Telerehabilitation Outcomes for Frail Aged Patients Following Fracture and Technology Uptake by Patients and Clinicians

by

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ABSTRACT

Background and Aims

Despite growing evidence of the effectiveness of telerehabilitation (TR) for patients with a wide range of conditions, and the need for improved access by frail aged patients to rehabilitation following hip and pelvic fractures, there is limited evidence of the provision of TR to this demographic. There are also acknowledged challenges to the uptake and use of technology by health professionals and their patients. The aim of this study was to evaluate the delivery of TR to frail aged adults following hip or pelvic fracture and identify factors that may influence uptake.

Method

Community dwelling patients admitted to a home rehabilitation service (HRS) in Southern Adelaide following femoral or pelvic fracture were offered TR. Using iPad technology, multidisciplinary rehabilitation was delivered via videoconferencing and therapeutic apps, as an alternative or in addition to usual care.

The study compared functional levels at admission and discharge between those who received TR (TR group) with a matched historical group (HC group) who received HRS prior to the introduction of TR.

Outcomes measures included Functional Independence Measure (FIM), Timed Up and Go (TUG) and length of stay (LOS). The number of therapy sessions and adverse events were also reported.

Focus groups to explore clinicians' perceptions of acceptability and usefulness of a scheduling app and their attitudes towards TR in general were conducted. Clinicians also completed self-assessed technology proficiency, perceived usefulness, and perceived ease of use scales.

Results

Patients who did not receive TR (nTR group) were older (p=0.014) and frailer (p=0.008) than patients who received TR (TR group). There was no significant difference in function at discharge as measured by FIM and TUG scores for the patients in the TR group, when compared to a historical comparison (HC) group, despite a shorter LOS. There was no significant difference between the two groups in the number of therapy sessions per day when adjusted for LOS (TR group 1 1.43 ± 0.55 vs HC group 1.26 ± 0.60). There were no falls in the TR group.

Clinicians described time constraints in rehabilitation practice and welcomed technology that could assist with the reliable scheduling of therapy sessions. The more experienced clinicians found the scheduling app more difficult to use than their less experienced colleagues, and did not see the app as useful nor adding value to the delivery of care. There did not appear to be a relationship between self-assessed level of technology proficiency and either perceived usefulness or perceived ease of use.

Conclusion

Frail elderly with a fractured hip or pelvis admitted to HRS and receiving TR achieved equivalent functional outcomes to the historical group receiving usual care. Although clinicians appreciated the concept of an avatar-directed scheduling and memory app, they did not see it as a useful tool in the provision of scheduling assistance in short-term rehabilitation services.

DECLARATION

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Signed

Claire Morris

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CHAPTER 1

INTRODUCTION

Australia has a large and growing elderly population. Almost 15% of Australia's population is aged 65 years and over and expected to rise to nearly 22.5% by 2050 (McPake & Mahal, 2017). With advancing age comes an increased incidence of hip and pelvic fracture (Dyer et al., 2016; Kanakaris, Greven, West, Van Vugt, & Giannoudis, 2017; Watts, Abimanyi-Ochom, & Sanders, 2013). Studies suggest that following hip fracture only 40–60 % of people who survive are likely to recover their pre-fracture level of mobility and in western nations, approximately 10–20 % of patients are institutionalised following hip fracture (Dyer, Diong, Crotty, & Sherrington, 2017). Rehabilitation can facilitate improved functional outcomes following fracture, however, access to rehabilitation following fracture is limited and inconsistent with many patients failing to receive the rehabilitation where and when they need it. With the shrinking health dollar, public health services must explore new, effective and affordable methods of rehabilitation delivery.

Telerehabilitation (TR), the provision of rehabilitation services at a distance using mobile technologies and various apps, may be able to provide part of the solution (Reeder, Chung, & Stevens-Lapsley, 2016). Currently, the evidence for TR for frail aged patients in the sub-acute phase following hip and pelvic fracture is sparse. This research seeks to add further information and insight into the provision of TR to this population, and the factors that may affect uptake both by the patient and the clinician.

Chapter 2 presents a review of the literature and will explore the impacts of fractures, in particular hip and pelvic fracture, on an ageing populace, the benefits of rehabilitation for all, the demonstrated evidence that home rehabilitation is a feasible and sometimes superior option for patients, and the emerging evidence of the effectiveness of TR for many conditions. Useful theories of technology acceptance including the Technology Acceptance Model (TAM) (Davis, 1989) and the Unified Theory of Acceptance and Use of Technology

(UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003) are also discussed to further explore the challenges of uptake and use of technology by health professionals, and their patients.

Chapter 3 is titled Telerehabilitation For Frail Aged Community Dwelling Patients Following Femur Or Pelvic Fracture: Outcomes And Uptake, and describes a pragmatic observational study which investigated the provision of TR to patients admitted to a Home Rehabilitation service (HRS) following a femoral or pelvic fracture.

Chapter 4 describes Clinician Perspectives Of An Avatar-Directed Scheduling And Memory App, through a mixed methods study with focus group analysis to investigate the use of, and attitudes towards, technology by rehabilitation clinicians.

Chapter 5 will include discussion of the results from both research elements, implications for practice and an overall conclusion.

CHAPTER 2

REVIEW OF THE LITERATURE

2.1 Hip and Pelvic Fracture - Impacts And Importance

Hip fracture is a global public health issue with 1.6 million hip fractures reported worldwide in 2000 (Beaupre et al., 2013) and expected to rise to 4.5 million by 2050 (Dyer et al., 2016). In Australia, it is expected there will be a 30% increase in the annual number of fractures by 2022 and, in South Australia alone, there will be 8 hip fractures every day among older adults (Watts et al., 2013). The risk of hip fracture is increased in frail elderly patients due to pre-morbid inactivity, reduced strength, weight loss, osteoporosis and a high frequency of falls (Rolland et al., 2008). The incidence of pelvic fracture is also increasing, particularly for frail aged with osteoporosis (Kanakaris et al., 2017). For an elderly individual, a hip or pelvic fracture can be a catastrophic acute event that can result in serious morbidity, permanent disability, loss of independence, and for many, premature death (Andrich et al., 2017; HQO, 2013). In their critical review of the long-term disability outcomes following hip fracture, Dyer et al. (2016) reported that hip fracture has a significant impact on function and quality of life with 10-20% institutionalised within 6 - 12 months. Independence with activities of daily living particularly those activities requiring lower limb function, and including balance and gait recovery, can take on average 12 months to recover with 50% or fewer regaining their previous level of independence (Magaziner et al., 2000).

Health services across the globe are being driven to consider alternative options for rehabilitation due to the ageing population and the increased prevalence of debilitating disease (Rogante, Kairy, Giacomozzi, & Grigioni, 2015). Access to best practice rehabilitation and organised falls prevention measures for frail elderly following hip fracture is difficult and inconsistent (Beaupre et al., 2013). This is particularly true for those with a cognitive impairment (Chu et al., 2016; Resnick et al., 2016; van Wyk et al., 2014). It is well established that with Australia's ageing population placing greater demands on health

services, the challenge is how to provide appropriate rehabilitation to every person following hip or pelvic fracture.

2.2 Rehabilitation Following Hip or Pelvic Fracture

There is mounting evidence that high intensity/duration exercise is an essential element of a post fracture rehabilitation programme and rehabilitation services that incorporate exercise and mobility training are essential for full recovery (Bedra & Finkelstein, 2014). There is a considerable decline in functional level in the elderly following hip fracture with the mortality risk in the first 5 years after hip fracture 1.5 times higher for those with lower levels of mobility (Kristensen & Kehlet, 2018). Therefore, continuous physical training after discharge is recommended (Hershkovitz, Brown, Burstin, & Brill, 2015). Exercise is beneficial and feasible (Beaupre et al., 2013; de Labra, Guimaraes-Pinheiro, Maseda, Lorenzo, & Millán-Calenti, 2015; Mangione, Craik, Tomlinson, & Palombaro, 2005; Sherrington et al., 2016), and an intensive exercise programme can result in 25% less falls (Bischoff-Ferrari et al., 2010). However, (Bischoff-Ferrari et al., 2010); Sherrington et al. (2016) conclude that there is still insufficient evidence regarding intensity and the frequency of exercise post hip fracture and there remains considerable difficulties in implementing these programmes to the frail aged. This may be due to a variety of reasons: poor availability of, and access to, exercise programmes; a lack of social support and transport to attend regular appointments; reduced self-efficacy; fear of falling while exercising; a lack of understanding that falls can cause serious injury and that exercise is beneficial; and other medical barriers such as experiencing pain when exercising (Beaupre et al., 2013; Chang, Latham, Ni, & Jette, 2015; Grindley & Zizzi, 2005; Hill et al., 2011)

Apart from the exercise element of rehabilitation following hip or pelvic fracture, the literature suggests that interventions should include functional activities that can assist with strength, balance, falls prevention and the promotion of independence (Beaupre et al., 2013). Other factors including pain and cognition are also important to consider in post hip fracture rehabilitation. Immediate rehabilitation with early mobilisation following fracture can result in

less pain for patients (Siu et al., 2006) and suitable rehabilitation services following fracture need to be considered for those frail elderly with a cognitive impairment (Resnick et al., 2016). Most rehabilitation services are not designed to meet needs of those with a cognitive impairment with little evidence to inform service providers (Smith et al., 2015). However, it is suggested that programmes that use innovative approaches such as home rehabilitation in familiar surrounds to enhance cognitive function are beneficial (Resnick et al., 2016).

