be a patient, and go up and have a go, going through perhaps standing, walking, that was good. A good sort of beginning to how to approach the safety aspects, and also the courtesy aspects of going up to the patients. I thought that that was good.

Volunteers also felt that the supervised sessions on the wards with real patients were helpful and helped them build their confidence. One volunteer suggested that a video presentation of the exercises would be helpful as they could refer back to the video presentation after the training session if they were any uncertainties. However, after several practice session, the volunteers became familiar with the exercises and did not need further prompting. Minor changes were made to the exercise sheets following feedback from volunteers to clarify the exercises.

Patient safety

One of the main concerns that was raised by some healthcare professionals when the research idea was conceptualised was the issue of inpatient falls. At the research ethics committee meeting, the issue of falls was also raised as a key point with regards to patient safety. This study has shown that with adequate training and competency assessments, volunteers can be trained to safely deliver the activity interventions independently. Important safety procedures were put in place to ensure that the risk of falls was as minimised. Firstly, volunteers strictly adhered to the type of activity (walking or exercise) prescribed by clinicians. Only patients who were discharged by therapy and deemed safe to mobilise independently were encouraged to walk. The walking

distance and walking aid were also prescribed by clinicians and carefully adhered to by the volunteers. Patients who were undergoing therapy were only encouraged to perform chair-based exercises. Prior to every patient contact, volunteers would also check with the nurse in-charge to ensure that patients were safe to participate in the activity session. Patients may fluctuate in their clinical condition during their hospital stay and this practice safeguarded patients who were unwell from being inappropriately mobilised. Volunteers were also trained to ensure that they waited for a minute or two after the patients stood up before mobilising them to ensure that patients did not have any symptoms of postural hypotension prior to mobilising.

Overall, the training of the volunteers appeared to be a success. The half day training session followed by individual competency assessments were adequate in ensuring that volunteers were well-prepared and competent in their role as mobility volunteers, working independently on the wards. Findings from this study suggest that it is feasible and safe to recruit and train volunteers to encourage older inpatients to mobilise or exercise. The retention of volunteers needs to be taken into consideration and more training sessions may be required to sustain a constant flow of volunteers on the wards.

6.5 Acceptability of the intervention

The acceptability of the volunteer-led intervention was explored by interviewing patients, volunteers, nurses and therapists. Patients, and staff members demonstrated awareness regarding the importance physical activity during hospitalisation. One patient expressed:

To get somebody mobile I think is half the way to getting them better.

Importantly, staff members felt that more could be done to encourage older inpatients to be more active. One therapist mentioned:

I think the activity levels of patients are quite poor to be perfectly honest. You have patients coming in and whilst they're in hospital they tend to sit on their bed, lie on the bed, or down by the bedside with a minimal amount of movement.

The concept of using trained volunteers was well-received by patients and healthcare professional as they were able to appreciate the benefits of being physically active in hospital. Therapists and nurses were also receptive of the idea as they felt more could be done to encourage patients to be more active. Nonetheless, there were several challenges that were identified which could hinder patients from being more active.

6.5.1 Barriers to mobility

Barriers to mobility identified through the interviews were classified into clinical factors, staff factors, and patient factors. Some of the barriers identified included: ward environment, acuity of patients, the lack of time from healthcare professionals, lack of staff members, and lack of encouragement from staff members and fear of falling. These findings agree with a previous study by Brown et al who employed qualitative methods to examine barriers to mobility among hospitalised older people by interviewing patients (n = 10, mean age 84), nurses (n = 10) and physicians (n = 9)[102], and similar barriers were reported.

An additional factor which was identified in this study was the misperception of the responsibility of mobilising patients. Four therapists commented that mobilising patients was commonly perceived as the role of the therapists. One therapist mentioned:

Sometimes I think we're perceived a little bit as a getting out of bed service. We will often pick up new patients who may have been on the ward 2, 3 days that haven't got out of bed because the physio hasn't been to see them yet.

This misperception was felt to be present both among patients and healthcare professionals. This study has been helpful in exploring the perspectives of therapists in identifying barriers to mobility, which was not included in the study by Brown et al. The use of trained volunteers could potentially address some of the barriers such as lack of encouragement, lack of staff and fear of falling. Volunteers offered valuable time and in their role as mobility volunteers to encourage patients to keep active. Having a person to mobilise with may also reduce the anxiety of patients who may have fear of falling. The perceived benefits and value of having mobility volunteers were reflected through the interviews with patients, therapists and nurses.

6.5.2 Patients

Analysis of the qualitative data showed that the patients were appreciative of the interaction and intervention they received from the volunteers. Patients felt encouraged and motivated by the volunteers to keep active to get better quicker.

One therapist reported on how the intervention had resulted in patients being more motivated in working with the therapists to improve their physical function:

We've had very good feedback from some of the patients that have been on the study. When we do come and see them they would report to us 'oh I've done these exercises with the volunteers',

and they are a lot more confident within themselves and would say 'So, what are we going to do now?' They are already trying to initiate therapy.

This is an encouraging finding as behavioural change is crucial in promoting increased physical activity among patients. Patients need to be empowered to take responsibility of their health and to self-motivate to work toward functional recovery and maintenance of physical function.

Patients also reported feeling the benefits of the exercises. One patient commented:

When the volunteers come to give me a few exercises, I welcome it. I'm now able to go to the toilet myself, which has given me freedom if you like, rather than being tethered to the bed.

Overall, the volunteer-led intervention was well-received by patients.

6.5.3 Volunteers

The volunteers enjoyed their role in encouraging older inpatients to be more active. One volunteer highlighted:

I think patient contact and the interaction with the staff that work on the wards are the things I enjoy most in my role. The intervention provides an avenue to actually speak to staff because I have to ask for their permission first. It helps develop confidence.

The volunteers also enjoyed the social interaction with patients and were motivated by the sense of being able to help patients get better. One volunteer commented:

Yes, I'm enjoying it. Just to see them getting up and walking. It is so vital for them, in order for them to get home.

A key aspect which could potentially impact on the success of the implementation of the intervention was the working dynamics between volunteers and healthcare professional. Volunteers reported that they were well-supported by staff members. One volunteer mentioned:

If I needed help, I'd ask a nurse and they have always been very helpful.

Another volunteer recalls her experience of working with nurses:

I've worked more with the nurses and I would say that it's a pleasant experience. They are willing to help you if you don't know what you're doing or where to go, they'll direct you. Also if you're having difficulty locating a patient, they can help you find them as well.

Positive experiences by the volunteers in their role are likely to be strong motivating factors for them to continue volunteering. The volunteers and staff members were also able to work well together even in a busy clinical setting.

6.5.4 Nurses and therapists

Therapy and nursing staff appreciated the involvement of volunteers in promoting mobility among patients. One nurse reported:

It's all been really good. Ever since it got started, it's been brilliant. I was walking past the other day and there was somebody in there doing leg exercises on the bed, brilliant!

One nurse also felt that the presence of volunteers freed up more time for nursing staff to attend to patients who needed more care:

It frees up time for us to do more critical care. The acuity of patients coming through now is a lot higher, we are tied up a lot more.

One of the senior nurses reported:

I think the volunteers are an asset to the team. I consider them as part of the team.

This is an important finding as it demonstrates that volunteers were highly valued by staff members who considered them as part of the team caring for patients. The King's Fund report on volunteering highlighted that in many hospitals, volunteers are increasingly being seen as an integral part of the care team, and this was clearly demonstrable through the interviews with volunteers and staff members[130]. Staff members also felt that the volunteer-led intervention did not have a negative impact on their work pattern. The therapy team felt that by promoting increased activity among patients who have been discharged by them, it could help reduce the referrals of patients who experience functional decline during their hospital stay after being discharged by therapy.

6.5.5 Challenges

Several challenges during the implementation process were highlighted through the interviews. The main difficulty for volunteers in carrying out their role was to locate the right nurse who is looking after the patients. Nurses were often busy and engage in clinical care and hence volunteers were sometimes left waiting for a while to speak to the right nurse. Volunteers also

felt that being on a ward where everyone knew what they were doing was rather intimidating. However, once they settled into their role, this was not an issue. Other challenges raised included frequent transfers of patients to different wards, patients' availability, and space limitation to do the exercises and physical restrictions such as intravenous lines and urinary catheters.

Prior to the implementation of the study, concerns were raised by a few therapy assistants on the safety of using volunteers to mobilise patients as well as the prospect of job security, in fear that the volunteers would replace them. A group meeting was arranged to address these concerns and reassurance was given to reaffirm that the role of the volunteers was to complement the work of therapists and nurses rather than to substitute them. During the implementation stage, the therapy assistants worked very closely with the research team to identify suitable patients and were helpful in prescribing exercises for patients. Several therapy assistants were also interviewed and provided very good feedback regarding the volunteers.

Overall, the volunteer-led intervention was well-received by patients, nurses and therapists. The volunteers also enjoyed their role in encouraging older inpatients to be more active. Facilitators and barriers to implement this volunteer-led intervention were identified as described in sections 5.4.2 and 5.4.3, which would be helpful for future implementation studies.

6.5.6 Reflexivity

In qualitative research, the researcher plays a central role in influencing, if not actively constructing, the collection, selection and interpretation of data[384]. The product of qualitative research is co-constituted by the participants, researcher and their relationship. Therefore, it is important that researchers reflect on their values, biases and knowledge, and on how they impact on the findings generated[385]. Reflexivity is a process of critical reflection both on the knowledge produced from research and how that knowledge is generated[386]. In this section, I will be reflecting on how my personal characteristics, and my role as an actor in the design and delivery of the intervention, and as an evaluator of the intervention, may have influenced the data collection and interpretation process.

Hertz argued: "Through personal accounting, researchers must become more aware of how their own positions and interests are imposed at all stages of the research process – from the questions they ask to those they ignore, from who they study to who they ignore, from problem formulation to analysis, representation, and writing – in order to produce less distorted accounts of the social world".[387] The perception of a particular phenomenon can be influenced by the researcher's own lived experience, specific understandings and historical background[388].

My clinical background as a doctor specialising in Geriatric Medicine is likely to have influenced the interview process and how research participants responded to them. During the recruitment process, I introduced myself as a doctor and a researcher and thus participants were aware of my clinical and research interests. This may have had a bearing on the willingness of patients to participate in the study as it may be perceived as a recommended advice from a doctor to participate in the study. This could have potentially introduced a bias in the sampling of participants who would otherwise have declined to participate in other circumstances.

An advantage that I felt was helpful particularly during the qualitative interviewing process, was the communication and interpersonal skills which I had developed over the course of my medical training. I was comfortable in communicating with patients and was able to build rapport with them very quickly, which helped with the interview process. Nonetheless, this may well have been a double-edged sword as taking a history from a patient is rather different from conducting qualitative interviews. Traditionally from a sociolinguistic perspective of communication, doctors often maintain a style of high control, which involves many doctor-initiated questions and interruptions, focusing on key aspects of the history to come to a diagnosis[389]. While communication styles vary among clinicians, patient-centred communication is the advocated approach in communicating with patients[390]. In this study, a conscious effort was made to ensure that the interview schedule included open questions to allow participants' views and experiences to be explored.

Additionally, a common problem faced in qualitative interviews is the tendency for interviewees to want to make a favourable impression on the researcher. As mentioned above, the relationship between the researcher and the interviewee can influence the product or outcome of the research. In this study, my role as a doctor to a patient, and a colleague to ward staff members, may have resulted in them providing a slightly biased response. For example, staff members who knew me from my clinical work may be disinclined to give overly negative comments or views about the study, in fear of appearing too negative or harming the work relationship. Similarly, patients may also feel less able to share their thoughts freely and may be inclined to provide favourable responses. In retrospect, introducing myself as a researcher may have given a more neutral perspective to things and allowed patient participants to freely express their views through the interviews without the possible pressure of providing favourable responses.

Growing up in Malaysia has given me a very different cultural perspective of healthcare. Malaysia provides a two-tier healthcare system where public-funded universal healthcare is available but sub-optimal, and a private healthcare system which is easily accessible as long as users have the means to pay for it. My personal experiences of living with my grandmother in the last few years

of her life after she was bedridden following a stroke, in a healthcare system where physiotherapy and occupational therapy services were scarce, made me more appreciative of the help given to patients to mobilise and improve functionally. As a clinician, I am also aware of the adverse effects of immobility in hospital and have seen first-hand, the consequence of sedentary behaviour among hospitalised older people. My background and experiences gave me greater motivation to deliver the intervention to ensure that patients would receive the additional help to exercise and mobilise on the wards. These pre-conceptions and personal motivations may have also influenced my interpretation of the qualitative data as I was keen to ensure that the intervention succeeded. I will address further on in this section, what measures were taken to counter this bias. The background, understanding and preconceptions of the researcher are all integral part of the whole process of qualitative research[391]. Thrisk and Clark argues that to better understand a complex intervention, researchers are required to draw on their hunches, disciplinary background and theoretical and substantive knowledge, rather than to dismiss such contributions as being biased[392]. Importantly, researchers need to move beyond their own preconceptions and be open to new ideas and views reported by participants.

Being an actor both in the design and delivery of the intervention and evaluator of the intervention has many benefits and also unique challenges. As I was closely involved with every aspect of the study, it allowed me gain a better understanding on the important details of the implementation process including engagement with key stakeholders, the process of volunteer recruitment, delivery of the training and appreciation of the ward culture surrounding the implementation of the intervention. As I was able to immerse myself in the ward environment and culture, it allowed me to provide a context to the data collected, particularly with the qualitative data. It also allowed me to observe the interaction between volunteers and patients, and also the ward staff members. Insight to the implementation process gave me greater confidence and certainty in analysing and synthesising the data collected. As an example, I observed that the interaction between volunteers and staff members were generally very good and staff member were welcoming to volunteers. Nonetheless, given the busy nature of the clinical environment, volunteers were often left waiting or hovering around the wards waiting for a nurse to speak to. This was reflected in the interview among volunteers and was brought up as one of the challenges by the volunteers. However, the volunteers also showed understanding about the nature of the clinical environment and aware that nurses were often busy with several tasks and thus were not put off by the waiting and constant searching for a nurse. One volunteer commented: '*That's the thing isn't it? Cos we have to balance that knowing that it may be that the nursing staff might actually have a medical issue that they have to deal with which is far more important than us trying to get a patient to do some exercises'.* Being involved in the whole

research process also gave me a broad overview of the implementation process which would be beneficial for future implementation plans.

However, being too immersed in the whole implementation process also presents its own challenges. Being personally motivated to implement the intervention successfully may have impacted on the way I analysed the data. It may have given me tinted lenses to view and analyse the data in slightly biased manner to reflect well on the study. Throughout the interview process, I made conscious effort to interview patients, volunteers and staff members from a neutral perspective and encouraged interviewees to be honest and open about the views and experiences of the intervention. Having had a good rapport with the volunteers and staff members during the intervention period may have also introduced an unconscious barrier for interviewees to openly share their negative views or criticisms about the intervention. Overall, the intervention was well-received by patients and staff members appreciated the additional help to encourage patients to be more active. Nonetheless, interviewees were able to raise challenges and difficulties faced during the implementation of the intervention. Ten key challenges to the implementation process were identified through the qualitative data as highlighted in section 5.4.2.

Another point of consideration which may reflect on the generalisability of the intervention is that the successful implementation of the intervention was in a part due to my constant involvement in every aspect of the study. At every stage of the study from the designing and delivery of the intervention, training and management of volunteers, regular interaction with patients for recruitment and data collection purposes, and engaging with ward staff members, I ensured that each step was done well to increase the chances of a successful implementation. In a real world implementation setting, it is less likely that one person would be involved in the whole process. There may be a lead for the implementation project but the workload would be divided up and delegated to several members of the project team, all of whom may have other commitments and clinical duties. Thus it is important to factor into consideration the additional challenges that may surface when the intervention is replicated or implemented in a different clinical setting.

6.6 Clinical relevance of findings

Findings from this study have shown that the physical activity levels of these older people receiving usual care in hospital were very low. To my knowledge, this is the first study in the UK which describes the ambulatory activity of hospitalised older people. It is important to address the issue of low physical activity in hospital due to its adverse effects which include: decline in

physical function, loss of independence in activities of daily living and increased mortality. Identifying the pattern of physical activity of hospitalised older people gave insight into the sedentary periods during the day which could help inform clinicians and researchers in implementing time-specific interventions to address sedentary behaviour.

In University Hospital Southampton NHS FT, there are an estimated 1000 volunteers registered with the hospital volunteer services. Volunteers are involved in a variety of roles across hospital services and there is increasing awareness that volunteers can be involved in direct patient care as mealtime assistants and mobility volunteers. The therapy team are often faced with major pressure on their resources and time. Patients who experience decline in physical function and mobility are assessed and seen by the therapy team. However, when patients are back to baseline mobility or have reached their potential, less time is allocated to these patients to maintain their physical function during their hospital stay. Trained volunteers may be a useful resource in providing extra help to encourage older inpatients to remain physically active and to maintain their physical function.

By examining the feasibility and acceptability of implementing the volunteer-led intervention, this study can help provide the blueprint to facilitate implementation of a similar intervention in other clinical settings. A valid and important concern which was raised before and during the implementation of the intervention was the risk of falls among patients. This study demonstrated that with a robust training programme and careful patient selection by healthcare professionals, volunteer can safely encourage older inpatients to be more active. A trend towards improvement in daily step count, reduction in length of stay and readmission in 1 month in the intervention phase were encouraging findings but these were not statistically significant.

6.7 Strength and limitations

6.7.1 Limitations

This study has some limitations. The recruitment of participants was not randomised hence the study was exposed to selection bias. The aim of this study was to assess the feasibility and acceptability of the intervention and hence randomisation of participants was not performed. Randomising patients in the same wards could potentially result in contamination of control patients as the activity sessions received by the treatment group may prompt behavioural change in other patients. Performing cluster randomisation was not an option as there was only one male ward on the department during the study period.

The inclusion criteria of this study also potentially contributed to the selection bias of the sample. As patients needed capacity to consent to participate in this study, patients with dementia and delirium, which are common among hospitalised older people, were excluded. Therefore patients recruited on to this study were likely to have better cognitive function and were less representative of the whole ward.

Collecting data for usual care at a different time period from the intervention introduces other confounding factors when comparing data. There are normally seasonal variations in healthcare use among older people across the year. Typically during the winter months (December, January, February) there are increased admissions to hospital with higher pressure on service providers[393]. This may impact on some of the outcome measures including length of hospital stay and hospital readmission rates. In the year 2015/16, 1260 patients were admitted in months June, July and August 2015 (summer months) to the Medicine for Older People department at University Hospital Southampton NHS FT, as compared to 1582 admission (26% increase) in months December 2015 and January and February 2016 (winter months). Data for the pre-intervention phase was collected between February 2016 and July 2016 (6 months) whilst the intervention phase took place from August 2016 to April 2017 (9 months). The intervention phase took place over three winter months and beyond whereas the pre-intervention phase only included one winter month. Nonetheless, the length of stay and one month readmission rates were better in the intervention phase than the pre-intervention phase.

In this study, the use of GENEActiv was not validated due to limitations in technical ability in writing the programme to analyse the raw data. There is also currently a lack of studies using GENEActiv among hospitalised older people and thus comparison of mean daily acceleration with similar populations could not be made. Another disadvantage of the GENEActiv is that it is wrist-worn and thus less accurate in measuring lower limb activity. Its accuracy also reduces among older patients who require mobility aids to mobilise. While the main advantage of the device is participant compliance to the device, it inaccuracy in measuring activity levels makes it less suitable for this frail and acutely unwell older population.

As the main aim of the study was to determine feasibility and acceptability of the intervention, it was not adequately powered to show statistical significance in the outcome measures. While there were positive trends towards improvement in physical activity levels, reduction in length of stay and readmission in 30 days, none of these differences were statistically significant. The positive signals were encouraging but a randomised controlled trial that is adequately powered is needed to demonstrate the impact of the intervention on patient outcomes.

University Hospital Southampton NHS FT is a large tertiary hospital and has close links to the University of Southampton. It has about 1000 volunteers registered with the organisation and has a well-organised volunteer services. These are unique features to the hospital which could impact on the generalisability of the findings of this study. A large proportion of volunteers in this study were students (50%) aspiring to a career in healthcare. Students are motivated to volunteer to gain experience working in healthcare and also to build up their resume[394]. This can help improve their chances of a successful university or job application[156]. The benefit of this is that there is a constant flow of people signing up to volunteer at the hospital. However, students are also less likely to volunteer long term due to their educational commitments and progression and thus there is often a higher turnover of volunteers. This needs to be factored into when developing plans for volunteer training. A district or community hospital may have their own unique challenges and benefits in term of volunteering. A smaller hospital may have a smaller pool of volunteers available to deliver the intervention. However, a different volunteer demographics may mean that the turnover of volunteer is less and thus the frequency of volunteer training may be less. An ideal scenario would be a blend of volunteers which include students, who can be recruited at a large number, and older volunteers, who are more likely to volunteer for a longer period of time. A future study should consider a pilot multicentre trial which would include tertiary and district hospitals to explore its feasibility in different hospital settings, and to determine the feasibility of a larger multicentre controlled trial.

Another important factor which contributed to the relative smooth running of the study was the research department's good working relationship with key stakeholders including the ward nursing staff, therapists and management team. Prior to the commencement of the study, I had been working in the clinical environment as a medical registrar and thus known by the nursing staff and therapists. This allowed the study to be introduced with relative ease as the rapport with staff members had already been established prior to the commencement of the study. The Academic Geriatric Medicine department has also conducted several inpatient studies on the Medicine for Older People department prior to this study and thus staff members were receptive to new ideas to improve patient care. Building good rapport and working relationship with key stakeholders is an important aspect to consider if the intervention was to be implemented in a different hospital. Different hospitals may have different culture of working too which can present its own challenges. The value of conducting a pilot study in a different clinical setting is that more can be explored and learned about implementing the intervention in a range of clinical settings, prior to conducting a larger controlled trial.

6.7.2 Strengths

This study also has many strengths. The use of two accelerometers ensured that ambulatory and non-ambulatory physical activities were captured. The benefit of using the SAM was that its outcome measure (step count) was simple to understand and clinically relevant. Examination of the accuracy of the SAM was also an important finding of this study to ensure that the step count that was captured among acutely unwell older medical inpatients was accurate. The use of GENEActiv also enabled the monitoring of upper limb activity. This study proposed a lower cut-off point of 20mg to measure physical activity levels of hospitalised older people. A further study is required to validate this finding particular in this patient group.

Implementing an intervention in a complex healthcare setting has its challenges. The use of qualitative methods in this study allowed key stakeholders' views to be explored to determine the acceptability of the intervention. The aim of delivering the volunteer-led intervention was to improve patient care and hence the used of mixed methods approach allowed for quantitative measures to be examined as well as patients' experience and views regarding the intervention to be explored, both of which were important. Facilitators and barriers to the implementation of the intervention were also identified through the interviews which would be helpful for future implementation studies. The use of a mixed methods approach has provided a better understanding on the feasibility and acceptability of the intervention and generated data which could be useful for a future controlled trial.

The use of well-established implementation theory, the normalisation process theory (NPT), was also a strength of this study. Using NPT to develop the volunteer training programme and the intervention study allowed important consideration to be made to address potential challenges in the implementation process. NPT was also used as a framework to analyse the qualitative data. This enabled the data to be analysed and presented in a systematic fashion.

6.8 Impact

Since the conclusion of the study, the mobility volunteer intervention had been adopted by University Hospital Southampton NHS FT (UHSFT) who were keen to continue and expand the work. I am a member of the steering group, working to develop a new hospital-wide quality improvement initiative: Eat, Drink, and Move (EDM). The aim of this initiative is to raise awareness among healthcare professionals regarding the importance of nutrition and physical activity, and to promote better nutrition and higher activity levels among inpatients. Central to

the EDM project are the mobility volunteers who will continue to deliver mobility and exercise interventions.

In October 2017, funding from an external organisation, HelpForce, worth £50,000 was awarded to UHSFT to support the EDM project. HelpForce is an organisation that works with NHS hospital trusts to improve patient care through the use of volunteers[395]. Half of the funding was used to improve the hospital volunteer services to increase their capacity in recruiting volunteers, with the aim of recruiting 100 volunteers over the course of 12 months. The other half of the funding was allocated to employ a band 7 therapist to continue the training of mobility volunteers. The support provided by the trust and their enthusiasm in adopting the intervention after the study period reaffirmed the feasibility and acceptability of the volunteer-led intervention.

To disseminate my findings, I presented my study locally at the hospital's quality improvement conference and several other regional, national and international meetings (Appendix 20). The mobility volunteer intervention was also showcased on the local media on BBC South Today[396]. Through the various modes of disseminating this study, I was able to establish links with key stakeholders from other hospitals who were interested in implementing the volunteer-led intervention in their respective hospitals.

Chapter 7: Future work

7.1 Summary of thesis

This thesis explored the feasibility and acceptability of using trained volunteers to encourage older inpatients to be more active, using a mixed methods approach. Whilst there is some evidence to suggest that volunteers can be trained to encourage patients to mobilise, most of the evidence came from smaller quality improvement initiatives which were done in other countries and were less well-evaluated. The best evidence came from a large study (Hospital Elder Life Program) which was conducted in the United States[162]. This thesis addressed some of the knowledge gaps of implementing a volunteer-led activity intervention in an inpatient setting in the UK and helped identify facilitators and barriers to the implementation process.

This study has shown that it is feasible to recruit, train and retain volunteers to encourage increased physical activity among older inpatients. The training programme received positive feedback from volunteers who felt that they were adequately prepared to carry out their role safely. Importantly, no adverse events were reported throughout the intervention period. Among participants who received the volunteer-led intervention, there were trends towards improvement in physical activity levels, shorter hospital stay and reduction in hospital readmission, however these differences were not statistically significant.

7.2 Suggestions for improvement

In retrospect, there were several things in this study that could have been improved to strengthen the rigor of its methodology. The use of a formal process of implementing the intervention such as the Plan-Do-Study-Act (PDSA) cycle would have helped strengthen the implementation and analysis of this study. The PDSA cycle is commonly used quality improvement tool that focuses on the crux of change, the translation of ideas and intentions into action[397,398]. It provides a structured approach to plan, analyse and deliver interventions, ensuring that adjustments are made accordingly to increase the chances of implementing an initiative or intervention that can be adapted and sustained in the local setting. In a complex healthcare system like the NHS, the PDSA approach can provide the tools required by individuals or teams to work together to deliver better care for patients. The conceptual framework of the PDSA approach are as follow: to plan a test of change or learning activity, to do it, to study what happens, and to act on the learning obtained[399]. A key aspect of the PDSA cycle is to explore what works and what does not for the local setting on a small scale. Any changes or adaptions needed are then taken forwards to a

subsequent PDSA cycles in an iterative process, prior to implementing the initiative on a wide scale. In this study, there are several adaptations that can be made which could be incorporated into a future study to improve the intervention and increase the chances of a successful implementation.

A future work could consider increasing the intensity of the exercise and mobility sessions to ensure that patients receive maximum benefit in their interaction with the mobility volunteers. The exercises could be improved by including progressive resistance exercise with the use of weights or exercise bands[379,380]. Considerations should also be made to train volunteers to safely increase the frequency and intensity of the prescribed activity, with the support of ward therapists. From the qualitative data, suggestions have also been put forward to include group activities or exercises (Section 5.4.4). Common rooms can come as a premium in busy clinical settings. Alternatively, group exercises could also be performed in the four or six bedded ward bays, depending on the clinical setting. To motivate participants to mobilise further, visual cues or markers on the walls along the ward corridors can be helpful to serve as prompts for patients, to encourage them to increase mobility levels.

To improve engagement of staff members, ward champions can be appointed to help support the implementation of the intervention on individual wards. Ward champions could consist of nursing staff or therapists who are given the responsibility to ensure the smooth running of the intervention on each ward. The role of ward champions would include engaging with volunteers and providing them with additional support if needed, assisting with administrative tasks such as ensuring that there are adequate documents available on the wards. This would be particularly useful if the intervention was to be implemented across several wards. Meetings could be held among ward champions to discuss about the implementation process and ward champions can then support and learn from each other to ensure successful implementation on their respective wards.

Through the qualitative interviews among volunteers, a suggestion was raised to have video recordings of the exercises where volunteers can revisit them at their leisure to refresh their memory. A possible suggestion moving forwards is to have online resources where volunteers can access them as and when needed. With adequate expertise and resources, considerations could be made to develop an online training package for volunteers before they start their training session to provide some basic background information. This can help reduce the cost of training by saving time, and also allows the training day to have a greater focus and emphasis on getting the exercise and mobility protocols right.

In this study, the volunteer-led intervention was implemented on the wards before the targeted number of trained volunteers was achieved. The reason for this was two-fold. Due to the uncertainty of how long it would take for the new volunteer service manager's recruitment plans to take effect, I felt that delaying the implementation process indefinitely would significantly impact on the time frame needed to deliver this study. Secondly, I needed to maintain the interest of the volunteers who were already trained. There was a potential risk that trained volunteers who subsequently had to wait for several months before starting volunteering may eventually lose interest in volunteering and thus drop out of the mobility volunteer programme. In future studies, the implementation of the intervention could be staggered to allow adequate volunteers to be trained prior to rolling it out across the whole department. Applying the principles of PDSA, the roll out of trained volunteers should start on a small scale, with a select few patients. The delivery of the intervention should then be studied to address changes that are needed to be made before moving on to the whole ward, and subsequently to the whole department.

With regards to outcome measures, measurement of functional outcomes such as Barthel Index or Elderly Mobility Scale at recruitment and at discharge would allow the impact of the volunteer-led intervention on functional outcomes to be explored. A follow-up measurement of functional outcomes and physical activity levels at 3 and 6 months post-discharge will also be helpful to determine if any impact, if present, was sustained post-hospitalisation. The shortcomings of a wrist-worn accelerometers were discussed in previous sections. A future study should include the use of the ankle-worn StepWatch Activity Monitor. Alternative measures of physical activity would include body-worn devices like the activPAL to measure posture, or subjective measures as described by Brown et al[35] and Zisberg et al[36].

In implementation science research, the involvement of end users from the onset of the study, in questioning framing, research design and delivery, with implementation and dissemination strategies, can be useful to better understand the intricacies of implementing a complex intervention and increase the chances of a successful implementation[400,401]. The collaboration between researchers and end users is known as co-design[400]. The use of co-design allows patient, public and carer voices to be involved at every stage of the research process. The involvement of patient and public in research is also commonly abbreviated to PPI (Patient and Public Involvement). Considering that the primary aim of most implementation study is to deliver tangible benefits for patients and the public, it is important that they are involved and engaged in the research process to maximise the potential benefits of any implementation[402]. Some of the benefits of co-design include: ensuring culturally and logistically appropriate research, enhancing recruitment capacity, generating professional capacity and competence in stakeholder groups,

and increasing the quality of outputs and outcomes over time[401]. In this study, PPI input was sought in the conception of the idea of using volunteers as mobility assistants. Surveys were conducted among older inpatients and community-dwelling older people to gather their views on the proposed idea[175]. PPI input was also sought during the development of the study protocol, development of lay summary and reviewing of the patient-facing information sheets, as described in section 2.6.4. Within the NIHR CLAHRC Wessex infrastructure, a PPI group (Wiserd) which consists of members of the public and researchers, meets quarterly to discuss projects and ideas. Feedback from these meetings also provided helpful guidance in the delivery of this study.

However, there is scope for further involvement of PPI in this study. An important aspect of any study is the outcome measures. End users should be consulted on what outcome measures are important to them and should be included in the study. A survey could be conducted among older inpatients to explore what are the important aspects of their care to them and how best to capture and measure them. PPI involvement in the data analysis process can also help provide a different perspective, particularly in the analysis of qualitative data. There may be contextual-rich information that PPI can bring to the table in the analysis of qualitative data. PPI can play a role in assisting the researchers in developing themes from data, or be consulted to see if the understanding and interpretation of the data was similar to the researchers. In a future study, there is also potential for PPI input in designing a recruitment strategy for both volunteers and patients, be a named co-applicants in a grant proposal and help steer the project throughout the research process including dissemination of findings.

7.3 Phased approach to future work

Steering group

Building on the ground work of this feasibility and acceptability study, the next steps will be to adopt a phased approach to develop the intervention, with the aim of conducting a randomised controlled trial (RCT). The first step is to form a steering group to discuss how this study can be progressed. The steering group should consists of key stakeholders including nursing staff, therapists, volunteer services representative, patient and public representatives and the research team. Complex interventions such as the mobility volunteer intervention, consist of several components which may act independently and interdependently[403]. Examples of these components include engagement from staff members and management team of the organisation, recruitment and training of volunteers, effectiveness of the physical activity intervention, the organisational culture, and engagement from patient participants. Thus it is important that key

stakeholders are represented in the steering group to move this study forwards. At this stage, input from the NIHR Research Design Service and statistical support would also be beneficial in preparation for the next study.

Optimising the intervention

This study has illuminated the challenges in the processes and mechanisms of implementing the intervention in an acute clinical setting. In this study, the physical activity intervention was identified as a possible component which could be further optimised. As discussed in section 6.8, exercises with greater intensity could be introduced to ensure that patients get the most out of the activity intervention. Possible suggestions include having exercises with graded level of intensity so that patients can be progressed onwards, and using exercise equipment such as weights and resistance bands. An updated review of current evidence can help guide the refining and optimisation of the exercise and mobility protocol.

Deciding on key outcome measures

In this study, the primary outcome measures were the feasibility measures and acceptability of the intervention. Secondary outcome measures included physical activity measures, as measured by accelerometry, and receipt of hospital care measures. To establish the primary outcome of a future study, a survey among older inpatients could be conducted to explore what matters most to patients. A survey conducted among older inpatients using a simple questionnaire can help illuminate this. The survey will help guide the decision about what the primary outcome should be in a future RCT. Important outcomes that should be included in a future study are physical activity levels, physical function measures, quality of life measures and economic measures. Patients could also be followed up post-hospitalisation to determine if there was a sustained impact beyond their hospital stay.

Identifying target population

In this study, patients from the Medicine for Older People ward who were able to provide written consent were recruited. Considerations should be given to include patients on other wards eg the ortho-geriatric wards or older patients in general medical wards. Patients with cognitive impairment are also likely to benefit from the activity intervention and considerations should be made to recruit this patient group by proxy. The intervention may need to be adapted to enable patients with cognitive impairment or ortho-geriatric patients to participate. Volunteers would require some training to engage with patients with cognitive impairment and modification to the exercise prescription may be needed for ortho-geriatric patients. Moving beyond the acute

setting, community-dwelling older people and care home residents are also possible target populations in future studies.

Pilot randomised controlled trial

The next stage is then to perform a pilot RCT. This is an important next step to determine the feasibility of recruiting and randomising patients to a treatment and control arm. This will give an idea of the practicalities of a full RCT and will provide important information such as recruitment rate, and help identify any methodological issues related to the intervention or the measurement of outcome variables[404]. It will also provide further data required to perform a sample size calculation, and permit appropriate planning in terms of time required and the cost of a full RCT. Ultimately, the aim of the pilot RCT is to investigate areas of uncertainty about a future definite RCT[405]. Findings of the pilot RCT will help inform if the protocol is suitable to be carried forwards to a full RCT, if the protocol needs amendment or whether the study should not proceed.

Randomised controlled trial

RCTs are recognised as the 'gold standard' to evaluate causal relationships between an intervention and its outcomes[403]. Some of the strengths of a well-designed RCT include minimised bias within the study, high internal validity, and the ability to evaluate causal relationships[406]. A RCT involving such a complex intervention is a huge undertaking and thus the pilot RCT is crucial to help inform the feasibility of a full scale RCT. One of the potential problems of randomising patients on the wards to two groups (intervention and control) is the potential for contamination among participants. In such circumstances, cluster randomisation can be used to minimize the potential bias introduced by contamination. Cluster randomisation could be performed at the ward level within hospitals, or at hospital level, in the context of a multi-centre RCT. To blind participants in the control group, sham stretching exercises could be introduced. Alternatively social interaction sessions could be delivered to counter the social aspect of volunteers. One of the potential limitations of an RCT is reduced external validity due to stringent inclusion and exclusion criteria. Conducting a multicentre trial which includes district and tertiary hospitals will increase the generalisability of the findings.

The definitive RCT is envisaged to be a multicentre single blinded cluster randomised controlled trial, with a mix of district and tertiary hospitals. The primary outcome measure will be determined following a survey among older inpatients but the proposed primary outcome measures include physical function measures (e.g. Barthel Index, Short Physical Performance Battery) or physical activity levels (mean daily step count). The implementation of mobility volunteers to deliver physical activity interventions in hospital requires an investment of money,

time and human resources. Thus a well-conducted RCT with robust methodology can help answer the question of the effectiveness of the intervention on patient outcomes and its cost implications, including formal health economic evaluation. This will provide decision-makers with evidence-based guidance to determine if such a complex intervention should be implemented in their respective settings.

Closing remarks

In closing, this study has demonstrated that it was feasible to recruit, train and retain volunteers to safely encourage older inpatients to be more active. The volunteer-led intervention was also well-received by patients, nurses and therapists and have been successfully embedded into routine practice in one hospital. There is scope for future work to assess the impact of the intervention on important patient outcomes through a randomised controlled trial but careful planning is required to ensure that the intervention is optimised and the methodology is rigorous to allow an accurate assessment of the true impact of the volunteer-led intervention on patient outcomes. Finally, a quote from a patient seemed apt as a summary of this thesis:

> W*ould I have done it if he hadn't have come in? I might not have done. It's having the volunteers, they encourage you to have a go. I think the more chances patients are given for activity I think they will all get well quicker. No doubt about it. I feel good now, and I want get home. So yeah. I think mobility is a very important thing for everybody.*

Appendices

Appendix 1.1

NHS
Health Research Authority
South East Coast - Surrey Research Ethics Committee
Bristol Research Ethics Committee Centre
Whitefriars
Level 3, Block B
Lewins Mead
Bristol
BS1 2NT

Telephone: 0117 342 1383

21 December 2015

Dr Helen Roberts
Academic Geriatric Medicine Mailpoint 807
University of Southampton
University Hospital Southampton
SO16 6YD

Dear Dr Roberts

Study title:	**The Southampton Mobility Volunteer programme to increase physical activity levels of older inpatients: a feasibility study (SoMoVe)**
REC reference:	**15/LO/2091**
Protocol number:	**RHM MED1297**
IRAS project ID:	**183545**

Thank you for your letter responding to the Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Chair.

We plan to publish your research summary wording for the above study on the HRA website, together with your contact details. Publication will be no earlier than three months from the date of this opinion letter. Should you wish to provide a substitute contact point, require further information, or wish to make a request to postpone publication, please contact the REC Manager, Maeve Groot Bluemink, nrescommittee.secoast-surrey@nhs.net.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Conditions of the favourable opinion

The REC favourable opinion is subject to the following conditions being met prior to the start of the study.

You should notify the REC in writing once all conditions have been met (except for site approvals from host organisations) and provide copies of any revised documentation with updated version numbers. The REC will acknowledge receipt and provide a final list of the approved documentation for the study, which you can make available to host organisations to facilitate their permission for the study. Failure to provide the final versions to the REC may cause delay in obtaining permissions.

Management permission must be obtained from each host organisation prior to the start of the study at the site concerned.

Management permission should be sought from all NHS organisations involved in the study in accordance with NHS research governance arrangements. Each NHS organisation must confirm through the signing of agreements and/or other documents that it has given permission for the research to proceed (except where explicitly specified otherwise).

Guidance on applying for NHS permission for research is available in the Integrated Research Application System. www.hra.nhs.uk or at http://www.rdforum.nhs.uk.

Where a NHS organisation's role in the study is limited to identifying and referring potential participants to research sites ("participant identification centre"), guidance should be sought from the R&D office on the information it requires to give permission for this activity.

For non-NHS sites, site management permission should be obtained in accordance with the procedures of the relevant host organisation.

Sponsors are not required to notify the Committee of management permissions from host organisations

Registration of Clinical Trials

All clinical trials (defined as the first four categories on the IRAS filter page) must be registered on a publically accessible database within 6 weeks of recruitment of the first participant (for medical device studies, within the timeline determined by the current registration and publication trees).

There is no requirement to separately notify the REC but you should do so at the earliest opportunity e.g. when submitting an amendment. We will audit the registration details as part of the annual progress reporting process.

To ensure transparency in research, we strongly recommend that all research is registered but for non-clinical trials this is not currently mandatory.

If a sponsor wishes to contest the need for registration they should contact Catherine Blewett (catherine.blewett@nhs.net), the HRA does not, however, expect exceptions to be made. Guidance on where to register is provided within IRAS.

It is the responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).

Ethical review of research sites

NHS sites

The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see "Conditions of the favourable opinion" below).

Non-NHS sites

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document	*Version*	*Date*
GP/consultant information sheets or letters [Letter to consultant]	1	28 October 2015
Interview schedules or topic guides for participants [Interview schedule]	1	28 October 2015
IRAS Checklist XML [Checklist_16122015]		16 December 2015
Letter from funder [CLAHRC Wessex funding letter]	1	06 October 2015
Letter from sponsor [UHS Sponsor letter]	1	14 October 2015
Non-validated questionnaire [Data collection booklet]	1	28 October 2015
Other [GENEActiv manual]	1	05 November 2015
Other [StepWatch Activity Monitor manual]	1	05 November 2015
Other [Response to Research Ethics Committee]	1	14 December 2015
Other [Volunteer training programme]	1	14 December 2015
Other [Correspondence with Head of Litigation and Insurance Services]	1	14 December 2015
Other [Insurance certificate]	1	14 December 2015
Other [Voluntary Services Policy]	1	14 December 2015
Participant consent form [Consent form (patient)]	1	28 October 2015
Participant consent form [Consent form (Staff)]	1	02 November 2015
Participant consent form [Consent form (volunteer)]	2	14 December 2015
Participant information sheet (PIS) [Patient information sheet]	2	14 December 2015
Participant information sheet (PIS) [Staff information sheet]	2	14 December 2015
Participant information sheet (PIS) [Volunteer information sheet]	2	14 December 2015
REC Application Form [REC_Form_04112015]		04 November 2015
Referee's report or other scientific critique report [Peer review report]	1	06 October 2015
Research protocol or project proposal [Study protocol]	1	28 October 2015
Summary CV for Chief Investigator (CI) [Chief Investigator CV]	1	28 October 2015
Summary CV for student [Curriculum Vitae]	1	29 October 2015
Summary CV for supervisor (student research) [Academic	1	28 October 2015

Supervisor CV]		
Summary, synopsis or diagram (flowchart) of protocol in non technical language [Lay summary]	1	28 October 2015
Validated questionnaire [Validated questionnaires]	1	28 October 2015

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Reporting requirements

The attached document *"After ethical review – guidance for researchers"* gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators
- Notification of serious breaches of the protocol
- Progress and safety reports
- Notifying the end of the study

The HRA website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

User Feedback

The Health Research Authority is continually striving to provide a high quality service to all applicants and sponsors. You are invited to give your view of the service you have received and the application procedure. If you wish to make your views known please use the feedback form available on the HRA website:
http://www.hra.nhs.uk/about-the-hra/governance/quality-assurance/

HRA Training

We are pleased to welcome researchers and R&D staff at our training days – see details at http://www.hra.nhs.uk/hra-training/

15/LO/2091	**Please quote this number on all correspondence**

With the Committee's best wishes for the success of this project.

Yours sincerely

Pp Dr Mark Atkins
Chair

Email:nrescommittee.secoast-surrey@nhs.net

Enclosures: "After ethical review – guidance for researchers"

Copy to: *Ms Jennifer Peach, University Hospital Southampton*

Appendix 1.2

NHS
Health Research Authority

South East Coast - Surrey Research Ethics Committee

Whitefriars
Level 3, Block B
Lewins Mead
Bristol
BS1 2NT

Tel: (020) 71048053

05 September 2016

Dr Helen Roberts
Academic Geriatric Medicine Mailpoint 807
University of Southampton
University Hospital Southampton
SO16 6YD

Dear Dr Roberts

Study title:	**The Southampton Mobility Volunteer programme to increase physical activity levels of older inpatients: a feasibility study (SoMoVe)**
REC reference:	**15/LO/2091**
Protocol number:	**RHM MED1297**
Amendment number:	**1, 23rd August 2016**
Amendment date:	**01 September 2016**
IRAS project ID:	**183545**

The above amendment was reviewed by the Sub-Committee in correspondence.

Ethical opinion

The members of the Committee taking part in the review gave a favourable ethical opinion of the amendment on the basis described in the notice of amendment form and supporting documentation.

Approved documents

The documents reviewed and approved at the meeting were:

Document	*Version*	*Date*
Covering letter on headed paper [Covering email]		01 September 2016
Notice of Substantial Amendment (non-CTIMP)	1, 23rd August 2016	01 September 2016
Research protocol or project proposal [SoMoVe protocol]	2	23 August 2016

Membership of the Committee

The members of the Committee who took part in the review are listed on the attached sheet.

R&D approval

All investigators and research collaborators in the NHS should notify the R&D office for the relevant NHS care organisation of this amendment and check whether it affects R&D approval of the research.

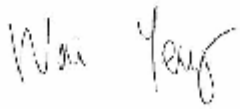
Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

We are pleased to welcome researchers and R & D staff at our NRES committee members' training days – see details at http://www.hra.nhs.uk/hra-training/

15/LO/2091:	**Please quote this number on all correspondence**

Yours sincerely



PP - Dr Mark Atkins
Chair

E-mail: nrescommittee.secoast-surrey@nhs.net

Enclosures: *List of names and professions of members who took part in the review*

Copy to: *Ms Jennifer Peach, University Hospital Southampton*

A Research Ethics Committee established by the Health Research Authority

South East Coast - Surrey Research Ethics Committee

Attendance at Sub-Committee of the REC meeting in correspondence

Committee Members:

Name	*Profession*	*Present*	*Notes*
Dr Mark Atkins	Consultant Virologist	Yes	
Mrs Christie Lawson	Nurse Specialist	Yes	

Also in attendance:

Name	*Position (or reason for attending)*
Mr Wai Yeung	REC Assistant

Appendix 1.3

University Hospital Southampton NHS Foundation Trust

Please reply to: Research and Development
SO16 - Level C, Laboratory & Pathology,
Block SCBR - MP 138
Southampton General Hospital

Telephone: 023 8120 4801
Fax: 023 8120 8878
E-mail: taru.jussila-knappett@uhs.nhs.uk

Dr Stephen Lim
Mailpoint 807, (connected to. Univ of South.)
University Hospital Southampton NHS Foundation Trust
Tremona Road
Southampton
SO16 6YD

08 February 2016

Dear Dr Lim

ID: RHM MED1297 **The Southampton Mobility Volunteer programme to increase physical activity levels of older inpatients: a feasibility study (SoMoVe)**

EudraCT:

Thank you for submitting all the required documentation for Trust R&D approval. I write to inform you that your study has full UHS R&D approval. Please find attached the Conditions of Trust R&D approval which you are obliged to adhere to.
Please note that according to the 70 day benchmark you should aim to recruit your first patient by 06/April/2016.

You are required to keep copies of all your essential documents relating to this study. Please download a copy of the relevant Investigator Site File template from the R&D website: http://www.uhs.nhs.uk/Research/For-investigators/Sitefile.aspx.

Your project is subject to R&D monitoring and you will be contacted by our office to arrange this.

Please note: A condition of approval is that any changes need to be timeously notified to the R&D office. This includes providing copies of:

. All NRES substantial amendments and favourable opinions;
. All Serious Adverse Events (SAEs);
. NRES Annual Progress Reports;
. Annual MHRA Safety Reports;
. NRES End of Study Declaration;
. Notifications of significant breaches of GCP or protocol

Please quote the above RHM No. On any correspondence with our office.

Should you, or any of your team, require training in any of the policies and procedures required to ensure compliance with the conditions of approval, please refer to the R&D Training website http://www.uhs.nhs.uk/Research/For-investigators/Mandatory-training-governance-and-safety-management/Mandatory-training-governance-and-safety-management.aspx for an up-to-date calendar of training events.

Yours sincerely

Taru Jussila-Knappett

Research Governance Officer

Appendix 2

Medline search strategy

	Search terms	Number of articles
1.	elder*.mp.	127328
2.	old*.mp.	674783
3.	exp Aging/	116246
4.	exp Geriatrics/	6530
5.	exp "Aged, 80 and over"/ or exp Aged/	1547869
6.	1 or 2 or 3 or 4 or 5	2085598
7.	exp Exercise/ or exp Exercise Therapy/ or exp Exercise Movement Techniques/	121610
8.	physical activity.mp.	48566
9.	mobility.mp.	77720
10.	ambulat*.mp.	84030
11.	exp Walking/	20128
12.	7 or 8 or 9 or 10 or 11	302132
13.	"Outcome Assessment (Health Care)"/	47629
14.	tool*.mp.	332655
15.	Questionnaires/	275960
16.	instrument*.mp.	138384
17.	measure*.mp.	1600442

18.	exp Monitoring, Ambulatory/	19882
19.	exp Motor Activity/ or exp Accelerometry/	157192
20.	13 or 14 or 15 or 16 or 17 or 18 or 19	2250696
21.	hospitalized.mp.	46085
22.	exp Inpatients/	11567
23.	(medical adj2 inpatient*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	1306
24.	acute care.mp.	10406
25.	21 or 22 or 23 or 24	65356
26.	6 and 12 and 20 and 25	943

Appendix 3

UNIVERSITY of York
Centre for Reviews and Dissemination

NHS
National Institute for Health Research

PROSPERO International prospective register of systematic reviews

Measurement of physical activity of hospitalised older people: a systematic review

Stephen Lim, Kinda Ibrahim, Avan Aihie Sayer, Helen Roberts

Citation
Stephen Lim, Kinda Ibrahim, Avan Aihie Sayer, Helen Roberts. Measurement of physical activity of hospitalised older people: a systematic review. PROSPERO 2015:CRD42015025278 Available from http://www.crd.york.ac.uk/PROSPERO_REBRANDING/display_record.asp?ID=CRD42015025278

Review question(s)
What are the measures of physical activity currently used to quantify the physical activity levels of hospitalised older people?

Searches
The followiing databases will be searched:

MEDLINE

EMBASE

CINAHL

AMED

Limits:

English Language publications from 1996 onwards.

Types of study to be included
There are no restrictions to the types of study design eligible for inclusion. Reviews will be evaluated with regard to the studies reported within them.

Condition or domain being studied
The main domain being studied is the physical activity levels of older people who are admitted to hospital. As low physical activity levels are associated with adverse health outcomes and functional decline, this systematic review aims to review the current available tools to measure physical activity accurately for clinical and research purposes.

Participants/ population
Participants should be age 65 years or above, who are admitted to hospital for any medical or surgical condition.

Studies of older people in other settings e.g. long-term care or rehabilitation settings will be excluded.

Intervention(s), exposure(s)
Any measure of physical activity that quantifies the frequency and duration of physical activity of hospitalised older people.

Comparator(s)/ control
No control group.

Context
Measures of physical activity which are used in the hospital or acute care setting will be evaluated.

Rehabilitation settings are excluded.

Outcome(s)

Primary outcomes

The types of measure used to assess physical activity levels of hospitalised older patients.

The measure should quantify physical activity levels, rather than test patient's ability to perform a certain task of activity.

Secondary outcomes

Validity and practicality of using the measure will be reported.

Data extraction, (selection and coding)

The initial search on the database was carried out independently by two researchers (SL and KI). Titles of the initial search were then screened by SL and KI for inclusion for abstract review. Three authors (SL, KI and HR) reviewed the abstracts and for abstracts selected by at least one of the authors as relevant, the full text was retrieved. The full text was then reviewed by SL, KI and HR for inclusion of studies for analysis. Any discrepancy or disagreement will be discussed among the authors until an agreement is reached.

Risk of bias (quality) assessment

The quality of each paper will be assessed using the Downs and Black checklist and reported. However, studies will not be excluded based on its quality as the aim of this review is to identify measures that are currently used to assess physical activity levels and the quality of the study design is unlikely to affect the primary outcome.

Strategy for data synthesis

A narrative synthesis will be used to report the measures and tools commonly used by researchers to quantify physical activity levels and a concise description of each measure will also be presented.

Analysis of subgroups or subsets

None planned.

Dissemination plans

The aim is to publish the review in a peer-reviewed journal.

Contact details for further information

Stephen Lim

Academic Geriatric Medicine, Mailpoint 807

University of Southampton

University Hospital Southampton NHS Foundation Trust

Tremona Road.

Shirley

Southampton

SO16 6YD

s.e.lim@soton.ac.uk

Organisational affiliation of the review

None

UNIVERSITY of York
Centre for Reviews and Dissemination

NHS
National Institute for Health Research

Review team
Dr Stephen Lim, University of Southampton
Dr Kinda Ibrahim, University of Southampton
Professor Avan Aihie Sayer, University of Southampton
Dr Helen Roberts, Univeriayt of Southampton

Anticipated or actual start date
01 July 2015

Anticipated completion date
31 May 2016

Funding sources/sponsors
NIHR CLAHRC Wessex

Conflicts of interest
None known

Language
English

Country
England

Subject index terms status
Subject indexing assigned by CRD

Subject index terms
Elderly; Health Services for the Aged; Hospitalization; Humans; Motor Activity

Stage of review
Ongoing

Date of registration in PROSPERO
25 August 2015

Date of publication of this revision
06 May 2016

DOI
10.15124/CRD42015025278

Stage of review at time of this submission	Started	Completed
Preliminary searches	Yes	Yes
Piloting of the study selection process	Yes	Yes
Formal screening of search results against eligibility criteria	Yes	Yes
Data extraction	Yes	Yes
Risk of bias (quality) assessment	Yes	Yes
Data analysis	Yes	Yes

Appendix 4

Barthel Index

1. Hygiene (washing & grooming)	Dependent in all aspects = 0 Assistance required in all steps = 1 Some assistance required in one or more steps = 3 Able to conduct own hygiene but min assistance before/ after = 4 Able to wash hands, face, comb hair, brush teeth and shave = 5	
2. Bathing (bath or shower)	Dependent in all aspects = 0 Assistance required in all aspects = 1 Assistance requires with transfer or washing/drying = 3 Supervision for safety in adjusting water temp/transfer = 4 Able to take all steps without anyone present = 5	
3. Feeding	Dependent in all aspects and needs to be fed = 0 Needs active assistance, patient can hold cutlery/cup = 2 Supervision for feeding, needs help with adding sugar etc = 5 Independent in feeding, may need meat cutting = 8 Able to feed self, cut food, spread butter etc = 10	
4. Toileting	Dependent in all aspects = 0 Assistance required in all aspects = 2 Assistance with clothing/transferring/washing hands = 5 Supervision for safety; needs help emptying commode if used = 8 Able to get on & off toilet/manage clothing/use paper without help. Empty and clean commode if used = 10	
5. Stairs	Unable to climb stairs = 0 Assistance required in all aspects = 2 Needs supervision and help carrying aids = 5 No assistance required, supervision at times for safety = 8 Independent, able to carry aids if needed = 10	
6. Dressing	Dependent in all aspects, unable to participate = 0 Able to participate to some degree but dependent in all aspects = 2 Assistance needed for putting on/removing any clothing = 5 Minimal assistance required eg for buttons, zips, bras, shoes etc = 8 Independent in all aspects = 10	
7. Bowels	Incontinent (all the time) = 0 Needs help to sit on toilet/commode = 2 Cannot clean self, accidents (3+/week), needs help with pads = 5 Supervision with suppositories/enema, accidents 1-2/wk = 8 Independent = 10	

8. Bladder	Dependent. Incontinent/catheter which can't manage = 0 Incontinent but assists with catheter bag/convene, pads etc = 2 Generally dry day but not night, needs assistance with devices = 5 Mainly dry, occasional accident, min help with devices = 8 Able to control bladder day & night. Independent = 10	
9. Transfer	Unable to participate in transfer. Requires 2 people +/- aid = 0 Maximum assistance of 1 person in all aspects = 3 Assistance of 1 person in some aspect (little physical help) = 8 Presence of 1 person for confidence/supervision = 12 Independent in all aspects = 15	
10. Mobility	Dependent in walking (unable) = 0 Constant presence of 1+ persons required (lot of physical help) = 3 1 person to offer assistance (little physical help) = 8 Independent in walking; needs supervision to walk 50m = 12 Independent in all aspects; able to walk 50m alone = 15	
11. Wheelchair (if scored 0 in section 10.)	Dependent in wheelchair ambulation = 0 Can self-propel short distances on flat surface. Assistance required for all other steps = 1 Presence of 1 and constant assistance required with chair = 3 Can self-propel well; needs min assistance with 'tight corners' = 4 Self-propels 50m independently, can manoeuvre round corners = 5	

Total Barthel Score

Appendix 5

Elderly Mobility Scale

Task	**Date**		
Lying to sitting	2 Independent 1 Needs help of 1 person 0 Needs help of 2+ people		
Sitting to Lying	2 Independent 1 Needs help of 1 person 0 Needs help of 2+ people		
Sitting to Standing	3 Independent in under 3 seconds 2 Independent in over 3 seconds 1 Needs help of 1 person 0 Needs help of 2+ people		
Standing	3 Stands without support and able to reach 2 Stands without support but needs support to reach 1 Stands but needs support 0 Stands only with physical support of another person		
Gait	3 Independent (+ / - stick) 2 Independent with frame 1 Mobile with walking aid but erratic/unsafe 0 Needs physical help to walk or constant supervision		
Timed walked (6 metres)	3 Under 15 seconds 2 16-30 seconds 1 Over 30 seconds 0 Unable to cover 6 metres		
	Recorded time in seconds		
Functional reach	4 Over 20cm 2 10 – 20cm 0 Under 10cm		
	Scores	**/20**	**/20**

Total Score

Scores under 10 – generally these patients are **dependent** in mobility manoeuvres; require help with basic ADL, such as transfers, toileting and dressing.

Scores between 10 – 13 – generally these patients are **borderlin**e in terms of safe mobility and independence in ADL i.e. they require some help with some mobility manoeuvres.

Scores over 14 – generally these patients are able to perform mobility manoeuvres alone and

Appendix 6

FRAIL scale

Each of the 5 questions is scored at 0 or 1 to give a total score of 0-5. 3-5 indicates frailty, 1-2 indicates a pre-frail state and 0 is normal.

1. **Fatigue**: "How much of the time during the past 4 weeks did you feel tired?"
   a = All of the time,
   b = Most of the time
   c = Some of the time
   d = A little of the time
   e = None of the time.

Responses of "a" or "b" are scored as 1 and all others as 0

2. **Resistance**: "By yourself and not using aids, do you have any difficulty walking up 10 steps without resting?"
   1 = Yes
   0 = No

3. **Ambulation**: By yourself and not using aids, do you have any difficulty walking several hundred yards?"
   1 = Yes
   0 = No

4. **Illnesses**: For 11 illnesses, participants are asked, "Did a doctor ever tell you that you have [illness]?"
The illnesses are: hypertension, diabetes, cancer (other than a minor skin cancer), chronic lung disease, heart attack, congestive heart failure, angina, asthma, arthritis, stroke, and kidney disease.
   1 = Yes to 5-11 of the illnesses
   0 = Yes to 0-4 of the illnesses

5. **Loss of weight**: "How much do you weigh with your clothes on but without shoes?" "One year ago, how much did you weigh without your shoes and with your clothes on?"
   Percentage weight change > 5% = 1
   Percentage weight change < 5% = 0

Total Score ☐

Appendix 7

Mini-mental state examination

ORIENTATION

Year	Month	Day	Date	Time	__/5
Country	Town	District	Hospital	Ward	__/5

REGISTRATION

Examiner names 3 objects (eg apple, table, penny)
Patient asked to repeat (1 point for each correct)
THEN patient to learn the 3 names repeating until correct __/3

ATTENTION AND CALCULATION

Subtract 7 from 100, then repeat from result.
Continue 5 times: 100 93 86 79 72 65
Alternative: spell "WORLD" backwards - dlrow. __/5

RECALL

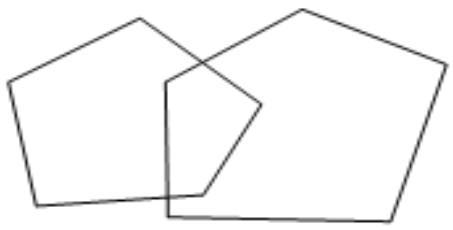
Ask for names of 3 objects learned earlier. __/3

LANGUAGE

Name a pencil and a watch __/2
Repeat “No ifs, ands or buts” __/1
Give a 3 stage command. Score 1 for each stage.
Eg. "Place index finger of right hand on your nose and then on your left ear". __/3
Ask patient to read and obey a written command on a piece of paper stating "Close your eyes". __/1
Ask the patient to write a sentence. Score if it is sensible and has a subject and a verb. __/1

COPYING

Ask the patient to copy a pair of intersecting pentagons:



__/1

__/30

Appendix 8

Geriatric Depression Scale

	No = 0 Yes = 1
1. Are you basically satisfied with your life?	☐
2. Have you dropped many of your activities or interests?	☐
3. Do you feel that your life is empty?	☐
4. Do you often feel bored?	☐
5. Are you in good spirits most of the time?	☐
6. Are you afraid that something bad is going to happen to you?	☐
7. Do you feel happy most of the time?	☐
8. Do you often feel helpless?	☐
9. Do you prefer to stay at home, rather than going out and doing new things?	☐
10. Do you feel you have more problems with your memory than most?	☐
11. Do you think it is wonderful to be alive now?	☐
12. Do you feel pretty well worthless the way you are now?	☐
13. Do you feel full of energy?	☐
14. Do you feel your situation is hopeless?	☐
15. Do you think that most people are better off than you are?	☐

Score 1 for each yes answer to questions **2, 3, 4, 6, 8, 9, 10, 12, 14** and **15**
Score 1 for each no answer to questions 1, 5, 7, 11 and 13

Total Score ☐☐

Appendix 9

Charlson comorbidity index

MEDICAL HISTORY

Primary Diagnosis: Code: | | | | |

Active Co-Morbidities:	No = 0 Yes = 1	Code
*Hypertension		0701
*Diabetes: type 1/type 2 (circle as appropriate)		
Without end-organ damage (1)		
With end organ damage (2)		
*Myocardial infarction (1)		0704
*Angina		0703
*Congestive heart failure (1)		0710
*Stroke or TIA (1) (circle as appropriate)		
Hemiplegia (2)		
*Asthma		1103
*Chronic lung disease (1)		
*Cancer: specify site		

Without metastases (2)	
With metastases (6)	
Liver disease: specify type	

No portal hypertension or complications (1)		
With complications (3)		
Peripheral vascular disease (1)		0709
Peptic ulcer disease (1)		0813
*Kidney disease		0418
Severe: creat >265, dialysis, transplant) (2)		

*Arthritis: specify type _____ ☐ ☐☐☐☐

Dementia (1): specify type _____ ☐ ☐☐☐☐

Connective tissue disease (1): specify type _____ ☐ ☐☐☐☐

Leukaemia or lymphoma(2): specify type _____ ☐ ☐☐☐☐

HIV or AIDS (6) ☐ ☐☐☐☐

Additional Comorbidities **Code**

1. _____ ☐☐☐☐
2. _____ ☐☐☐☐
3. _____ ☐☐☐☐
4. _____ ☐☐☐☐
5. _____ ☐☐☐☐
6. _____ ☐☐☐☐
7. _____ ☐☐☐☐
8. _____ ☐☐☐☐

Use additional comorbidity continuation sheet if needed and attach to booklet
Number of additional comorbidity sheets used ☐

Charlson Comorbidity Index

Comorbidity Score (total scores in brackets) ☐☐

Age Score (1 point for each decade starting at 50 years) ☐☐

Total Score ☐☐

Current regular medications:

Medication name Code

1. _____ ☐☐☐
2. _____ ☐☐☐
3. _____ ☐☐☐
4. _____ ☐☐☐

5. _____ | | | |

6. _____ | | | |

7. _____ | | | |

8. _____ | | | |

9. _____ | | | |

10. _____ | | | |

11. _____ | | | |

12. _____ | | | |

13. _____ | | | |

14. _____ | | | |

15. _____ | | | |

16. _____ | | | |

17. _____ | | | |

18. _____ | | | |

19. _____ | | | |

20. _____ | | | |

Use additional medication continuation sheet if needed and attach to booklet

Number of additional continuation sheets used | |

Appendix 10

Simplified Nutritional Appetite Questionnaire

1. My appetite is ☐
   1 = very poor
   2 = poor
   3 = average
   4 = good
   5 = very good

2. When I eat ☐
   1 = I feel full after eating only a few mouthfuls
   2 = I feel full after eating about a third of a meal
   3 = I feel full after eating over half a meal
   4 = I feel full after eating most of the meal
   5 = I hardly ever feel full

3. Food tastes ☐
   1 = very bad
   2 = bad
   3 = average
   4 = good
   5 = very good

4. Normally I eat ☐
   1 = less than one meal a day
   2 = one meal a day
   3 = two meals a day
   4 = three meals a day
   5 = more than three meals a day

Total SNAQ Score (total all 4 answers) ☐☐

Appendix 11

EuroQol-5D-3L

By placing a tick in one box in each group below, please indicate which statements best describe your own health state today.

Mobility

I have no problems in walking about ❑

I have some problems in walking about ❑

I am confined to bed ❑

Self-Care

I have no problems with self-care ❑

I have some problems washing or dressing myself ❑

I am unable to wash or dress myself ❑

Usual Activities *(e.g. work, study, housework, family or leisure activities)*

I have no problems with performing my usual activities ❑

I have some problems with performing my usual activities ❑

I am unable to perform my usual activities ❑

Pain / Discomfort

I have no pain or discomfort ❑

I have moderate pain or discomfort ❑

I have extreme pain or discomfort ❑

Anxiety / Depression

I am not anxious or depressed ❑

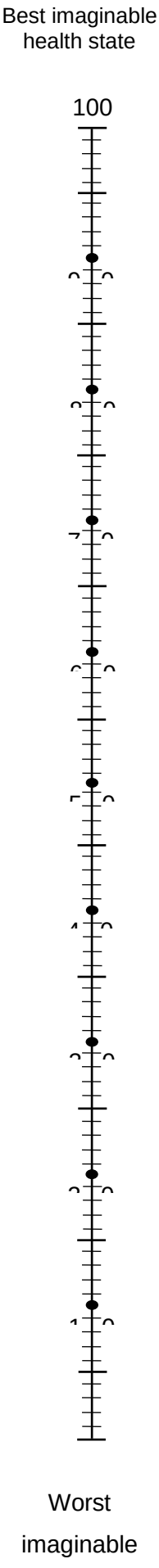
I am moderately anxious or depressed ❑

I am extremely anxious or depressed ❑

To help people say how good or bad a health state is, we have drawn a scale (rather like a thermometer) on which the best state you can imagine is marked 100 and the worst state you can imagine is marked 0.

We would like you to indicate on this scale how good or bad your own health is today, in your opinion. Please do this by drawing a line from the box below to whichever point on the scale indicates how good or bad your health state is today.

Your own health state today



Appendix 12

Data collection proforma for volunteers

Section 1 (to be completed with volunteers)

1. Do you have any previous volunteering experience?

2. Do you have any previous healthcare or caring experience?

3. Why did you choose to become a mobility volunteer (MV)?

4. How did you hear about the SoMoVe study?

5. Sex: Male ☐ Female ☐

6. Ethnicity:

……

7. Marital status: Single ☐ Married/living with partner ☐ Divorced ☐

Widowed ☐

8. DOB:

……

9. Employment status: Employed: Part-time ☐ Full-time ☐ Unemployed ☐

Retired ☐ Student ☐ Other ☐

……

10. How do you get to the hospital?

……

…

11. Do you own a car? Yes ☐ No ☐

If no, do you hold a current driving licence? Yes ☐ No ☐

12. Accommodation: Rented ☐ Owned ☐ Other ☐ ……

13. At what age did you leave full-time education?

……

14. What qualifications did you achieve before leaving education?

GCSE/O-level or equivalent ☐ A-level or equivalent ☐ College or university degree ☐ Professional qualification ☐ Other ☐ (please state) ……

Section 2 to be completed by Research staff

1. Date attended MV training: ……

2. Date competencies achieved: ……

3. Date started as MV: ……

4. Ward and intervention time: ……

5. Level of supervision required after 4 interventions:

None ☐

Supervision required for confidence: Minimal ☐ Moderate ☐ Constant ☐

Supervision required for safety: Minimal ☐ Moderate ☐ Constant ☐

6. Number of interventions conducted:……

7. Date ceased as MV: ……

8. Reasons for leaving: ……

Collection sheet completed by:

……

Date completed: ……

Appendix 13

The Southampton Mobility Volunteer programme to increase physical activity levels of older inpatients: a feasibility study (SoMoVe)

Why are we doing this study?

Studies have shown that low activity levels among older people in hospital is harmful and may result in worsening physical abilities and longer hospital stay. Patients who are inactive are also more likely to be discharged to nursing homes and have an increased risk of death. Studies have shown that mobility and exercise interventions can help older people to be more active in hospital resulting in improved physical function, shorter hospital stay and fewer nursing home admissions. Many NHS trusts have an established volunteer workforce and in Southampton, trained volunteers have successfully assisted older inpatients at mealtimes.

Our aim: The aim of this study is to assess if it is possible to train volunteers to help older patients in hospital keep active by walking more frequently and/or through exercises.

Where will it be conducted?

This study will be carried out on 2 wards (G8 and G9) within the Medicine for Older People department.

What will be done?

In the first phase of this study, we will be measuring the baseline physical activity levels of older people admitted to ward G8 and G9. We will be using 2 wireless devices (GENEActiv and StepWatch Activity Monitor) to measure the physical activity levels of older people. We aim to recruit 50 inpatients aged 70 years and above and are able to provide written consent. The devices will be worn for 7 days or until the day of discharge, whichever is shorter. We will also collect other relevant physical and mental function outcome measures.

What's next?