2.3 Home Rehabilitation

Greater demand and limited funding for rehabilitation services has made it essential to provide the right services at the right time in a cost-effective manner. There is extensive evidence for the feasibility and benefits of providing rehabilitation to patients in their own home. Patients who receive rehabilitation at home have lower utilisation of costly health services (Cook et al., 2013), reduced long-term dependency and admission to institutional care and shorter hospital stays (Langhorne et al., 2005). A systematic review of economic evaluations of rehabilitation found that a customised home based exercise programme is the best value for money and that early supported discharge for hip fracture was a cost effective way to provide rehabilitation (Howard-Wilsher et al., 2016). If a portion of rehabilitation can be equivalently carried out in patients' homes post hip fracture, there would then be an increase in access to rehabilitation for those who are unable to attend a rehabilitation clinic (Mayo, 2016).

In addition to economic analysis supporting home rehabilitation as a cost effective way to provide rehabilitation, there is additional evidence supporting the benefits from the patient's perspective. In a study concerning early supported discharge and rehabilitation for patients with fractured hips, Crotty, Whitehead, Gray, and Finucane (2002) found supervised rehabilitation in the environment in which the original injury occurred, may enhance patients' confidence in their ability to function in this environment. Older patients receiving home rehabilitation after hip fracture and receiving task-specific training as well as individual support in their own home environment, regain their walking ability similar to those in

traditional in-patient rehabilitation (Karlsson et al., 2016) and are more likely to achieve complete functional recovery, which is important for long-term survival (Peng et al., 2016). However, in contrast, Latham et al. (2014) provided home based exercise for patients for a duration of 6 months with only a modest improvement on functional recovery. Whilst Edgren et al. (2015) found that home based exercises may reduce disability after hip fracture in patients on average more than 70 days post fracture, there is less evidence for the provision of home based exercise in the sub-acute phase post hip or pelvic fracture.

A familiar home environment enables a more satisfying client-centred approach, encourages patients' involvement in the rehabilitation process, and calls on problem-solving skills such as managing daily household tasks (Cabana, Pagé, Svotelis, Langlois-Michaud, & Tousignant, 2016; Siemonsma et al., 2014). Therefore emphasis needs to be placed on early supported discharge and discharge destination to enhance rehabilitation rather than prolonging length of stay in a hospital environment (Ftouh, Morga, & Swift, 2011; Sharrock, Davies, Smith, & Lovell, 2016). With increasing demand and pressure on health systems due to an ageing population (Rogante et al., 2015), access to a comprehensive rehabilitation programme is often limited. Providing rehabilitation at home, and incorporating the use of technology to do so, may help alleviate the pressure on rehabilitation services.

2.4 Telerehabilitation

Telerehabilitation (TR) is the provision of rehabilitation services at a distance with the primary aim to allow equitable access for patients who may not live near a metropolitan hospital (Antón, Nelson, Russell, Goñi, & Illarramendi, 2016; Kairy, Lehoux, Vincent, & Visintin, 2009). Rural and remote dwelling patients may also benefit greatly from a reduction in travel costs and improved access (Bashiri, Greenfield Jr, & Oliveto, 2016; Cary Jr et al., 2016; Poultney, Maeder, & Basilakis, 2015). Access to rehabilitation is particularly limited in the elderly due to travelling difficulties, health and social status. TR allows the patient to receive rehabilitation at home, without travel from a patient or clinician (Cabana et al., 2016). TR may include the delivery of therapy remotely using videoconferencing but can

also include information dissemination, store and forward technology, remote monitoring and utilisation of the many thousands of apps available to assist with condition information, chronic disease management or exercise prescription (Laver et al., 2013). TR can be provided using simple, readily available, off the shelf, technology (Crotty et al., 2014) and could involve the use of mobile phones, telephones and wearable technologies (Levy, Geiss, & Omura, 2015) providing patients with an effective home based rehabilitation.

Rehabilitation services across Australia are beginning to integrate the use of technology into usual practice. Furthermore, there is growing evidence that older people are prepared to use these technologies if they are designed for and with the older person, and are perceived to be useful, reliable and easy to use (Evans et al., 2016; Matthew-Maich et al., 2016; Shulver, Killington, Morris, & Crotty, 2017; Sintonen & Immonen, 2013). Eriksson, Lindström, and Ekenberg (2011) found patients receiving TR post shoulder replacement surgery adhered to the programme, developed a good relationship with the therapist, and reported increased motivation and independence.

In a systematic review, Kairy et al. (2009) found that clinical improvements following TR are generally equal to those in conventional programmes and that there is preliminary evidence that it is a cost effective way to provide rehabilitation. Indeed, there are a wide range of medical conditions for which TR may be of benefit including patients with dementia (Poon, Hui, Dai, Kwok, & Woo, 2005), mobility impairments (Peel, Russell, & Gray, 2011; Sanford et al., 2007), and joint replacement surgery (Antón et al., 2016; Eriksson et al., 2011; Tousignant et al., 2011; Tousignant et al., 2015). There is also extensive evidence for the use of TR for cardiac rehabilitation. Traditional cardiac rehabilitation services typically have very low rates of adherence due to inconvenient scheduling and lack of flexibility, particularly for those participants who work, reduced access for rural and remote patients, and lack of transport options (Rawstorn, Gant, Direito, Beckmann, & Maddison, 2016). TR can promote greater attendance and adherence to exercise than usual out-patient programmes with remote monitoring and increased psychosocial support from daily telephone or video contact

(Ades et al., 2000; Hwang, Bruning, Morris, Mandrusiak, & Russell, 2017; Piotrowicz et al., 2010).

In another systematic review, Pastora-Bernal, Martín-Valero, Barón-López, and Estebanez-Pérez (2017) found that there was strong evidence for TR, particularly for hip and knee arthroplasty, and that TR groups often had more contact and intervention than those receiving traditional face-to face physiotherapy. Whilst TR physiotherapy can be delivered reliably for knee arthroplasty, the need for technology support was highlighted (Moffet et al., 2017).

A more recent systematic review of TR for the treatment of musculoskeletal conditions, including postoperative hip and knee rehabilitation concluded that real-time TR is effective in improving physical function. The evidence suggests that TR may be superior to conventional care in increasing physical function and reducing pain and disability (Cottrell, Galea, O'Leary, Hill, & Russell, 2017) .

Remote physical monitoring and assessment of patients with neurological disease has also been shown to be feasible including for those with moderate to severe disease (Block et al., 2016) and web-based exercises for MS supervised by a physiotherapist can be a feasible and easy method of delivering a rehabilitation programme (Paul et al., 2014). However, there is insufficient evidence that TR is an effective way to provide rehabilitation after stroke (Laver et al., 2013) or for multiple sclerosis (MS)(Amatya, Galea, Kesselring, & Khan, 2015) with no statistically significant results in independence in activities of daily living, reduction in disability or alleviation of symptoms with many studies being too small and of low methodological quality. There is a growing body of evidence regarding the delivery of TR to patients with Parkinson's Disease (PD). TR speech pathology for patients with PD can deliver equivalent clinical outcomes (Theodoros, Hill, & Russell, 2016) and remote monitoring of medication response for patients with PD is feasible (Zhan et al., 2016).

2.5 Telerehabilitation For Frail Aged Patients With Hip or Pelvic Fracture

Despite the growing evidence of the effectiveness of TR, and the wealth of knowledge regarding the need for rehabilitation following lower limb fractures, particularly hip and pelvic fractures in the frail elderly, there is limited evidence of the provision of TR to this demographic in real world settings. Peel et al. (2011) investigated the feasibility of using videoconferencing for geriatric rehabilitation and found barriers to the implementation of TR programmes including patient limitations, staff issues and logistics. Many patients in geriatric rehabilitation services were considered unsuitable by clinicians for TR due to poor vision, hearing and cognition, anxiety, needing hands on therapy, or the unsuitability of the home environment. TR was not considered to be as effective as face-to-face therapy by these clinicians and without a clinical champion and adequate on-going staff training to promote, maintain and develop services, TR was not considered to be a viable solution for rehabilitation.

Only one paper identified has attempted to address the delivery of TR to patients in the sub-acute phase post femoral or pelvic fracture. Bedra and Finkelstein (2014) investigated feasibility of providing TR to fourteen elderly patients (77 +/- 9 yrs) following hip fracture. Patients were provided with a wireless home monitoring tablet that could provide multimedia education modules, individual exercise programmes, reminders and alerts and tailored feedback designed to encourage exercises. A clinical unit was used to collect data, update exercises and provide feedback. More than 50% of the patients had no prior experience using technology. Statistically significant improvements were found in exercise self-efficacy, mobility, quality of life and satisfaction. However, patients who were, on average, 159 days post fracture and no comparison with patients receiving usual care limits the generalisability of the findings.

2.6 Technology Uptake and Acceptance

Implementation of new technologies into health services is dependent on the uptake by both clinician and patient. In order to understand the factors influencing uptake it is important to examine the various theoretical models that assist in predicting and explaining information technology acceptance and use. The most notable of these is the Technology Acceptance Model or TAM developed by Davis (1989). The most basic version of the theory accounts for 30 - 40% of technology acceptance (Holden & Karsh, 2010). It explains that behavioural intention can reliably predict technology use and that behavioural intention is influenced by attitude towards using the technology. Furthermore, the model proposes that attitude towards using technology has two determinants. The first determinant is perceived usefulness (PU) - the degree to which a person believes that using a particular technology would enhance their task performance. For example, something that is more difficult to use might be persevered with provided the user thinks it is very useful to the task. The second determinant is perceived ease of use (PEOU) - the degree to which a person believes that using a particular technology would be free of effort. For example, something that is easier to use is more likely to be accepted. Although the TAM is important, a number of modifications have been suggested to include the consideration of external and contextual factors that may influence the uptake of technology such as culture, gender and age (Marangunić & Granić, 2015).

The Unified Theory of Acceptance and Use of Technology (UTAUT) model developed by Venkatesh et al. (2003) proposes that technology uptake is influenced by performance expectancy, the extent to which the technology will improve task performance and effort expectancy, the degree of ease associated with use. These factors closely correspond to PU and PEOU respectively. However, Venkatesh et al. (2003) also suggest that social influence, particularly from peers and health professionals, and facilitating conditions such as technical support and cost could also be influential factors.

2.61 Uptake By the Patient

Whilst older people are often willing to give new technologies a try, they remain reluctant if they cannot clearly see that the technology will achieve a purpose meaningful to them, for example assisting them with everyday life tasks (Lee & Coughlin, 2015). Patients will decline to use to use technology if the relative advantage i.e. the time and effort required to use the item versus the benefits obtained is not clearly demonstrated (Greenhalgh, 2017). Russell et al. (2015) investigated the predictors of uptake of technology by elderly Australian healthcare consumers aged between 50 and 68 years and found that the TAM was one of five significant predictors of uptake. However, whilst Gagnon, Orruno, Asua, Abdeljelil, and Emparanza (2012) also concluded that the TAM was good at predicting telemonitoring usage intention, they found that PU was the only significant predictor. When considering the uptake of technology by older patients, the literature suggests that there are many other factors that need consideration. Value (usefulness) and usability (ease of use) act as determinants for the adoption of technology, but other factors including technical support, social support and confidence are all important (Lee & Coughlin, 2015). The extension of the UTUAT model in the context of technology uptake by the consumer, UTAUT2 (Venkatesh, Thong, & Xu, 2012) describes three more factors: hedonic motivation (enjoyment), cost and habit. These three factors are in turn moderated by age, gender and experience. Older people are less familiar with technology and have different cognitive and physical abilities (Laver, George, Ratcliffe, & Crotty, 2012; Nelson, Crossley, Bourke, & Russell, 2017). They may have more difficulty processing complex information and learning new skills, and place more importance on training and support than younger people. However, this reliance on external supports may also be moderated by gender. It is suggested that women consider ease of use rather than usefulness as more important, and are more likely to regard external supports as essential in the acceptance of new technology. In contrast, men are more likely to consider usefulness as more important (Ilie, Van Slyke, Green, & Hao, 2005; Venkatesh & Morris, 2000).

Technology anxiety or low self-efficacy is recognised as another significant factor in the initial uptake of technology (Laver et al., 2012). Patients with higher self-efficacy will engage more frequently in technology related activities. Therefore older patients with lower self-efficacy need sufficient technological support and coaching to alleviate their anxiety (Cimperman, Brenčič, Trkman, & Stanonik, 2013; Sintonen & Immonen, 2013; Tsai, Shillair, Cotton, Winstead, & Yost, 2015). Self-directed goal specific training appears to be more effective than general lessons, further supporting the evidence that the technology must be seen as useful to achieve specific personal goals.

Patient involvement in the technology design process is important for any patient centred service (Bergmann & McGregor, 2011; Pramuka & van Roosmalen, 2009), and social influence, particularly from peers and a patient's professional team, is essential in the uptake of technology by the patient (Cimperman et al., 2013; Mallenius, Rossi, & Tuunainen, 2007). Therefore, for patients to benefit from the increased access to rehabilitation afforded by TR, it is evident that clinician acceptance and uptake of technology are of paramount importance.

2.62 Uptake By the Clinician

There are well documented difficulties with clinician uptake of technology (Wade, Eliott, & Hiller, 2014). Wade et al. (2014) describe how telehealth, in general, has been difficult to adopt and sustain concluding that clinician acceptance is the key factor aided in part by resourcing and adequate technology. PEOU and PU in turn are essential in influencing clinician acceptance and subsequent uptake (Schutte et al., 2012; Zheng, Padman, Johnson, & Diamond, 2005). However, Holden and Karsh (2010) argue that whilst the TAM as a model is a good predictor of use of technology in the general sense, it needs modification to adapt to the health care setting and clinicians, including a broader definition of usefulness. PU for clinicians needs to include not only enhanced performance for individual user, such as increased capacity to do their job, but should also be applied to usefulness in terms of gaining outcomes for the patient. Yarbrough and Smith (2007) studied technology acceptance among physicians and proposed a new model as they found time,

financial constraints, organisational issues, system issues and personal characteristics especially the level of IT competency were all barriers to the uptake of technology. Acceptability of TR is also influenced by the perceived reliability and quality of the technology (Hines, Lincoln, Ramsden, Martinovich, & Fairweather, 2015). However, supportive infrastructure, training and skill recalibration may be more critical than exposure to the technology and perceived useability (Shulver, Killington, & Crotty, 2016). Clinician involvement in technological design and content is also essential for widespread adoption (Azevedo, de Sousa, Monteiro, & Lima, 2015; Bergmann & McGregor, 2011; How, Hwang, Green, & Mihailidis, 2017) and sufficient time for training without negative impact on existing clinical standards must be provided (Varnfield & Karunanithi, 2015). Consideration of the above will develop technology that can integrate with existing systems, work practices and responsibilities and promote successful uptake and subsequent implementation.

CHAPTER 3

TELEREHABILITATION FOR FRAIL AGED COMMUNITY DWELLING PATIENTS FOLLOWING FEMUR OR PELVIC FRACTURE: OUTCOMES AND UPTAKE

3.1 Introduction

The incidence of hip and pelvic fracture is increasing in line with an ageing population (Dyer et al., 2016; Watts et al., 2013). Older people struggle to recover their premorbid level of function post hip fracture and frail aged adults who are more at risk of falls resulting in a hip or pelvic fracture, are at greater risk of poor functional recovery (Beaupre et al., 2013). Frailty can be described as a combination of factors including a loss of energy, physical capability, cognition and general health. This results in a decrease in physiological reserves leading to a poor recovery from illness and an increased reliance on external supports (Rockwood et al., 2005; Rolland et al., 2008). In addition to an increase in frailty and a complexity of care needs, up to 40% of older adults who suffer hip fracture also have some degree of cognitive impairment (Resnick et al., 2016).

Rehabilitation services are seen as essential for full recovery (Bedra & Finkelstein, 2014) but with an ageing population, there is a subsequent increased demand on health systems (Rogante et al., 2015) and limited access to comprehensive rehabilitation particularly for those with cognitive impairment.

Telerehabilitation (TR), the provision of rehabilitation services at a distance using technologies such as videoconferencing, remote monitoring, wearable technologies and the use of therapeutic apps, has been suggested as a method of service delivery that may maximise access to rehabilitation (Levy et al., 2015). However, there has been limited evidence of the effectiveness of TR for frail aged adults. It is also often assumed by clinicians that older people will not or cannot engage with the technology (Peel et al., 2011). However, a trial of TR to provide general rehabilitation to adults post hospital admission demonstrated feasibility (Crotty et al., 2014) and that older people accepted and enjoyed the

technology (Shulver et al., 2017). Additionally there is emerging evidence that patients with mild dementia are able to engage with, and independently use, technology such as an iPad (Lim, Wallace, Luszcz, & Reynolds, 2013) suggesting TR may be a suitable alternative to traditional rehabilitation.

A few studies have investigated the provision of TR following fracture to an older population Patients immediately following humeral fractures can achieve promising outcomes in upper limb function, range of motion and satisfaction after an 8 week TR programme (Tousignant et al., 2014). A study of hip fracture patients (Bedra & Finkelstein, 2014) found significant improvements in self-efficacy, mobility, quality of life and satisfaction after a 30 day home-based TR programme. The participants were almost six months post hip fracture and in both studies participants had an average age of 65 years. No other studies in the evaluation of TR for the frail aged in the immediate subacute phase following hip fracture have been identified.

The Home Rehabilitation Service (HRS) in Adelaide, South Australia offers TR to all community dwelling patients receiving their rehabilitation at home. Therefore, the aim of this study was to evaluate the delivery of TR frail aged adults following hip or pelvic fracture. In order to achieve this aim, the following research questions were proposed:

1. Are the characteristics of patients who were offered, accepted and received TR similar to those who were not offered, or did not accept, TR?
2. Are the outcomes for those who received TR equivalent to the outcomes of an historical age and gender matched group who received traditional home rehabilitation services?

3.2 Method

This was a prospective observational study of patients admitted to HRS. All patients deemed suitable for receiving home rehabilitation following femoral or pelvic fracture, two patient

groups with similar recovery pathways, sequentially admitted to HRS between January and November 2017, were included in this study.

Traditional rehabilitation following hip or pelvic fracture in Adelaide, South Australia includes multidisciplinary rehabilitation in an inpatient, outpatient or home setting. HRS is an intensive home based interdisciplinary rehabilitation service, which enables early discharge from hospital as an alternative to an inpatient rehabilitation admission. Patients are admitted to the service directly from a hospital bed, either from the acute sector or via an in-patient rehabilitation bed. The service includes a Rehabilitation Medicine Specialist assessment and review, daily nursing and allied health, personal care assistance and short term equipment loan. Patients routinely receive an environmental assessment and falls prevention advice, nursing for wound care and/or medication management, and physical therapies including lower limb strengthening, balance and mobility progression. A carer or allied health assistant may be asked to provide supervision or support if deemed necessary. A weekly case conference is held to discuss progress and plan for discharge.

Standard multidisciplinary rehabilitation and care as required was provided to all participants based on the assessment and clinical reasoning of the clinicians involved including medical, nursing and allied health assessment and therapeutic intervention.