Once we have completed baseline data collection, we will train hospital volunteers, with the help of the therapy team, to encourage independently mobile patients to walk twice daily or for those who require some assistance, to perform chair-based exercises. We aim to interview patients, volunteers and staff members to gain their views about the acceptability of this study.

StepWatch Activity Monitor

This device is worn at the ankle and is water resistant. It measures the step count of patients. Please remove the device temporarily if the patient wants to take a shower as the Velcro strap is not waterproof and a wet strap can be uncomfortable to patients. It can be worn if patient's personal hygiene care is done by the bedside. The device will be fitted and removed by the researcher after recruitment and upon completion of the study. If the strap is wet and needs changing, please contact us and we will supply a new strap.

GENEActiv

The GENEActiv is worn at the wrist and is waterproof. It can be worn continuously even during shower. Both devices will be checked by the researcher every one to two days to ensure that it is comfortable for patients and worn correctly. Please do not remove the devices unnecessarily as this will affect their accuracy. If the devices need to be removed, please store them safely in the SoMoVe research folder or by patients' bedside locker and kindly inform the research team.

Role of the nursing team:

1. Before every activity session, volunteers will have to ask the nurse in-charge or the nurse looking after the patient if they are suitable to participate in the walking or chair-based exercises. Volunteers are not clinically trained and hence it is important for them to confirm with the nursing team that the participants are clinically stable and able to walk or perform bedside exercises.
2. The type of activity will be tailored specifically to each participant and will be prescribed by the therapy team or the study PI, Dr Steve Lim. The documentation containing this information is kept in the SoMoVe folder.
3. Every patient recruited on to the study will have a SoMoVe magnet placed by their names on the whiteboard. Please remove both devices if your patient is being discharged and place the devices in the SoMoVe folder available on both wards. Most of the time, the devices will be removed by the study PI but please check that the devices have been removed before patients leave hospital as some patients leave during the weekends or when the study PI is not available.
4. If you feel that a particular patient is suitable for the study but have not been approached or recruited, please contact the Principal Investigator for the study.
5. If the volunteers have any concerns about the patients for example if the patient reports symptoms of dizziness or if there is any adverse incidents, they will approach the nursing team to inform you about this.
6. Every activity session is documented and the documentation is kept in the SoMoVe folder.

Thank you very much!

If you have any questions or would like further information, please contact:

Dr Stephen Lim, Principal Investigator for SoMoVe

Tel: ext 6131, E-mail: s.e.lim@soton.ac.uk.

Appendix 14

Training programme

I) Role of the volunteer

1. Receive training and competency assessment
2. Observed independent session with patients
3. Introduce themselves to nurses and therapist
4. Enquire suitability of patients for intervention with nurses
5. Hand washing
6. Introducing themselves to patients and offer to mobilise or do exercises
7. Clearing bed space to mobilise patient safely
8. Check for appropriate footwear
9. Get mobility aid if required
10. Mobilise patient as allowed or as patient able
11. Bed or chair based exercise for patients who are not independently mobile
12. Know when and where to get help
13. Caring for the falling patient
14. Returning patient back to bed space, including rearranging bedside table, call buzzer within reach
15. Hand washing
16. Log activity

II) Mobility levels

<table>
<tr><th>Level</th><th>Mobility</th><th>Volunteers role</th></tr>
<tr><td>I</td><td>Mobilises independently or with distant supervision, with or without a mobility aid
Patients who can walk alone safely, or with minimal prompting (NB distant supervision refers to observing the patient, guiding and directing them, without having to physically assist the patient)</td><td>Volunteers to encourage patients to mobilise as able</td></tr>
<tr><td>II</td><td>Mobilises with assistance
Patients who require STAFF assistance or close supervision to mobilise safely</td><td rowspan="3">Volunteers must not mobilise patients with mobility level II, III, and IV.

Volunteers to encourage patients to participate in a range of bed or chair-based exercise</td></tr>
<tr><td>III</td><td>Transfers with assistance
Patients who are not mobile, and need help with transferring from bed to chair with assistance and use of transfer aid</td></tr>
<tr><td>IV</td><td>Immobile
Patients who are hoist transferred or bed bound</td></tr>
</table>

III) Day training programme for volunteers

- 2-4 hour training programme, with practical sessions led by therapist.
- Volunteers to be supervised on the wards, and competency assessed.

1. Programme background
2. General guidelines
3. Volunteers' own safety
4. Patient safety
5. Pre-intervention checklist
6. Mobility protocol
7. Mobility aid
8. Exercise protocol
9. Post-intervention checklist
10. Caring for the falling patient
11. Communication
12. Documentation

1) Background

Older patients who are admitted to hospital are at an increased risk of a decline in functional status. One of the factors contributing to functional decline is low physical activity levels in hospital. One study showed that patients spend up to 83% of their time in bed during a hospital stay. Prolonged bed rest is harmful and may lead to loss of muscle strength, poor balance, and development of hospital-acquired infections. This may result in a loss of independence, longer hospital stay, and an increased likelihood of needing a nursing home placement.

The aim of this study is to reduce the risk of functional decline in older people by promoting physical activity in hospital. Several studies reporting on mobility programmes have been promising in their results, showing improvement in physical function, shorter hospital stay and more patients being discharged home. Keeping older people active during their hospital stay can help promote and preserve their independence.

We are keen to explore the use of trained volunteers to promote increased physical activity among hospitalised older people. Patients who are mobile will be encouraged to walk around the bed space, within set markers or around the ward twice a day. Patients who need assistance in walking or who are immobile will be encouraged to participate in some bedside exercise.

2) General guidelines

I) Always check with the nurse that the patient is safe to participate with the intervention
II) Always confirm with nurses patient's mobility level prior to intervention
III) Refer to the board above the patients bed which documents their mobility level
IV) Hand washing before and after intervention
V) Introduce yourself to the patient and explain your role
VI) Ask if they would like to participate with the intervention
VII) If in doubt about anything, always ask the nursing staff
VIII) Do not offer patients food or beverages without first asking the nurses
IX) If there are any concerns during your visit, please discuss with the nurses or ward therapist
X) Thank the patient for participating
XI) Do not answer any medical queries, please advise the patients to ask the nurses
XII) Document the outcome of the intervention

3) Volunteer's own safety

- Pay attention to your own safety
- If you are uncomfortable working with a patient for any reason, stop and inform the nursing staff
- Ensure good posture
    - Ears over shoulders over hips over knees over heels
    - With proper posture there is balance between the muscle groups
    - Try to avoid bending or twisting your back unnecessarily
- Appropriate footwear and clothing
- Avoid rushing

4) Patient safety

- If you are concerned about something during the intervention, stop and call for help
- Notify nursing staff to report any concerns
- If there are any changes in the patient's presentation, call for help. Examples of symptoms include: (not exhaustive)
    - Pain
    - Dizziness/lightheaded
    - Confusion
    - New weakness
    - Agitation
- Have an understanding of the emergency buzzer – when it should be used and how

5) Pre-intervention checklist

	Task	
1.	Introduce yourself to staff members	
2.	Ask nurse in charge if patient is safe to participate and confirm mobility level	
3.	Wash hands	
4.	Check that you have the right patient (check their wrist band)	
5.	Introduce yourself to the patient and explain your role	
6.	Check if patient is happy to participate with the intervention	
7.	Get walking aid if needed and check it is labelled for that patient	
8.	Ensure patient has appropriate clothing and footwear if mobilising	
9.	Clear obstacles	

6) Mobility protocol

Assisting patient in getting out of bed:

- ❑ Clear the space of any clutter or obstacles
- ❑ Lower bed to lowest horizontal position, raise head of bed, lower side rails
- ❑ Use the cot side rail for the patient to teach over and grab (if required) whilst they lower their legs off the edge of the bed
- ❑ Advise patient to get into a sitting position at the edge of the bed

- ❑ Have patient sit at edge of bed for a few minutes to prevent dizziness
- ❑ Help patient to put on robe, if needed, and appropriate footwear
- ❑ Have mobility aid ready, if needed
- ❑ Position feet flat on the floor directly under knees
- ❑ Give verbal coaching: lean forward, push hands down onto bed, push feet onto floor, stand at edge of bed, once standing use mobility aid for balance. NEVER allow the patient to pull up on the frame
- ❑ Have patient stand up briefly before walking away. This is to make sure that they are not dizzy before walking away from the bed space. If a patient reports feeling dizzy on standing, please encourage the patient to sit down again and inform the nursing staff.

Assisting patient in getting out of chair

- ❑ Clear the space of any clutter or obstacles
- ❑ Ensure the patient is wearing appropriate clothing and footwear, and assist with these if necessary
- ❑ Encourage the patient to move forwards towards the front of the set
- ❑ Give verbal coaching: lean forward, push hands down onto arm rests, push feet onto floor, stand at edge of chair, once standing use mobility aid for balance. NEVER allow the patient to pull up on the frame
- ❑ Have patient stand for a few minutes to prevent dizziness before walking away

Assisting patient to walk:

- ❑ Follow, walking behind and to one side
- ❑ Encourage patient to walk normally, heel-toe; not shuffling or toe walking, to have a gap between their feet, to use the walking aid correctly
- ❑ Stay with patient at all times
- ❑ Walk as far as directed, stop if patient fatigues and offer a seated rest
- ❑ Return patient to bed/chair if patient feels unwell (dizzy or weak) and report this to a member of nursing staff immediately

7) Mobility aid

- Check with staff to see if aid is needed, and above bed board
- Ask for help if you have any questions about the walking aid
- Use the right equipment designated for the right patient. Ask if unsure. All equipment should be labelled for specific patient use
- Do not prescribe a mobility aid. This is the responsibility of staff
- Do not adjust the equipment
- Do not touch the mobility aid while the patient is walking, unless this is for mild steering
- Examples of mobility aid: Walking stick, Zimmer frame, 3 wheeled walker, 4 wheeled walker, elbow crutches

8) Exercise protocol

I) Chair exercises: Hip flexion, knee extensions, ankle pumps, glutes squeezes, lower limb abductions, functional upper limb tasks

II) Bed exercises: Bridging, hip flexion, static quads, hip abductions, ankle pumps, bottom squeezes

9) Post-intervention checklist

Returning patient to bed:

- ❑ Have patient stand near top of bed, remove robe if necessary
- ❑ Encourage patient to feel the bed with the backs of their legs
- ❑ Have patient reach back one hand at a time to edge of bed
- ❑ Have patient bend waist, hips and knees and lower slowly to sitting position
- ❑ Have patient shuffle/move toward centre of bed
- ❑ Remove slippers/footwear
- ❑ Make sure patient is comfortable, replace covers.
- ❑ Return the bed rails to as they were when you approached the patient and ensure their call bell is within reach
- ❑ Replace bedside table and walking aid
- ❑ Wash hands
- ❑ Log activity

10) Caring for the falling patient

Sometimes, patients in hospital fall whilst walking or standing. This may be due to dizziness, weakness, pain, lethargy or other medical causes. It can also be due to slipping because of wet floors, or tripping over an object. While it is natural to want to hold on to the patient and prevent a fall, this may result in an injury to you or the patient. If you feel a patient is beginning to fall, the best thing to do is call for help. Try to protect the patient's head from hitting the floor or surrounding objects if you can. Do not physically assist the patient.

- DO NOT try to stop the fall
- Protect the patient's head
- Call for help calmly but loudly
- Source a chair for the patient to be seated if you have time or are able to
- Stay with the patient and call for a nurse to check the patient
- Do not move the patient

11) Communication

It is important to inform the nurses that you are on the ward and explain what your role is. Maintaining good communication with the healthcare professionals on the ward will ensure that the right patient receives the right intervention. This will also allow ward staff to respond to your needs or queries effectively and efficiently.

It is also important to communicate well with patients. This will help them understand your role and the intervention suggested. Be attentive to the needs of the patients and seek help from ward staff as required.

12) Documentation

At the end of each session, please take time to complete the necessary documentation. It is important to log the activity as soon as the session is completed, to prevent error in recalling. Accurate documentation helps prevent bias in a study and is a legal requirement of intervention or care giving.

Role of the therapy team

1. Identify suitable patients and determining mobility level
2. Communicate with nursing staff regarding patients mobility level
3. Clearly identify patient walking aids
4. Ensure appropriate exercise resources are available
5. Assist in the training programme for volunteers and ensure competency

Role of the nursing team

1. Identify suitable patients, guided by the therapy team
2. Ensure patient medical stable to participate with intervention
3. Provide help and support to volunteers as required

Acknowledgement: Adapted from the Hospital Elder Life Program: Early Mobilization Program and the Sunnybrook Health Science Centre. Mobility Volunteer Program Orientation Module by Rachel Leyland and Hannah Wood, University Hospital Southampton Medicine for Older People therapists.

Appendix 15

Exercises

Arm exercises to strengthen your muscles

These exercises can be done in your chair, or sitting up in bed. Try to repeat the exercises 3 times a day. If you experience any pain, stop and tell your nurse or therapist.

Roll your shoulders forwards in a circle

Repeat ____ times

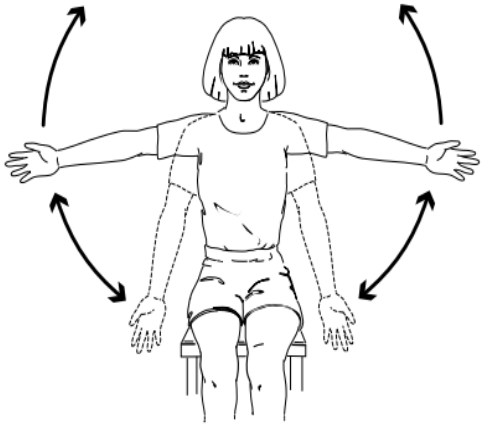
Roll your shoulders backwards in a circle

Repeat ____ times

Start with your arms by your side, with palms facing each other

Raise your arms up in front of you as far as you can

Repeat ____ times



Start with your arms by your side, with thumbs facing up

Raise your arms out to the side and above your head as far as you can

Repeat ____ times

Start with your arms by your side, palms facing forward

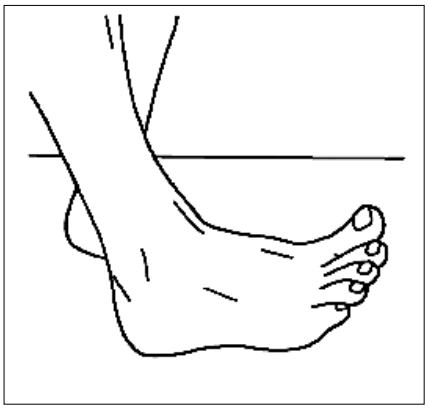
Bend your elbow so your palm touches your shoulder

Straighten your arm fully again

Repeat ____ times

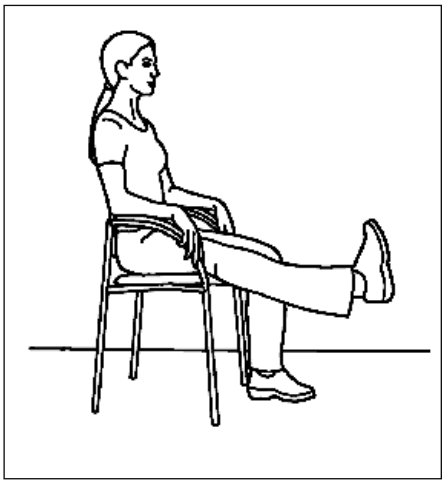
Chair exercises to strengthen your muscles

These exercises should be done when sitting in your chair. Try to repeat the exercises 3 times a day. If you experience any pain, stop and tell your nurse or therapist.



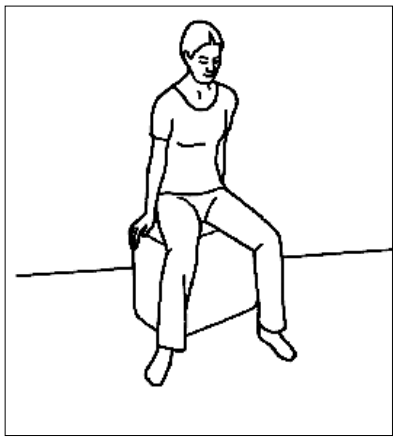
Circle your ankle in one direction, and then the other

Repeat ____ times on



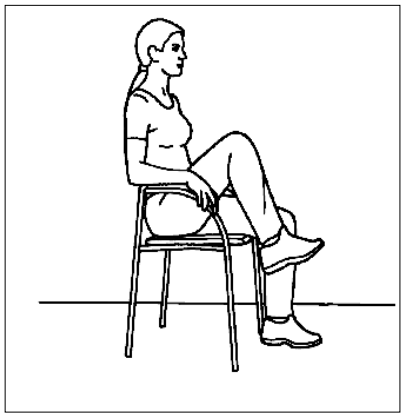
Straighten your knee and keep it straight for ____ seconds

Repeat ____ times on each leg



Take your leg out to the side and then back to the middle again

Repeat ____ times each leg



Lift your knees one at time (like marching but sitting down)

Repeat ____ times

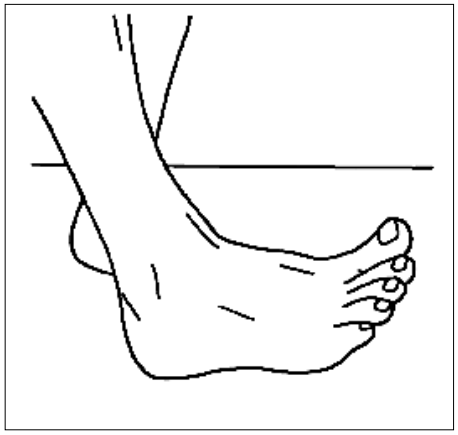
Squeeze your bottom cheeks together

Hold for ____ seconds

Repeat ____ times

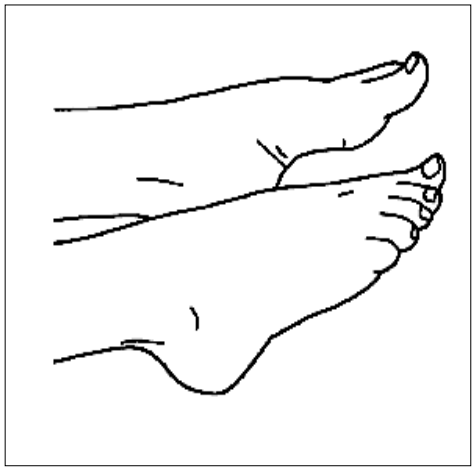
Bed exercises to strengthen your muscles

These exercises should be done on your bed. Try to repeat the exercises 3 times a day. If you experience any pain, stop and tell your nurse or therapist.



Circle your ankle in one direction, and then the other

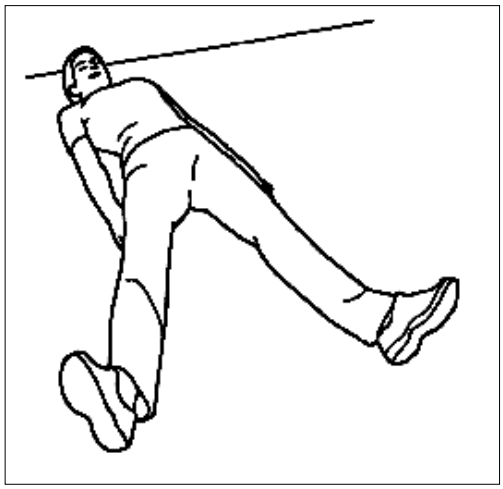
Repeat ____ times each leg



Point your toes away and hold for 3 seconds

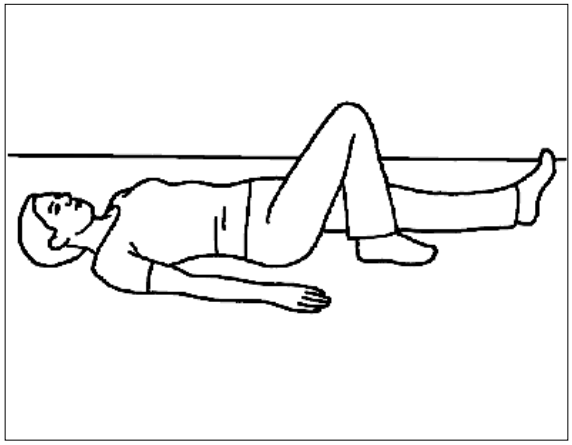
Pull your toes towards your shin and hold for 3 seconds

Repeat ____ times each leg



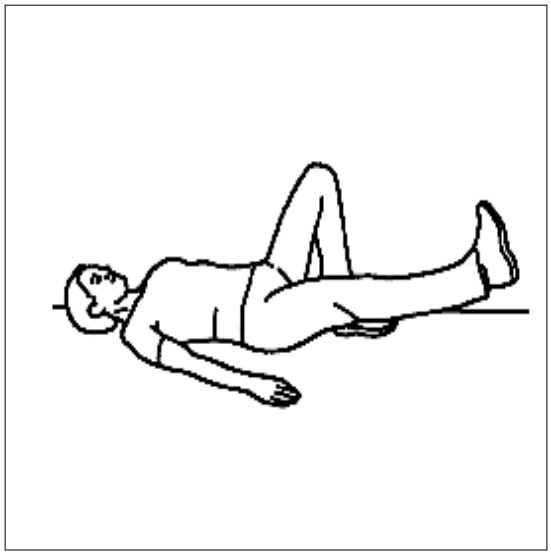
Take your leg out to the side and then back to the middle again

Repeat ____ times each leg



Bend your knee up and then straighten it

Repeat ____ times each leg



Lying on your back, pull your toes towards you and brace your knees down firmly against the bed

Hold for ____ seconds

Repeat ____ times

Appendix 16

Physical activity chart

Activity Prescription "So MoVe" project

Patient sticker

Prescriber details:

Name:

Position:

Date & Time:

Mobility

The patient can be mobilised (please tick):

To the end of bed and back ☐
To the doorway and back ☐
To the bay window and back ☐
To the nursing station and back ☐
To the toilet and back ☐
To the ward entrance and back ☐
Approximate distance…….

Mobility aid

No aids required ☐
Walking stick ☐
Wheeled walking frame ☐
Walking frame without wheels ☐
3 wheeled walker ☐
4 wheeled walker ☐

The patient can repeat this activity……..times over ……period

Additional Information regarding
mobility……
……
…..
……
…..
……
……

The patient should be encouraged to undertake the following exercises
NB – not all appropriate exercises for this patient. Patient must have sets and repetitions documented
e.g. 2 at 8 means patient can do 2 sets of 8 repetitions (= 16 times) with a rest in the middle

Bed Exercises

Exercise	Sets of reps
Bridging	
Hip Flex	
Hip Abduction	
Static Quads	
Ankle Pumps	

Other comments:

Chair Exercises

Exercise	Sets of reps
Ankle pumps	
Knee Extension	
Leg exercises	
Marching	
Bottom squeeze	
Shoulder exercise	
Arm raise	
Arm abduction	
Arm flexion	

Please refer to laminated exercise templates for instructions

Patient sticker

Once the patient has completed all ………… Volunteer sessions please inform the ward therapist to enable the prescription/ plan to be reviewed. Thank-you

PLEASE COMPLETE AFTER EVERY PATIENT INTERACTION

	Total time spent with patient	
Name: Signature: Date/ time: Patient consent gained Y ☐ N ☐	Total distance walked Seated rest required	Bed exercises completed Chair exercises completed
Additional comments:		

	Total time spent with patient	
Name: Signature: Date/ time: Patient consent gained Y ☐ N ☐	Total distance walked Seated rest required	Bed exercises completed Chair exercises completed
Additional comments:		

	Total time spent with patient	
Name: Signature: Date/ time: Patient consent gained Y ☐ N ☐	Total distance walked Seated rest required	Bed exercises completed Chair exercises completed
Additional comments:		

Appendix 17

Interview schedule for patients

	Questions	NPT concepts
1	Demographics including patient's age and pre-hospital functional status. • How far can you walk? • Mobility aid • Independence in activity of daily living	
2	What do you think about walking or being physically active in hospital? • Are there any potential benefits? • Any potential harm?	Coherence
3	In your view, what are the things in hospital which may encourage patients to be more active? • What are the things in hospital which may discourage patients to be more active? • Explore hospital systems, personnel including healthcare professionals	Coherence
4	What do you think of the way hospitals currently help people in hospital to stay active? • Is it sufficient? • What works well and what doesn't.	Coherence
5	What kind of activities did you do with mobility volunteers? • How easy was it to perform the exercises or walk on the wards? • Were there any barriers?	Cognitive participation
6	What do you think about trained volunteers helping patients stay active in hospital? • In what way were they helpful or unhelpful to you? • Were there any benefits? • Were there any negative experiences? • Were they able to encourage patients to be more active?	Reflexive monitoring
7	What do you think about the timing and frequency of the volunteers' visits?	Reflexive monitoring
8	Do you have any suggestions or comments about the volunteers helping patients? • Any changes or improvement to be made?	Reflexive monitoring

Interview schedule for volunteers

	Questions	NPT concepts
1	Tell me a bit about yourself and why you chose to volunteer as a mobility volunteer.	Coherence
2	Tell me about the training programme which you received? How easy was it to understand/make sense of all training components? • What went well? • What was not so good? • Would you change anything?	Coherence
3	What benefits will the intervention bring to patients in your opinion? • Do you think that patients understand the purpose of your role? • Do they see the point of the intervention?	Coherence
4	What do you think about the role of a mobility volunteer? • What do you enjoy most? • What is less enjoyable? • What difference do the mobility volunteers make? • Are there any negatives about it? • What do you think about the timing and frequency of your visits?	Cognitive Participation
5	Describe your experience on working together with the nurses and therapists. • Were you adequately supported? • Do you feel appreciated by them? • How does your role fit with other activities in the wards? Timing of intervention? Working with other staff? • How does the intervention affect the work of other staff on the word? Did it impede or promote their work?	Collective action
6	How do you find the experience of mobilising patients? • Do you think that you were able to help older patients be more active? • What difference do the mobility volunteers make? • Are there any negatives about it? • How other staff perceive the intervention on their wards?	Reflexive monitoring
7	Did you experience any difficulty or uncertainty helping patients mobilise? • Were there any barriers/hindrances • Anything that facilitated or helped?	Reflexive monitoring
8	Do you have any suggestions or comments about the volunteer programme? • Any changes or improvement to be made?	Reflexive monitoring

Appendices

Interview schedule for nursing staff

	Questions	NPT concepts
1	Can you tell me about your role in the care of hospitalised older people? • How many years of experience do you have?	
2	What do you think of the current physical activity levels of patients in hospital?	Coherence
3	What do you think about the services currently provided to encourage patients in hospital to be more active? (before the introduction of the volunteers) • What works well? • What can be improved?	Coherence
4	What are your thoughts on the use of trained volunteers in encouraging older inpatients to stay active? • Any particular benefits for patients • Any negatives? • Any benefit to staff members? • Overall view.	Coherence
5	Describe your experiences of working with the trained volunteers. • Were they helpful? • Any concerns?	Cognitive participation
6	Has the volunteer programme impacted on the work load or work pattern of the nursing team? • Any positive impact/ were they helpful? • Any negative impact • Were there any difficulties which arose with the volunteer programme?	Collective action
7	How useful did you find using mobility volunteers on the wards? Any concerns? • Are there any changes or improvements that would you suggest to make the volunteer programme more sustainable in hospital or in other healthcare settings?	Reflexive monitoring
8	Are there any changes that could be made to the volunteer programme to better compliment the current practice of mobilising older people?	Reflexive monitoring

Interview schedule for therapy team

	Questions	NPT concepts
1	Can you tell me about your role in the care of hospitalised older people? How many years of experience do you have?	
2	What do you think of the current physical activity levels of patients in hospital?	Coherence
3	What do you think about the services currently provided to encourage patients in hospital to be more active? (before the introduction of the volunteers) • What works well? • What can be improved?	Coherence
4	What are your thoughts on the use of trained volunteers in encouraging older inpatients to stay active? • Any particular benefits for patients • Any negatives? • Any benefit to staff members? • Overall view.	Coherence
5	Describe your experiences of working with the trained volunteers. • Were they helpful? • Any concerns?	Cognitive participation
6	Has the volunteer programme impacted on the work load or work pattern of the therapy team? • Any positive impact/ were they helpful? • Any negative impact Were there any difficulties which arose with the volunteer programme?	Collective action
7	How useful did you find using mobility volunteers on the wards? Any concerns? • Are there any changes or improvements that would you suggest to make the volunteer programme more sustainable in hospital or in other healthcare settings?	Reflexive monitoring
8	Are there any changes that could be made to the volunteer programme to better compliment the current practice of mobilising older people?	Reflexive monitoring

Appendix 18

SoMoVe: Focus Group - Volunteers


Coherence


Cognitive participation


Collective action


Reflexive monitoring

Interviewer:

So thank you very much for attending the Focus Group and we really value your input, and your help as volunteers in the, in the SoMoVe programme. Now

Answer:

(female)I'm sorry but do you want us to say our names before we speak would that help?

Interviewer:

That would really - no

Answer:

(female)No, no, I'll shove the pen down. That's okay.

Interviewer:

Interviewer X will take notes as we go.

Answer:

(female) sorry, okay

Interviewer:

I'm going to start by asking the first question and chip in as we go along. Now what were your thoughts on the volunteer training programme? So when you received the actual training any feedback at all about the training programme?

Answer:

(male) um, I, I thought it was pretty good. Um, especially the bit where we actually went, pretended to be a patient or we had somebody pretending to be a patient go up and have a, have a sort of an approach (um) and go through perhaps standing, walking, um, that was good. A good sort of beginning to how to approach, um the safety aspects, and also the courtesy aspects (um, um) or going up to the patients and I thought, I thought that, that was good. That was good, useful, (um) very useful. **(Reflexive Monitoring/ Usefulness of practicing with one another)**

Interviewer:

Thank you.

Answer:

(female 2) it was good that we actually went on the ward and tried it out with an actual patient as well. **(Reflexive monitoring/ Practising with actual patients)**

(male) absolutely. With supervision of course which was another bonus as well cos then you start to feel a bit more confident when you approach somebody making sure things are correct and remembering all the different sections we were taught (yeah) and um **(Reflexive Monitoring/ Usefulness of close supervision)**

(female) um, I think that is, that is the aspect of remembering everything through the training session. Um, I'm somebody who works at um, how you say, concrete operations stuff, and sometimes for something which is totally brand new, cos you might have done something else which might have had some similar skills, but for me to actually make sure that the patients are doing the correct movements. Um, perhaps a little video, I mean we have all the sheets with the exercise, with all the different forms of exercises on. That's good for the reminder, although I look at them and keep thinking 'oh what's this one'. Um, if you had a little video, which sort of said 'this is what we want the patients to do'. So for example, especially with you know, say the shoulder movements, you know, gosh is it the rolling movement, the rolling bit?

Um, there's obviously an aim to get, to actually get the patients doing a particular range of movements (um). And so for me to actually see that to see that, see that particular movement over I could make sure that I was getting the patient to do it, to actually get the best benefit (ah, hum) out of it. Cos I look at the, I mean it's um I look at the sheets with the exercises on (ah, hum) and I think 'oh which one's this?' I mean it's good that we've actually got the, the, um, those information sheets (ah hum, ah hum) in with the patient's um details **(Reflexive monitoring/ Usefulness of visual aids)**

(male) yeah, yeah, they're actually

(female) as to what they actually need to do (ah hum ah hum). But it's that aspect of thinking 'Aw, which one, which exercise was that and

Interviewer:

So something more visual might help?

Answer:

(female) yeah, something more visual might help as to what the expectation because um, the two don't, the um drawings do so much(ah, hum, ah hum)and if so, when I work on those patients, I mean ah, is this what is really needs to be, to be done, to actually make sure that (**Reflexive monitoring/ Benefits of visual aids)**

Interviewer:

And by enlarge do you think that the um training programme has um adequately prepared you for your role and what is expected of you in the ward? Not just on the day, but the, the competencies and everything?

Answer:

(female) yeah I think, I think so. I think it depends on whether you do other, other volunteering roles therefore you're used to particular systems **(Collective action/ Training complements with other volunteering role)**

(male) yeah, used to being on the ward

(female)Yeah, used to being on the ward, and actually you know, the handwashing and the cleanli, you know, that side of the um, you know, keeping clean so you're not putting the patients at risk. Um, so yeah, the, the, that's always a good reminder for volunteers (um) as to what they actually need to do with a particular patient. **(Coherence/ Importance of training)**

Interviewer:

So a bit of experience in volunteering

Answer:

Yeah

Interviewer:

really helps in your role?

Answer:

(female) yes it helps.

(male) in this role

(female 2) yes but I'm not too sure as to how

(female) are you a brand new one?

(male) no, no, I was er volunteering, I was volunteering beforehand

(female) oh right

(male) I was doing it for some time

(female) yeah I've done that, so I did some, yeah yeah

Interviewer:

Okay

Answer:

(female 2)Er, I was thinking on the handouts that you gave us with the pictures of the exercises it could say on there, I, I think one of them is on flexion and I can't remember, there's different terms for it (um). And on the um prescription for the patient it says those different terms but it could, it could actually

Interviewer:

say on these.

Answer:

(female 2) yes on these **(Reflexive monitoring/ Clearer exercise sheets)**

Interviewer:

Okay

Answer:

(female 2) you know so we'd know for sure whether they

(male) or perhaps if there are any like, really important um points that the exercise (ah, hum) for example if there's, if there's a common thing that they might do that would negate the benefit (ah hum) thinking like the ankle rotations that they might start moving the leg **(Cognitive participation/ Importance of getting the exercise right)**

Interviewer:

The whole leg.

Answer:

Yeah

Interviewer:

Okay, that's a good point.

Answer:

(male)I try as much as possible to look after patients

Interviewer:

Yeah, of course.

Answer:

(male) the ankle rather than moving the whole leg. It's if there's like a really important point that's... . Might be worth

Interviewer:

Thank you. So we're going to ask our second question. And the question is – could you describe your views and your experience on carrying out physical activity and interactions with older people on the wards.

Answer:

Sighs and giggles

(female) some of them, some, some of the patients can be er challenging, (ah hum) because they're resistant to do the actual um exercise (ah hum) or do anything full stop. **(Reflexive monitoring/ Lack of motivation from patients)** Um so that's, that's one of the challenges to

actually try to get them to do something anyway as opposed to saying 'I'm tired' and I mean they might be tired, (ah hum) but perhaps I'm a cruel taskmaster. (laughter) And actually trying to get them to, like touchy, floppy, flog the actual benefits of actually doing the, doing the exercises, let somebody else do. **(Cognitive participation/ Encouragement from volunteers)**

(female 2) Um, I think once I went to a patient and he was feeling quite tired but there was a member of staff there, er a nurse or somebody and, and that person sort of encouraged (um) him and got him going. So I suppose sometimes you can get a bit of help from other staff, you know, from staff that might be there (ah hum). Um, um, yeah it's always nice when they're keen to do the exercises isn't it? **(Collective action/ Support from staff)**

(female)I had a keen lady, very keen lady. **(Cognitive participation/ Motivated patients)**

(female2) oh, was that the lady that had been doing, um, keep fit for 40 years

(female) and was a gold medallist dancer and loved the foxtrot.

(female2) yeah that sounds like the one. Yes, and she, she, she was actually

(female) she was eighty

(female 2)I don't know, I didn't like to

(female)I asked her age

(female2) No I didn't ask the age

(female) I asked her age, I illicit all sorts of information. (laughter)

(female 2)but she was definitely the one, the one who made the most, an effort with it **(Cognitive participation/ Motivated patients)** and it made me think how important exercise is. Because if she'd been doing keep fit for 40 years and she was so, she was the best of all the people I've been to at doing the exercises. So it made me think that well, you know, it just shows how important exercise is. **(Coherence/ Importance of exercising)**

(female) And it's interesting that there's issues about these mobility scooters, and how people think they're a good idea but there's a certain group of people who only make their condition worse because they actually just put on weight, cos they're actually not moving not taking the exercise, therefore it's, it's a bad idea. And actually had um, the particular patient who was reluctant to do exercises, but in conversation um, after his wife died he's taken to using the chairlift which was actually put in for her, but he's actually taken to actually using that all the time. As well as some of his wife's mobility aids. So he, he could probably do a lot more activity,

but he's not (um, um) so. I did tell him to stop using the lift. (laughter) I said it won't benefit you long term, come on you've got to keep yourself moving. **(Coherence/ Importance of exercise)**

Interviewer:

So by enlarge you, you know, they do need a bit of encouragement

Answer:

(female) they do need encouragement. I think if you do other things like you've done time, if you've done meal time assistant. It's, it's those patients you actually see around the hospital, so 20 per cent of the patients on the ward where I do meal time assistant last week were actually MOP patients. And that's what, you know, as opposed to the actual specialism but the actual designation of that particular ward. So, so, you know, there are a number of um older people who could probably, rather than be just sat in their chairs, be encouraged to actually do some form of movement. Not necessarily everything that we've got, but some form of movement just to keep their circulation going and all those sorts of things. (ah hum, okay)(**Cognitive participation/ Patients need encouragement)**

Interviewer:

Now, we'll move on to our third question. Did you experience any difficulty or uncertainty during the delivery of the intervention or was it fairly straightforward?

Answer:

(female) I think, I don't know about the others, sometimes I actually find the person who's in charge of that particular bay, just to make sure that that person is fit, and it's actually okay to do the exercise. That's the most challenging thing to actually do is to find that person so before you start off doing anything, (ah hum) that you've actually checked. To make sure that particular patient **(Reflexive monitoring/ Challenge of finding the right nurse)**

(female 2) yeah

(female) is okay (ah, hum, ah hum). I'm not too sure as to what information has been provided to the, the, the nursing staff and medical staff, about the role of the, the mobility volunteers. To make sure they're aware that we're just not somebody else who has a blue t-shirt and has come along to, but we're there actually for a particular purpose. **(Reflexive monitoring/ Information provision)**

Interviewer:

So the um older, so the wards G7, G8 and G9 in particular, the nurses' lead would know of the study.

Answer:

(female) Right.

Interviewer:

Their role is to disseminate down to the nursing staff and each time when a patient is recruited I would inform the nursing staff, so also on top of that I have prepared a circular, a very brief circular, about SoMoVe and each nursing staff, nursing member of the ward would receive that to inform them about the research project.

Answer:

(female) right, that's okay. It's still a matter of finding, going on a particular

(female 2) well cos see you know the different shifts which people do, you might not speak to the same person for a particular bay, there's sort of, both the weeks, so I just sort of find just to, just to double check just to make sure this particular patient hasn't had some major medical issue overnight (ah hum). **(Reflexive monitoring/ Challenges of different shift patterns)**

Interviewer:

Are there any other sort of areas or facilitators to your role a volunteer on the wards?

Answer:

(female) Yeah, all the trolleys around. Sometimes (laughter) when you're, when you're trying to yeah(laughter) encourage somebody to actually walk, um, and then you, you might have the cleaner who's trying to clean the floor and moving everything into your way, you know, those but as I say, all those extra trolleys that they stick out in the corridors. It's when you're trying to make sure your patient, you're guiding along, isn't (um) put at risk. **(Reflexive monitoring/ Ward environment as a barrier)**

Interviewer:

And in some circumstances can you see the importance of the role of the volunteer, because if it's challenging for the volunteer, you know, it will be more so for the patient

(male) and on their own

Interviewer:

and on their own.

Answer:

(female) yeah

(male) and struggling to get around the ward.

(female) because the actual patient, um, probably they've got that reluctance to move because they know when they're at home that, they know the layout and they know the risks. But when you're in a different environment, (um) um and you've got all these trolleys and people and everything else that's not very, its, its, it's a backward. Actually patients coping with that risk of (um, um) moving around, you know moving around **(Reflexive monitoring/ Strange environment as barrier to mobility)**

Interviewer:

Okay. Now do you think that the intervention was able to promote and increase, activity, physical activity among our patients?

Answer:

(male) um I think so, I think so. People, I think, even other sort of patients see other people walking around (ah hum) and getting benefit of the volunteering they become interested. And on the ward people sort of try to join in like when we're sat down doing that sort of thing. So I think it does kind of promote (ah hum) um this idea of moving around and getting a bit of exercise. It's something also for people to do in hospital cos a lot of them when they're sat in the bay are sat there quite bored (um) **(Reflexive monitoring/ Benefits to patients)**

(female)Yeah

(male) and we come on the ward and patients can see us doing some exercises, joining in thinking it's a bit of fun, (yeah) something, something to do. (ah hum) Yeah so I think it does. (ah hum, ah hum) **(Reflexive monitoring/ Benefit to other patients)**

(female 2) comments

(female) I mean it does make you think about, just generally um, when patients are admitted that they're they're just, you know… how much encouragement are they actually given to actually think about moving? Because often they've, we've often found, I know from the um, they move

patients from the bed to the chair to actually but it's those other little things that, that might not um, er, be too risky which could encourage people to actually do. (um) But it is sort of we're twiddling your ankles. I mean, I mean I don't know about you, but I go through, apart from bed exercises, I'll sit in the chair and do all the exercises **(Coherence/ Patient encouragement)**

(female 2) I know

(female) just to make sure that I'm actually

(male) to demonstrate

(female) yeah just the demonstration, well not only the demonstration but

(male) but doing it

(female) it keeps me active

(male) absolutely

(female) it keeps me supple (giggles). Benefits of doing the exercises **(Reflexive monitoring/ Benefit to volunteers)**

Interviewer:

So you get the benefit as well?

Answer:

(female) I get the benefit as well by actually doing some **(Reflexive monitoring/ Benefit to volunteers)**

(male) …

(female) er you know, yes (laughter). My counting's, my counting's not very good though (laughter)

Interviewer:

Now what do you think of the timing and the frequency of your visits? Are they quite appropriate times you think?

Answer:

(female 2) like I think the time that I do it is good. It's um 11 o'clock so it's before lunch, um, you know as a mealtime assistant I notice that quite often patients, after they've had their lunch, they

just want to have a rest or go to sleep. So I think doing it, before lunch is good time isn't it (ah hum, ah hum). **(Reflexive monitoring/ Good timing)**

(female) yeah definitely. Mine's before lunch, although I say to the patient 'you could do these any time you're sat on your chair you can'

(male) absolutely

(female) absolutely, do do your exercises

(male)Practice. I think it's more challenging, from what, from what I've heard here, since I changed from doing both shifts (ah hum, ah hum) just doing the afternoon shifts. It is more challenging in the afternoon. **(Reflexive monitoring/ Challenging timing)**

(female 2) right

(male) it is (ah hum, ah hum). Cos people, not only that people get a bit tired after, but also they've had a big lunch (um) and they don't like doing much (ah hum) and then sometimes you got rest periods on wards and that sort of thing (um) so it's quite a difficult um, difficult judgement call as to when's the best actual time to go and (um). I think, at the moment, sort of between 1 and 2 (um) half past two seems to be a good time. (ah hum, ah hum)Because some people you do get 'oh I've just had lunch' and that sort of thing (um). But then if you come back a little bit later on I say 'I'll try again in half an hour, see how you feel in half an hour'. (um, ah hum, ah hum). Um often they'll be okay. (okay) okay and we'll do it then. But then other people, you want to catch them before they have a rest on the bed, cos once they're in the bed they don't want to get out, do they (no) so (ah hum, ah hum) no so I think it's about the right time yeah afternoon. (yeah okay) **(Reflexive monitoring/ Barriers from patients)**

(female)Actually I've just thought of something. Not within this question, I think it was one of the other questions. Um there's some of the exercises if you've got a patient sat in their armchair, (ah hum)and they don't want to move in their armchair, there are some exercises which can be difficult for people to actually do, because there is some

(female 2) yeah

(female) there is like the, there isn't, like the space, **(Reflexive monitoring/ Lack of space)**

(male) yeah, yeah sort of

(female) there isn't the space to actually

(male) yeah not a little bit

(female) yeah that's the

(male) especially for the arms

(female 2) yeah, so they have to do sort of one arm in front, one arm at the side don't they?

(female)Yes, that's, that's a difficulty to, um, some of the exercises, it's the actual space where they're actually, you know, sat on the chair. We want them to stay sat on their armchair, we don't want them just sat on a stool trying to do the exercises (no)but I think it is that range of exer, like can you. When, when whosever prescribing the exercises, can you actually do all those exercises in a chair with arms? (ah hum, ah hum). That's the, that's the, the aspect. It's the one where they move the legs, you can't do that one very well with a

Interviewer:

Because of the arm

Answer

(female) because of the arms yeah, **so (Reflexive monitoring/ Lack of space)**

(female 2) yeah, yeah. It was a bit worrying with one of the patients I was with and she sort of shuffled forward in the chair so that she could do the exercises easier and I thought 'oh I hope she's safe'. I mean she was, she knew what she was doing (ah hum) but I didn't. I feel a bit worried. Is she going to shuffle forward a bit too much? **(Reflexive monitoring/ Concerns about falls)**

(female) a bit too much, yeah

(female 2) you don't want them to shuffle forward a bit too much

(female) the v further things. So yeah, sorry it just suddenly occurred to me about the, actually carrying out the exercises and on what.

Plus, that's the thing, if you've got bed exercises, it's the other aspect is making sure they can safely get on the bed. And, or if they want to get off the bed (ah hum, ah hum) that they can safely get off the bed. I don't like, like go getting a member of the nursing staff to say whoever it is wants to get back into their chair is that okay? Cos, or get them, cos I'd hate them to have them fall (yeah) that's the thing**. (Reflexive monitoring/ Concerns about falls)**

Interviewer:

Okay. Now um, in terms of thinking about the intervention on the wards, what other improvements would you suggest for the intervention or to make it a, work as sustainable in a hospital?

Answer:

(female)(whispering) that's a good question.

(pause)

(female 2) well is suppose that's one way it could be improved, what we've just been talking about, if that could be if the patient could be move to a part of the bay where there was a bit more space. (ah hum, ah hum) Not just sitting next to their bed**. (Reflexive monitoring/ Need for more space)**

Interviewer:

So an area where there's more place, more space to do, to do exercises?

Answer:

(female 2) well I suppose it would, maybe in some cases, it would need a member of staff to help the patient (ah hum) get up and (ah hum) move the chair over to the area.

(female)Yes it is that, it is the space bit I think more than anything. **(Reflexive monitoring/ Need for more space)**

Interviewer:

Would you think something like um, a group exercise in a specific room. Is that kind of what you're thinking of or?

Answer:

(female 2) um

(male) that could be one thing

(female) or we could run our own keep fit sessions couldn't we?

(female 2) yeah.

(male) I think that would be a good way of getting more people (ah hum, ah hum) to do the exercises for the time given. (ah hum) If you get a set, quite a few patients then. (**Reflexive monitoring/ Group exercise)**

Interviewer:

Cos at the moment you're doing 'one-to-one'?

Answer:

(female) yeah

Interviewer:

Whereas a group session might give you more contact with more patients and actually to get more

Answer:

(female)Although, I suppose if we're on a bay we could always say to the others in the bay 'I'm doing exercises with Mr, but if you please join in if you fancy having a bit of a movement' or rather 'if you want' **(Cognitive participation/ Engaging with other patients)**

(female 2) yeah, but then it would have to be checked with the nurse again, wouldn't if, for if they were okay to do it.

(female)Yes. I think you would get, cos that's the thing isn't it. Because you're always checking all the time to make sure the patients' alright and as you're, when you're actually doing the exercises you're always saying 'are you okay, you alright? Shall we do some more?' Just to make sure they're not, it also themselves. **(Reflexive monitoring/ Patient safety)**

(male) if it was a group session, make it more a kind of, slightly more of a regimented part of the day if you see what I mean for the patient, they'd, it would be something they they didn't go do twice a day or whatever, so it would become more of their normal daily activities so might be more um agreeable to doing it? I don't know if it would become sort of, what, more part of the set part of the day (um) **(Reflexive monitoring/ group exercise)**

(female2) Yeah. I suppose it would have to be patients that could mobilise to the room wherever it was gonna be happening

(male) good. Yeah that could be, cos otherwise you have to get staff to move them

(female2) yes, and while they're doing other things as well I

(male) yeah, they're busy and that sort of thing. That could be a problem.

(female) I mean it's always like, I've just realised it's always a problem when you've got er, er a patient who's actually on a drip. (ah hum, ah hum)

(female 2) yeah

(female) I could, I got one patient the other week, before he got hooked up to the drip. So I got him to do all of his exercises (laughter) do all the arm ones, all the arm exercises before they hook you up on the drip (laughter). I sort of challenged him to try and do some exercises otherwise they end up doing one armed exercises (um, um) so I think so yeah so. (**Reflexive monitoring/ Barriers to mobility)**

Interviewer:

So that's one of the difficulty

Answer:

(female) yeah it is a difficulty if they're actually on a drip.

(female2) ah hum.

(female) most inconsiderate.

(female 2) I think the one-to-one is nice because, you know, they,

(male) um, it all helps

(female 2) it is how you like, their life history so that's what others doing the exercises have this kind of

(male) yes that is true. If you had a group session you might, you actually might lose that and

(female) yeah

(male) I think quite a lot of the patients really like that. In fact they're quite excited when you come round (um)and like to have a bit of a chat they say 'oh, you coming round tomorrow' (um, um, um). **(Cognitive participation/ Social aspect of intervention)**

(female 2) yes, no not till next Tuesday.

(male) yeah, yeah, all coming round. (um,um, um). But they really like that (um) social.

(female) it is the social

(male) and the

(female) cos you found that, the time for, it's that aspect of the social aspect. That it's so boring

(male) yeah

(female) being in hospital and to actually have somebody

(male) exactly

(female) who completely different and doing, um, not actually medical staff, is a volunteer who'll just chat away and doing things with them. (**Cognitive participation/ social aspect of intervention)**

(male) yes someone to listen to them

(female) yeah

(male) rather than telling them what they're going to do. (um)

(female) yeah

(male) to, they've got a bit more time to (ah hum, ah hum)

Interviewer:

That's very true.

Answer:

(female) so you can tell from talking, we found out you know, the, one of the patients was a, you know, did um keep fit for a long time. She was a ballroom dancer, you know, you just pick out little bits of

(female 2) information.

Interviewer:

And I suppose in some sense it makes your role interesting as well?

Answer:

(female) oh it does.

(female 2) yes it does for us

(female) yes that's nice for us. yes if you can actually get an interesting story, you think 'oh yeah that was'

(male) you get to know the patients a bit more. Like and that's nice as well (um) cos its, you've got that sort of connection with them. **(Reflexive monitoring/ Connecting with patients)**

Interviewer:

Very good. Right we're onto our last question now. Um, could you describe your experience of working with the nurses and physiotherapists? The, you know, whatever contact that you've had with them?

Answer:

(male) very positive I think. I think they've been, they've been always happy to sort of. When I've approached them they've always been very supportive. They've very approachable and always been very proactive sort of thing 'yeah, yeah that'll be good yeah'. (um, um) Particularly as I said, surprisingly perhaps, particular physio staff (um, um) the therapy technicians and that sort of thing (ah hum, ah hum) have been very helpful. Yeah they're always very helpful. (**Collective action/ Encouragement from staff)**

(female 2) yeah I've found them very helpful yeah. There was one patient that was in a bed and the um member of staff, I think it was a nurse, he insisted on helping get the patient out of bed and into the chair so he could do the (um) chair exercises. (very good) Yeah I think they've been very helpful yeah (**Collective action/ Supportive staff)**

(male) they've been very supportive.

(female) I haven't had much contact with the physiotherapy people as it were (um) but obviously with the nursing staff, the um, I mean there was one of who said 'I don't think you're get that one to actually do anything' and was amazed that I did get her to. (laughter) (um)

Interviewer:

That's really good. (laughter)

Answer:

(female 2) well sometimes they'll say I'll really busy, you know. There was one senior nurse that I was asking whether a patient was okay to do the exercises with me. She was so busy she said 'well you'll have to walk along with me you know' so I had to, you know, rush along with her while I was asking her what I was asking. (um). **(Collective action/ Busy staff)**

(female) that's the thing isn't it? Cos we have to balance that knowing that there may be that nursing staff might actually have a medical issue (um)

(male) that they have to deal with.

(female) that they have to deal with which is far more important than, yeah us trying to get a patient to actually their doing some sort of test or something or another (um), that's far more important.

(female 2) yeah. I asked, I asked a senior nurse once, and she said it'll be best to ask the nurse that's actually in the bay (um) because she knows how the patient has been that morning. (ah hum, ah hum)

(female) but it's actually tracking that person down for the bay, that's the thing, you know. I look at the board, and the pictures and the names and the faces and everything else and think 'oh, cos people never look like their photographs' (laughter) and sometimes

(female 2) you're so right.

(female) and to actually see what it says on their name badge (laughter) as well, to work out whether it's the right person so yes. Difficult. **(Reflexive monitoring/ Challenge of finding the right nurse)**

Interviewer:

And maybe in the future er, a thought of having volunteers assigned to each ward like what the MTA is doing, then you get to know the nursing staff better. That might be a, a way forward might it?

Answer:

(female) it depends on whether you've got enough for the patients as to actually do the. It's like you know I'll do the mealtime on a particular ward, and there was one week I went there was literally nobody who needed assistance (um). But I still, so I did, the time for you aspect. (um, um) to actually it's so boring being in hospital. **(Cognitive participation/ Social aspect of intervention)**

(female 2)yeah

Interviewer:

Okay, then just a follow on from that question – now do you feel appreciated um by the healthcare profession team?

Answer:

(male) yeah.

(female) um

(male) certainly, definitely.

(female2) yes. **(Reflexive monitoring/ Appreciation from staff)**

(female) well I don't know. No, I wouldn't, I don't know yeah. I don't know whether I could actually (pause) like I'm trying to think

(male) anyone in particular?

(female) about any healthcare professional that has said to me. No I'm just trying to see whether I've had any healthcare professional say to me 'thanks for' 'that was good I saw Mr or Mrs whatever or saw her do that'. So I can't, I can't nod my head and say 'no'. (**Reflexive monitoring/ Lack of encouragement from staff)**

(male) I think I have. I'd say particularly from the, the more junior physio staff like.

(female) that's probably cos I haven't had the contact with the physio people. I've probably

(male) I've also noticed if I've asked some of the Staff Nurses if it's okay to do something an they've been sort of unwell that day or they don't think they're really up to it they'd say ' I'd rather you didn't, but thank you very much for coming and doing this'. I'm quite, that, that sort of comment.**(Reflexive monitoring/ Appreciation from staff)**

Interviewer:

It's a very variable experience and I think that might be dependent on

Answer:

(male) depends on the nurse, yeah, yeah. It depends on the member of staff

(female) yes it's dependent on the nurse. It depends on the staff on duty on that, you know, that, that particular session sort of thing and you know, what other pressures they're actually under. We're probably not top of their list (ah hum) for anything really, cos the patients are to them ((ah hum, ah hum) is.

(female 2) I don't think anyone's actually said 'thank you' to me, but I'm, I just take it in their attitude to sort of being helpful (um)I suppose I pick that as appreciation really ((ah hum, ah hum) **(Reflexive monitoring/ No negative experience)**

(male) sort of not having negative experience, or I could

(female 2) yeah

(female) yeah, yeah. Yes not having the experience or you're a blooming nuisance (laughter) for goodness sake. I can't have that, no.

Interviewer:

Well that's encouraging. (laughter) That's a good start. (laughter)

Answer:

(female) not you again (laughter)

(female 2) so if you have one of those days when so maybe everyone's asleep or they don't want to do the exercises. Do you find someone to talk to or

(female) find somebody to talk to or go back to the volunteer office and get a Time for You Sheet and see if there's somebody who is – just go and

(female 2)I don't have that happen very much but last week actually one person was fast asleep and somebody else was behind the blue curtains so I, so I spent most, well I'm only there for an hour but I spent most of the time going backwards and forwards between the two to see if one had woken up or to see if the curtains had been opened again. **(Reflexive monitoring/ Barriers to intervention)**

(female) cos I had an empty bed, I don't know where the patient was so (laughter) yeah.

(female 2) yeah, so just on those odd days I think it's only happened once really. Um, you know, you can feel or you know, I've made the effort to get here and don't really feel like I've done anything useful (um). Um, but there's probably, well yes there's only been one time that it's actually been like that really. Yeah.

(male) but especially as we come in and give them the opportunity for the person to do that. If they didn't want to do that it's fine, but if we didn't come in and do it then they wouldn't do it so

(female) yeah

(female 2) yeah. Yes and I suppose on the Wednesday that I come in anyway, I'm here to do the mealtime assistant work afterwards so, you know, it's not as if I've come here especially for this (um) that's it.

Interviewer:

So having two roles sometimes helps as well, more things to do?

Answer:

(male) yeah

(female 2)yeah, because, because I come from the far side of the city, I'm not going to come here every day of the week just to do a couple of hours, and so I do all my volunteering on one day. So I'm here all day on Tuesdays to do all my different volunteering roles. (**Reflexive monitoring/ Several volunteering role helps)** (ah hum, ah hum) Then I do other things on other days. (giggle) Not proper jobs but. I do my school volunteering on a Monday.

Interviewer:

Right, so that's it, I mean that's it for the um, interview , so thank you very much um for your time. Are there any last words at all or?

Answer:

(female) yeah there was something just came to my mind; I thought I must mention that you know. What was it now? Ah, oh dear. Oh I came in and thought oh I ought to mention that but it's gone.

(female 2) save it for the next meeting.

(female) no, no, no. it'll definitely be forgotten by then (laughter). That'll definitely, definitely be forgotten by then, what was it? It can't be (talking to herself) Well at least I've found a cupboard to actually put your bag in, that's helpful because when you're a volunteer here you're like a little nomad (um, um) and if you're bringing in a bag which has got various t-shirts in (laughter) where do I, I've actually got a, a key code now to bung it in the, bung it in the cupboard, it's quite handy

(female 2) yeah

(female) rather than having to, you know, cos I'm conscious about ensuring you're, everything above your elbows and those, those sort of things. You don't want to carry a jammy old bag

around. (talking to herself)Oh what was it? What's it to do with?)Patients? Medical people? No, it's no good; it'll come to me in the middle of the night (laughter).

(male)

(female) it will be. I'll walk along and think 'oh yeah that was what I was going to say' oh, oh. I didn't want to interrupt you when I actually ah, ah. No.

Interviewer:

Well thank you, thank you anyway.

Appendix 19

Framework analysis of interviews and focus groups

Volunteers Patients Nursing staff Therapy team

Themes	Codes	Transcripts
Coherence	**Awareness of sedentary behaviour**	• And it's interesting that there's issues about these mobility scooters, and how people think they're a good idea but there's a certain group of people who only make their condition worse because they actually just put on weight, because they are not moving or exercising. I had a particular patient who was reluctant to do exercises, but in conversation, after his wife died he's taken to using the chairlift which was actually put in for her. He could probably do a lot more activity, but he's not doing so. I did tell him to stop using the lift. **(V02)** • I think they were quite low. Personally I do feel they were not as good as they are now. There's more going on now than there was before. **(N04)** • Something has got to change. You've got to get them out. **(N03)** • I think a lot of patients need encouragement from members of staff or they're quite happy to sit there**.** Obviously there's the select few who are independent, and they only really get up to go to the toilet or go and have a wash, that kind of thing. They don't really get up to go and walk around or anything. They only get up if they need to or they're asked. But a lot of patients, they will happily sit in the bed or the chair all day without asking, yeah. **(N06)** • I think they're quite poor to be perfectly honest. You almost have patients coming in and whilst they're in hospital they tend to either sit on their bed, lay on bed or down by the bedside with a minimal amount of movement. **(T04)**

Themes	Codes	Transcripts
		• Normally if we don't do it there's not an awful lot to be honest **(T06)** • It's so like very, if they can walk out to the bathroom and the nursing staff know that they can do it well, then they might do that but, at the most that's it. Isn't it? **(T07)**
	Understanding the importance of exercise and mobility	• It made me think how important exercise is. Because if she'd been doing keep fit for 40 years and she was so fit, she was the best of all the people I've been to at doing the exercises. So it made me think that well, you know, it just shows how important exercise is. **(V03)** • Well I think it will help, hopefully, that they'll become mobile so they can go home faster. And when they are at home they can move around more and have a better life really. I think mobility's so important as you get older **(V05)** • As I say getting home is important because I know in hospital it's not very nice**.** The sooner they get home, I'm sure they are much happier**,** so the more they can move the more they can do at home and they won't need as much care **(V05)** • Yes. Everybody says to me 'I hope I look like you when I get to your age. How do you do it?' And I say 'well I just keep moving' **(P01)** • Oh, yes much as you can, I think really. Otherwise you stagnate, sort of stall don't you? **(P02)** • Well I think it's very necessary because you do sit about a lot. **(P03)** • Well yes keeping your muscles active **(P03)** • I think it's important. For somebody like me, who's physically fit. Just sitting here is not doing me any good **(P04)** • I think it's a matter of keeping the body mobile which is the important thing. I've been in hospital now 6 times with pneumonia and fortunately, and luckily for me, I'm physically fit I can get out of bed every day. Yeah, so to get somebody mobile I think is half the way to getting them better **(P04)** • I think it's important. It doesn't take long to start seizing up, does it? **(P05)**

Themes	Codes	Transcripts
		• My general demeanour really. You feel fresher for having exercised for a bit. **(P05)** • Well yes it keeps me muscles going. Yeah, I'm I don't get so stiff or anything like that **(P06)** • I mean the more active you are the better it is **(P06)** • Actually everyone should be up mobilising and doing that unless, contraindicated. **(N03)** • I think it's really important to stay active and try and maintain that baseline that they've got. If somebody only walks 10 metres at home, they can get them to walk 10 metres here, which is all they need to do and I think that's really important to try and maintain that level, at that baseline. I think it's really important **(N04)** • On this ward we do aim to sit patients out every single day if we know they can get up, they do walk to the toilet. It's all about promoting independence for us **(N05)** • I mean I work 13 hours a day in here, I go stir crazy. Some of these people are here for months; it is nice to be able to get them downstairs. It is nice to feel and say 'right come on, let's get up we're going to Carers Café' which is on the same floor. It's only at the end of the MOP corridor. So it's nice to say 'right come on jump up, let's get our frame, we're going for a walk to MOP' cos it gets them up and it gets them moving. So otherwise the only trip they do is from here to the toilet **(N05)**
	Understanding the value of the volunteers	• I think it's a very useful role because patients in the hospital don't often get the opportunity to exercise and having Mobility Volunteers means that they are getting something else that should be part of their normal life anyway, even while they're at the hospital**. (V04)** • I think the intervention will encourage the patients to mobilise more, because they aren't too strenuous. Although some of the patients are quite old, it does, it does give them the idea that there are other ways to exercise rather than just the standard running or being exhausted so it shows them that there are other ways to keep fit **(V04)**

Themes	Codes	Transcripts
		• So my role is to make sure the patients are doing some form of exercise when I am with them. And sometimes I also talk to them, if they want to talk as well because some people prefer to communicate to people that are helping them out. And I also just make sure that they're not in pain at any point during the intervention and I make sure that they're okay when I leave them. **(V04)** • Because if basically, if you can find voluntary people for it because you know you're hard up enough for staff aren't you? And they seem to be so busy, but if you've got volunteers like I've had…. they seem to enjoy coming don't they and it doesn't cost anybody **(P05)** • I think volunteers play a vital role within the hospital generally. I think they play a vital role definitely. **(N04)** • Like I said, talking about time before, we should have time but we haven't and they, that's the role they've been playing which is a very vital support role to us I think **(N04)** • I think, I think it's useful, it's an asset to the team. I consider them as part of the team. They're an asset to the team. Anyone who comes in and provides that extra bit of service, it's a good thing. **(N04)** • Yeah, definitely. I mean with the issue of staff and time, volunteers often work for free and they have their own time. They're not running round trying to do observations and notes and care plans and this and that with us, so they've got that time to be able to say 'shall we go for a walk round the ward'. 'Shall we go for a walk downstairs?' 'Shall we get in the chair?' How about we go outside for a little while?' They are brilliant because they can get people out **(N05)** • They only need someone to go and sit down and talk to them and gain their trust and actually, supervise them and walk to and from the toilet or walk down and get up and go and look out of the window or have a look round their surroundings **(T04)**

Themes	Codes	Transcripts
		• And they've probably, they've got more time really to spend with those patients whereas we're sometimes pushed for um, how long we've got to do the assessment with that patient. Actually they've got more time to spend with the patients whether getting them up and doing the exercises. **(T02)** • It's sometimes that patients are discharged from therapy because they are able to mobilise. They then might not do it on the ward especially if its busy and they're say partially sighted they can't see where they're going. A volunteer can come in and walk with them and guide them and say sort of 'oh mind that to your left there's something, there's an obstacle up here' and it gives them that bit of confidence to do a bit more as well which I think is so important. Because, it, like we said already, it's an unusual environment; it's a risky environment; there's brighter lights, there's slippery floors. There are different things that might put somebody off walking by themselves, especially if they're fearful of falling. And having that person with them can sometimes be a bit of a safety blanket if you like, to know they are safe to do it. **(T01)** • If they're doing what we were going to do, it's giving us more free time to see that patient who may need a bit more hands on treatment, who needs extra time **(T03)** • And the other great thing they can do is when they do the chair and bed exercises, because a lot of our patients for whatever reason will need prompts to do those chair and bed exercises. And with the best will in the world we don't have the scope in our service to go round and do those with every patient that we would like to do. Um because we have to be so focused on the discharges and that type of thing, but the exercises, they shouldn't be overlooked at all so having volunteers that can come in and prompt that, is brilliant **(T01)** • Ultimately if you've got volunteers coming into see the patients, potentially if we discharge them and then that's going to help prepare them for home as well, because if you've got somebody who's not really getting up much and we discharge them, and they're not getting up, then they've

Themes	Codes	Transcripts
		got to home and be walked to the toilet 5 or 6 times a day. But in the in between time they are just sat in hospital, sat in bed then that's hard if they're going to jump to going home and needing to walk all the time. If they've got the mobility volunteers, they could be doing more walking than if they weren't there. **(T02)**
	Perceived barriers to mobility	**Ward environment**
		• Maybe that's because we're old people on the G level of the hospital. Yeah, and they may not feel it totally practical to go walking downstairs something like that. But you know if I was on a lower floor I would want to go out, wander out without the shadow of a doubt **(P04)** • The only sensible one I can think of is patients are on the ground floor or the first floor up. Ground level, they can get out into the fresh air whereas it's a long journey from here G Level. So that's the only thing I can think of. I've lived in the fresh air fairly all my life and it hasn't done me any harm. **(P04)**
		• Most hospitals across the country got rid of their Day Rooms and places where you can go to. Everything nowadays everything is either clinical or office so it's, or their bedroom which means they've got nowhere to go to. **(N01)** • And it's still limited as to where they can go **(N01)** • We've also lost a lot of wash up facilities. When I started we used to have little cubicles which just had a sink and a shower and people would go and sit in there behind the door and just do their own little wash and that was the reason for them to get out of bed and walk to the bathroom**.** **(N03)** • Yeah you can get somebody up get them dressed get them all looking lovely but where are they going? **(N02)**

Themes	Codes	Transcripts
		• I don't think I'd particularly want to get up and get dressed if I was only going to be sat right in that chair and next to the bed anyway **(N02)** • Well one is, having somewhere to go **(N01)** • I mean there's not many places to go on this ward. **(N05)** • We are 6 storeys up so patients will find it difficult to go downstairs. A lot of our patients are Dementia sufferers; they do have confusion, UTIs, that kind of thing. It's all well and good saying 'yeah, they're mobile and independent they can go downstairs' but it's mentally as well, would they be able to get themselves back? Would they know where they were? **(N05)** • Well they haven't got a lounge or anything for them to go to. We can't have every patient sat in here**,** just not enough room. **(N05)**
		• They may get up to go to the toilet if they're able to do that, if not, everything comes to them. So their drinks, their meals, the social interaction is all encouraged to come to them at their bed space therefore it negates the need to actually get up and move **(T04)** • It's also a new environment to them, isn't it? It's not their own home. You've got bells, buzzers, people moving in and out, doctors in and out, nurses in and out, you've got a whole plethora of people and different things going on. **(T04)** • They don't know where they can go, what they can do. **(T01)** • And it's confusing. I mean it's bad enough sometimes going in as a member of the team with all the different, things that disorientate you, so I can understand why people actually feel safe within their bed space **(T04)** • Sometimes it's more of a confidence thing as well. You're in an alien environment, there's lots going on. **(T04)**

Themes	Codes	Transcripts
		• It's also from them being in an unusual environment and not then progressing and challenging themselves because, especially if they've come in with a fall, it's an increased risk isn't it on the ward. **(T04)**
		Time
		• We used to have more activities, particularly in Medicine for Older People. The plan was to get a room especially for more activities so patients could be brought round and things but that never happened. And I think over the years it's always been a plan, but obviously the wards are too busy **(N02)** • Like in the last year I think where we've had like the Dementia Team and the Enhanced Care Support Team haven't we? Trying to do a little bit more and the wards have got a little bit more structured with the Green Bays. Again, that's all very much dependent on how busy the ward is and the patients. **(N02)** • Who's got the time to do it? **(N02)** • Really to be honest it's like I said, it's not just the, the activity it's the company. It's that person who's got the time. In as much as we'd love to say that the nurses would have time to sit and chat and reminisce, give them that thing that makes them want to get up and do… You know, we're dealing with reality, nurses do not have time to do that anymore. All those days are gone and unless they reopen convalescence homes and units that they used to have when I started, which was the place where you could do it because you had more time. **(N03)** • Normally once the physios had finished that's when any physical therapy finished. With the best will in the world the nurses just haven't got that level of time to, to carry out ongoing plans for people in hospital. Yes time is a major issue at the moment. **(N04)**