TR was offered to all participants admitted to HRS excluding those residing in residential aged care facilities. The primary clinician, tasked with introducing the home rehabilitation programme on admission, also included information about TR. Participants who agreed to use TR were provided with a 4G enabled iPad configured with commercially available therapeutic disease-specific and exercise apps, and a videoconferencing platform that can be used to provide all or some of the usual rehabilitation interventions. The exercise app allowed the remote prescription of standard exercises accompanied by a demonstration video, a record of completion and the ability for clinicians to track adherence. Clinicians within the HRS and their patients decided when and how frequently TR interventions were provided. A simple instruction booklet describing the iPad and use of apps was provided to

all participants. It was a service decision not to give iPads to patients who live in residential aged care for ease of installation and recovery of equipment.

Three groups were identified for comparison of baseline characteristics and outcomes:

1. TR Group – patients admitted between January and November 2017 who received TR
2. nTR Group – patients admitted between January and November 2017 who did not receive TR
3. HC Group - an historical comparison group of community dwelling patients with femoral or pelvic fractures who were admitted to HRS prior to the implementation of TR, and matched by age and gender to TR group. Only those with completed outcome measures were selected. These patients were identified to provide a comparison group for functional outcomes and to avoid selection bias.

It was not possible to match patients in the TR and HC groups based on time since fracture nor baseline functional level due to significant changes in service practice between 2013 and 2017, in particular length of stay requirements.

On admission to HRS, demographic information including age, accommodation and carer supports, and baseline measures of functional level, cognition and frailty were collected. This information is routinely collected and stored as part of the HRS usual practice, and thus recorded for all participants. All measures are reliable and validated for use in the community with patients following hip or pelvic fracture.

Baseline Measures on Admission:

1. Clinical Frailty Scale (Rockwood et al., 2005) which defines levels of frailty between 1 (very fit) to 7 (severely frail)
2. Mini-mental State Examination (MMSE) to establish cognitive status (Folstein, Folstein, & McHugh, 1975). Scored out of 30 with a score of 20 to 24 suggesting mild

dementia, 13 to 20 indicating moderate dementia, and less than 12 indicating severe dementia.

3. Short form Mini Nutritional Assessment (MNA-SF) which is used for screening patients in need of dietetic intervention (Rubenstein, Harker, Salvà, Guigoz, & Vellas, 2001). Scored out of 14 with a score of 8-11 identifying patients at risk of malnutrition and a score below 8 indicating malnourishment.

These baseline measures on admission were not routinely collected prior to 2016 and are therefore not available for the HC group. Baseline and outcome measures listed for each group in Table 1.

Table 1 Baseline and Outcome Measures Per Group

	TR Group	nTR Group	HC Group
Clinical Frailty Scale	√	√	
Mini-mental State Examination	√	√	
Short form Mini Nutritional Assessment	√	√	
Functional Independence Measure	√	√	√
De Mortons Mobility Index	√	√	√
Timed Up and Go	√	√	√
System Usability Scale	√		
Adverse events	√	√	√
Length of Stay	√	√	√
Number of face-to-face sessions	√	√	√
Number of TR sessions	√		

Measures on admission and discharge:

1. Functional Independence Measure (FIM) (Forer & Granger, 1987) 18 item, 7 level scale with maximum score of 126. A lower score indicates a lower functional level.
2. De Mortons Mobility Index (DEMMI) (de Morton, Harding, Taylor, & Harrison, 2013) 15 item measure of mobility with maximum score of 19 converted to an interval score out of 100, with 6 points representing a clinically important change in the patients mobility. A lower score indicates a lower functional level.

3. Timed Up and Go (TUG) (Podsiadlo & Richardson, 1991) Timed walking speed over 6 metres. A lower score indicates a higher walking speed.

On Discharge:

1. An iPad-based Patient Reported Evaluation Measure (PREM) which incorporates the patient impressions of the technology, using the System Usability Scale (SUS) (Brooke, 1996) completed by the TR group (Appendix B). The SUS is a 10 item, 5 point Likert scale. Raw scores are normalised to create a score out of 100. A normalised score greater than 68 is considered to be indicative of above average usability of a system.
2. Adverse events especially falls
3. Length of Stay
4. Number of face to face home visits and virtual therapy sessions

Statistical analysis was conducted using IBM SPSS statistics software. Gender balance between groups was measured using chi-squared tests. Independent sample t-Tests, with $p<0.05$ considered to be of statistical significance, were used to investigate differences in group baseline characteristics and outcomes.

The study was approved by the Southern Adelaide Clinical Human Ethics Committee.

3.3 Results

A total of fifty-two patients were admitted to HRS between January and November 2017. Thirty-five patients received TR (TR group) and seventeen patients did not receive TR (nTR group) during this period. This was due to a variety of reasons including living in residential care (n=6), readmission (n=2), hearing, vision or language deficits (n=6), or simply declining to participate (n=3). Decisions not to provide TR to these people were made by the clinicians. All patients who received TR also received face-to face home visits as part of the intervention. Baseline characteristics of the TR and nTR groups are presented in Table 2.

At admission to HRS, patients in the nTR group, with a mean age of 81.35 yrs (±11.46yrs), were significantly older (p = 0.014), significantly frailer (p = 0.003), and had a significantly lower functional level (p = 0.012), as measured with the FIM, than the TR group. There was a significantly greater percentage of females in the nTR group (p = 0.016). There was no significant difference in cognitive level nor nutritional status between the two groups. In the TR group, three patients had a MMSE score between 13 and 20 indicating a moderate cognitive impairment and three patients in the nTR had a mild cognitive impairment.**Table 2 Characteristics and Functional Scores on Admission for TR and nTR Groups**

	TR Group n=35	nTR Group n=17	Significance (2-tailed)
Age, mean ± SD	72.14 ± 12.61	81.35 ± 11.46	0.014*
Female, n (%)	19 (54.29%)	15 (88.24%)	0.016*
Living alone, n (%)	8 (22.86%)	3 (17.65%)	0.666
Time since fracture, mean ± SD	10.26 ± 10.01	12.35 ± 10.83	0.493
Time in Rehab bed prior to HRS	1.51 ± 3.87	1.12 ± 3.71	0.727
Admission FIM	95.71 ± 14.03	77.18 ± 25.95	0.012*
Admission DEMMI	42.00 ± 11.52	33.63 ± 16.49	0.080
Admission TUG	38.29 ± 23.54	32.00 ± 25.46	0.475
MNA, mean ± SD	9.56 ± 2.63	7.93 ± 2.96	0.063
Frailty Score, mean ± SD	4.91 ± 1.01	5.82 ± 0.95	0.003*
MMSE, mean ± SD	28.6 ± 3.46	28.23 ± 3.06	0.737

* $p<0.05$

Thirty-four community dwelling participants admitted to HRS following hip or pelvic fracture between 2011 and 2013 (HC group) were matched by age and gender to the TR group. Although matched for age and gender, comparison of other baseline characteristics (Table 3) in the TR and HC groups revealed the average number of days since fracture on admission to HRS and the time spent in an in-patient rehabilitation bed prior to admission to HRS were both significantly longer in the HC group. Functional level, as measured by the FIM and DEMMI, were both significantly lower in the TR group.

Table 3 Characteristics and Functional Scores on Admission for TR and HC Groups

Characteristics Total, n= 69	TR Group n=35	HC Group n=34	Significance (2-tailed)
Age, mean ± SD	72.14 ± 12.61	74.03 ± 10.88	0.508
Female, n (%)	19 (54.29%)	18 (52.94%)	0.911
Time since fracture, mean ± SD	10.26 ± 10.01	19.12 ± 20.39	0.024*
Time in Rehab bed prior to HRS	1.51 ± 3.87	5.03 ± 5.25	0.002*
Admission FIM	95.71 ± 14.03	103.15 ± 9.39	0.012*
Admission DEMMI	42.00 ± 11.52	47.85 ± 7.27	0.014*
Admission TUG	38.29 ± 23.54	30.59 ± 14.94	0.117

* $p<0.05$

Comparison of outcomes between the TR and HC groups demonstrated home rehabilitation length of stay was significantly lower ($p < 0.001$) in the TR group (Table 4). However, there was no significant difference in discharge FIM between the two groups ($p = 0.128$) and therefore, a significantly higher change in FIM in the TR group ($p = 0.028$) despite a reduced LOS. There was no significant difference in discharge TUG scores nor the change in TUG time and both groups achieved the MCID change of 31% (Kristensen, Henriksen, Stie, & Bandholm, 2011) with the TR group achieving a 43% change in TUG scores. DEMMI discharge scores were significantly higher in the HC group. This mirrored the higher scores on admission. However, there was no significant difference in the change in DEMMI scores between the TR and HC groups and both groups achieved greater than the MCID of 6 points of change.

The HC group received significantly more therapy sessions in total ($p = 0.008$). When number of visits was normalized to LOS, there was no significant difference between the two groups. The TR group received an average of 3.4 ± 2.48 TR sessions instead of home visits per patient per admission. There were no falls recorded in the TR group.

Twenty-two TR group participants (62.86%) completed the SUS questionnaire at discharge from HRS. The mean score was 75.23 ± 19.44 with 13 of the respondents scoring >68.