Themes	Codes	Transcripts
		• Obviously we don't have time to get people in and out, in and out all the time, but we do try to make sure patients are sat out at least for their main meals, so lunch and dinner they are sat out for. Or even breakfast if they want to get up for breakfast as well. So they're not bad but there's always room to improve **(N05)** • If there's a patient and if they can get up and get in the chair then I encourage them to sit in the chair and, but the thing is we don't have time to necessarily see every patient and say 'do you need to go and have a walk or do some leg exercises?' **(N06)**
		Medical reasons
		• From my personal point of view I would be delighted to be doing an awful lot more, like I used to be, if it wasn't for my, my lungs now **(P04)** • (Limitations to mobility) only my breathing. That's the only thing **(P04)**
		• So for me it's the same as what they've said, but it's just that perfect storm that patients are sicker that they used to be, which means that the rehab and the niceties of moving, and that kind of social thing's gone in place of more intensive care focus. **(N03)** • And also the dependency you know. I know when I started training there was very few patients that needed 45 minutes to feed and I know there was only an occasional one. But a lot of them do need a lot more assistance and a lot of patients are now coming in from nursing homes where they're a lot more dependent prior to coming into hospital **(N01)** • Plus there's the added pressure from the tissue viability side. People aren't supposed to be in chairs for longer than 2 hours. So if you get someone out in their clothes and then you virtually have to put them back and people will be: 'I don't want to get rid of my clothes so I get back in my pyjamas'. In which case you get back and forth and it's a lot of effort for people who are often not well. **(N03)**

Themes	Codes	Transcripts
		Lack of staff
		• We used to have an activity lead as well, but that disappeared many many years ago which used to help on the wards. At the moment there's not really anything apart from Dementia Days. **(N02)** • The staff are now less than they were in terms of numbers **(N03)** • Unfortunately with 28 patients there's only so many members of staff you can spare to be taking them off the ward every day. It's just not possible **(N05)** • It would be nice to be able to get patients outside more but unfortunately, again time and staff; we don't have 28 members of staff to take each patient downstairs. **(N05)**
		• And the potential that when you get them up, there are not enough staff at times. The answer is obvious. Ward staff getting them up if they need more assistance **(T02)** • We did have the group exercise class that we've had running for a few months. 2 or 3 months I think. That has been okay but then again staffing has been the issue, because you need to have the proper staffing to support the number of patients to actively participate in, in the group session **(T05)** • We've tried quite a few times to do, like chair exercises in groups. And as (name) says it, they keep coming up against obstacles like the timing, not getting the patient, not having the staff. **(T07)** • Well I have been given a grant with the ILA to do my Otago Training and I have done that. I have made a proposal for Otago Base Exercise Group for MOP patients but that has always been on the back burner because there are other… I don't know staffing, like everybody says, has been an issue **(T05)** • Yeah, because I think when we piloted it we picked up G6's Red Room, because they've got a massive area there. There's a table where we could conduct the chair based exercises. But that's

Themes	Codes	Transcripts
		all dependent with how the ward is on the day as well. Just liaising with all the other patients from the other ward to go into them wards so yeah**.** So this takes the staffing, what the ward is like on the day. Nursing staff as well, because they might need to attend to unwell patients on that day **(T05)**
		Lack of encouragement from staff
		• I mean it does make you think about, just generally, when patients are admitted that they're they're just, you know… how much encouragement are they actually given to actually think about moving? Because often, we've often found, I know they move patients from the bed to the chair to actually but it's those other little things that, that might not be too risky which could encourage people to actually do. But it is sort of we're twiddling your ankles. **(V02)** • I don't think the ordinary staff would be aware of the importance of encouraging patients. As I've said, no I don't think they would. **(P02)** • I don't think they sort of mentioned it (in terms of encouraging patients to mobilise). **(P04)** • Not directly so. I mean anybody taking part in this research obviously works towards that but I don't think it's the first priority in the minds of the staff. **(P02)** • I don't get a lot of encouragement from staff members **(P03)** • But also in terms of probably experience and world experience more than anything. They wouldn't think of the whole picture of the patient getting about doing that because it's about task. It's about doing the observations, doing the wash doing the IV antibiotics that's it. They don't think actually this is a person. They live at home we'll leave them in bed for 3 days in a row. **(N03)** • (On encouraging mobility among inpatients) It's not really there is it? **(N01)**

Themes	Codes	Transcripts
		• So I think it depends on that relationship you've got with the Therapy Team. Apart from that there's not really anything is there though to encourage patients? **(N02)** • I think the only sort of service there is physiotherapy. Other services I don't think exists to help people mobilise**.** No, so I'm not aware of anything that's out there before, not really. **(N04)** • Sometimes with our patients when they get to a certain level and we discharge them from therapy, they don't have the stimulation from the therapists going in and saying' come one we're getting them up, we're getting them mobilising. They don't have that encouragement **(T04)**
		Lack of patient awareness
		• Patients don't necessarily want to get up either **(N01)** • I've had it recently where a patient declined to get up with the nurses, so they then asked me and a therapy technician to get them up. And I said if they were decline you they're going to decline me **(T03)** • Depending on the patient as to their personality, and their views on getting up, if they're initiating it but otherwise yeah, it's kind of you have two extremes really **(T06)** • I think there's still quite a big culture though that 'I'm in hospital I need to stay in bed because I'm poorly'**.** And even if these patients are medically fit they're still like 'no, I'm poorly, I'm in hospital I need to stay in bed' **(T07)**

Themes	Codes	Transcripts
		Lack of encouragement from family members
		• On the flip side though you do also get some of the relatives who say 'no my mother can't possibly get out of bed they're too sick' or too poorly and it's about kind of the education that actually… getting up, getting moving is going to help you get better quicker than staying in bed for goodness knows how long **(T01)**
		Fear of falls
		• I think those that need more assistance to move, where that person is more challenging, if they're walking with two, and that type of thing, it often doesn't happen because of that high risk of falling and fear of falling and the fear of injury and that type of thing as well for the more complex patients. **(T01)** • With the patient group that we've got in MOP they do need a lot of encouragement. Some of them who have been admitted with falls would need that reassurance, because after the falls their confidence level gone done. So that would be a factor of why they would stay in bed **(T05)**
		Misperception of responsibility to mobilise patients
		• When a patient is discharged from physio sometimes they think that's it. They don't bother. If they're able to walk out of the door they don't bother to continue it once. The patients assume that it's a physio that must come and walk them. **(T03)** • Sometimes I think we're perceived a little bit as a getting out of bed service. So we will often pick up new patients who may have been on the ward 2, 3 days that haven't got out of bed because

Themes	Codes	Transcripts
		the physio hasn't been to see them yet. There's a lot of sort of mind set of actually the physios are the only ones that can get people up and moving which is a complete myth, because everyone has moving and handling training. Everyone has the same risk assessment training. I think it's just a cultural **(T01)** • I think it's the Healthcare Professionals'. So you will hear people on the wards saying to the patients 'oh no wait till the Physio comes to get you up'… No you won't! **(T01)** • I think a lot of it is cultural thing from the, the nurse, some of the nursing team, the fact that the physios and the therapists have to walk them. **(T04)** • Oh they usually think that it would be the therapists who would get the patient out of the bed, to get them mobile **(T05)** • Mostly all our patients would need that extra bit of encouragement 'come on let's get you out now' which mostly would be coming from therapists **(T05)**
	Suggestions for improving mobility	**Education** • I think we need to be educating ward staff, nurses in as much as possible in that actually they can, you know, get patients out of bed and that when patients come into hospital there's no reason why they shouldn't be getting their baseline or asking the patient. For most of the time they ask us to get that information or get patients up when they're actually mainly the first port of call and they could ask the patients themselves or family to get that information not mainly necessarily down to us all the time. There may only be one of us per ward, when they're obviously a lot of nurses, and we're not here all the time. Nurses are there all the time and they could be asking for this information when patients come in, not leaving it for us to do. **(T03)** • And the generation that we've got coming through in Elderly Care at the moment, I think there's a lot of education we need to do there because they don't have that knowledge. And actually it,

Themes	Codes	Transcripts
		it's very prevalent in the younger generation as well, that they come into hospital and think 'that's it, I don't need to do anything'. **(T04)** • I feel like the, the nursing staff just need a bit more confidence about it and education to feel confident to get those patients up so they don't have to wait for us to get them up and assess them or walk to the bathroom. They could just do it **(T07)**
		Change in ward culture
		• There's also, I think, a huge change with encouraging patients as well. Back in the day, it was – you come into hospital you don't get up. You don't move, you're there to get well. You're therefore being in bed you get treated, and when you're better you leave hospital and that's when you, that's when you start your recovery. But the whole ethos I think, of medicine is actually changed now; it's the fact that they're wanting the shortest stays in hospital. We want people to get home as quick as possible and wanting them to be more active whilst they're in hospital. I mean, 10 years ago we didn't have the services where people went in and mobilised people in ITU and got them out of bed on drips and drains. **(T04)**
		Team working
		• I think a lot of that could be achieved by better joint working in terms of working with the MDT, to actually upskill people to increase their confidence with a whole manner of tasks really. Because it can work on both ways. Like I mean there's so much we can learn from our nursing colleagues about the sort of things we can do for patients when we're with them as well so it works both ways **(T01)** • So the nurses spend so much time with them and I mean on G7 at least then, getting into the habit of having the same staff and the same patients. It's about getting to know them. Yeah

Themes	Codes	Transcripts
		they're obviously the first point of call really a lot of the time before we're able to get to them **(T06)**
		Implementing activities for patients
		• If we had somebody who just, like I was saying, you know, just somebody on one unit who would do activities then actually they could go round to those patients that really need encouragement and do something, you know, do actually do it with them **(N02)** • Yeah really. It's like they do in Care Homes don't they when they have the activities co-ordinators. What do they do? The get the patients into Day Room, don't they? And they do stuff like Bingo or, you know the things that…. But it's just obviously having the person to do it with. **(N02)** • And more activities to do **(N01)**
Cognitive participation	**Commitment from volunteers in:**	**Encouraging and helping patients**
		• One of the challenges is to actually try to get them to do something anyway as opposed to saying 'I'm tired'. I mean they might be tired, but perhaps I'm a cruel taskmaster and actually trying to get them to do the exercises. **(V02)** • They do need encouragement. I think if you do other things like you've done 'Time for you', if you've done meal time assistant. It's those patients you actually see around the hospital. So 20 per cent of the patients on the ward where I do meal time assistant last week were actually MOP patients. So, you know, there are a number of older people who could probably, rather than be just sat in their chairs, be encouraged to actually do some form of movement. Not necessarily everything that we've got, but some form of movement just to keep their circulation going and all those sorts of things. **(V02)**

Themes	Codes	Transcripts
		• Although, I suppose if we're on a bay we could always say to the others in the bay 'I'm doing exercises with Mr, but if you please join in if you fancy having a bit of a movement' or rather 'if you want' **(V02)** • I said it won't benefit you long term, come on you've got to keep yourself moving **(V02)** • My eldest daughter was in hospital from the age of 3 to 25 here and I just felt that I wanted to give something back after the care she was given. And also having had parents, elderly parents that have had mobility problems I understood what was needed, and I just thought I could help in that way **(V05)** • I just like to help people. I guess most of my, most of my married life, I've been a carer looking after my daughter and the parents and I've missed that once they, they're all gone. I feel that it was coming back here and helping them, has helped me, you know, be part of a team **(V05)** • Well I like to hope that I'm helping them remember to do the exercises so I'm hoping I make a difference **(V05)** • If the patient doesn't want to stand up straightaway and do any exercises they won't just leave them to it. They'll actually sit there and have a chat with them. And then once the patients got to know them, they might warm to the volunteer and say 'actually yeah, I might do some exercises now' which is quite good. **(N06)** • So I've found them um, I've met a few different ones and actually each person that I've met has been really sort of engaged, with what they're doing **(T01)**

Themes	Codes	Transcripts
		Ensuring patient safety
		• It was a bit worrying with one of the patients I was with and she sort of shuffled forward in the chair so that she could do the exercises easier and I thought 'oh I hope she's safe'. I mean she knew what she was doing I felt a bit worried. Is she going to shuffle forward a bit too much? **(V03)** • Plus, that's the thing, if you've got bed exercises, it's the other aspect is making sure they can safely get on the bed. And, or if they want to get off the bed that they can safely get off the bed. I would go get a member of the nursing staff to say whoever it is wants to get back into their chair is that okay? Or get them to do it, because I'd hate them to have them fall, that's the thing. **(V02)** • You're always checking all the time to make sure the patients' alright and as you're, when you're actually doing the exercises you're always saying 'are you okay, you alright? Shall we do some more?' Just to make sure they are fine. **(V02)**
	Patients commitment	**Positive commitments**
		• I had a keen lady, very keen lady **(V02)** • She was definitely the one, the one who made the most effort with it. **(V03)** • I think quite a lot of the patients really like that. In fact they're quite excited when you come round and like to have a bit of a chat they say 'oh, you coming round tomorrow'. **(V01)** • I think so because they respect it and they also try their best to participate as far as possible **(V04)** • It's generally a pleasant experience because most patients are willing to do it **(V04)** • Yeah it's always nice when they're keen to do the exercises isn't it? **(V03)**

Themes	Codes	Transcripts
		• I have actually been asked twice by different patients, they wanted to do exercises. So I told the nurses to ask you whether they could um, be included in the programme. Because I didn't know anything about what they needed **(V05)** • I haven't had any problems with patients not wanting to see me. They normally asked their visitors to go for a walk or something while I'm doing the exercises. **(V05)** • And there was one gentleman that wanted to do the exercises with us in the other bed. He was watching **(V05)** • Others are really keen to do it and try to do it really well **(V06)**
		• No I would say just very grateful that you asked me to do it **(P01)** • I would have thought that, well depends on how you are of course. I suppose once you start, it's a case of make haste, slow beat; you know work your way... **(P01)** • It's not a drag. I think it's a jolly useful exercise to do **(P02)** • Well just the thought that I want to be more fit and able to get back to walking again so **(P02)** • I like to feel that now I'm doing it that I'm actively working towards the same end as the people who're setting them up exercises **(P04)** • So when the gentleman, whoever, comes to give me a few exercises I welcome it. I'm now able to walk to the toilet myself with the frame, which has given me freedom if you like**.** Yeah, rather than tethered to the bed. **(P04)**
		• I think I've seen a positive aspect as well. When you are actually in the bay and someone comes in, one of the volunteers, and they are mobilising and going through the exercises, other patients are trying to join in the exercises that they are going through. Quite often you hear people 'oh I wish someone would come and give me a walk. I wish I could get up and walk'. Or Mr so and so is doing very well, when are they going to come and see me?' So there is a lot of engagement from them, which I find really nice. **(T04)**

Themes	Codes	Transcripts
		Lack of commitment
		• Some of the patients can be challenging, because they're resistant to do the actual exercise or do anything full stop. **(V02)** • I mean when I first started I was seeing mainly ladies, and they seemed very very keen and the men weren't so bothered. But now, I'm seeing mainly men and they seem much happier. I suppose it varies from the patient to patient **(V05)** • Only the time when that one patient told me not to come back, but I think she had other issues going on and she was quite grumpy when I arrived. But I wasn't expecting her to tell me to go away and don't come back. But I didn't think I'd done anything wrong, it was just the way that she asked **(V05)** • So sometimes patients who straight up and just like say 'no'. It's a, not necessarily annoying but they seem to take really no interest in what we're doing for them. And obviously they have their own reasons for that **(V06)** • Some patients say: 'I can never walk again so what's the point of doing exercises for '? **(V06)**
	Staff engagement	• I think so our therapist on the wards is very proactive with making sure all the staff gets patients up**.** And I think she's only been with us for 4 months and I can see an improvement as well. And I quite like to get patients up so every patient that I look after, we get them up if we can. But that's really just dependant on who the staff are on the ward. I think it depends on the therapist that you have**. (N02)** • We've obviously got above the bed now how patients are transferring, which makes a big difference because that wasn't there. That's only since the therapists had taken over that she's

Themes	Codes	Transcripts
		started writing that on the walls, whereas if that's not there the patient, the staff don't know or necessarily look at the Handover Sheet, so won't question if the patient stays in bed. **(N02)** • (On the use of volunteers) It'll be great. **(N02)** • Don't see a downside to it. **(N03)** • I can't see any other option other than bringing in volunteers because they are going to be the person that's free to do it **(N03)**
		• I love it. Personally. I think it's a brilliant idea. For the patients there are so many benefits to it **(T01)** • There are actively thinking of trying to facilitate patients to get moving in MOP and I think having the mobility volunteers come up has been a very very good idea **(T05)** • There are loads of people would benefit from it. It's a very very good study and, yeah if it can be rolled out to everybody that is appropriate, it would be good **(T05)**
Collective action	**Compatible with other volunteering roles**	• Yeah I think, I think so. I think it depends on whether you do other, other volunteering roles and therefore you're used to particular systems **(V02)** • Yeah, because, because I come from the far side of the city, I'm not going to come here every day of the week just to do a couple of hours, and so I do all my volunteering on one day. So I'm here all day on Tuesdays to do all my different volunteering roles. **(V03)**
	Supportive staff	• I think once I went to a patient and he was feeling quite tired but there was a member of staff there, a nurse or somebody and, and that person sort of encouraged him and got him going. So I suppose sometimes you can get a bit of help from other staff, you know, from staff that might be there. **(V03)** • Very positive I think. I think they've been, they've been always happy to sort of… When I've approached them they've always been very supportive. They've very approachable and always

Themes	Codes	Transcripts
		been very proactive sort of thing 'yeah, yeah that'll be good yeah'. Particularly as I said, surprisingly perhaps, particular physio staff the therapy technicians and that sort of thing have been very helpful. Yeah they're always very helpful. **(V01)** • Yeah I've found them very helpful yeah. There was one patient that was in a bed and a member of staff, I think it was a nurse, he insisted on helping get the patient out of bed and into the chair so he could do the chair exercises. Yeah I think they've been very helpful yeah **(V03)** • They've been very supportive. **(V01)** • I haven't had much contact with the physiotherapy people as it were but obviously with the nursing staff, the um, I mean there was one of who said 'I don't think you're get that one to actually do anything' and was amazed that I did get her to. **(V02)** • I've worked more with the nurses and I would say that it's a pleasant experience. They're willing to help you if you don't know what you're doing, or where to go, so they'll direct you. Also if you're having difficulty locating a patient they can help you find them as well. **(V04)** • I think they welcome it on the whole. To most of the staff it's quite a new process**.** I think because it doesn't impede on their work, they're quite supportive of it. **(V04)** • Then another nurse came up and said 'could I take a gentleman for a walk'. I said 'well I have, really has she got to speak to you first'. Because I didn't know what his needs were **(V05)** • They've all been very nice to me. Um, I've had to ask whether I can see the patients and I haven't had any problems **(V05)** • Yes I know that you're here. I'm, I know I can. If I have had a problem I have asked a nurse whether I could do something. No, so um I think I'm adequately supported yes **(V05)** • I said if I needed help I'd ask a nurse and they've always been very helpful **(V05)** • They'll always come to us and say 'can we just go and do some voluntary work with… ?' 'Absolutely' **(N04)**

Themes	Codes	Transcripts
	Working well with busy staff	• Well sometimes they'll say I'm really busy, you know. There was one senior nurse that I was asking whether a patient was okay to do the exercises with me. She was so busy she said 'well you'll have to walk along with me you know' so I had to, you know, rush along with her while I was asking her what I was asking **(V03)** • That's the thing isn't it? We have to balance that knowing that the nursing staff might actually have a medical issue to deal with **(V02)** • The things that they have to deal with is far more important than us trying to get a patient to exercise. **(V02)** • Occasionally it's a problem to find a nurse because they're all so busy, but on the whole I haven't had any problems **(V05)**
	Encouragement from staff to patients	**Positive encouragement** • Oh yeah. Yes when certain doctors come round and grab the whip **(P01)** • From what I've seen, they're quite good at encouraging people in hospital to be more active**. (P01)** • Well I've taken part in this research and I find that the staff that know what they're doing will obviously encourage me. **(P02)**
	Impact on work pattern	• I think it slots in nicely. It doesn't necessarily link to all the other activities but it doesn't interfere with them either. **(V04)** • Negative impact) No I don't think so. **(N02)**

Themes	Codes	Transcripts
		• No, I don't, I think they fitted really well generally, you know. They're not; they don't come in sort of strange times of the day. They're always, sort of afternoons or whatever, mornings and, no problem at all. **(N04)** • Yeah definitely. It, it takes off the workload of staff members. Like we can, we can be sure that the patients' mobilising and not just sitting in the chair all day. And also it's beneficial for us cos we know that they're preventing pressure sores because they're getting up and mobilising with someone else apart from us. So it's like another member of staff involved in their care which is really good**. (N06)** • I think it's definitely relieved workload mobility wise and also, with the rest of the MDT like the physios, they find them really beneficial. I worked with one of them the other day and they said it's really handy having a mobility volunteer with certain patients, because they know that the patient will do the exercises more regularly than**,** rather than when just the physios and OTs are visiting them once a day**.** They're doing it more than once a day. So I think it's really beneficial**. (N06)** • I think the biggest impact was the initial stages with the training. To be honest, I think because we've got to be so careful to safeguard our patients, you've got to make sure the training is spot on and that people are safe to be doing what they're doing on the wards. So I think the biggest investment was the training side of things **(T01)** • On a day-to-day basis, the impact on us is minimal. It doesn't take much time up out of us at all, the most it will take is 'oh, shall we, what shall we refer to SoMoVe? Let's put that on the board'. It takes a minute **(T01)** • And it's actually preventing people from going back downhill again as well. Because when we do, we obviously have our remit, we get people to their baseline. And unless they continue doing the walking they can then go off their baseline again and then they're re-referred. And I think actually

Themes	Codes	Transcripts
		we haven't looked statistically whether that's affected our re-referrals or not. But from a practical point of view I can see that stopping those patients from being re-referred back to us **(T04)** • And that also facilitates the nursing staff's initiative to help also mobilise patients because if they see a patient doing that with the volunteers, then there is no reason why the nursing staff can't facilitate or follow that through **(T05)** • I think we get less re-referrals. Previously people would just be sat there and they'd just be waiting for a package of care which could take weeks or months sometimes, and they wouldn't be walking out to the bathroom because nurses don't have the time or whatever. So their mobility would get worse again. We'd have to pick them up and we'd have to do all the assessments and everything all over again. Whereas, because the volunteers are going in and keeping them ticking over, I don't think we've had many re-referrals. We've had a few but not, not that many. **(T07)** • No, I sometimes forget to do the referrals but that's like. It's not because they take too much time or anything that's just me **(T07)**
Reflexive monitoring	**Reflecting on training**	**Usefulness of training**
		• I thought it was pretty good. Especially the bit where we actually pretended to be a patient or we had somebody pretending to be a patient go up and have a sort of an approach and go through perhaps standing, walking, that was good. A good sort of beginning to how to approach, the safety aspects, and also the courtesy aspects of going up to the patients and I thought that that was good. That was good, useful, very useful. **(V01)** • It was good that we actually went on the ward and tried it out with an actual patient as well. **(V03)**

Themes	Codes	Transcripts
		• Absolutely. With supervision of course which was another bonus as well because then you start to feel a bit more confident when you approach somebody making sure things are correct and remembering all the different sections we were taught **(V01)** • I would say the training programme was quite thorough because I had at least 3 or 4 training sessions so I could get used to as many different kinds of scenarios I may be presented with. And I think that was really useful because it's quite easy to forget things, but doing the training over and over again helped to cement things in my head **(V04)** • I think it went very well. I mean you went through all the exercises with us**.** It was all straightforward and then we had another meeting with the Head of the Volunteers. She went through a lot more, no so I think that went well. Yes, I didn't have any problems with the training **(V05)** • Yeah, used to being on the ward, and actually you know, the handwashing and the cleaning, keeping clean so you're not putting the patients at risk. so yeah, that's always a good reminder for volunteers as to what they actually need to do with a particular patient **(V01)** • I feel like it was helpful because without it I wouldn't necessarily know exactly what to do. I think it was be good. **(V06)** • Yes I feel like when I go to do my, my volunteering every week, I know what I'm doing. I know what I need to do before I start, so I'm ticking box, safety boxes **(V06)** • The training is good **(N03)**
		Suggestions to improve training: Better visual aid
		• I think that is, that is the aspect of remembering everything through the training session. Um, I'm somebody who works at um, how you say, concrete operations stuff, and sometimes for something which is totally brand new, you might have done something else which might have had

Themes	Codes	Transcripts
		some similar skills, but for me to actually make sure that the patients are doing the correct movements, perhaps a little video. I mean we have all the sheets with the exercise, with all the different forms of exercises on. That's good for the reminder, although I look at them and keep thinking 'oh what's this one'. If you had a little video, which sort of said 'this is what we want the patients to do'. There's obviously an aim to get the patients doing a particular range of movements. And so for me to actually see that to see that, see that particular movement over I could make sure that I was getting the patient to do it correctly, to actually get the best benefit out of it. Yeah, something more visual might help as to what the expectation because the drawings only do so much **(V02)**
	Challenges of the intervention	**Finding the right nurse**
		• I don't know about the others, sometimes I actually find that finding the person who's in charge of that particular bay, just to make sure that that person is fit, and it's actually okay to do the exercise is the most challenging thing to actually do. **(V02)** • well cos see you know the different shifts which people do, you might not speak to the same person for a particular bay, there's sort of, both the weeks, so I just sort of find just to, just to double check just to make sure this particular patient hasn't had some major medical issue overnight **(V03)**

Themes	Codes	Transcripts
		Staff awareness of the programme
		• I'm not too sure as to what information has been provided to the nursing staff and medical staff, about the role of the mobility volunteers to make sure they're aware that we're just not somebody else who has a blue t-shirt and has come along to, but we're there actually for a particular purpose. **(V02)**
		• Well the immediate ones that come to mind are the fact that the staff, nice as they are, can't really tell you what to.., how to use the different bits of equipment and things to help you to start walking again. They're very good, but if they knew a bit about the research themselves they'd know what you were working towards. I think that would be helpful **(P02)**
		• I think like I said to you earlier, it's almost like nobody really knows about this project on the wards. It's almost done covertly so I don't know if anybody's even noticed that they're doing the exercises with the patients. That's the only thing. So whether or not if they got more involved, then actually that would really encourage the staff that are on the ward as well**. (N02)**
		Patient factors tiredness/availability
		• I don't have that happen very much but last week actually one person was fast asleep and somebody else was behind the blue curtains so I spent most of the time going backwards and forwards between the two to see if one had woken up or to see if the curtains had been opened again. **(V03)** • Because I had an empty bed, I don't know where the patient was so **(V02)**

Themes	Codes	Transcripts
		Space limitation
		• There's some of the exercises if you've got a patient sat in their armchair, and they don't want to move in their armchair, there are some exercises which can be difficult for people to actually do, because there isn't the space to do it. **(V02)** • well is suppose that's one way it could be improved, what we've just been talking about, if that could be if the patient could be move to a part of the bay where there was a bit more space. Not just sitting next to their bed. **(V03)** • Yes it is that, it is the space bit I think more than anything **(V02)**
		Physical restrictions
		• It's always a problem when you've got a patient who's actually on a drip. I got one patient the other week, before he got hooked up to the drip, I got him to do all of his exercises, to do all the arm exercises before they hook him up on the drip. I sort of challenged him to try and do some exercises otherwise they end up doing one armed exercises. **(V02)** • if they're in bed and they've got medicine from drips attached to them its awkward to move them or do stuff that involves moving their arms or legs **(V06)**
		Lack of appreciation for the volunteers
		• I'm just trying to see whether I've had any healthcare professional say to me 'thanks for that' or it was good that I saw Mr or Mrs whatever or saw her do that'. I can't, I can't nod my head and say 'yes' **(V02)** • I don't think anyone's actually said 'thank you' to me, but I'm, I just take it in their attitude to sort of being helpful I suppose I pick that as appreciation really **(V02)**

Themes	Codes	Transcripts
		• I think they confuse the fact that it's a volunteer service with the fact that it's a kind of pot luck service **(N03)** • The volunteers are there in the background **(N01)** • I don't think I know what their names are and what day they come **(N01)** • And I think the mobility; I think is more difficult to measure the mobility volunteers because they're coming in almost to do a nice thing whereas the Mealtime Volunteers are coming in to do an essential part of the day. Whereas, but that comes back to I think the staffs' mentality that they won't necessarily think of getting somebody walking that's something that they need to do. That they'll get them up to walk if they need the toilet or is a task **(N03)** • I don't think they think 'well I've got a spare 5 minutes let me go and get (name) up because actually I know she hasn't walked for a bit'**.** So because of that, I don't think they will pick up that Mobility Volunteers are any different than 'Pat the dog' or something or League of Friends or Cake Concert. They'll know it's a volunteer thing but they'll see it as a bonus and not something that if the volunteers are there that they will do. **(N03)** • I think their feeling at the moment is that it's more a bonus. **(N03)**
		Inconvenient timing
		• I think it's more challenging from what I've heard here, since I changed from doing both shifts just doing the afternoon shifts. It is more challenging in the afternoon. **(V01)** • Some patients would have a big lunch and they don't like doing much afterwards and then sometimes you got rest periods on wards and that sort of thing. So it's quite a difficult judgement call as to when would be the best actual time to go and do the exercises. I think, at the moment, sort of between 1 and 2 half past two seems to be a good time. Because some people you do get 'oh I've just had lunch' and that sort of thing. But then if you come back a little bit later on I say

Themes	Codes	Transcripts
		'I'll try again in half an hour, see how you feel in half an hour'. Um often they'll be okay. Okay and we'll do it then. But then other people, you want to catch them before they have a rest on the bed, cos once they're in the bed they don't want to get out, so I think it's about the right time yeah afternoon. **(V01)** • So I see them once a week happens to be at 5.30 roughly, which is convenient for me, but not for them because that's when they eat their food. So sometimes I'm sort of touring around trying to come back to them while they're eating and in fact some weeks I do everyone and they're still eating so I sort of, it's not feasible to stay there because they get, I don't know, half an hour to eat their food so yep **(V06)**
		Patient expectation
		• The woman that came was very nice and did the exercises alright but, she didn't know how to help me get up or do anything. But the man, the fella that came he was very good. He knew what he was about and he was business-like about it and everything. **(P02)** • I think it may help if the volunteers knew how to help people who are disabled or lying in bed or something**.** Helping get up and how to stand and how to manage properly. **(P02)**
		Intimidating environment
		• sometimes it can be quite intimidating going into a place where everyone knows what they're doing **(V04)**

Themes	Codes	Transcripts
		Frequent patient transfers
		• Most important thing I had to deal with was just locating the patient. Because between one intervention and the next the patient can be moved to a different ward, so that's the only thing **(V04)**
	Facilitators of the intervention	**Positive experiences**
		• They don't make me feel unappreciated **(V04)** • And then after they're done they're really happy, or they seem happy and they say 'thank you very much we're very grateful to you'. Some of them who don't get very many visitors, and they are happy for you to come and talk to them and that sort of thing **(V06)** • And those who don't want to they just, they aren't rude or anything they just, they just don't feel like mobilising at that particular time. Which is perfectly understandable? **(V04)** • None. None whatsoever. **(P04)** • No nothing negative at all **(N03)** • Not at all. I don't see anything negative **(N04)** • No-one's heard anything negative about them. I haven't had any complaints **(N05)** • Not that I know of, no. **(T07)**
		Benefits to patients
		• I think, even other sort of patients see other people walking around and getting benefit of the volunteering they become interested. And on the wards people sort of try to join in like when we're sat down doing that sort of thing. So I think it does kind of promote this idea of moving around and getting a bit of exercise. It's something also for people to do in hospital cos a lot of them when they're sat in the bay are sat there quite bored **(V01)**

Themes	Codes	Transcripts
		• And we come on the ward and patients can see us doing some exercises, joining in thinking it's a bit of fun, something to do. Yeah so I think it does. **(V01)** • Well I'd like to think that they do, help people become mobile faster. If they were just sitting in a hospital bed, and then they went home, they wouldn't be able to do a lot. I think helping them exercise in hospital is, you know hopefully helping them get out faster and be more mobile at home **(V05)** • Well they, encourage patients to get out of the chair and use their muscles **(P03)** • Keeping the body, keeping the legs nimble, keeping the arms nimble. The arms help the heart I believe. So that's fine, all of which I could do with no effort. **(P04)** • Yes. Yeah. Purely and simply keeping the body moving **(P04)** • Talking, communicating with them and encouraging them to, even if they don't feel like doing exercises. To do one or two is better than nothing at all **(P04)** • I certainly felt fresher, yeah. **(P05)** • He did say 'no you are walking; you're on your feet. Come on let's do it'. And to the point where eventually we did move her further up the ward and she took herself out to the toilet. Obviously with the help of our physiotherapist as well, doing their bit of stuff, but yeah it was a confidence booster, like brilliant **(N05)** • just doing that activity even if it is doing chair exercises, if its mobility, they've still got somebody else with them to help them to feel valued and to try and make sure that they are improving, encouraging that sort of culture of 'come on you are well, let's do, let's do something to get you moving' **(T01)** • And actually you can tell the difference as well, from a physical point of view, actually having that one-on-one time from somebody who is not from the hospital team per se, makes them feel really quite valued. And you might have somebody who's been quite low mood, the volunteer's

Themes	Codes	Transcripts
		been in and when they leave they've got a smile on their face and they're like 'oh tomorrow I'm going to walk a little bit further' or they carry on with their exercises once the volunteers have gone as well. So that's a huge benefit from a psychological aspect as well. **(T04)** • It's almost maintaining their exercise tolerance isn't it? To a certain degree so that they don't fatigue as much on the first day of going home. So you always get that couple of days blip after someone's been in hospital and not being doing that much and they go home. The first 2,3 days, for whatever reason they're absolutely tired because they've had to get up and go up and down the stairs or, walk 10 metres further to the toilet or answer the front door. It's really nice for them and actually that would give them more confidence if they're not as drained when they do get back home as well. **(T04)** • So we, we do sometimes get people going 'you haven't seen me in three days, I'm not doing anything 'etc etc .The SoMoVe project comes along and they actually feel like they're doing something. It may not be getting up and walking down the corridor, but at least they're having some physical input **(T07)** • Reinforcing that, and I think in the bays in particular, you know, patients are seen to be getting up walking then it might encourage others **(T06)**
		Benefits to volunteers
		• Just to make sure that I'm actually doing the demonstration, well not only the demonstration but the exercises. It keeps me active. It keeps me supple. Benefits of doing the exercises. I get the benefit as well by actually doing some. **(V02)** • You get to know the patients a bit more. And that's nice as well because you've got that sort of connection with them. **(V01)**

Themes	Codes	Transcripts
		• I think patient contact and the interaction with the staff that work on the wards are the things I enjoy most in my role **(V04)** • The intervention provides an avenue to actually speak to staff because I have to ask for their permission first. So it's just like, it just develops confidence. **(V04)** • I mean I don't know about you, but I go through, apart from bed exercises, I'll sit in the chair and do all the exercises **(V02)**
		Volunteers enjoying their role
		• I think it's quite a nice role; it's quite sort of interactive. Some patients may want to talk to you as well, so you spend maybe an extra 5 minutes chatting to them about their day or about their week or how long they're here for. Some of them you see maybe them few weeks in a row, so you kind of 'you think oh, he's back again to do volunteering so they will probably get on with you better**,** but otherwise it's quite a, it's quite fun **(V06)** • I don't know just seeing them like exercise is quite nice because they're older patients and they're probably sitting in a chair or bed most of the day. And so if they move around, they'll feel better, or if they're walking you know some of them really do as best as they can. Some of them are driven, so those people who are driven it's nice to see really like flourishing and they're all fulfilled. **(V06)** • Yeah. In fact I think one patient in particular I spoke to I was like 15 minutes talking just talking to them cos they just wanted to talk and it was. You felt like, you felt good about it because obviously you made them feel happier **(V06)** • I think patient contact and the interaction with the staff that work on the wards are the things I enjoy most in my role **(V04)**

Themes	Codes	Transcripts
		• Yes, I'm enjoying it. Just to see them getting up and walking is so vital for them when they get home. **(V05)**
		Benefits to staff
		• It frees up time for us to do more critical care. The acuity of patients coming through now is a lot higher. We're tied up a lot more. **(N04)** • I suppose it might decrease the amount of people getting re-referred to us if they are still getting up and walking. **(T03)** • Then it might show, like we talked about, the attitude that the Physio is the get up and go people, because the nurses can see that the volunteers are getting them up as well aren't they. So it is showing the nurses that anyone, you don't have to have physio manual handling skills to keep these patients' mobility up. **(T03)** • It frees staff members up as well. Because obviously when you're interacting with people and you're doing different things, if you're then going to see someone to walk them and they're walking them because they know they need the confidence. You've then got a volunteer to sit and go through exercises and walk with them that frees up a potential 10 – 20 minutes to half an hour where you can actually be treating a patient clinically and progressing them in another direction. So from a, purely like a therapy perspective, that really helps as well. But it helps, the benefits help with the fact that they're not going back downhill again and they're maintaining what level they are **(T04)** • And I think that's helpful to everybody and then the doctors as well, I think they appreciate it because again their patients are just sat there waiting for therapy to do something and get better. **(T07)**

Themes	Codes	Transcripts
		Convenient timing
		• I think the time that I do is good. It's 11 o'clock so it's before lunch, being a mealtime assistant I notice that quite often patients, after they've had their lunch, they just want to have a rest or go to sleep. So I think doing it, before lunch is good time. **(V02)** • I think it's quite a good time cos it's not too close to lunch or dinner so they're willing to like mobilise (**V04)** • Well, they came when nothing was happening. Now whether they noticed that**,** or whether they've asked the doctors or asked the nurses when, is a case of if the patients' got nothing to do any time will do as far as I'm concerned. **(P04)** • They were alright; I worked with it without any problems. They were always very willing to go away and come back another time. **(P02)**
		Social aspect of the intervention
		• It's that aspect of the social interaction. It's so boring being in hospital and to actually have somebody who is completely different and doing, not actually medical staff, someone who is a volunteer who'll just chat away and doing things with them. **(V02)** • yes someone to listen to them **(V01)** • It's like you know I'll do the mealtime on a particular ward, and there was one week I went there was literally nobody who needed assistance. But I still, so I did, the time for you aspect. Actually it's so boring being in hospital. **(V02)** • Sometimes with nurses and doctors working around them they may not necessarily be involved, but the Mobility volunteers help them, to like talk to someone if they need to. **(V04)** • Well, certainly the volunteer service that comes round is great to have a chat with somebody. **(P04)**

Themes	Codes	Transcripts
		• Yes I believe they would. Especially if they come and talk to somebody first. Communication, I'm a great one for communication and not via electronic devices. And if they talk, it's somebody to talk to, to somebody like me who doesn't get many visitors. It's funny when I'm home I get visitors all the time. Haven't seen one since I've been here, but there we go. Yes, just by talking, welcome visitor and if they can keep encouraging the patient to try a few mobile exercises, it can only be good**. (P04)** • And it's somebody to talk to as well isn't it **(N02)** • It's that boredom though of being in hospital isn't it? **(N02)** • Yeah. Well if it maintains it and it's somebody to talk to as well. I know they're not there primarily for that but they can have a chat about what they would normally do and they can talk to them and build up a good rapport with them **(N04)** • Not just the mobility and keeping active, it is that the patients have got somebody to interact with socially. They've got somebody to talk to**. (T01)** • It's seen as, someone who's not necessarily the same uniform that comes to interact, and they bring such a wide variety with the volunteers. So they've not necessarily gone through the different type of educational lines we have. They come from different backgrounds; they come from a whole different era. We're getting younger people and older people and a whole age range through and I think people respond really nicely to that and it gives them motivation and something else to talk about as well. **(T04)** • Aside from the actual therapeutic physical aspects of the exercise of the SoMoVe study, the actual socialisation as well, that really builds up. **(T05)** • Time spent with them I think is really valuable as well **(T06)** • And the social interaction that they are getting as well, that really plays a vital role as well **(T05)**

Themes	Codes	Transcripts
		Positive patient response
		• A lot of the time afterwards they usually say that it's good to keep fit, because maybe they don't usually do it. Or sometimes they do quite a bit and they just think it's important to keep going **(V04)**
		• They're all lovely people anyway. **(P01)**
		• I think it's lovely. And I think they're lovely people to do it. **(P01)**
		• Well I, I thought it was rather nice anyway **(P01)**
		• (On the question whether volunteers were helpful) Yes. **(P02)**
		• I think they've been very good **(P03)**
		• They were very patient **(P03)**
		• And it's great to do some exercises with somebody. **(P04)**
		• But would I have done it if he hadn't have come in? I might not have done. Its having the volunteer they encourage you to have a go **(P04)**
		• I think the more chances patients are given for activity I think they will all get well quicker. No doubt about it. I feel good now, and I want get home. Yeah, so yeah. I think mobility is a very important thing for everybody so yeah. **(P04)**
		• Oh, very much helpful. Yeah. **(P04)**
		• I think it's a superb idea. Patients can get themselves mobile and physically fit, as far as they are able. It can only do good for their health **(P04)**
		• Just by being here. Talking and going through simple exercises. It is better than, it's a whole new world. Better than nothing at all **(P04)**

Themes	Codes	Transcripts
		• I think it's a brilliant idea. I'm sure there are many people who would be pleased to volunteer. Of course it's then free. A free service you offer the patients anyway. I know it's all free in a sense, but that's like an extracurricular activity isn't it? **(P05)** • I think the volunteers are quite helpful **(P05)** • Very generous of the people that do give up their time for these things **(P05)** • I think that's a very good idea **(P06)** • (Were the volunteers helpful?) Oh very much so! **(P06)** • They like it like when you come up and you've been with patients and they have done the exercises, they love it. **(N02)** • We've had very good feedback on some of the patients that have been on the study, and when we do come and see them they would report to us 'oh I've done this with so and so' or something fantastic, and they are a lot more confident within themselves and say 'so what are we going to do now?' So they are already tried to initiate **(T05)** • Oh we've got a patient on G9 at the minute who said 'I love doing these exercises because I feel much more flexible since they started coming'. He rants about it all the time and he obviously likes it **(T07)**
		Staff appreciation

Themes	Codes	Transcripts
		• Most of the staff are very friendly and they seem, like they seem like happy that we were there doing this stuff **(V06)** • No, no it's all been really good. Ever since it got started it's been brilliant yeah. **(N04)** • Well I came past the other day and there was somebody in there doing leg exercises on the bed. Brilliant. Well that's very good today, that's fantastic. **(N04)** • Well I just think it's, it's a good service. What they do is brilliant. It's certainly the good, the ones on here they've been here a long time and they come and they're seeing somebody regularly**.** Yes you actually get to know them, it's a good rapport. **(N04)** • I met one in our Orange Bay I think. It was a young gentleman who was lovely. Went in, he was bubbly, he was obviously happy to be there and, he clearly wanted to do well. He introduced himself to the girls who were like, the other ladies over in the room and introduced himself to the members of staff who were there and he got them up moving. Talking about what they wanted to do, where they wanted to go and he was really positive. There was no negative vibe, it was all very positive reinforcement. 'No, come on we can do this' and 'right come on we're going to do this next' and he was, he was really good actually**.** He was nice **(N05)** • It's all been positive. They always come and introduce themselves. Obviously there are a few regular ones now, I think, absolutely brilliant. They'll always ask. They'll always ask 'are there any problems today? Is there anything going wrong?' or whatever when they're there yeah. **(N04)** • I think it's really good. I've spoken to a few of them and I sort of, not got involved in what they're doing, but I've been observing them and seeing what they're up to and I think it's a really good thing **(N06)** • Oh definitely. I think they encourage patients to mobilise basically. They do their job really well I think. As I said like, we don't have time to approach patients just purely for, to get them to

Themes	Codes	Transcripts
		mobilise whereas that is their sole job in the ward so they can yes, they can go and get them **(N06)** • Very useful yeah. I can't really put it any more simpler than that, yeah **(N06)** • All really friendly members of staff. Very motivated to help out there. Obviously they are volunteers, so they're not paid and they could easily not really be that involved with it. But no they're all really nice and yeah, very keen to help out. **(N06)** • They would come onto the ward; they are kind of well-recognised on the ward now. The staff knows who they are. They would stop and have a chat. Sometimes if they're with a patient that I've been seeing, and referred on to SoMoVe, I will often sort of have a chat with the patient and the volunteer at the same time to see how things are going. That's been great because it sort of allows us to sort of keep a bit of a peripheral approach of what's going on and so that's been brilliant **(T01)** • The volunteers themselves have always been quite approachable, so if there's somebody you think they'll be quite good to come onto the programme, they always say 'oh yeah let me know about them and I'll get them sorted on the list'. So really approachable **(T01)** • No concerns that I've heard or experience. It's always been very positive. And a lot of positive feedback from the ward team members, nurses and doctors. **(T04)** • That would be fantastic if we could roll it out. I mean there are so many people who ask whether they can have the service or use the service from different wards as well. Although it's been, well this is fantastic this is what we're doing, this is what's going on on the wards, other people are like 'we'd love to be able to do that, we'd love to be able to do this,' I think there's huge scope for rolling it out across other wards (**T04)** • It's worked really well actually. **(T07)** • It has positive effects on the wards with the patient and also with the teams as well **(T05)**

Themes	Codes	Transcripts
		• From a patient's account to me after the volunteers had been and the patient had reported that they've been doing their exercises, she was really thorough with what she'd done, and could explain how the volunteer had clearly gone through the exercises with her which is fantastic **(T05)** • I have seen them around and as you say they're always professional and generally friendly **(T07)** • The other day I think one of the patients, can't remember medically wise but they were going to stay in bed for the day. Whereas they would quite normally sit out and do the exercises so I just sort of said 'oh head's up'. She was absolutely fine with that. She was happy to document all of that, yeah very professional. **(T06)** • And with regards to rehab, because we are not a rehab setting on an acute ward on G Level, if a patient has been established going for a rehabilitation pathway, as an inpatient, it will be a bit of a low priority for us to see her again. We've got patients who are there, on the rehab pathway, but is having the mobility volunteer's input that they're already starting their rehab pathway whilst waiting for their actual rehab bed which is fantastic. **(T05)** • Well it facilitates patients on their journey in the hospital especially with their rehabilitation. Even though as an inpatient rehab, but to get them back to where they're on a safe level that would facilitate a safe discharge **(T05)**
		Family members' appreciation
		• Yes I remember I think it was someone's daughter or something. They were really happy that I was able to give their dad something to do, to do some moving around and exercises because she couldn't persuade him. So she was very grateful to me and that sort of, it was kind of rewarding to think you know, they actually care and you made a difference to this person's day. So that feels good. **(V06)**

Themes	Codes	Transcripts
		Confidence in the volunteers
		• It's done with people who really know what they're, what to suggest, and what exercises you need to do in order to improve your mobility. **(P02)** • **And** occasionally it's been you know, 'Is that the right height for that person to use the frame', but actually that's really showing the fact they're risk assessing them. They're making sure that their walking aid that they're using is the most appropriate for the patient. Which is really a safety awareness and I'd much rather someone came and said 'is that frame the right height' 'is that Mr so and so's frame, I can't find, it's different from yesterday'? I've taken 5 minutes out to say 'yes that's the right frame; it's the right height off you, carry on'. And that shows quite a lot, the fact that they've taken on the safety aspects of it**. (T04)**
		No adverse events
		• Not that, not that I've been made aware of. I think there have been a few incidences where patients have sort of become, not medically fit and not medically appropriate to do the intervention. But where the volunteers are always checking with us, or the nursing staff before they go in and do it, that hasn't actually had an effect on the patients as such (**T01)** • I mean I don't think it's, thankfully I don't think it's happened on the ward. Not that I've been aware of, there's always the risk that patients will deteriorate. And that volunteer goes to see them and they aren't able to get walk down the corridor**,** but as I say I don't think that's happened because we do refer generally are the, the better, don't have concerns, yeah on a day-to-day basis. **(T07)**

Themes	Codes	Transcripts
		• I think it was voiced when it was kind of first becoming a thing that we were going to trial it, about how the volunteers would know whether or not they were medically well enough to receive the treatment on that particular day. About how they would know if they were pushing them too far etc., just because they haven't had training and they hadn't had previous knowledge and things. As I say I, don't think we've ever, never had any problems. If they have any concerns, they would step back and talk to you or us **(T07)**
		Volunteers seen as non-medical personnel
		• They see them on a regular basis, I think it's absolutely yeah, and it's a different outlook**.** It's not just a physio or nurse, it's somebody completely different, and I think it helps to motivate them a lot more to maintain **(N04)** • I feel it works very well now. It's, for the patients they don't see it as a Physiotherapist, they see it as um... The therapists come across as a little bit threatening maybe? If they see a Physiotherapy they can feel a little bit that they 'must do this, they've got to do it'. But when somebody come up 'I would just like to help you do', 'oh okay. So they seem more positive and more sort of accepting of it probably **(N04)** • It's nice to have volunteers come in. It's a fresh face, someone different, someone new, and they all come in and they might be recognised by one of the patients. The patient associates that person with 'right we're getting up, we're going to something now'. 'I'm not just going to sit here and have my obs done and take medication and wait for visitors, I'm going to get up and go somewhere now because that person's come in to see me' (**N05)**
		• I think it's good because actually by bringing in volunteers you break down some of the boundaries as well, so it's not seen as someone medical coming to see them. **(T04)**

Themes	Codes	Transcripts
	Improvement to the volunteering programme	**Group sessions**
		• I think that having group exercises would be a good way of getting more people to do the exercises for the time given. If you get a set, quite a few patients then. **(V01)** • If it was a group session, make it more a kind of, slightly more of a regimented part of the day if you see what I mean for the patient. So that it would become more of their normal daily activities so might be more agreeable to doing it? **(V01)** • Perhaps group exercises? **(P03)**
		Working with student nurses
		• We could have Student Nurses too as well. Actually it could be part of their placement to actually spend a bit of time in here if you have this room with a volunteer to actually, man it if you like. **(N02)**
		Opt out basis
		• I don't know if you kind of. I don't know if there's a kind of opt out, as opposed to opt in, that everyone should be partaking in mobility activities. The volunteers have a list of everyone, the only people that are taken off of it are, or the nurses take off cos they're not clinically well enough. So that rather than people having to be referred in, you're referred out**. (N03)**

Themes	Codes	Transcripts
		Implementing on other wards
		• Especially somewhere like Trauma and Orthopaedics, like your Orthogeriatrics. Like your hip fracture rehabs would benefit massively from this. Having somebody that can go through those chair exercises with them daily. Orthogeriatrics would be a brilliant place to do it as well **(T01)** • If anything it's expanding the role, making it sort of more often, more of them. More of them would be absolutely brilliant. You could have sort of 2 or 3 of them based on a ward, on every single ward. I think it would be a massive asset to the team**.** They could follow through on anything that physio's put in place um or the OT's put in place whichever. Yeah I think why not? The more the merrier **(N04)** • Put it out more, so get more people to volunteer. Be able to bring more people in. Obviously I only met the one guy and I don't know how long it's running for**,** but that one, it would be nice to have more people coming up. More people saying 'oh great come on, let's take you outside; let's go for a walk; let's go here, let's go there. It would be nice to get more of our ladies up and out of this bay. It would be benefit, it would be amazing to have more volunteers **(N05)**
		Greater variety of exercises
		• From my point of view perhaps a greater variety. First visit on the patient, if the same volunteer is coming to the same patient then a) the patient will know who the guy is especially breakdown communications again. And keep a record of exercises done and try and introduce some new ones. For instance, like standing up from a sitting position, most important when somebody's at home **(P04)**

Themes	Codes	Transcripts
		Improving referrals
		• I don't know maybe like getting the senior nurses to be able to refer in as well **(T07)** • And then it could be like potentially maybe a note on the therapy databases that we have where we collect all the information about the patients' home, just a little note saying 'is this patient suitable for the SoMoVe potentially'? **(T07)**
		Including patients with dementia
		• I think the challenge so far where it's been a study is with regards to patients' capacity to consent to agree to partake in the study. For example on G7 where it's a Dementia Ward, a lot of those patients would probably really engage in a basic exercise programme so I think, if it was going to be rolled out as a sort of practice, rather than a study, I think it would really be important that we could include any patients that are deemed safe if you like, to be part of it. So that those that, they might have capacity and dementia issues but actually they can follow, if I'm sat there saying 'oh march your knees, pump your ankles' and they can follow that. I wouldn't see any reason why they shouldn't be working with the volunteers because I think they're the ones that would really benefit from the intervention because they are the ones that generally are less mobile and less active on the Unit. **(T01)** • I remember my conversation with you when you were trying to screen patients. It's specifically for those who haven't got any cognitive impairment isn't it? And that's where I find it a little bit of a oohh, If we do have it with those people, especially up in MOP the number of patients that we've got that have got dementia or cognitive impairment that would benefit from that input. I think it would be, it would get a lot better **(T05)**

Themes	Codes	Transcripts
		• I think it's the criteria that is needed for the project, for the study, that is the negative aspect for me, because there are loads of patients that we've got with cognitive deficit or impairments that would really benefit from the service **(T05)**
		Increased frequency of volunteers visit
		• Well they could be more often, as far as I'm concerned. Um so that's its perfectly adequate but it could be even better. I personally would like more **(P05)**

Appendix 20

Publications and presentations from thesis

Publications

1. Baczynska AM, Lim SER, Sayer AA, Roberts HC. The use of volunteers to help older medical patients mobilise in hospital: a systematic review. *Journal of Clinical Nursing.* 2016:25(21-22):3102-3112
2. Lim SER, Ibrahim K, Sayer AA, Roberts HC. Assessment of physical activity of hospitalised older adults: a systematic review. *Journal of Nutrition Health and Aging*, 2018;22(3):377-386.
3. Lim SER, Purkis A, Strike G, Baxter M, Rogers A, Sayer AA, Roberts HC. Ambulatory activity of older inpatients on acute geriatric medicine wards [abstract]. In: British Geriatric Society Spring Meeting; April 2017; Newcastle. *Age and Ageing* 2017:46 supp 2 pg 55.
4. Lim S, Strike G, Baxter M, Purkis A, Rogers A, Sayer AA, Roberts HC. The use of trained volunteers to encourage increased ambulatory activity among hospitalised older people: a feasibility study [abstract]. In: European Geriatric Medicine Society Congress; Sept 2017; Nice. *European Geriatric Medicine 2017: 8 Supp1(174)*.
5. Lim SER, Dodds R, Bacon D, Sayer AA, Roberts HC. Physical activity among hospitalised older people: insights from upper and lower limb accelerometry. Aging Clinical Experimental Research. 2018 (Epub ahead of print)
6. Lim SER, Ibrahim K, Dodds R, Strike G, Baxter M, Rogers A, Sayer AA, Roberts HC. The role of volunteers in preventing hospital-associated deconditioning among older people: a feasibility and acceptability study. Eur Geriatr Med 2018; 9 (Suppl 1):S208

Presentations

1. Oral presentation at the Wessex British Geriatric Society & NIHR Wessex Conference, July 2015.

2. Poster presentation at the NIHR Trainees Meeting, November 2015

3. Presentation of research project at the University Hospital of Southampton NHS FT Medicine for Older People departmental meeting, December 2015

4. Oral presentation at the NIHR CLAHRC Wessex Annual Stakeholders Event, June 2016

5. Poster presentation at the University of Southampton Faculty of Medicine research conference, June 2016

6. Presentation of research project at the University Hospital of Southampton NHS FT Medicine for Older People departmental meeting, October 2016

7. Poster presentation at the NIHR Trainees Meeting, November 2016

   ***Poster Competition Prize Winner**

8. Poster presentation at the British Geriatric Society Spring Meeting, Newcastle, April 2017

   ***Poster Prize Nominee**

9. Oral presentation at the University of Southampton Faculty of Medicine and Health Science research conference, June 2017

10. Poster presentation at the University of Southampton Faculty of Medicine and Health Science research conference, June 2017

    ***Highly commended poster prize award**

11. Poster presentation at the European Geriatric Medicine Congress in Nice, France, September 2017

12. Invited speaker at the British Geriatric Society Autumn Meeting, London, November 2017

13. 3 Minute Thesis competition, Faculty of Medicine, March 2018

    *** Winner**

14. 3 Minute Thesis competition, University of Southampton Grand Finals, May 2018

    ***People's Choice Winner**

15. Oral presentation at the University of Southampton Faculty of Medicine and Health Science research conference, June 2018

    ***Oral presentation prize winner**

16. 9th NIHR Doctoral Research Training Camp, July 2018

    ***Highly Commended Poster presentation award**

17. Poster presentation at the European Geriatric Medicine Congress in Berlin, Germany, October 2018

Appendix 20.1

Abstract for the NIHR Trainees Meeting November 2016

Title: The Southampton Mobility Volunteer programme to increase physical activity levels of older inpatients: a feasibility study (SoMoVe)

Studies have shown that low activity levels among older people in hospital can be harmful and may result in worsening physical abilities and longer hospital stay. Patients who are inactive are also more likely to be discharged to nursing homes and have an increased risk of death.

The aim of this study is to assess if it is possible to train volunteers to encourage older patients in hospital to keep active by walking more frequently and/or through exercises.

This study will be carried out on 2 acute medical wards (1 male 1 female). Participants will be encouraged by trained volunteers to walk or exercise twice a day during their hospital stay.

To determine the usual activity levels of our patients, we measured the number of steps taken by 50 patients (25 males) using an accelerometer and found that on average, participants took about 645 steps per day. Since August 2016, we have recruited and trained 5 volunteers and the walking and exercise sessions have started on both wards. We aim to recruit 50 patients to take part in the volunteer-led activity sessions. We will measure their activity levels as well as other measures such as length of hospital stay, discharge destination, mental well-being and physical function. We will interview patients, volunteers, therapists and nurses to better understand their views and experiences regarding this intervention.

From the findings of this study, we hope to deliver a larger service to provide volunteer-led activity sessions to older people in hospital.

Appendix 20.2

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ASSESSMENT OF PHYSICAL ACTIVITY OF HOSPITALISED OLDER ADULTS: A SYSTEMATIC REVIEW

S.E.R. LIM[1,2,3], K. IBRAHIM[1,2], A.A. SAYER[1,2,4,5], H.C. ROBERTS[1,2,3]

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Abstract: *Background:* The assessment of physical activity levels of hospitalised older people requires accurate and reliable measures. Physical activities that older people in hospital commonly engage in include exercises and walking. Measurement of physical activity levels of older inpatients is essential to evaluate the impact of interventions to improve physical activity levels and to determine associations between physical activity in hospital and other health-related outcome measures. *Objective:* To determine which measures are used to measure physical activity of older people in hospital, and to describe their properties and applications. *Method:* A systematic review of four databases: Medline, Embase, CINAHL and AMED was conducted for papers published from 1996 to 2016. Inclusion criteria were participants aged ≥ 65 years and studies which included measures of physical activity in the acute medical inpatient setting. Studies which specifically assessed the activity levels of surgical patients or patients with neurological conditions such as stroke or brain injury were excluded. All study designs were included in the review. *Results:* 18 studies were included from 127 articles selected for full review. 15 studies used objective measures to measure the physical activity of older inpatients: 11 studies used accelerometers and four used direct systematic observations. Seven accelerometers were identified including the StepWatch Activity Monitor, activPAL, GENEActiv, Kenz Lifecorder EX, Actiwatch-L, Tractivity and AugmenTech Inc. Pittsburgh accelerometer. Three studies used a subjective measure (interviews with nurses and patients) to classify patients into low, intermediate and high mobility groups. The StepWatch Activity Monitor was reported to be most accurate at step-counting in patients with slow gait speed or altered gait. The activPAL was reported to be highly accurate at classifying postures. *Conclusion:* Physical activity levels of older inpatients can be measured using accelerometers. The accuracy of the accelerometers varies between devices and population-specific validation studies are needed to determine their suitability in measuring physical activity levels of hospitalised older people. Subjective measures are less accurate but can be a practical way of measuring physical activity in a larger group of patients.

Key words: Measure, physical activity, older people, hospital, systematic review.

Introduction

The adverse effects of hospitalisation on older people are well recognised and it is estimated that between 30-60% of older people become more dependent in activities of daily living as a result (1). Studies have reported that physical activity levels of older adults in hospital are generally very low (2-4). Physical activity is defined as any bodily movement produced by skeletal muscle that results in energy expenditure (5). In the hospital setting, the common physical activities that patients are involved in include exercises and mobility. Exercise is a subset of physical activity and is planned, structured, and repetitive and has a final or an intermediate objective of improvement or maintenance of physical fitness (5). Mobility is also an aspect of physical activity and is a critical characteristic for functional independence (6). Previous studies have demonstrated the association between low mobility in hospital and several adverse outcomes including functional decline, admission to nursing home and death (7, 8). Importantly, studies have shown that interventions which promoted increased physical activity of older inpatients through rehabilitative or mobility interventions, were associated with improved physical functioning, shorter hospital stay, and reduced nursing home admissions (9-11).

Assessment of physical activity involve quantifying or describing behaviours and activities of the patient, and is different from physical function measures which generally relate to the patient's ability to perform (12). Physical activity measures can be broadly classified into objective and subjective measures. In general, objective measurement using devices such as accelerometers and pedometers are reported to be more accurate than self-reported instruments or questionnaire (13). However, the accuracy of these objective measures vary across a whole range of devices (14). Additional factors such as sample size, population demographic, primary outcome variable of interest, cost and staffing levels are important considerations when deciding on which measure to use. Measuring physical activity of older people in hospital often presents a particular challenge as patients are acutely unwell and are generally frailer than their community-dwelling counterparts. Yet, in order to understand physical activity of hospitalised older adults and its association with health outcomes, an accurate and reliable measure is necessary.

The aim of this review is to systematically search from

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existing literature, the tools and measures which are currently used to assess physical activity levels of hospitalised older adults and to describe their clinimetric properties and applications.

Methods

Data Sources and Searches

An initial search of the Cochrane library and PROSPERO confirmed that no similar systematic review was identified. In August 2016, a literature search was conducted using four databases: Medline, Embase, AMED, and CINAHL. Two of the authors agreed on the keywords and MESH terms and the full search strategy for Medline is provided (see Appendix). Inclusion criteria for the review were: participants aged ≥ 65 years, any study which included measures of physical activity, studies involving acute medical inpatient setting, published from 1996 onwards. The authors chose 1996 as a cut-off point since it was highly unlikely that that any studies older than 20 years would be relevant. Studies which specifically assessed the activity levels of surgical patients or patients with neurological conditions such as stroke or brain injury were excluded. Papers not meeting all of the inclusion criteria were excluded. All languages were included in the review. Additionally, a manual search was conducted primarily from manufacturer websites for the characteristics, functionality and cost of the accelerometers included in this review.

Study selection

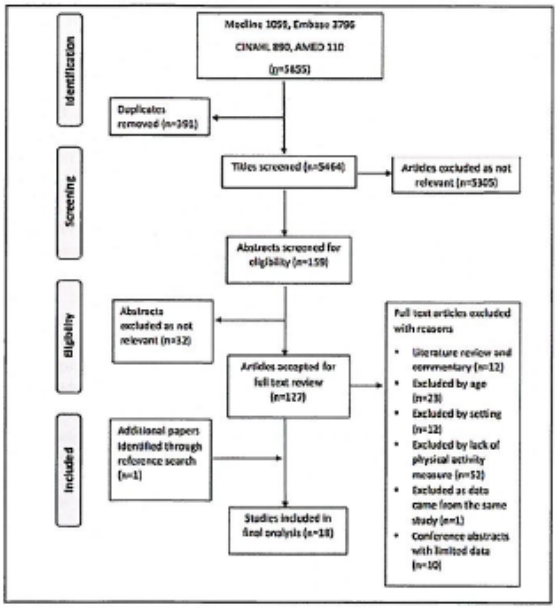
Two authors conducted the initial search of the four databases individually. Titles of articles retrieved through the initial search were then screened independently for relevance prior to abstract review. (Figure 1) Three authors independently reviewed the abstracts and articles selected by at least one author were included for full text review. Two authors reviewed the full texts and identified relevant studies for final analysis. Any disagreements were resolved through discussion. The references of selected articles were also screened for relevance.

Data extraction and Quality Assessment

Two investigators independently abstracted data from each paper with regard to study characteristics (patients' age, study setting, number of participants), physical activity measure employed, and authors' comments regarding each measure, including its accuracy. Additionally, data regarding the aim of the study, the duration of physical activity monitoring and comparators used were also abstracted. Any disagreement during the data abstraction process was resolved through discussion with the third reviewer.

The quality of each paper was assessed using the Downs and Black study quality checklist by two authors working independently (15). The Downs and Black checklist is commonly used to assess health care intervention studies and is appropriate for both randomised and non-randomised studies. The overall study quality is assessed by 27 questions under the following sections: study quality (10 items), external validity (3 items), study bias (7 items), confounding and selection bias (6 items) and power of the study (1 item). The quality of the study is rated against a total score of 32, with 25 items scoring 0 or 1, 1 item scoring 1 or 2, and 1 item scoring 0 to 5. No studies were excluded based on the quality of the paper.

Figure 1
Flow diagram



Data synthesis and analysis

The studies included were analysed based on the type of assessment of physical activity of hospitalised older people. For studies which utilised accelerometers, information such as the make and general description of the accelerometers, the outcome measures, the reported accuracy of the devices and its practical application are described.

Due to the heterogeneity of the studies, statistical pooling of data was not appropriate and the results are presented as a narrative synthesis of the methods currently used to measure physical activity of older acute medical inpatients. PRISMA guidance was adhered to in the reporting of this review. This review is registered on PROSPERO, an international prospective register of systematic reviews: CRD42015025278.

Results

The initial search identified 5855 articles after duplicates were removed. 159 articles were selected for abstract review.

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Table 1
Summary Table of Included Studies

	Author/ Year	Setting	No of pts	Mean age	Physical activity measure	Primary outcome	Validity or accuracy reported	Quality
Objective measures								
1	Fisher 2010 (18)	University hospital, US	162	77.4	StepWatch Activity Monitor	Mean daily step count	Accuracy cited from other papers. (29,30,32)	12/32
2	Fisher 2011 (Sep) (17)	University hospital, US	198	76.9	StepWatch Activity Monitor	Mean daily step count	Not reported	12/32
3	Fisher 2011 (Jan) (4)	University hospital, US	239	76	StepWatch Activity Monitor	Mean daily step count	Accuracy cited from other papers. (29,30,32,35) Accuracy of SAM tested on 1 patient in this study showed 99% accuracy in step count.	12/32
4	Ostir 2013 (19)	University hospital, US	224	Age > 65, no mean given	StepWatch Activity Monitor	Mean daily step count	Accuracy cited from other papers. (18,29,32)	17/32
5	Taraldsen 2011 (20)	University hospital, Norway	14	84	activPAL, video recorded observation	Posture	High accuracy in classifying posture but high underestimation of step counts at gait speed < 0.47m/s.	18/32
6	Rowlands 2014 (16)	Acute hospital, Australia	10	75.9	GENEActiv, activPAL	Posture	Validity of GENEActiv in measuring activity intensity48,49 and activity type50,51 cited. No previous study using GENEActiv to measure posture. GENEActiv underestimated sitting/ lying time by about 130min (p <0.05) compared to activPAL Validity of activPAL cited from other papers (52,53)	12/32
7	Brown 2009 (2)	45	74	Augmen-Tech Inc accelero-meter	Posture	Validity conducted and published in a separate paper.54	Department of Veteran Affairs Hospital	12/32
8	Pederson 2012 (18)	University Hospital, Denmark	48	84.7 (median)	AugmenTech Inc accelero-meter	Posture	Cross-validation of algorithm conducted on 6 patients with level of correspondence ranging from 89.6% to 100% for all postures. Unable to differentiate between standing and walking	14/32
9	Vinzio 2002 (22)	Acute care unit, France	8	80.5	Actiwatch-L	Rest-activity times	Validity cited from other papers (55,56)	11/32

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Table 1 (continued)

	Author/ Year	Setting	No of pts	Mean age	Physical activity measure	Primary outcome	Validity or accuracy reported	Quality
11	Sallis 2015 23	Community Hospital, US	287	Age > 65	Tractivity	Step count	The authors report a comparison of the StepWatch and Tractivity, which showed high reliability of the Tractivity device (intraclass correlation = 0.99)	15/32
12	Mudge 2008 (25)	Tertiary teaching hospital, Australia	124	82.1	Direct observation	Time spent in various activities	Not applicable	21/32
13	Boltz 2012 (26)	Academic medical centre, US	93	80.8	Direct observation using Restorative Care Behaviour Checklist	Time spent in various activities	Not applicable	15/32
14	Doherty- King 2013 (27)	Veteran/ Teaching Hospital, US	47	76.6	Direct observation	Time spent in various activities	Not applicable	9/32
15	Mudge 2016 28	Tertiary teaching hospital, Australia	132	Age >65, no mean given	Direct observation, Behavioural mapping	Time spent in various activities	Physical activity levels estimated from behavioural mapping are similar to those identified by accelerometry. (16,58,59)	19/32
	Subjective measures							
1	Brown 2004 (7)	University Hospital, US	498	78.7	Mobility scale completed through interviewing nurses	Mobility level from 0-12 trichotomised in 3 mobility group: low, intermediate and high	Acknowledged that nurses may miss some mobility activity.	15/32
2	Zisberg 2011 (8)	Teaching hospital, Israel	525	78.9	Daily interview with participants using a mobility scale	Modified mobility index on a scale of 0-14.	Acknowledged that measure is subject to recall bias	17/32
3	Zisberg 2015 (43)	Teaching hospital, Israel	68	78.	4-6 interviews with participants during their hospital stay	Modified mobility index on a scale of 0-14.	Not reported	19/32

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Table 2
Downs and Black quality assessment

Study	Reporting (Q1-10)	External validity (Q11-13)	Internal validity – bias (Q14-20)	Internal validity - confounding (Q21-26)	Power (Q27)	Total score
Fisher 2010 (18)	7/11	1/3	4/7	0/6	0/5	12/32
Fisher 2011 (Jan) (4)	7/11	1/3	4/7	0/6	0/5	12/32
Fisher 2011 (Sep) (17)	6/11	1/3	4/7	1/6	0/5	12/32
Ostir 2013 (19)	8/11	2/3	5/7	2/6	0/5	17/32
Taraldsen 2011 (20)	8/11	1/3	4/7	1/6	0/5	14/32
Rowlands 2014 (16)	6/11	1/3	5/7	0/6	0/5	12/32
Brown 2009 (2)	5/11	3/3	4/7	1/6	0/5	13/32
Pederson 2012 (18)	8/11	3/3	4/7	4/6	0/5	19/32
Vinzio 2003 (22)	7/11	0/3	4/7	0/6	0/5	11/32
Izawa 2014 (24)	7/11	3/3	5/7	1/6	0/5	16/32
Sallis 2015 (23)	8/11	2/3	3/7	2/6	0/5	15/32
Mudge 2008 (25)	9/11	2/3	6/7	4/6	0/5	21/32
Mudge 2016 (28)	9/11	3/3	4/7	3/6	0/5	19/32
Boltz 2012 (26)	7/11	2/3	4/7	0/6	0/5	13/32
Doherty-King 2013 (27)	5/11	1/3	4/7	0/6	0/5	10/32
Brown 2004 (7)	9/11	3/3	4/7	2/6	1/5	19/32
Zisberg 2011 (8)	8/11	3/3	4/7	2/6	0/5	17/32
Zisberg 2015 (43)	9/11	3/3	4/7	2/6	1/5	19/32

Table 3
Characteristics of accelerometers

Device	Site worn	Outcome measure	Length of monitoring	Approximate cost excluding docking station
StepWatch Activity Monitor (4,17-19)	Ankle	Step count	Continuous monitoring, battery life of 7 years, non-rechargeable	£350 per device
activPAL (16,20)	Thigh, Sternum	Posture, Step count	Continuous monitoring up to 7 days	£320 per device
GENEActiv (16)	Wrist	Posture, physical activity intensity	Continuous monitoring up to 45 days	£160 per device
MotionWatch 8 (22)	Wrist	Sleep and circadian parameters, physical activity intensity	Continuous monitoring up to 120 days	£500 per device
Tractivity (23)	Ankle	Step count	Continuous monitoring up to 30 days	£15 per device
Kenz Lifecorder (24)	Waist	Step count, physical activity intensity, physical activity energy expenditure	Continuous monitoring up to 6 months	£720 per device

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127 articles were selected by three reviewers for full text review, and 17 studies met the inclusion criteria. Reference screening identified one additional article which met the inclusion criteria thus 18 papers were included in the final analysis (Table 1). The quality of the papers, which ranged from 9/32 to 21/32, is presented in Table 2.