Table 4 Outcomes Measures for TR and HC Groups

Functional Change Admission/Discharge, LOS, Number of Visits	TR Group n=35	HC Group n=34	Significance (2-tailed)
Admission FIM	95.71 ± 14.03	103.15 ± 9.39	0.012*
Discharge FIM	105.94 ± 12.77	109.82 ± 7.32	0.128
FIM Change	10.23 ± 7.81	6.67 ± 4.99	0.028*
Admission DEMMI	42.00 ± 11.52	47.85 ± 7.27	0.014*
Discharge DEMMI	52.21 ± 14.54	58.79 ± 10.92	0.040*
DEMMI Change	10.12 ± 8.66	10.76 ± 8.44	0.760
Admission TUG	38.29 ± 23.54	30.59 ± 14.94	0.117
Discharge TUG	22.83 ± 9.06	20.53 ± 14.76	0.472
TUG Change	-16.62 ± 18.13	-9.63 ± 11.52	0.074
Home Rehabilitation LOS, days	12.09 ± 3.62	19.09 ± 6.51	0.000*
Number Home Visits	13.63 ± 7.29	23.29 ± 10.84	0.000*
Number Virtual Visits	3.43 ± 2.48	0	
Total	17.06 ± 7.83	23.29 ± 10.84	0.008*
Visits per LOS	1.43 ± 0.55	1.26 ± 0.60	0.227

* $p<0.05$

3.4 Discussion

This study aimed to identify whether frail aged patients following fracture can successfully receive TR and achieve equivalent outcomes to those who receive traditional rehabilitation. Analysis of the results demonstrated that those who received TR during the study period were significantly younger and more likely to be male, than the nTR group. The significantly greater proportion of males in the TR group could be partly explained by the fact that all 6 of the residential care participants who were not offered TR were female and there is a higher proportion of females than males in the older age groups. This is most marked among the population aged 85 years and over, attributable to the longer life expectancy of female Australians (Austen, 2016). This may also confirm the suggestion that the older the adult, the less confidence they have with technology and older woman, in particular have a greater reliance on external supports (Venkatesh et al., 2012), which were possibly not available or perceived to be unavailable whilst they were admitted to HRS.

Practical service decisions can explain why patients were not offered an iPad, such as their place of residence being a residential care facility. However, other community dwelling

patients in the nTR group either declined or were deemed unsuitable by clinicians to receive TR mainly due to vision or hearing impairments. The final decision to not provide TR was largely based on clinician decision or opinion. It could be that some assumptions regarding the acceptability or suitability of the patient for TR may have been made due to clinician attitude and/or bias (Shulver et al., 2016), and that TR was not 'promoted' or encouraged by some clinicians based on those assumptions. As clinician acceptance and uptake is deemed vital in uptake of technology by patients, this would support the evidence that external supports such as professional endorsement is vital for patient acceptance of TR.

There was no significant difference in cognition between the TR and nTR groups. It would be reasonable to assume that older patients, and particularly those who live in residential care, would have a lower cognitive status. However, home rehabilitation services rely on referral from acute settings and it is possible that the more cognitively impaired patients from residential care facilities are not routinely referred for rehabilitation in the first place. The results demonstrate that having a cognitive impairment did not preclude patients from receiving TR, particularly if they had a carer to support them. This further supports the evidence that social support and endorsement will assist in uptake.

TR is offered to all community dwelling patients admitted to HRS but is completely voluntary. Choosing to not receive TR may be reflective of reduced experience with technology, lack of perceived usefulness, or lower self-efficacy (Laver et al., 2012) which may also have an impact of functional outcomes (Langford, Edwards, Gray, Fleig, & Ashe, 2018). Those patients who 'choose' TR may also be more confident in participating in the rehabilitation programme in general. The decision to use a historical group was made to remove the issue of selection bias in the comparison. However, it was only possible to match the TR and HC groups by age and gender. When comparing outcomes, the admission FIM and DEMMI scores for the TR group were significantly lower than the HC group, and those patients had a shorter LOS. Furthermore, the HC group had significantly greater total number of visits per admission due to the extended LOS. This can be explained by the fact that HRS delivery

model in 2017 has changed significantly since 2013. A greater pressure on acute hospital services and a stronger emphasis on early supported discharge from the acute sector meant that it was not possible to match the time since fracture between the TR and HC groups. These two factors have led to patients being admitted to HRS earlier with a lower functional level.

Despite this, the TR group made significantly better functional gains, as per FIM change, with no significant difference in the discharge FIM or TUG scores between the TR and HC groups. This may be due to the fact that the TR participants were in a slightly more acute phase of their recovery and hence, more likely to make rapid gains in function.

When LOS is taken into account, there was no significant between group difference in therapy occasions of service per day and therefore TR achieved equivalency of therapeutic dosage. TR was able to substitute a mean of 3.4 home visits for virtual visits. Patients who received TR were provided with an iPad which had an exercise app installed. The amount of homework that patients completed with use of this app was not evaluated. It is possible that more emphasis was placed on completing the prescribed exercises due to use of the app, rather than the reliance on the therapist home visits, and that technology was effective in promoting independence and greater adherence and self-management (Rawstorn et al., 2016), instead of relying on traditional therapy home visits alone. Hence, this provides a possible explanation for the equivalent functional gains made by the TR group.

This study did not include a formal financial analysis but taking into account the reduced travel, reduced LOS, reduced total number of visits and the equivalent functional gains made by the TR group, these results may support preliminary evidence that this method of delivery of a rehabilitation programme is potentially more cost efficient (Kairy et al., 2009; Tousignant et al., 2015).

3.5 Limitations

There are a number of limitations that should be considered. This research was a pragmatic evaluation of TR implementation in a real home rehabilitation service, a representation of how current evidence is implemented into practice. It was, however, highly context specific and may not be generalisable to other home rehabilitation services. Although some would argue that research of this nature particularly in relation to the use and implementation of technology into health services may be of great value (Greenhalgh, 2017), there were a number of confounding factors influencing the provision of TR to these patients. These factors include the variability of the videoconferencing platform access, the organizational support for TR, staffing levels and variable clinician uptake during the study period. The size of the sample was small and the historical comparison group only matched with age and gender due to changes in and outside of the service over time. All patients received home visits in addition to TR and the time spent in home visiting versus TR was not collected, nor was the specific content of each session. Measures of self-efficacy were collected for some patients, but an insufficient number completed the scale to draw any conclusions from this data. This may have given greater insight into why patients declined the offer of TR and possibly why more males consented.

3.6 Conclusion

The aims of the study were to evaluate the provision of TR to frail aged community dwelling patients post femoral or pelvic fracture and to see if equivalent gains could be made compared to those receiving traditional home rehabilitation services, whilst identifying characteristics that may influence the uptake of TR. Despite the limitations as described above, it is clear that the delivery of TR to this group is feasible and can be provided with no adverse effects to the patient and with equivalent functional gains being made by those who received virtual visits by way of videoconferencing, as a replacement for home visits. Decisions regarding whether TR is offered in the first place or not appear to be driven more

by the clinician than the patient, both from a service level and from an individual perspective, with the assumption that the oldest and frailest in the population will not manage TR particularly if they have a hearing or sight difficulty. This warrants further investigation. Difficulties finding a suitably matched historical comparison group highlight the service changes over time and a randomised trial to compare those receiving TR with those receiving traditional HRS during the same time period may control for these differences.

CHAPTER 4

CLINICIAN PERSPECTIVES OF AN ELECTRONIC AVATAR-DIRECTED SCHEDULING AND MEMORY APP.

4.1 Introduction

Intensive rehabilitation requires the scheduling of multiple therapy appointments each day. A clearly designated schedule ensures the patient, and their family or carer, is able to receive the necessary dosage of therapy whilst maintaining social and leisure activities important for full recovery (Langford et al., 2018; Northcott, Moss, Harrison, & Hilari, 2016). Regular information sharing with the patient, including planning and treatment timelines, also allows them to be fully informed members of the rehabilitation team (Hammell, 2004; MacLeod, Chesson, Blackledge, Hutchison, & Ruta, 2005; Saletti-Cuesta, Tutton, Langstaff, & Willett, 2016). Traditionally, schedules and reminders for patients and their families have been paper-based and unable to be accessed remotely. There is emerging evidence supporting electronic devices for cueing and reminders for patients with acquired brain injury (Charters, Gillett, & Simpson, 2015; Hines et al., 2015) and to facilitate adherence to medications in chronic disease (Tao, Xie, Wang, & Wang, 2015).

Providing rehabilitation to patients in their own home has proven to be feasible (Crotty et al., 2002; Howard-Wilsher et al., 2016), and rehabilitation services are beginning to integrate the use of technology to provide telerehabilitation (TR) into usual practice. Patients admitted to the Home Rehabilitation Service (HRS) in Adelaide, South Australia receive an iPad as part of the usual provision of care. The tablet is loaded with therapeutic apps, to deliver exercises, cognitive activities, homework, information, and ability to videoconference with the treating clinicians to enable the remote delivery of therapy.

As a result of the implementation of TR into Home Rehabilitation Service (HRS) in the Southern Adelaide Local Health Network, the need for scheduling support was recognised by the clinicians. It is common for therapists, nurses and medical staff to arrange multiple appointments with the patient each day. Home visits are frequently cancelled, rescheduled

or forgotten resulting in wasted time and frustration for both the clinician and the patient and their family.

Despite an identified need, and an interest, in the use of a scheduling app by patients and clinicians, there are well documented difficulties with technology uptake among clinicians in all areas of health provision. Clinician acceptance has been identified as one of the key factors influencing uptake (Wade et al., 2014) and a number of theoretical models have been developed to assist in explaining and predicting technology use. The most well-known model is the Technology Acceptance Model (TAM) (Davis, 1989) which proposes that attitude towards using technology has two determinants: perceived usefulness (PU) and perceived ease of use (PEOU). Whilst these are essential in the uptake of new technologies for clinicians (Schutte et al., 2012; Zheng et al., 2005), there are other variables including facilitators, barriers and beliefs that influence use and acceptance (Holden & Karsh, 2010; Marangunić & Granić, 2015; Yarbrough & Smith, 2007). Clinician involvement in technological design and content is also seen as essential for widespread adoption (Azevedo et al., 2015; Bergmann & McGregor, 2011). Moreover, a clinician's opinion of technology is seen as an important influence in the uptake by the patient (Cimperman et al., 2013).