Objective measures

15 studies employed objective measures to measure physical activity. 11 studies used accelerometers , including one study (16) which employed two different accelerometers. Four studies (4, 17-19) used the StepWatch Activity Monitor, two studies (16, 20) used the activPAL, two studies (2, 21) used the AugmenTech Inc Pittsburgh accelerometer, and the other accelerometers used include the GENEActiv (16), Actiwatch-L (22), Tractivity (23) and Kenz Lifecorder EX 1-axial accelerometer (24). Sample sizes for the accelerometer studies ranged from 8 to 287 participants. Four studies (25-28) used direct observation as a measure of physical activity with sample sizes ranging from 47 to 124 participants. The characteristics of the accelerometers are summarised in Table 3.

StepWatch Activity Monitor

The StepWatch Activity Monitor (SAM) is a water-resistant dual-axis accelerometer worn at the ankle, attached by a Velcro strap. It is suitable for continuous monitoring and its primary outcome measure is step count (calculated by the stride count multiplied by two). Stride count is recorded at one minute intervals synchronized to a 24-hour clock. The device is time-stamped and outcomes include the average step count and percentage of time spent at low (1-15 steps/minute), medium (16-40 steps/minute) and high (>40 steps/minute) activity. The activity level definitions can be modified to suit different participant characteristics. It has a typical battery life of seven years, which is not rechargeable. Of the four studies which used SAM, only one study (4) tested its accuracy on one representative patient against direct observation and reported the device to be 99% accurate in step counting although the participant's gait speed was not reported. The SAM has previously been reported to be accurate in measuring step counts among community-dwelling older adults (29-31), and at slow gait speeds (32) down to 0.44 m/s. Among 34 community-dwelling older people (mean age 79.2 years), the SAM was found to overestimate steps by 6.5% at gait speed <0.8m/s (33). Under laboratory conditions, the accuracy of SAM was tested on 20 participants (mean age 30 years, SD 13) who walked on a treadmill at three selected speed (0.44m/s, 0.89m/s and 1.34m/s) (32). The mean accuracy of the SAM across the three speeds was 99.7% (SD 0.67) and the intraclass correlation coefficient for SAM counts versus manual counts was 0.999. The SAM has also been shown to be accurate in step counting among patients with gait abnormalities including muscular dystrophy (34), cerebral palsy (35), multiple sclerosis (36), stroke (37), and patients who require a walking stick to aid mobility (38). It is reported to be well-tolerated by older patients (19).

activPAL

The activPAL is a single-axis accelerometer which is attached at the thigh using hydrogel pads. It can be waterproofed by wrapping medical grade adhesive around the device and attached to the thigh with a dressing, which allows continuous monitoring up to seven days. Based on thigh inclination and limb movement, the software can classify posture as sitting/lying, standing or walking. It is able to calculate step count and cadence. The output is time stamped which allows detailed analysis of the activity profile. This review identified one study which validated the use of activPAL in 14 older inpatients (mean age 84 years) against video observation and reported it to be highly accurate (100%) in classifying sedentary versus upright positions. However, the accuracy of activPAL in step counting was affected by slow gait speed (< 0.47m/s) (limits of agreement = -2.01 to 16.54, absolute percent error = 40.31) (20). One study involving 21 older community-dwelling adults (mean age 71.9±5.7) examined the accuracy of the activPAL in step counting using a treadmill and found the device to be accurate in measuring step counts with gait speeds ranging between 0.67m/s to 1.56m/s (39).

AugmenTech Inc. Pittsburgh wireless monitors

Two studies (2, 21) utilised the AugmenTech Inc. Pittsburgh accelerometer. To the authors' knowledge, this device is no longer manufactured and attempts to contact the manufacturer were unsuccessful. As such, further description of the device is not relevant to the aims of this review.

GENEActiv

The GENEActiv is a waterproof, wrist-worn tri-axial accelerometer which produces raw data output that is time stamped. It contains a temperature sensor which enables researchers to determine how long the device was worn and if the device was removed at any point. The device allows continuous monitoring for a maximum of 7 to 45 days depending on the settings of the logging frequencies. By developing algorithms and with the use of analysis packages such as R, Matlab and Excel macro, raw data can be converted into clinically relevant outcomes such as body posture, sleep/wake measurements, and physical activity levels in terms of acceleration and metabolic equivalent of tasks (MET).

One study in this review examined the accuracy of the GENEActiv in posture classification under 3 different conditions (free-living, laboratory-based and hospital inpatients), by comparing it against another device, the activPAL (16). Ten patients (mean age 76 years) admitted to hospital with COPD wore both devices continuously for 1-2 days. The study reported that the number of minutes classified as sitting by the wrist-worn GENEActiv significantly

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correlated with the number of minutes classified as sitting by the activPAL ($r = 0.78$, $p<0.01$). The study also reported that the GENEActiv underestimated patients' sitting and lying time by approximately 2.2 hours compared to the activPAL ($p<0.05$).

Actiwatch-L

This device which uses actigraphy technology, is wrist-worn and records movement-induced accelerations during one minute time periods. The most common clinical use of the Actiwatch-L is in evaluating sleep disorders and rest-activity rhythm disturbance. One study in this review used the Actiwatch-L to measure the rest-activity rhythm and light exposure of 10 older inpatients (mean age 81 years) admitted to an acute care unit (22) and reported that the device was well-tolerated by patients. Advances in accelerometer technology have led to further development of the device which has now been phased out and replaced by a new device, the MotionWatch 8. The MotionWatch 8 is a waterproof wrist-worn tri-axial accelerometer which allows continuous monitoring. It has been used to study physical activity levels of older adults in the community (40) and it produces data in counts per minute which can be used to classify patients into sedentary, light and moderate vigorous physical activity.

Tractivity

One study used the Tractivity to measure ambulatory levels of hospitalised patients and included a subgroup of medical inpatients age ≥65 (23). The Tractivity is water-resistant and worn on the ankle secured by an ankle band with Velcro straps. The main outcome measure is step count, which is time-stamped, and the sensor memory allows up to 30 days of continuous monitoring. This study reported an unpublished sub-study on the Tractivity and found the device to have acceptable limits of agreement with the StepWatch Activity Monitor (+284 steps; 95% limits of agreement -911 – 343) in 20 hospital inpatients whose age and gait speed was not reported (23). They also reported high reliability (intraclass correlation = 0.99) and high correlation between the Tractivity step counts and the nurses' documentation on a paper log of distance walked measured in feet ($r = 0.76$).

Kenz Lifecorder EX

This device is non-waterproof, and is worn at waist level just above either leg. It is able to record step counts and time spent in various levels of intensity. Using pre-entered data such as age, sex, height and weight, the device is also able to compute physical activity energy expenditure. The device is built with an internal memory which is capable of recording up to 200 days and has a battery life of 6 months. One study in this review used the Kenz Lifecorder EX 1 axial accelerometer to measure physical activity levels of 235 cardiac inpatients (mean age 74 years) (24). It has also been used to measure step count and intensity of physical activity of community-dwelling older people (age range 60-78 years) (41). However this accelerometer may be less accurate at slow gait speeds: in one study assessing the accuracy of pedometers using a treadmill, the Kenz Lifecorder EX, which was worn by 10 male subjects (mean age 33), underestimated actual step counts by about 10% at 0.9m/s but was found to be accurate at a gait speed of 1.1m/s and above (42).

Direct observation

Four studies identified (25-28) used direct observation alone to measure physical activity and two studies (4, 20) used direct observation to validate or supplement the accelerometer data. Mudge et al (2008) measured patient activity on the ward by monitoring hallway ambulation (25). Participants were observed for 2 to 3 hours periods at varying times in the morning and afternoon shift over a 7 day period and the frequency and time spent walking in the hallways were recorded. More recently, Mudge et al (2016) utilised a behavioural mapping protocol, where participants in each room were observed for 2 minutes before moving to the next room, with the sequence repeated in the same order for 4 hours (28). Observations were done by trained physiotherapy students with 2 observation periods between 10am to 2pm and 2pm to 6pm. Activities were classified as lying in bed, sitting in or on the bed, sitting on a chair, standing, actively wheeling, or walking.

Boltz et al used a previously developed tool, the Restorative Care Behaviour Checklist, which is an observational measure of patient involvement in activities such as bed mobility, transfers, ambulation, bathing, dressing, hygiene, eating, use of personal assistive devices, communication, and exercise (26). Patients recruited in this study were observed over a 3 hour period on 3 separate occasions. Doherty-King et al utilised trained observers who shadowed 15 registered nurses each for two to three 8 hour periods. A hand-held computer tablet was used to collect data on the frequency and duration of patients' mobility events such as standing, transferring, walking by the bed space, walking to and from the bathroom, walking in the bay and walking in the hallway (27).

Subjective measures

Three studies (7, 8, 43) utilised subjective methods to measure the physical activity of older inpatients. All three studies interviewed nurses or patients regarding the frequency of mobility of patients over the past 24 hours. Brown et al developed an empirical scoring system for increasing levels of mobility , with a score of 0 for complete bedrest, 2 for transferring from bed to chair once, 4 for transferring ≥ twice, 6 for ambulation once with total assistance, 8 for ambulation ≥ twice with total assistance or once with partial or no assistance, 10 for ≥ twice with partial assistance, and a score of 12 for independent ambulation ≥ twice per day (7). In this study, nurses looking after the patients were interviewed at baseline and on alternate days. An average score of 4 or less was classified as low level mobility, 4-8 was defined as intermediate and a score of 8 and above was considered as high mobility.

Zisberg et al modified this scale with a change in scoring to 14 to take into consideration the distance mobilised by patients, classified by ambulation inside or outside their hospital room (8, 43). The sample sizes for the three studies ranged between 498- 684 participants but the validity and reliability of this measure was not reported.

Discussion

This review has shown that objective methods using accelerometers were most commonly used among researchers investigating the physical activity levels of hospitalised older people. The outcome measures produced by accelerometers include step count, posture identification, physical activity energy expenditure and physical activity intensity. The variety of outcome measures reflect the multidimensional construct of physical activity and hence using one method of measurement can be difficult to fully capture its entirety. One of the benefits of using accelerometers is continuous objective monitoring of physical activity. This review has also shown that the accuracy the accelerometers in measuring step counts or posture vary across devices.

Only three studies tested the accuracy of the devices among older people in hospital. The activPAL was shown to be highly accurate in comparison to video observation in classifying postures but lacked accuracy in step counting at gait speed <0.47m/s (20). The GENEActiv underestimated time sitting/ lying by comparison with the activPAL (16). In the study by Fisher et al in 2011, the SAM was found to be 99% accurate in step counting in one representative patient (4). Older people in hospital are more likely to engage in lower intensity physical activity and have lower gait speed then their community-dwelling counterparts (44) and hence it is important that the accuracy of the device is population-specific.

The limited evidence available suggests that the SAM is the most accurate device currently available for measuring step counts of older inpatients and is reported to be well-tolerated. The activPAL is the most accurate at classifying postures in studying the activity and sedentary behaviour of hospitalised older people. It does provide step counts but has been reported to be less accurate at slower gait speeds. The GENEActiv is able to measure physical activity intensity and also classify posture.

Direct observation using a systematic approach of observing patients and coding their behaviour has benefits including elimination of the risk of recall bias, and additional contextually rich data such as the types of activity, frequency and the physical and social environment in which the physical activity takes place (45). Barriers to using direct observation include limitation of time and resources although the use of hand-held devices allows data to be entered and stored efficiently, making the data more manageable and easier to analyse. Video observation is useful for observing patients for a short period of time but is less practical for continuous monitoring.

The only subjective measure identified in this review was a score to classify patients into low, moderate and high mobility levels. The advantage of this method of measurement is its ease of use, requiring little resources, which may be relevant when studying a larger number of participants. However, it only provides an estimate of patients' physical activity level and is susceptible to recall bias (46, 47) as the information is dependent on participants to recall activities over the past 24 hours. As older people have a higher risk of cognitive impairment or short-term memory loss, this may have an impact on the accuracy of the information collected.

For routine measurement of physical activity in the clinical setting, subjective measures are more cost-effective and practical to administer to a higher number of patients. However objective measures may be more appropriate for use in research as it provides more accurate measurements of physical activity. This review has identified a lack of evidence for the accuracy of accelerometers specifically to measure physical activity among hospitalised older people. Future research should focus on determining the accuracy of these devices in this very specific patient group.

Limitations

The search strategy was designed to include studies involving older general medical inpatients and hence studies limited to specific neurological conditions such as stroke and Parkinson's disease were excluded. The quality of the studies included was generally modest to poor, with scores ranging from 9 to 21 out of a total of 32. Of the 18 studies included, 11 studies had a score of less than 16 out of 32. However the aim of the review is to explore the methods of measurement in current practice and hence these studies were included.

Conclusion

This review has identified and described the measures currently used to assess physical activity levels of older people in general medical wards in hospital. The seven accelerometers identified each have their own strengths and weaknesses. There are few validation studies looking specifically at the accuracy of these devices in measuring physical activity of hospitalised older people. Further population-specific validation studies are needed to determine which devices are most suitable for this group of patients to better inform researchers and clinicians who are interested in measuring physical activity levels of frail hospitalised older people. Among the devices currently used in practice, the StepWatch Activity Monitor appears to provide the most accurate step count for older people with low gait speed or altered gait. The activPAL has been shown to be highly accurate in measuring posture and while it is able to measure step count it appears to be less accurate at slow gait speed. Direct systematic observation is often time consuming and labour intensive but with the use of hand-held devices and a carefully designed observation protocol, it can be a

useful measure of physical activity. Subjective measures are less accurate but can be a practical way of measuring physical activity in a larger group of patients.

Key points

- Accelerometers are used to measure physical activity levels of older people in the acute hospital setting.
- The StepWatch Activity Monitor appears to provide the most accurate step count among older people with low gait speed or altered gait.
- The activPAL has been shown to be highly accurate in measuring posture.
- Subjective measures are less accurate but can be a practical way of measuring physical activity in a larger group of patients.

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Ethical standard: Informed consent was obtained from all participants.

Appendix

Medline search strategy

	Search terms	Number of articles
1.	elder*.mp.	127328
2.	old*.mp.	674783
3.	exp Aging/	116246
4.	exp Geriatrics/	6530
5.	exp «Aged, 80 and over»/ or exp Aged/	1547869
6.	1 or 2 or 3 or 4 or 5	2085598
7.	exp Exercise/ or exp Exercise Therapy/ or exp Exercise Movement Techniques/	121610
8.	physical activity.mp.	48566
9.	mobility.mp.	77720
10.	ambulat*.mp.	84030
11.	exp Walking/	20128
12.	7 or 8 or 9 or 10 or 11	302132
13.	«Outcome Assessment (Health Care)»/	47629
14.	tool*.mp.	332655
15.	Questionnaires/	275960
16.	instrument*.mp.	138384
17.	measure*.mp.	1600442
18.	exp Monitoring, Ambulatory/	19882
19.	exp Motor Activity/ or exp Accelerometry/	157192
20.	13 or 14 or 15 or 16 or 17 or 18 or 19	2250696
21.	hospitalized.mp.	46085
22.	exp Inpatients/	11567
23.	(medical adj2 inpatient*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]	1306
24.	acute care.mp.	10406
25.	21 or 22 or 23 or 24	65356
26.	6 and 12 and 20 and 25	943

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Appendix 20.3

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REVIEW

Journal of Clinical Nursing

The use of volunteers to help older medical patients mobilise in hospital: a systematic review

Alicja M Baczynska, Stephen ER Lim, Avan A Sayer and Helen C Roberts

Aims and objectives. To review current evidence for the use of volunteers to mobilise older acute medical in-patients.

Background. Immobility in hospital is associated with poor healthcare outcomes in older people, but maintaining mobility is frequently compromised due to time pressures experienced by clinical staff. Volunteers are established in many hospitals, usually involved in indirect patient care. Recent evidence suggests that trained mealtime volunteers had a positive impact on patients and hospital staff. It is unclear whether volunteers can help older inpatients to mobilise.

Design. Systematic review.

Methods. We searched Cochrane, Medline, Embase, CINAHL, AMED and Google databases using MeSH headings and keywords within six key themes: inpatients, older, mobility/exercise, delirium, falls and volunteers. Full texts of relevant articles were retrieved and reference lists reviewed.

Results. Of the 2428 articles that were identified, two scientific studies and three reports on quality improvement initiatives were included in the final review. One study included volunteer assisted mobilisation as part of a delirium prevention intervention (HELP). The second study has not reported yet (MOVE ON). The contribution of volunteers in both is unclear. Three quality improvement initiatives trained volunteers to help mobilise patients. They were not formally evaluated but report positive effects of the volunteers on patient and staff satisfaction.

Conclusions. This review has identified a lack of scientific evidence for the use of volunteers in mobilising older medical inpatients, but quality improvement initiatives suggest that volunteers can be employed in this role with reports of staff and patient satisfaction: this is an area for further development and evaluation.

What does this paper contribute to the wider global clinical community?

- Sedentary behaviour among older people in hospital is associated with an increased risk of physical and cognitive decline and loss of social independence, but time-pressured hospital staff struggle to encourage mobility among older patients.
- Volunteers are well established in many hospital areas with recent evidence that they can help with direct patient care such as helping feed patients.
- This review has identified a global lack of published peer-reviewed evidence for the use of volunteers in helping mobilise older medical inpatients.
- Reports of quality improvement initiatives from USA and Australia suggest that hospital volunteers can be a useful resource in encouraging older inpatient to mobilise, with positive outcomes on patient and staff satisfaction.
- More well-designed studies are needed to formally evaluate the role of volunteers in assisting older people in mobility and its impact on health and hospital-related outcomes.

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Relevance to clinical practice. This review outlines the evidence for the involvement of volunteers in maintaining patients' mobility, identifies mobilisation protocols that have been used, the need to train volunteers and for formal evaluation of volunteers in this role. Prospero registration number: CRD42014010388.

Key words: ambulation, hospital, inpatients, mobilisation, mobility, older, systematic review, volunteer, walking

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Introduction

Physical activity levels are low among older people and sedentary behaviour in those admitted to hospital typically exceeds the 18 hours per day reported for community dwelling older people (Golubic *et al.* 2014). Accelerometer-based studies have demonstrated that 45 previously independent older medical male inpatients (mean age 74 years) in the USA typically spent only 43 minutes per day in an upright position, i.e. standing or walking (Brown *et al.* 2009). Importantly, sedentary behaviour among older people in hospital is associated with an increased risk of physical and cognitive decline and loss of social independence (Brown *et al.* 2004, Wilson *et al.* 2012). It is also associated with sarcopenia (Sayer 2014). An American study of 11 healthy older adults who underwent 10 days voluntary bed rest demonstrated a significant reduction in lower limb strength (13%) and power (14%) (Kortebein *et al.* 2008) with a loss of almost 1 kg of lean tissue from their legs (Kortebein *et al.* 2007).

Factors contributing to the sedentary behaviour of inpatients include acute illness, staff availability and patient beliefs. An American study reported that the barriers to increased mobility most commonly described by patients, nurses and doctors were symptoms of weakness, pain and fatigue; presence of urinary catheters or intravenous lines and concern about falls (Brown *et al.* 2007). A lack of staff to assist with mobility, an apparent lack of interest among ward staff in promoting mobility and the absence of walking aids and appropriate clothing were also concerns. A recent qualitative study reported that for most patients exercise in hospital meant walking (So & Pierluissi 2012). Motivating factors included avoiding negative effects of bed rest (such as boredom, functional decline or pain and fatigue), improved sense of well-being, promotion of functional recovery as well as recommendation of exercise by health professionals. While only 27% of respondents recalled being encouraged to exercise by hospital staff, most (85%) felt that such encouragement would be a good motivation to undertake exercise while in hospital.

Current UK Department of Health guidelines on physical activity for adults aged 65 years and over recommend at least 150 minutes of moderate aerobic activity/week plus muscle strengthening exercises on two days (UK Department of Health 2013). Similar guidelines are published in the USA (US Department of Health and Human Services 2013). However, there are no national guidelines for physical activity in hospital. There is silver (Cochrane Musculoskeletal Group grading of levels of evidence) level evidence from the 2007 Cochrane systematic review that targeted exercise intervention may be beneficial to older inpatients, resulting in an increased proportion of patients discharged home and reduced length and cost of hospital stay. However, all of the studies included in the review (from the USA, Australia, Sweden and Netherlands) employed additional trained staff members to deliver the intervention (De Morton *et al.* 2007). A recent systematic review similarly reported that early rehabilitation programmes on acute geriatric wards may improve patients' physical function at hospital discharge, reduce length of stay and prevent patients from being discharged to a nursing home (Kosse *et al.* 2013). However, the availability of staff to help patients mobilise is an issue in many countries. In the UK, relatively low staff:patient ratios have been reported on medical wards for older people, with 9·1–10·3 patients per registered nurse compared to 6·7 and 4·2 patients on adult medical/surgical and paediatric wards respectively (Royal College of Nursing 2012). Promoting mobility was one of the aspects of care reported to be most frequently neglected due to time pressures according to 59% of nurses surveyed.

Volunteering is common in many countries, and in England it is estimated that up to three million people are involved in voluntary work within health and social care, in both the voluntary sector and in within public services (Naylor *et al.* 2013). Many hospitals have an established volunteer workforce who play an important role in improving patient experience in hospital through a number of

important roles including befriending/visiting, signposting, hospitality/activities support (drink trolley, play assistant) and administrative support (Galea *et al.* 2013). Volunteers are typically rarely involved in direct patient care, but the Southampton Mealtime Assistance Study has recently demonstrated that trained volunteers were able to safely assist older medical patients at mealtimes, including feeding, and were highly valued by patients and ward staff (Roberts *et al.* 2014). It is unknown whether trained volunteers could potentially help older medical patients maintain their mobility in hospital, supporting time-pressured staff and improving patients' healthcare outcomes. We were interested to review the research evidence for the involvement of volunteers in helping older medical patients mobilise in hospital.

Aims

The aim of this paper was to provide a systematic review of studies describing the involvement of volunteers in mobilising older patients in acute medical wards.

Methods

A systematic review of the literature was undertaken according to the systematic review guidelines from the Centre for Reviews and Dissemination from University of York (Centre for Reviews and Dissemination 2008). The study was registered with Prospero (registration number: CRD42014010388).

Inclusion criteria

The review included hospital based studies, projects or programmes in which volunteers assisted in the mobilisation of general medical inpatients aged 65 years and over. Multi-intervention trials were included if mobilisation was part of the protocol. We included all study designs to in order to capture the breadth of literature currently available. We did not exclude non-English publications and we did not use publication year limits. Studies were excluded if they were conducted in non-acute healthcare settings, in non-medical wards or were limited to specific neurological conditions such as stroke as we were interested in the use of volunteers on general medical wards for older people.

Search strategy

Search criteria were created using a combination of subject headings (where available) and free terms. The terms were divided into three groups: terms related to the setting (Hospital and Aged), terms related to the intervention (Exercise/Mobility + Delirium + Falls) and volunteer terms. The possibility of delirium and fall prevention programmes including volunteers as part of the intervention was reflected in the search terms. Boolean operators 'AND' and 'OR' were used to combine the searches. The electronic databases Ovid MEDLINE(R) 1946 to August Week 2 2015, Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations August 19, 2015, Embase Classic + Embase (1947–2015 August 19), Cumulative Index to Nursing and Allied Health Literature (CINAHL) and Allied and Complementary Medicine (AMED) were accessed via EBSCOhost and Ovid SP. The Cochrane Library was searched using the terms: mobility, walking, older people, volunteers. In order to minimise publication bias the grey literature was reviewed. Google Scholar, Web of Science, Current Contents Connect, BIOSIS Citation Index, BIOSIS Previews and Zetoc were searched using a combination of terms: mobility, walking, project, volunteer, hospital, elderly, older, patients. Google was searched using broad terms: walking, hospital, older people, and volunteers: the first twenty pages were screened. Reference lists in retrieved articles were hand searched for relevant articles. The searches were performed in August 2014 and repeated in August 2015. The search strategy undertaken in Medline is presented in Table 1.

Article selection and data abstraction

Titles and abstracts of all potentially relevant studies were assessed against the inclusion criteria by two reviewers (AMB and HCR) working independently and any disagreements were resolved by discussion. Full texts of those articles selected by either author were retrieved and reviewed independently by both reviewers again to confirm that they met the inclusion criteria. Data were extracted from the articles included in the review by the two researchers working independently and using a predefined data extraction form. Information was extracted on study design, participants, training and intervention delivered by the volunteers, comparators used, analysis methods and reported outcomes. Statistical pooling of data was not conducted due to the wide variance in study design, intervention and outcomes between studies.

Quality of studies

Studies included in the review were assessed for methodological quality by two researchers working independently using published criteria with a maximum score of 27 points (Downs & Black 1998).

Results

Search results

The total number of articles arising from the electronic database searches was 2425 (See Fig. 1). Review of the titles and abstracts identified 24 articles which met the review inclusion criteria. After full text review, only 12 papers were still relevant, 10 of which related to the Hospital Elder Life Program (HELP), 2 of them related to Mobilisation of Vulnerable Elders in Ontario (MOVE ON). Of the 12 studies that did not meet the inclusion criteria, the reasons for exclusion were due to the lack of mobility intervention (eight studies), the lack of volunteer involvement in the mobility protocols (three studies) and limited information available in a single patient case report (one study). The Google Internet search additionally identified three reports of quality improvement initiatives (the Footprints Walking Program, the ACTIVe Program, and Mobility is Medicine). References cited in articles that met the inclusion criteria were screened but yielded no new results. No relevant non-English papers were identified from screening of English titles. The details of included studies are summarised in Table 2.

Quality of studies

Of the five studies evaluated by two researchers only one (HELP) received a high score of 22. The results of the MOVE ON study are yet to be published therefore we could not complete the quality assessment. The remaining three studies were not scored as they were published as abstracts and there was insufficient data to assess the quality of their conduct.

Study characteristics

The five studies included in the review consist of a large controlled clinical trial (n = 852) based in a teaching hospital (HELP), a published protocol of a multicentre intervention trial using interrupted time series design (MOVE ON) and three quality improvement initiative reports (The Footprints Walking Program, ACTIVe Program, and Mobility is Medicine). Three studies were conducted in the USA (HELP, Footprints Walking Programme and Mobility is Medicine), one in Canada (MOVE ON) and one in Australia (ACTIVe Program). All studies involved trained volunteers in mobilising older people in an acute hospital setting. In three studies, volunteers were trained specifically to encourage mobility of older inpatients and in two studies, mobility was one aspect of more comprehensive care provided to patients which included activities, interaction and nutrition. Each study, including its mobility protocol and involvement of volunteers will be presented individually (Table 3).

The Hospital Elder Life Programme (HELP)

The Hospital Elder Life Programme (HELP) (www.hospitalelderlifeprogram.org) is a model of care designed to

Table 1 Search strategy for: Ovid Medline (R) + Non-indexed (1947 – August 2015)

		Number of articles
	Terms related to the setting	
1	exp Inpatients/or (inpatient* or in-patient* or hospitali#ed or ward*).ti,ab.	1,292,146
2	exp Aged/or exp Ageing/or exp Geriatrics/or ((geriatr* or elder* or old*) or (6#year* or 7#year* or 8#year*)).ti,ab.	3,246,120
3	1 and 2	553,634
	Terms related to the intervention	
4	exp Exercise/or exp Exercise Therapy/or exp Exercise Movement Techniques/or exp animal assisted therapy/or exp exercise movement techniques/or exp musculoskeletal manipulations/or exp Walking/or exp Physical fitness/or exp Rehabilitation/or (rehabilit* or physical therapy or physiother* or (strength* adj 3 train*) or exercise* or walk* or ambulat*).ti,ab.	1,059,621
5	exp Delirium/or exp Confusion/or (delir* or confus*).ti,ab.	52,150
6	exp Accidental Falls/or fall*.ti,ab.	153,600
7	4 or 5 or 6	1,241,718
8	3 and 7	53,457
	Volunteer terms	
9	exp Voluntary Workers/or exp Hospital Volunteers or (volunt* or unpaid or charit*).ti,ab.	200,002
10	8 and 9	1153
11	exp stroke/or (CVA or stroke or cerebrovascular accident).ti,ab.	182,221
12	10 not 11	1030

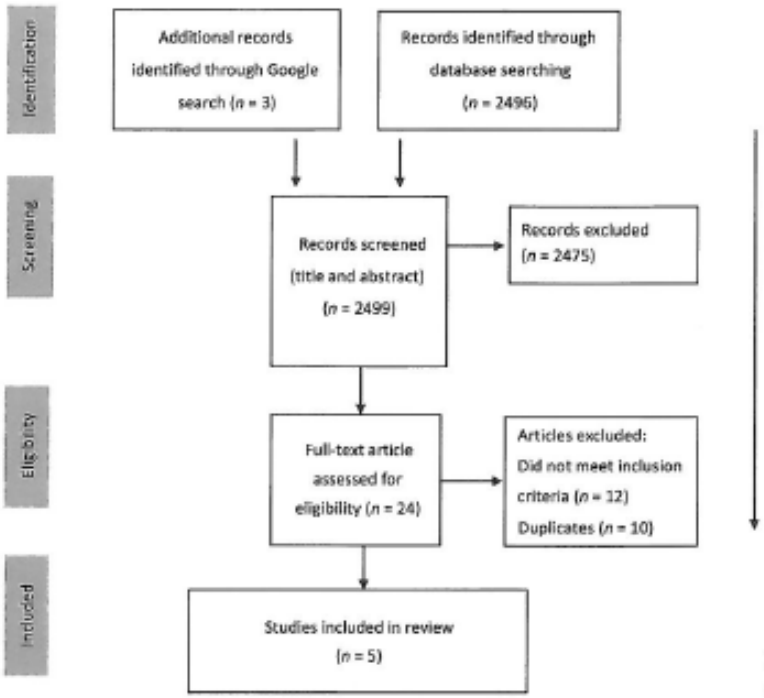

Figure 1 PRISMA flow diagram of search results.

prevent delirium and functional decline among hospitalised older patients (Inouye *et al.* 1999, 2006, Sandhaus *et al.* 2006). The programme aims to involve multidisciplinary staff and trained volunteers in the delivery of protocols addressing six risk factors for delirium: orientation, therapeutic activities, early mobilisation, vision and hearing protocols, oral volume repletion and sleep enhancement. The programme has been demonstrated to be effective in preventing and managing delirium and functional decline in sites in the USA and Australia (Rubin *et al.* 2011). It has been disseminated to over 60 acute and community hospitals in the US (Bradley *et al.* 2006), Australia (Caplan & Harper 2007), Taiwan (Chen *et al.* 2011) and Canada (John 2013).

The early mobilisation protocol comprises ambulation or active range-of-motion exercises performed three times daily, but it is reported to have been implemented less often and less completely than the other protocols (e.g. 84% for mobilisation protocol vs. 96% for orientation protocol) (Inouye *et al.* 1999). A majority of the protocols are implemented by the volunteers under the guidance of the Elder Life Specialist and Elder Life Nurse specialist. However, the extent of the involvement of volunteers (rather than healthcare professionals) in delivering the mobility protocol is unclear. Volunteers were involved with the basic and enhanced mobility protocols at the community teaching hospital linked with the original site, but implementation of these protocols was delayed because of an initial shortage of volunteers (Rubin *et al.* 2011). Replication of the HELP programme at another community hospital in New Jersey did not include the mobility intervention because of reported staffing limitations (Zaubler *et al.* 2013).

The HELP programme is currently being evaluated in the UK as part of a Prevention of Delirium programme in eight hospitals on geriatric and orthopaedic wards (Young 2009).

Table 2 Description of the components of PICO in the systematic review

Population	General medical inpatients aged 65 years and older admitted to an acute medical healthcare setting. Specific neurological conditions such as stroke were excluded to reflect the general medical ward for older people setting
Intervention	Any studies that involved volunteers in mobilising patient, whether partially or completely, were included in the review
Comparison	Usual care
Outcome	Any physical and mental health outcomes, receipt of care, patient and staff satisfaction

However, it is unclear whether the protocols will be delivered by trained staff or volunteers (J. Young, pers. comm.) and an initial participatory research study (Godfrey *et al.* 2013) which examined current knowledge and practices relating to delirium and delirium prevention in three UK hospitals found that the current practice of volunteer employment on the wards was not consistent or reliable. The authors recommended that there should be a clear support system in place to enable volunteers' participation in care and better communication with staff members.

In the Netherlands, the cost-effectiveness of the HELP programme is also being evaluated over a period of 18 months in eight hospitals, and the experiences of patients, families and staff will be explored through qualitative methods. It is reported that volunteers will have an important role in the study stimulating patients to eat, drink and walk (Strijbos *et al.* 2013).