The purpose of this study was to explore clinician perspectives of the use of an avatar-directed scheduling and memory app to overcome scheduling difficulties in the context of a home rehabilitation service. The range of factors that influence use and acceptability of technology have not been explored in this setting, an environment with a unique set of challenges for the clinicians including travel time, remote management of patients and the unpredictable nature of the home environment.

4.2 Method

This was a mixed methods study using quantitative and qualitative data collected from a convenience sample of clinicians from various disciplines working in two rehabilitation teams in the Southern Adelaide Health Network. A commercially available avatar-directed

scheduling and memory app (Anna Cares™) was identified as a potential solution to scheduling difficulties for HRS patients. The app is suitable for patients or families who are capable of using a tablet or iPad at a basic level and had been introduced to both community settings and aged care services. It had not been trialled in a rehabilitation setting. The app allows appointments to be scheduled by clinicians, family members or the patient themselves either directly via the tablet or remotely via the website. It has an interface in the form of an avatar called Anna who talks to the patients to remind them, with a certain time frame, of an activity, important task or appointment and also provides details of the appointment. For example, the name of the clinician and why they are coming is entered by the clinician through a web portal. This appointment then appears on the patient's tablet calendar and ten minutes prior to the event, Anna will verbally remind the patient. Clinicians were provided with basic training by the developer and the clinicians in turn introduced the app to the patients during the orientation to their rehabilitation programme.

Clinicians from all backgrounds were eligible for study participation if they had been exposed to the app for evaluation or implementation within their workplace and with their patients. Clinicians were approached by email and those who voluntarily expressed an interest in participating were provided with a Participant Information Sheet (Appendix C) explaining the purpose, aims, associated benefits, potential risks and the voluntary nature of the study. Once consent was obtained (Appendix C), demographics of the participants were collated, including age, years of professional experience and self- assessed level of experience with the technology using the descriptors below (Table 5). These descriptors were based on the Six levels of the Performance Model (Benner, 1984) and modified by Gillies and Howard (2003) and were used in the Tool Kit for Providing Home Based Tele-rehabilitation Services Using an iPad (Appendix G) as an aid to establish clinician competencies to conduct TR. Clinicians were asked to complete modified 7 point Likert Perceived Usability (PU) and Perceived Ease of Use (PEOU) scales (Davis, 1989). Scores range from 1 – absolutely agree to 7 – absolutely disagree, with all statements framed in the positive (Appendix D). A

lower score on both scales indicates a greater perception of usefulness and ease of use, with a score of 4 considered a neutral response i.e. neither agreeing not disagreeing with the statement.

Table 5: Technology Proficiency

Technology Level	Descriptor
Novice	little or no experience, needs close supervision
Learner	some experience, needs minimal supervision
Competent	uses on a day to day basis, without assistance
Proficient	good experience, would be able to demonstrate to others

In order to ensure rigour and trustworthiness in the qualitative analysis of the focus groups, the strategies outlined by Shenton (2004), based on constructs developed by Lincoln and Guba (1985), were utilised. Descriptive statistics were used to describe the characteristics of the focus group participants. The relationship between participant characteristics and individual and mean scores for PU and PEOU were analysed using Spearman's correlation (alpha<0.05).

Participant perspectives were then gathered in two focus groups. Focus groups are a useful method to reveal beliefs and attitudes through interaction with others which would not be available through individual questionnaires or interview (Tong, Sainsbury, & Craig, 2007).

The two focus groups consisting of participants from a range of professions were conducted on the same day. To assist with credibility, these were led by an external independent researcher with experience in qualitative research. The focus groups took approximately 60 mins and were semi-structured with a series of pre-determined open ended questions allowing discussion regarding structure and intensity of typical clinical workloads, the need for a scheduling capability for the clinician and for the patient, the advantages and disadvantages of using the app, and the ease of use and usefulness of the app in assisting with service delivery. The focus group guide is presented in Appendix A.

The focus groups' discussions were audiotaped for transcription and any important comments or repetitive ideas were noted to highlight the significance. All participants were de-identified following the focus groups.

The focus group recordings were transcribed verbatim by an external source. The data was initially coded by reading the written transcripts and manually summarising the data to ascertain overall meaning. Following this, the data was organised into broad categories and sub-categories that described the participants' perceptions of the app and its use within their practice using NVivo qualitative data analysis software (QSR International Pty Ltd) by the researchers CM. The broad and sub-categories were then re-read to ensure that they were clear and logical, and were in line with the main focus of the study. A second reviewer (MB) revised the themes to aid confirmability and remove any perceived bias towards the primary researcher's viewpoint. The categories were then grouped into a number of emerging themes. These emergent themes were then discussed to confirm whether they adequately described all the participants' responses before 4 final predominant themes were identified. In an iterative process, the transcripts were reviewed again to establish confidence that no new themes were emerging.

The study was approved by the Southern Adelaide Clinical Human Ethics Committee.

4.3 Results

Quantitative

Fifteen clinicians and one IT professional who worked within the rehabilitation service consented to participate in the focus groups. Age, number of years of experience and self-assessed level of IT ability are presented in Table 6. Over 80% of the participants were 30 years of age or older and 75% identified themselves as competent or proficient in the use of technology.

Table 6: Participants Characteristics (N = 16)

Variable	Number (%)
Age	
20-29	3 (18.75)
30-39	5 (31.25)
40-49	4 (25)
50-59	4 (25)
Experience (years)	
<2	2 (12.5)
2-5	1 (6.25)
6-10	5 (31.25)
11-15	3 (18.75)
16-20	2 (12.5)
21-25	0 (0)
26+	3 (18.75)
Technology Proficiency	
novice	1 (6.25)
learner	3 (18.75)
competent	5 (31.25)
proficient	7 (43.75)

Mean scores for both Perceived Usefulness and Perceived Ease of Use were all below 4, indicating a higher than average perception of usefulness and ease of use (Table 7). There was a significant positive relationship between age and mean value for ease of use ($r = 0.540$, $p = 0.046$) and professional experience and mean value for ease of use ($r = 0.586$, $p = 0.027$). There was a significant positive relationship between the participant's level of experience and score for PEOU question 2 - It is easy to get Anna Cares to do what I want it to do ($r = 0.574$, $p = 0.032$). Furthermore, there was a significant positive relationship between level of experience and PU question 6 - I find Anna Cares useful in my job ($r = 0.609$, $p = 0.021$). There was no significant relationship observed between age and experience, and the overall score for usefulness. Nor was a significant association found between self-assessed level of technology proficiency and either PU or PEOU.

Table 7: Mean Scores for PU and PEOU Scales

Perceived Usefulness	Mean (SD)
Using Anna Cares in my job enables me to accomplish tasks more quickly	3.64 (1.082)
Using Anna Cares improves my job performance	3.86 (1.027)
Using Anna Cares in my job increases my productivity	3.71 (1.204)
Using Anna Cares enhances my effectiveness on the job	3.86 (0.949)

Using Anna Cares makes it easier to do my job	3.5 (0.855)
I find Anna Cares useful in my job	3.29 (0.726)
Perceived Ease of Use	
Learning to operate Anna Cares was easy for me	2.71 (1.139)
It is easy to get Anna Cares to do what I want it to do	3.07 (1.141)
My interaction with Anna Cares is clear and understandable	2.71 (0.914)
I find Anna Cares to be flexible to interact with	3.5 (0.65)
It would be easy for me to become skilful at using Anna Cares	2.36 (1.008)
I find Anna Cares easy to use	2.86 (1.099)

Qualitative

Focus groups explored participants' beliefs, experiences and perceptions of the app. Four main emergent themes were:

1. Effectiveness vs Efficiency
2. Patient Empowerment
3. Practicality and Ease of Use
4. Likeability of Anna

Effectiveness vs Efficiency

Participants expressed concern about the time constraints experienced by the clinicians within rehabilitation services. It was reported that the time spent travelling to patients' homes and an increasing workload were significant issues. Compounding time constraints were the demands to schedule appointments and therapy sessions for patients. Scheduling was described as difficult due to unpredictable work variability and the subsequent need to reschedule appointments was described as burdensome and frustrating.

> *And I find it hard to schedule more than, say the next day I'm at work – in advance – because things change. You get new patients. People get admitted. And if I schedule too far in advance, I find I spend more time changing things.* (Participant 2)

Participants were open to strategies that reduced the time taken to book and frequently change their plans. Reflections suggest that they recognised the potential benefit of a

scheduling app, such as the ability to schedule around other staff and the benefits of reminders for patients..

> *And we can see when other therapists are going out and make appointments from the office.* (Participant 3)
>
> *It's not just over the phone. And we're not relying on them remembering.* (Participant 2)

However, participants questioned the usefulness of the app in relation to whether it decreased individual workload and made their role easier, or whether it added to their work demand.

> *It's not increasing efficiency in performing that specific task. It may help a bigger picture but when you break it down to the individual tasks, it actually makes it more difficult.* (Participant 2)

They questioned whether it effectively provided immediate and recognisable benefits to their patients and achieved the desired outcome of informing and reminding the patient of their appointments.

> *Only useful if the patient can hear it and remembers to turn on.* (Participant 4)

Likewise, participants were concerned about the accuracy of the app.