Mobilisation of Vulnerable Elders in Ontario

The MOVE ON project started in February 2012 and aims to improve the mobility of older inpatients and prevent functional decline across 26 hospitals in Ontario, Canada (Straus & Liu 2012). This project aims to implement a progressive, scaled mobilisation of participants at least three times per day as well as a mobility assessment and care pathway within 24 hours of admission and results are awaited. Some of the hospitals (Sunnybrook Hospital and St Michael's Hospital) are reported to be using volunteers in addition to paid staff. However, the extent of volunteer involvement is unclear since the published protocol for MOVE ON does not detail the involvement of volunteers (Liu *et al.* 2013). Additionally a recent paper reporting the development of a mapping guide to support the intervention by linking identified barriers and intervention activities did not report any contact with volunteers (Moore *et al.* 2014).

The Footprints Walking Program

The Footprints Walking Program was implemented as a clinical quality improvement initiative in one acute hospital in the US (Boyd & Lipowich 2011). The objectives of the project were to maintain mobility and prevent deconditioning during hospital stay, with the aim of reducing length of stay, prevent complications of bed rest and increase patient and staff satisfaction. Over 50 trained volunteers assisted adult inpatients in daily 15-minute walking sessions and 20–25% of the inpatients were reported to take part every day. The project outcomes reported were increased patient and staff satisfaction and reduced length of stay. However, this programme was just one of many hospital-wide clinical service improvements and as such the outcome cannot be attributed solely to the volunteer-assisted mobilisation scheme.

ACTIVe Program – Aged Care Therapeutic interventions by Volunteers

The ACTIVe Program – Aged Care Therapeutic interventions by Volunteers – was developed in one acute ward for older people at an Australian hospital (Tawbe 2011). Twenty volunteers were trained to provide a range of interventions aimed at improving patients' experience and preventing functional and cognitive decline. The interventions included meal assistance, mobility assistance, companionship and therapeutic activities. Within a few months of implementing the programme an exercise class was created to engage patients in regular activity twice a week. Reported outcomes of the programme included a decrease in the frequency of one-to-one nursing care required for the patients at risk of falls and those with delirium, greater family involvement in patient care while in hospital as well as increased patient and staff satisfaction.

Mobility is Medicine

The Mobility is Medicine pilot project was implemented in 2011 on two acute care medical nursing units in a hospital in the USA (Eaniello *et al.* 2011). The aim of the programme was to increase the frequency of patient mobilisation, to improve communication around mobilisation and to increase the accuracy of nursing documentation. Six college student volunteers were recruited and received three hours of training with a physiotherapist and several hours of supervised practice. They delivered 200 mobility encounters during a period of three months, mainly walking the patients in the hallway. The intervention was not formally evaluated but the authors reported improvements in nursing documentation of patient mobilisation, patient reported mobilisation, and observed discussion of patient mobilisation by nursing staff in handover meetings as well as positive patient and staff perceptions of the programme.

Discussion

This systematic review has identified a lack of scientific trials specifically designed to study volunteer-assisted mobilisation in older acute medical inpatients. The best current

Table 3 Outline of studies identified

Study name Authors (date)	Study design and setting	Population	Intervention	Comparator	Outcomes	Volunteer role
The Hospital Elder Life Program (HELP) Inouye *et al.* (1999)	Controlled clinical trial, one acute hospital, USA	852 patients aged 70 years or older (61% female), acute general medical services Number of volunteers not reported	Multicomponent strategy for reducing delirium targeting cognitive impairment, sleep deprivation, immobility, visual and hearing impairment, dehydration	Usual care	Significantly lower incidence of delirium in the intervention group OR 0·6 (95% CI 0·39–0·92) and reduced length of delirium. Overall adherence to intervention 87% (84% for early mobilisation). Reduction of risk factors for delirium in the intervention group	Volunteers worked as part of a multidisciplinary team which included geriatric nurse specialists, elder life specialists, therapeutic recreation specialists, physical therapy consultants and geriatricians to deliver the multicomponent intervention which include mobility. More detailed information regarding the role of volunteer is not available
MOVE ON (Mobilisation of Vulnerable Elders in Ontario) project Straus and Liu (2012)	Multi-centre study, interrupted time series design, 14 acute Canadian hospitals	General medical inpatients aged 65 years and older, total number not reported Number of volunteers not reported	Mobility assessment and care pathway implemented within 24 hours of admission, progressive scaled mobilisation at least three times a day	Usual care	Primary outcome: frequency of patient mobilisation secondary outcomes: length of stay, ADL on admission and discharge, discharge destination, falls, injurious falls, perceptions and satisfaction of patient/caregivers and staff obtained, rate of documentation	The extent of volunteer involvement is not clear. Some hospitals have included volunteers in the delivery of the programme, but more detailed information is not available
Footprints Walking Program Boyd and Lipowich (2011)	Quality improvement initiative, one acute hospital, USA	Acute general medical patients, total number not reported Number of volunteers: 50	Daily patient ambulation seven days a week	None	20–25% of patient participation, patients, staff and volunteers report satisfaction with the programme	Volunteers were scheduled to encourage patients to walk seven days a week. Suitable patients were identified by trained nurses
ACTIVe Program The Aged Care Therapeutic Interventions by Volunteers Tawbe (2011)	Quality improvement initiative, one acute hospital, Australia	266 older acutely hospitalised patients Number of volunteers: 20	Assistance with mealtimes, walking companionship, and therapeutic activities	None	266 patients visited, 1020 interventions, 55 attendances at the exercise class established twice a week, better orientation of patients, decrease in 111 nurse specials, encouragement of family involvement in hospital care	Volunteers provided one of four main interventions including mealtime assistance, mobility assistance, companionship and therapeutic activities which were carried out daily with exercise classes twice a week

Table 3 (continued)

Study name Authors (date)	Study design and setting	Population	Intervention	Comparator	Outcomes	Volunteer role
Mobility is Medicine Faniello *et al.* (2011)	Quality improvement pilot project, one acute hospital, USA	One acute general medical ward and one medical oncology ward, total number of patients not reported Number of volunteers: 6	Mobilisation and assisting staff in mobilisation of patients	Usual care	200 volunteer mobility encounters, increase in nurse initiated and assisted patient mobilisation, improved reporting of patient mobility status (by 34–40%), uniformly positive perception of the value of the programme among staff and volunteers	Volunteers independently mobilised patients deemed safe by the physical therapist or nurse They also assisted therapy/nursing staff to mobilise patients requiring assistance by more than one person, and assisted patients to prepare for planned mobilisation sessions and wellness workout

evidence comes from the well-designed and evaluated clinical controlled trials of the HELP programme that included volunteers. However, the aim of this programme was to prevent delirium, and so the primary outcomes did not include mobility or functional level. Furthermore, the mobility protocol appears to have been one of the more difficult to implement in several different settings and it is unclear to what extent volunteers rather than clinical staff were involved with this protocol. The MOVE ON study in Canada has yet to report and again it is unclear to what extent volunteers will be involved in helping older inpatients mobilise. Three small quality improvement initiatives, the Footprints Walking Program and Mobility is Medicine in the US and the ACTIVe Program in Australia, involved trained volunteers in mobilising patients and were reported to be acceptable and regarded as useful by patients their families and staff but were not otherwise formally evaluated.

Many hospitals have an established volunteer workforce, whose tasks are typically centred on talking to patients, helping with refreshments for patients and staff, conducting patient surveys and administrative support for clinical staff. As an example of volunteer involvement in direct care, the Southampton Mealtime Assistance Study showed that volunteers can be successfully trained to help older patients at mealtimes, including feeding them, without any adverse incidents (Roberts *et al.* 2014). The benefits of early mobilisation of adult inpatients are well recognised and include physical effects (improved physical function, fewer medical complications), psychological effects (less anxiety, depression and emotional distress), social effects (improved quality of life and independence) and organisational outcomes (reduced length of stay and cost) (Kalisch *et al.* 2014). Trained volunteers could potentially help promote increased mobility among older people during hospital admission and support time-pressured staff but further research is required to evaluate this extension of the volunteers' traditional role.

The lack of a controlled trial to evaluate the use of volunteers to mobilise older inpatients is a limitation and there is a need to establish whether volunteers can deliver this intervention effectively. Future research should focus on using robust research methods to establish the feasibility and acceptability of training volunteers to mobilise older inpatients, with particular emphasis on providing a detailed description of the training and retention of volunteers, the delivery of the mobility protocol, and its effect on patient outcomes. The five studies in this review did not report on adverse outcomes, which is an important aspect in the context of this patient group and the intervention involved. Cost analysis is also important to determine the

sustainability of the intervention and help guide health service managers considering the implementation of volunteer mobility programmes.

Limitations

The review identified only one study which was assessed as being of high quality (the HELP programme) and so the main limitation of this review is the lack of evidence on the efficacy of the volunteers in delivering the mobility intervention. The published articles on the MOVE ON study do not yet include any participant details or outcomes. The three quality improvement initiatives provided some valuable insight regarding the use of volunteers in mobilising older people, but the application of their findings is limited due to the lack of information provided. It is possible that other examples of small-scale quality improvement initiatives were not identified.

Conclusion

Sedentary behaviour among older people in hospital is associated with an increased risk of physical and cognitive decline and loss of social independence. It is well recognised that early ambulation programmes and maintaining patients' mobility can improve healthcare outcomes but time-pressured hospital staff struggle to encourage mobility among older patients. Volunteers are well established in many hospital areas with recent evidence that they can help with direct patient care such as helping feed older medical patients safely. We were interested to know whether with appropriate training and support volunteers could potentially help older medical patients maintain their mobility in hospital, supporting time-pressured staff and improving patients' healthcare outcomes. This review has identified a lack of published peer-reviewed evidence for the use of volunteers in helping mobilise older medical inpatients, but reports of quality improvement initiatives suggest that volunteers can be employed in this role with reports of staff and patient satisfaction: this is an area for further development and evaluation.

Relevance to clinical practice

Nurses and other clinical staff are well aware of the benefits of maintaining the mobility of older medical patients, but competing tasks often mean this is difficult to achieve in a time-pressured ward environment. Currently the mobility of patients is the responsibility of ward staff. This review outlines the evidence for the involvement of volunteers in maintaining patients' mobility, identifies mobilisation protocols that have been used in studies and quality improvement initiatives, the need to train volunteers and the need for formal evaluation of volunteers in this role.

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Contributions

Study design: HCR, AAS; data collection and analysis: AMB, SERL, HCR; manuscript preparation: AMB, HCR, SEL, AAS; all commented on draft versions of the paper and approved the final article.

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Conflicts of interest

None.

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Appendix 20.4

BGS Spring Meeting 2017, Newcastle, 26 – 28 April 2017

Scientific Research – Health Services Research

AMBULATORY ACTIVITY OF OLDER INPATIENTS ON ACUTE GERIATRIC MEDICINE WARDS

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Introduction
Accelerometers are often used to objectively measure physical activity in older people. We conducted a literature review which demonstrated few studies examining the ambulatory activity of hospitalised older people. We aimed to describe the pattern of ambulatory activity of older inpatients and evaluate the use of the StepWatch Activity Monitor (uniquely able to measure gait ≤ 0.4 metre/second) in this population.

Methods
An observational cross-sectional study was conducted on the acute Geriatric Medicine wards of one hospital. Inclusion criteria were patients aged ≥70 years, able to mobilise prior to admission and to provide written consent. Ambulatory activity was measured using the ankle-worn StepWatch Activity Monitor (SAM) for ≤ 7 consecutive days, recording the total step count per 24-hour day. The accuracy of SAM was examined by comparing measured and observed step count over 40 metres.

Results
42 patients (mean age 87.5 years ± 4.6) had a median device wear time of 4 consecutive days (IQR 2-7 days) and median daily step count of 636 steps (IQR 298-1468 steps). Analysis demonstrated two peak periods of ambulatory activity, between 8am–12pm and 6pm–8pm. However, 33 patients (79%) were considerably mobile between 10pm and 6am, with a median step count of 94 steps (IQR 36 - 289 steps). A subgroup analysis of 13 patients (mean age 86.3 years, median gait speed 0.55metre/second) who completed the 40 metre walk demonstrated a mean absolute percentage error between the observed and SAM step count of 8.6% (SD 10.5). Bland-Altman analysis demonstrated good level of agreement between both measures (mean difference = -8.23 steps; CI -17.99 – 1.53).

Conclusions
Ambulatory activity was very low in this patient group who walked slowly. Despite the slow gait speed the SAM was an accurate measure of ambulatory activity in these older acute medical inpatients. An understanding of the variation in daily activity levels can help researchers and clinicians implement time-specific interventions to address this important issue.

Appendix 20.5

P-467
The use of trained volunteers to encourage increased ambulatory activity among hospitalised older people: a feasibility study

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Introduction: Sedentary behaviour among older inpatients is associated with functional decline, social isolation, prolonged hospitalisation and nursing home admission. The objective of this study was to explore the use of trained volunteers to promote increased ambulatory activity among older inpatients.

Methods: This pre-post feasibility study was conducted on acute Geriatric Medicine wards at one hospital. Inclusion criteria were patients aged ≥70 years, who were able to walk prior to admission and provide consent. Participants received twice daily volunteer-led bedside exercises or walking sessions on weekdays. Participants who were not independently mobile performed exercises only. The StepWatch Activity Monitor measured mean daily step count before and during the intervention as the primary outcome.

Results: 42 patients (mean age 87.2 years, SD 4.6) had their activity measured (median daily step count 636 steps, IQR 298–1468) pre-intervention. 17 volunteers received half-day training including competency assessment. 50 patients (mean age 86.2 years, SD 5.1) were recruited to the intervention group and 310 activity sessions were offered. The median daily step count of the intervention group was 912 steps (IQR 337–1824), an increase of 43.4%. Adherence to the activity sessions was 74.2% (230 sessions). Common reasons for declined participation were patients feeling unwell or tired, and the need for clinical care. No falls or adverse incidents were reported.

Conclusion: Volunteers can be recruited and trained to safely encourage older inpatients to increase ambulatory activity, with an average increase of 276 steps/day. Research into the acceptability and impact of this intervention is on-going.

Appendix 20.6

Aging Clinical and Experimental Research
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ORIGINAL ARTICLE

Physical activity among hospitalised older people: insights from upper and lower limb accelerometry

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Abstract

Background Few studies have explored the activity levels of hospitalised older people and the intra-daily activity patterns in this group have not been described.

Aims To describe the quantity and daily pattern of physical activity among hospitalised older people using two accelerometers: the ankle-worn StepWatch Activity Monitor (SAM), and the wrist-worn GENEActiv.

Methods This cross-sectional observational study was conducted on the acute medical wards for older people in one UK hospital. Inclusion criteria: participants aged ≥ 70 years, and able to mobilise prior to admission. Participants wore both devices for up to seven consecutive days, or until hospital discharge, whichever was sooner. Intra-daily activity levels were analysed hourly over each 24 h period.

Results 38 participants (mean age 87.8 years, SD 4.8) had their activity levels measured using both devices. The SAM median daily step count was 600 (IQR 240–1427). Intra-daily activity analysis showed two peak periods of ambulatory activity between 9 am–11 am and 6 pm–7 pm. With physical activity defined as ≥ 12 milli-g (GENEActiv), the median time spent above this cut-off point was 4.2 h. 62% of this activity time was only sustained for 1–5 min. Acceptability of both devices was high overall, but the wrist-worn device (96%) was more acceptable to patients than the ankle-worn device (83%).

Conclusion Activity levels of these hospitalised older people were very low. Most physical activity was sustained over short periods. The intra-daily pattern of activity is an interesting finding which can help clinicians implement time-specific interventions to address the important issue of sedentary behaviour.

Keywords Older people · Hospital · Physical activity · Accelerometer

Background

Deconditioning can be defined as the physiologic changes occurring with prolonged bed rest or other inactivity [1]. There is increasing recognition that deconditioning associated with physical inactivity during hospitalisation can result in a range of adverse effects for hospitalised older people, including increased frailty [2], functional decline [3] and development of disability in activities of daily living [4]. There is a growing interest in interventions promoting increased physical activity among older people in hospital [5, 6].

A recent systematic review [7] has highlighted how a range of different physical activity measures have been used in this patient group, including step count [8, 9], posture identification [10–12], and physical activity energy expenditure [13]. Studies conducted in the US suggest that hospitalised older people are inactive, with low daily step counts

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(478–846 steps) [14] and with little time spent in an upright position per day (43 min walking or standing) [10].

However, we are not aware of any studies which have described the daily pattern of activity levels of hospitalised older people in detail. Such information could be beneficial in the future when deciding the optimum time of day and duration of physical activity interventions. In addition, whilst many existing studies have focussed on step count or time spent standing, they have not captured activities in the seated position using accelerometry. This is an important area to address because amongst the less mobile, such activities may be the best target for intervention. The aim of this study was, therefore, to describe in detail the quantity and daily pattern of physical activity among hospitalised older people using simultaneous ankle- and wrist-worn accelerometry.

Methods

Study design and population

The data for this study come from the baseline phase of SoMoVe, a study examining the feasibility of implementing a volunteer-led physical activity intervention on acute medical wards for older people (ClinicalTrials.gov no: NCT02594527). This observational cross-sectional phase of the study was conducted between February and July 2016 before volunteers were trained. Patients admitted to the acute medical wards for older people in one hospital were invited to participate. Inclusion criteria included patients aged ≥ 70 years who were mobile prior to admission and able to provide valid written consent. Patients isolated for infection control reasons and those receiving end-of-life care were excluded. Patients were identified through discussions with the nurse in-charge on the study wards and by reviewing medical notes to determine if the inclusion criteria were met. Patients who were eligible to participate were approached and details about the study were provided including the patient information sheet. Written consent was obtained from patients who wished to participate. This study was approved the South East Coast—Surrey Research Ethics Committee.

Measure of physical activity

Physical activity levels were measured using two accelerometers, the StepWatch Activity Monitor (SAM) (Modus health, Washington, US) and GENEActiv (Activinsights, Kimbolton, UK). Participants wore both devices for a maximum of 7 days or until hospital discharge, whichever was sooner. A minimum of 24 h recording from both devices was required for data analysis.

The SAM is an ankle-worn dual-axis accelerometer. Its primary output is stride count per minute, with each stride equivalent to two steps. It has been used in previous studies measuring step counts of hospitalised older people [14, 15] and has been reported to be accurate at slower gait speeds, down to 0.45 m/s [16]. The GENEActiv is a wrist-worn tri-axial accelerometer [17]. It records acceleration in three planes with a frequency of 100 Hz. Its output is summarised in the form of a signal magnitude vector of the three planes with the acceleration due to gravity subtracted (unit milli-g). The device contains a temperature sensor to allow detection of periods of non-wear.

Covariates

Several covariates were recorded including Barthel Index [18], gait speed [19], grip strength [20], Charlson Comorbidity Index [21] and number of medications. The Barthel Index is a physical function measure which assesses patients' functional abilities in activities of daily living: transfers, walking, stairs, toilet use, dressing, feeding, bladder control, bowel control, grooming and bathing, to give a maximum total score of 100. Gait speed was measured by recording the time taken for each participant to walk 4 m at a comfortable pace, using a stopwatch. Hand grip strength was measured using the Jamar dynamometer. Participants were seated either on the chair or upright in bed, with shoulders adducted and neutrally rotated, elbow flexed at 90° and wrist neutrally rotated. Grip strength was then tested on both hands twice and the highest of the four scores was recorded as the final score for maximum grip strength. A review of participants' medical notes was conducted to collect data regarding comorbidities and number of medications.

Device acceptability

A questionnaire was designed to explore the views of the participants regarding the comfort and ease of wearing the devices over the period of the recording and whether the devices interfered with any aspect of their daily activities including personal hygiene, washing, toileting, mobility and sleep. Upon removal of the devices, an interviewer went through the questionnaire with each participant and completed the questionnaire. Participants who were discharged out of hours did not complete the questionnaires.

Statistical analyses

The SAM data were analysed using the software provided with the device; for the GeneActiv data we used the GGIR library [22] for the statistical package, R [23]. We performed all subsequent analyses using STATA version 14 [24]. We restricted each recording to the period when data were

available from both devices and excluded hours with only partial data at either end of recordings.

The mean step count and the mean acceleration per hour of each day for each participant were analysed. Each minute of recording from each device was classified as a binary output (active or inactive) to make the output from the two devices comparable. We were not aware of existing cut-points for activity in this population, which is characterised by very low activity levels as previously described [10]. Each minute of the SAM recordings was classified as active where participants took four or more steps (two or more strides). Receiver operating characteristic curve analysis was used to determine an equivalent cut-point for the GENEActiv recordings. The analysis showed that a 1-min mean acceleration cut-point of ≥ 12 milli-g produced an area under the curve value of 0.822, with sensitivity and specificity of 82% for detecting if participants had taken four or more steps in the same minute. Activity periods were classified into bouts of 1–5 min, 6–10 min or greater than 10 min duration.

Mixed effects logistic regression was conducted to investigate the associations between hour of the day and the likelihood of activity from the above binary variables, whilst taking account of clustering of data at the level of each participant. Differences in activity by day of recording were investigated. In both logistic regression analyses, evidence of interaction by gender was tested.

Results

67 inpatients met the inclusion and exclusion criteria and 50 participants consented to participate in the study. 38 participants (18 men and 20 women, mean ages 88.3 and 87.5 years, respectively) had at least a 24-h recording from both devices. The characteristics of participants are shown in Table 1. The median Barthel Index score was similar for men (80) and women (71). The median gait speed for both men and women was 0.47 m/s. The mean grip strength for men and women was 22.8 and 13 kg, respectively. The illnesses that commonly precipitated hospital admission included: pneumonia (18%), urinary sepsis (18%), musculoskeletal problems (18%) and heart failure (13%).

Average step count and wrist acceleration across the day

The step count in the sample was positively skewed, with median 600 (IQR 240, 1427) steps per day and a trend towards a higher step count in men (Table 1). There were two peak periods of median step count throughout the day: 9–11 am and 6–7 pm (Fig. 1a).

The measured acceleration at the wrist was low with a mean of 8.8 milli-g per minute, with higher values in men than women (9.9 and 7.8 milli-g, respectively, $P = 0.02$). The mean values for acceleration per hour (Fig. 1b) suggested a general increase in activity during the daytime compared to the night.

Number of minutes spent above cut-points across the day

Participants spent a median 40 min (IQR 20, 73) per day taking four steps or more per minute and these were typically in bouts of 5 min or less. By comparison, participants spent longer at or above the wrist acceleration cut-point of 12 milli-g: a median of 4 h and 19 min (IQR 3 h 10 min, 5 h 36 min) per day. Most of this activity was again in bouts of 1–5 min duration. Men tended to undertake a greater duration of activity than women, as shown in Table 1.

The findings from the models for the likelihood of activity by time of day are shown in Fig. 2. They revealed low levels (1 or 2 min/h) of step activity between 6 am and 9 pm. By contrast, we saw sustained activity at the wrist over the same period, with peaks of approximately 18 min/h at 9 am, 12 pm and 5 pm. We did not find differences in activity by day over up to 5 successive days of recording.

Device acceptability

23/38 (61%) participants (14 men) completed the questionnaire upon removal of the devices. Four participants (17%) reported that the SAM device was uncomfortable to wear overnight although it was well-tolerated during the day. Only one participant (4.3%) reported that the GENEActiv was uncomfortable to wear on the wrist; the participant in question had never regularly worn a watch.

Discussion

Summary of findings

Using simultaneous ankle- and wrist-worn physical activity devices, we have described the physical activity levels and patterns of 38 acute medical inpatients aged ≥ 70 years. Participants in this study appeared to be physically frail and at high risk of sarcopenia as suggested by a low median gait speed (0.47 m/s) and low median grip strength among men (22.8 kg) and women (13 kg). The European Working Group on Sarcopenia in Older People (EWGSOP) cut-off points for identifying sarcopenia are 0.8 m/s for gait speed [25] and < 32 kg for men and < 22 kg for women for grip strength [26].

We found overall low activity levels with both devices, with activity typically occurring in bouts of 5 min or shorter duration. We saw different patterns of activity from the two

Table 1 Participants' characteristics and physical activity levels

Characteristic	Men ($n=18$)	Women ($n=20$)
Age (years)[a]	88.3 (5.1)	87.5 (4.5)
Barthel Index[b]	80 (72, 92)	71 (45, 88)
Gait speed[b] ($n=18$)	0.47 (0.31, 0.77)	0.47 (0.17, 0.67)
Grip strength[a] ($n=34$)	22.8 (7.9)	13 (11, 17)
Charlson's Comorbidity Index[b]	7 (6, 8)	7 (5, 9)
Number of medications[b]	7 (4, 11)	9 (6, 12)
Mini-mental state examination[b]	27 (23.5, 27)	22 (20, 28)
Diagnosis		
Pneumonia	4 (22%)	3 (15%)
Urinary sepsis	4 (22%)	3 (15%)
Heart failure	2 (11%)	3 (15%)
Musculoskeletal problems	3 (17%)	4 (20%)
Neurological problems	1 (5.5%)	2 (10%)
Other respiratory illnesses	3 (17%)	1 (5%)
Other source of sepsis	0	3 (15%)
Electrolyte imbalance	0	1 (5%)
No acute medical illness	1 (5.5%)	0
Recording length (days)[a]	4.8 (2.1)	3.8 (1.9)
Steps (SAM)		
Steps per day[b]	834 (316, 2161)	404 (211, 979)
Total minutes per day with ≥ 4 steps[b]	54 (24, 104)	32 (19, 54)
Minutes spent in sustained ambulation with ≥ 4 steps		
1–5 min[b]	46 (15, 77)	30 (19, 49)
6–10 min[b]	5 (0, 18)	1 (0, 4)
10+ min[b]	1 (0, 7)	0 (0,0)
Wrist acceleration (GeneActiv)		
Mean acceleration per minute (milli-g)[a]	9.9 (3.0)	7.8 (2.5)
Total minutes per day with acceleration ≥ 12 milli-g*[b]	315 (223, 377)	236 (165, 289)
Minutes spent in different bout lengths with acceleration ≥ 12milli-g		
1–5 min[b]	161 (125, 193)	139 (108, 176)
6–10 min[b]	53 (34, 68)	39 (20, 58)
10+ min[b]	61 (46, 158)	29 (19, 50)

SAM stepwatch activity monitor

[a]Mean (SD)

[b]Median (IQR)

*This cut-off point was chosen as being most comparable to taking four or more steps in a given minute

devices, with peaks in step count per hour between 9–11 am and 6–7 pm, compared to peaks in wrist acceleration at 9 am, 12 pm and 5 pm, which corresponds to patient meal times.

Comparison with other studies

We are not aware of existing studies looking at ambulatory activity of older medical inpatients in the UK. However, the low median daily step count of 600 steps reported in this study appears to be consistent with findings from research in other countries. McCullagh et al. examined the mobility levels of 150 medical inpatients (mean age 77.5, SD 7.4) in a hospital in Ireland and reported a median daily step count ranging from 299 to 661 steps per day [27]. Studies in the US report a similar range of daily step count. Ostir et al [14] reported a median of 478 steps among patients aged > 65 years in the first 24 h of hospitalisation and 846 steps in the last 24 h of hospitalisation. Fisher et al [15] examined the step count of 162 patients who were admitted to Acute Care of the Elderly unit (mean age of 77.4 years) and reported a mean daily step count of 662.

Interpretation of findings

The intra-daily variation in physical activity levels is a novel finding. Peak step counts occurred between the

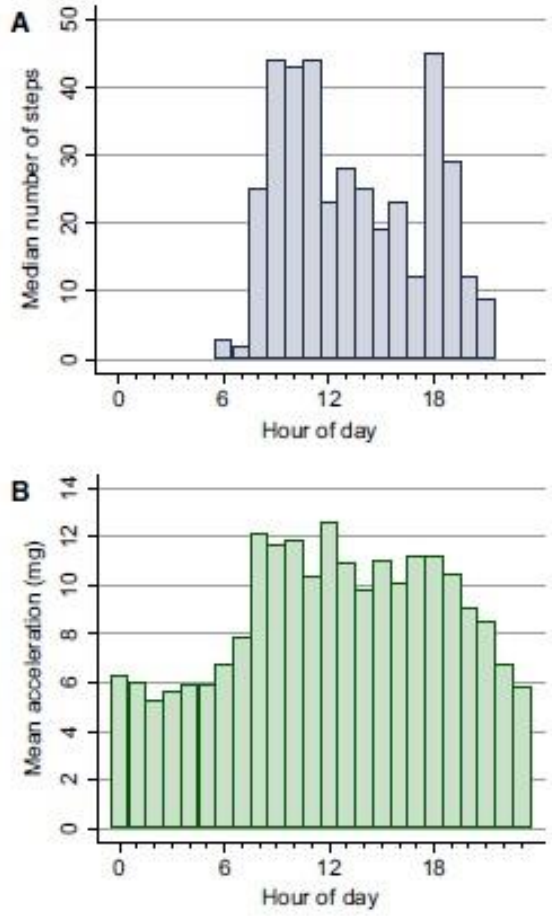

Fig. 1 Step count and wrist acceleration by hour of day. Values shown are for all 38 participants. **a** Median number of steps per hour from the Stepwatch device. **b** Mean acceleration (milli-g) per hour from the GeneActiv wrist-worn device

hours of 9–11 am and 6–7 pm. The increase in step count in the morning could be explained by higher levels of therapy input during this period as well as personal care. Step count then declined steadily from lunch time onwards and was at the lowest towards the end of visiting hours. The increase in step count was noted again later in the evening between 6 and 7 pm, which could be due to patients preparing themselves for bedtime and may include trips to the bathroom for personal care. An interesting finding of this study was the low step count during visiting hours. An observed culture on the wards was that visitors tended to gather around patients' bedside rather than encouraging them to be more active and taking them out for walks. A cultural change may be needed to empower family members and friends to encourage patients to be more active in hospital. Future studies looking at promoting increased physical activity among older inpatients should aim to implement interventions particularly during these sedentary periods.

We also used an activity cut-point of four steps or more per minute and found that participants achieved this for 40 min on average per day. This is consistent with findings from other studies, which have found inpatients to be in an upright position for about 43 min [10] and 48 min [28] per day. Interestingly, we did not see the same peaks of walking activity using the cut-point (Fig. 2) as we did from the median step count (Fig. 1a). A possible explanation for this discrepancy is that a more mobile subgroup within our sample undertook most of the walking activity, with the extra steps in each of their active minutes (above the four steps needed to meet the cut-point) then not being counted. This idea is supported by the positively skewed distribution of the daily step count (as shown in Table 1); for example, the most active individual had a daily count of around 3500 steps.

We saw very low mean daily acceleration at the wrist(8.8 milli-g), with 10.9 milli-g previously suggested as a cut-off for sedentary behaviour for community-dwelling individuals [29]. There was little variation in the mean level of acceleration per hour during the daytime (Fig. 1b). By contrast, there appeared to be a meaningful variation in the number of minutes spent at or above our 12 milli-g cut-point, presumably related to upper limb activity during personal care and mealtimes (Fig. 2). These findings would suggest that the assessment of wrist acceleration in this population benefits from minute-by-minute analysis with a low threshold for activity.

While the acceptability for both devices were high (GENEActiv: 96%; SAM 83%), the wrist-worn GENEActiv was found to be more acceptable to patients than the ankle-worn SAM. This is consistent with previous reports of higher compliance of wrist-worn devices [30]. The main negative feedback received regarding the SAM was that it was uncomfortable to wear during sleep time. For future studies, an alternative approach would be to allow patients who find the SAM uncomfortable during sleep time to remove it at night and to put it on again in the morning. The caveat to this would be that night time ambulation may be missed and it would also depend on participants remembering to put it back on in the morning, both of which may affect the accuracy of the data collected. Additionally, difficulties may arise in standardising and enforcing the protocol for daily removal and re-siting of the monitor.

The benefit of using the GENEActiv as shown in this study is the ability to capture upper limb activity, which is important in the rehabilitation process of older inpatients. It also appears to be more acceptable to patients than the ankle-worn device. However, previous studies have shown that wrist-worn devices are less accurate in measuring lower

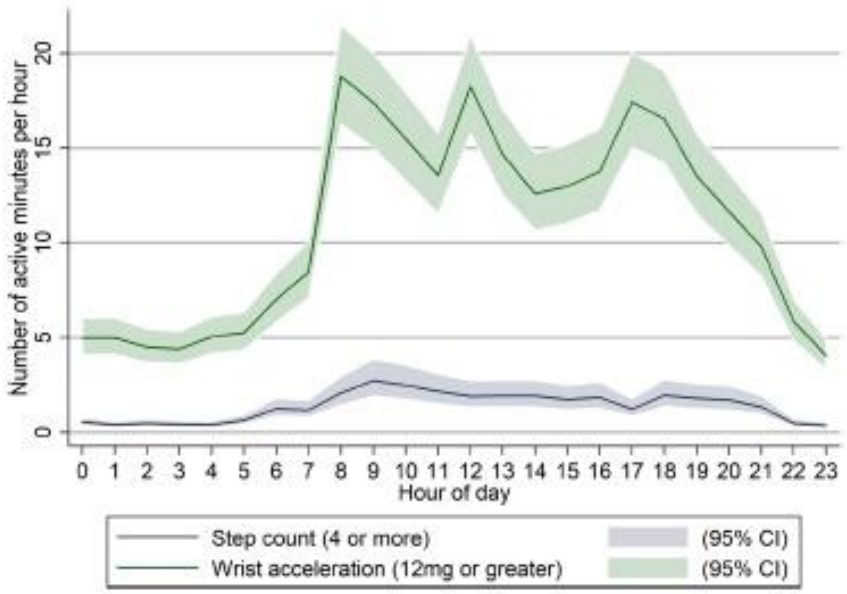

Fig. 2 Number of minutes of activity at or above cut-points for step count and wrist acceleration, shown by hour of day. This graph shows the findings from the mixed effects logistic regression models (with the predicted probabilities multiplied by 60 to give number of minutes per hour), using the binary variables for step count and wrist acceleration for each minute as outcomes

limb and walking activity [11]. The strength of the SAM is in its accuracy in step counting.

Strengths and limitations

We have undertaken a comprehensive assessment of physical activity in a sample of older medical inpatients using devices worn for several days on both the ankle and the wrist. We have used detailed minute-by-minute analyses of the physical activity data, allowing us to detect the short bouts of activity which appear typical in this population.

Given the smaller sample size of this study and the inclusion criteria that requires participants to provide valid written consent, our findings may not be generalizable to all acute older medical inpatients. The participants recruited are likely to be functionally and cognitively more robust than older medical inpatients in general, who are likely to have lower physical activity levels than we measured.

Conclusions

Physical activity levels among 38 acute medical inpatients aged ≥ 70 years were very low, with most activity occurring in bouts of less than 5 min duration. Accelerometers can provide useful information to improve our understanding on patients' activity levels in hospital. A wrist-worn device may provide valuable extra information in older inpatients, where time spent walking is particularly low. Periods of low activity levels such as during the afternoon were identified in this study, which could offer an opportunity to clinicians and researchers interested in promoting increased inpatient physical activity to prevent deconditioning.

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Compliance with ethical standards

Conflict of interest All authors have no conflict of interest to declare.

Ethical standard This study was reviewed and approved by the South East Coast - Surrey Research Ethics Committee and Health Research Authority.

Informed consent All participants gave written informed consent.

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