> *One of the biggest problems that we had and what was kind of decided by the team was a scheduling app or a scheduling process that's not accurate is actually worse than not having a scheduling process at all for the patient. Because if they've got information that's wrong, that's worse than them not having any information at all. That was the perspective of the team and that was discussed.* (Participant 10)

As a result, while some participants were prepared to use the app, others were reluctant. This was reported as being due to a heavy workload and lack of time availability to assist them in developing skills to use it.

> *I'd like to learn how to utilise it more. I was quite enthusiastic about it, to start with, but then you're pushed for time with everything and if it was easier to learn how to use it, then I would probably use it.* (Participant 2)

A few participants who had not extensively used the app with their patients perceived it would be time-consuming. In addition, there was general consensus that if the app was to be

useful it needed to be used by everyone across the whole service; it depended on comprehensive clinician buy-in.

> *When it works and everyone is using it, it's really effective.* (Participant 2)
>
> *It works on the enthusiasm of the therapist I think.* (Participant 1)

It was, however, acknowledged by the groups that although the participants may perceive it to be of limited use, it may be more useful for the patient.

> *So I think they haven't designed an Anna Cares app just for our … programme. That's why some of the features aren't as well designed for it.* (Participant 2)
>
> *I think that the issues we have with it are issues with it in our setting. (Participant 4)*

Participants were sceptical about their patients willingness to embrace the technology, and being able to use the app independently.

> *I think it's a nice utopia but actually delivering it would be almost impossible I'd suggest.* (Participant 10)
>
> *The older population now are not necessarily interested in technology. It's a new thing and they're like "I'm too old for this. I don't care about it." And they're often quite set in their ways and don't want to try it.* (Participant 11)

There was a difference in opinions between those participants who had implemented the app into clinical practice and those who had evaluated the app but not yet implemented it clinically. One participant who had not yet used the app with patients stated:

> *I actually think that mild cognitively impaired group are actually where there is a big opportunity* (Participant 10)

In contrast, the experienced clinicians in the Home Rehabilitation service who had implemented use of the app for scheduling, did not see it as beneficial to this group of patients, and instead, described the difficulties of scheduling appointments for patients with mild cognitive deficits. They reported that they would revert to using previously learned methods such as diaries, wall calendars or handwritten notes rather than trying to teach their patients a new system.

> *I use whatever system they find works for them. So a lot of them will keep their own diary or a calendar or something like. So I work out however they record their*

appointments at the moment – so doctor's appointments things like that. And I just tap into whatever they're already doing. (Participant 2)

Patient Empowerment

Most participants agreed that there were some very useful aspects to the app for the patient both from an orientation perspective and as a memory tool.

..I thought it was a good idea. I thought it was nice for the patient to know what was going on. (Participant 12)

That orientation element was nice I think. Where it told you the date and the time, which I liked as well. (Participant 10)

An exercise reminder. That would be good. (Participant 9)

"Make sure you come to the gym in 10 minutes for physio' or "get ready for hydro" (Participant 12)

All participants acknowledged the empowering nature for patients of having a schedule pre-arranged. This was seen as particularly relevant for younger patients who would benefit from having control over elements of their day.

And you wonder how much we are disempowering our patient by bringing them to physio when it suits us… (Participant 9)

I'm more aware of the younger clientele wanting structure, therefore that's why you think they would use it a bit more and enjoy that aspect a bit more. (Participant 7)
The younger patients – TBIs – return to school, return to work – getting them to work on their own schedule before they leave hospital might be good. (Participant 12)

The need for family members and carer to be involved in the rehabilitation process was a common thread. The ability to log appointments external to the service such as GP appointments and social events was seen as useful in organising the patient's programme.

Putting in appointments but that's the – where it sits with carers and family who have a program, who learn to use it, daughters who can put things in from their own home so that there's alerts for their parents and they can see where they've interacted with it. (Participant 4)

Practicality and Ease of Use

The general perception from all participants was that while setting the app up was problematic, once set up, the app was reasonably easy to use. In a fast paced service, clinicians did not want to take the time, nor had the time, to register every new patient and train each patient in the use of the app. This was particularly relevant when there was another system for scheduling or reminders, such a paper diary or outlook calendar, in place.

> *It also takes quite a long time to just put an appointment in.* (Participant 1)

Practical physical issues were identified such as the size of the font and the need to scroll through numbers. It was felt by many participants that some patients would have difficulty managing this task.

> *You know how that was quite small numbers and people's fat fingers couldn't get the right numbers?* (Participant 2)

Some participants found that the time setting function was difficult to navigate as it defaulted to 2am meaning that scheduling an appointment for 9am required scrolling through many times.

> *if you accidentally schedule an appointment at two am instead of pm, your patient is not very happy, if Anna reminds them at two o'clock in the morning.* (Participant 2)

There was also a comment regarding the number of steps required to organise one appointment and lack of interoperability with other systems.

> *you've got to log into the web portal and then program within that web portal, whereas if there were some sort of interface that linked say for example your Outlook calendar with the .. patient end kind of thing, I think you'd get a lot more buy-in with it because people, obviously not many people in this room, but people often use their Outlook calendar as their daily planner and if you're using that same kind of interface for scheduling of patients, I think they're more likely to interact with it and adjust it as they go.* (Participant 10)

> *And then for some reason it's put it in twice so then you've got to go back and delete one. Every time I put it in lately it's done two of the same thing.* (Participant 2)

Likeability of Anna

Many of the participants personified the app, referring to it as 'Anna' and frequently using terms such as "she" / "her" when discussing functionality. There were a number of negative comments regarding her voice and the fact that she 'interfered' when other conversations were being held with the patient.

> *Her voice is a problem, you could change that.* (Participant 3)
>
> *I think when you're trying to use it, she often talks and confuses the situation – like you just wish she would be quiet because it frazzles me and I'm capable of operating it whereas I think if someone who isn't so confident using the iPad has got her talking at her while she is trying to do it. It just blows their mind.* (Participant 2)
>
> *She interrupts a lot.* (Participant 5)
>
> *She's quite sharp. Quite aggressive.* (Participant 4)

Generally, the participants disliked Anna but this was in the context of perceiving the app to be 'another' thing to do rather than a helpful tool for service delivery. They agreed that the app was not necessarily designed for clinician use in a rehabilitation setting but may be more suited to the patient.

> *I guess the app is designed for the patient. Not for us.* (Participant 4)

4.4 Discussion

The results highlight clinician perceptions of an avatar-directed app to enter therapy appointment times and create reminders for patients. Ease of use, in particular the time it took to use the technology and usefulness were the overriding concerns. The older, more experienced clinicians found the app more difficult to use but neither the level of technological competency nor gender was found to be associated with attitude towards usefulness or ease of use. Self-assessed IT proficiency in these participants was fairly high and did not prove to be a positive predictor of perceived usefulness. This is in contrast to the findings of Yarbrough and Smith (2007) who found that a lower level of IT competency was a

barrier to technology uptake, and suggests other factors were more important in influencing behavioural intent in this group of rehabilitation clinicians.

Although participants commented on issues related to the reliability of the technology, the focus seemed to be much more about clinician's lack of time and the usefulness of the app for the particular task of scheduling appointments in a rehabilitation context. There is strong evidence that PU influences clinician acceptance, and subsequent use, of technology (Holden & Karsh, 2010). The participant scores for PU were only slightly above neutral, a score of 4 considered a neutral response i.e. neither agreeing not disagreeing with the statement, further explaining the poor uptake of the app for scheduling.

Clinicians with busy workloads will not use a new technology especially if they perceive it to be 'doubling up', or an addition to their traditional patterns of care delivery (Zheng et al., 2005). In a time poor work environment clinicians will want something that immediately alleviates burden. This suggests that if the perception is that using the app for scheduling will take more time and effort than writing it in a paper diary, it will not be used, even if that perception is not based on evidence (Yarbrough & Smith, 2007). There is clear evidence that organisational support and sufficient time needs to be provided in training clinicians outside of clinical duties (Shulver et al., 2016). The avatar app was introduced to the Home Rehabilitation team as part of a suite of other technology changes with little formal training and support to use the app provided.

One finding from our study was that preconceived beliefs and behavioural intention will influence the implementation of the app, regardless of the level of exposure, which is in agreement with previous findings that clinician beliefs and subjective norms need to be taken into account when implementing new technology (Holden & Karsh, 2010).

The assumption that new technologies will automatically add value to the delivery of care and patient outcomes is not supported by this study. Horsky et al. (2010) state that applications not appropriately matched to clinical tasks tend to be chronically underused,

and may be eventually abandoned. Usefulness in this context was limited as the clinicians not only found that the app was less than adequate for scheduling of their appointments but also questioned whether the app actually achieved effective scheduling for their patients, particularly in a short term rehabilitation programme, and especially for patients with cognitive decline.

Interestingly, although the app developers report spending significant time and research in their choice of avatar based on user preferences, the rehabilitation clinicians reported 'her' to be condescending and annoying despite liking the concept. The acceptability and likeability of the avatar characteristics from the point of view of both patients and clinicians appeared to be an important influence on uptake. This lends weight to the evidence that the design process for all technology must involve all end users (How et al., 2017).

The on-going, open and helpful dialogue between the clinicians in the service and the app developers was considered essential to assist with implementation. This dialogue may have contributed to the developers moving towards a different use for their app, changing the intent to the delivery of health coaching rather than scheduling.

Understanding the key factors necessary for clinician acceptance of this form of electronic diary will aid future clinical app development and facilitate uptake of electronic diaries and reminders in rehabilitation services.

4.5 Limitations

There are several limitations to this study. This study evaluated the use of a single app. Other apps may result in different experiences and these results may not be applicable to the use of scheduling apps in general. The focus groups were conducted in the early stages of the app use with many other changes to practice occurring simultaneously such as the introduction of exercise apps and videoconferencing to provide therapy. Some teething problems with implementation and lack of familiarity may have influenced responses. However, aspects such

as clinician preconceptions, design requirements and perceived usefulness of the technology are all applicable and may be generalisable to other services and settings.

4.6 Conclusion

Rehabilitation clinicians felt that they were time poor, and saw accurate and reliable scheduling of appointments and therapy sessions as extremely important from both the clinician and patient perspectives. While they welcomed any technology that could support scheduling, and liked the concept of an avatar-directed scheduling and memory aid, they did not see it as a useful tool in the provision of scheduling assistance in short-term rehabilitation services. They identified potential benefits including the reminders for exercise or for taking medications but highlighted they would like the app to be more time-efficient in use and 'talk' to other electronic systems also used in their daily work.

CHAPTER 5

SUMMARY DISCUSSION, IMPLICATIONS FOR PRACTICE AND CONCLUSION

5.1 Discussion

Despite a growing demand by an ageing population for rehabilitation at the right time and in the right place, implementation of the most appropriate, timely, and cost effective rehabilitation services remains a challenge. Telerehabilitation (TR) may be able to provide a partial solution by providing services close to or in a patient's own home, thereby reducing the need for travel and allowing the patient to receive their rehabilitation in a familiar environment. However, there is little evidence of the effectiveness of TR for the frail aged population and there are significant challenges in the uptake of the new technologies required to provide TR by both patients and clinicians.

Chapter 3 described the provision of TR to frail aged community dwelling patients post femoral or pelvic fracture. This study was designed to evaluate if equivalent gains in outcome could be made by those receiving TR compared to an historical group receiving traditional home rehabilitation services. Furthermore, it aimed to identify factors that may influence the uptake of TR by patients. The study results revealed that the delivery of TR to frail aged patients following hip or pelvic fracture in a home rehabilitation setting is a feasible and acceptable method of rehabilitation service delivery and can be provided with no adverse effects to the patient. Equivalent functional gains were made by those who received virtual visits by way of videoconferencing as a partial replacement for home visits, as demonstrated by the equivalent FIM scores in the patients who received TR when compared to the historical comparison group. This was despite a much shorter length of stay in the TR group. As current rehabilitation models advocate early supported discharge from the acute setting with less time spent in rehabilitation overall, TR may prove to be an effective method of rehabilitation delivery to frail older adults in this context.

The oldest and frailest patients admitted to HRS during the study time period were less likely to receive TR, and there was a disproportionate number of females in the nTR group. This was either due to patients declining the offer of TR and choosing to have traditional home visits, or patients not being offered TR at all. Age and technology experience are not necessarily factors that negatively influence uptake of TR if it is offered (Crotty et al., 2014), but older people do tend to be more technologically anxious, and older women, in particular, have a greater reliance on external supports (Lee & Coughlin, 2015). Whilst the technology was affordable (provided at no cost to the patient) and simple (a simple interface with no log in and passwords and minimal choices to make), it was not designed in collaboration with the patient, and the time, training, and coaching available in the fast paced environment of the HRS may not have allowed for sufficient support to be provided to this vulnerable group. It is not clear whether the benefits and usefulness of the technology in achieving meaningful outcomes, such as independence in activities of daily living or functional ability (Chumbler et al., 2012; Lam et al., 2015), were clear to those patients who declined, and whether they perceived the effort to learn to use the new technology outweighed the perceived benefit. Information regarding the level of self-efficacy in the declining group was insufficient to draw any conclusions.

Decisions regarding which patients should be offered TR appear to be influenced by the clinicians' attitude towards the technology and assumptions they made regarding their patient's ability to participate. It is possible that some patients' did not feel that the clinicians sufficiently endorsed the use of TR in their rehabilitation, an important factor in uptake.

The research in this thesis was conducted following the implementation of TR into HRS during the Flinders Telehealth in the Home trial, in South Australia, an initiative funded by the Australian Government. This author was involved with the initial implementation and evaluation of TR provided to older people post hospitalisation (Crotty et al., 2014; Shulver et al., 2017) which demonstrated that the delivery of TR to older people was feasible and acceptable (Appendix E and F). However, although patients found TR convenient and

motivating, they preferred face-to-face contact and appreciated the physical presence of the therapist (Shulver et al., 2017). TR is seen as a supplementary option rather than a direct alternative particularly if TR is perceived to reduce physical and social contact with others. The frail aged patients in this study were given the option of a home visit rather than a video-consultation at any time during their home rehabilitation. All patients chose to receive home visits in addition to their TR. The results indicate that as the effort and resources required to receive a face-to-face consultation i.e. extensive travel, cost of travel or lack of social support to attend appointments was not a significant factor for these patients, they were more likely to choose a face-to-face intervention. However, patients who live in rural and remote communities, where there are fewer options for rehabilitation and lack of opportunity to receive home visits, may be more likely to perceive TR as a valid alternative to traditional methods of rehabilitation service delivery.

Whilst TR can be offered by HRS to patients who live outside the health network boundaries, in rural or remote areas, there were no patients from these areas referred to HRS during the time period covered by this study. This meant that all patients receiving rehabilitation in this research lived within the health network boundaries and received TR in addition to, not as a replacement for, home visits. It was therefore not possible to compare outcomes for patients receiving TR only. Reasons for non-referral of country patients could be due to the patients and clinicians being unaware of the TR services on offer, and either returning home without rehabilitation or going to a metropolitan/regional rehabilitation centre until able to return home. Enabling a patient to return to their own home to receive rehabilitation often relies on the availability of practical hands-on assistance such as personal care, wound care and meal preparation in the local area. It is possible that a lack of local community support in country areas means that TR is not an option for some patients. Future research comparing the delivery of TR only with a combination of TR and traditional approach would be warranted.

Although the HC group was matched to the TR group by age and gender, it was impossible to match the other key baseline characteristics, particularly length of stay in both the acute

and sub-acute environments, due to the changes in the rehabilitation service changes over time. Hip fracture has a significant impact on quality of life in the medium- to longer-term, and structured exercise programmes that continue for at least 12 weeks can make improvements in overall mobility and quality of life (Dyer et al., 2017). The average length of stay for participants in this study was 12.09 ± 3.62 days. TR encourages self-management and adherence to exercise, and access to cheap affordable technologies may allow patients to continue with their rehabilitation via use of exercise apps and access to remote clinical advice well beyond the time-frame of traditional service provision. A randomised controlled trial with a TR arm as well as a traditional HRS arm would overcome the problem of rapidly changing rehabilitation services and evaluate the effectiveness and cost of providing TR for frail aged patients over a longer period of time.

Chapter 4 described the evaluation of clinician attitudes towards the use of a particular app for scheduling support. Generally, rehabilitation clinicians highlighted the need to include patients and their families in scheduling therapy visits and were keen to use any technology that could support scheduling. In the presented study, the clinicians liked the concept of an avatar-directed scheduling and memory app. Developers are increasingly using avatars or embodied conversational agents (ECAs) in applications where some form of communication is required, and well-designed ECAs can make this communication more intuitive and enjoyable (André & Pelachaud, 2010; Dascal et al., 2017; Grolleman, van Dijk, Nijholt, & van Emst, 2006). These agents are being used to deliver automated health education or provide support and coaching for health behaviour change. The use of avatars or ECAs allows the ability to adapt health messages to particular users and contexts and can be more effective than using written material or videos (Bickmore, Pfeifer, & Jack, 2009). It is argued that the time required to learn and familiarise with new technology can be reduced by ECAs because they use communication styles that are familiar to the user, and personification of the ECA can contribute to a feeling of trust. For example in the sales environment, an avatar sales agent can lead to more satisfaction with the retailer, a more positive attitude toward the

product, and a greater purchase intention (Holzwarth, Janiszewski, & Neumann, 2006). However, despite liking the concept of Anna and acknowledging that the app may be beneficial to their patients, the clinicians in this study did not “like” Anna, nor see the evaluated app as a useful tool in their daily routine as it failed to integrate into their usual work practices. The use of the app was therefore seen as time consuming, requiring more effort and time to implement than the benefits it delivered. This poor likeability and reduced perception of usefulness can possibly be explained by the clinicians’ lack of involvement in the app design process, involvement that is considered essential for technology adoption (How et al., 2017).

A lack of time to familiarise with the new app was also offered as a reason for poor adoption of the app by the rehabilitation clinicians. When implementing new technologies, adequate time for training must be considered (Shulver et al., 2016; Varnfield & Karunanithi, 2015; Yarbrough & Smith, 2007) . During the Telehealth in the Home Trial, this author, a team of clinicians from various disciplines, and a technical expert, developed a tool kit and a series of videos to assist in training of clinicians implementing iPads into usual home rehabilitation practice (Appendix G). The tool kit sought to introduce the basic concepts of iPad use and practical tips for clinicians working in real services on how to conduct remote therapy assessments and interventions. It also included an app sorting tool developed to provide practical guidelines for identifying high quality therapeutic apps, and clinical risk assessment and decision-making pathways to assess patient suitability for TR. These resources were made available in hard copy and on-line and were considered essential in the successful implementation of TR to HRS. However, rapidly changing technologies and regular staff turnover require resources to be updated frequently, and training and technical support need to be on-going in order to maintain momentum.

5.2 Implications for Practice

For TR to be offered routinely, and as part of usual practice in rehabilitation services, the following recommendations are made:

1. More evidence of its effectiveness and usefulness for specific diagnostic groups and in specific clinical contexts, needs to be provided to both patients and clinicians.
2. The ability of the technology to contribute to the achievement of specific meaningful goals for individual patients must be made evident to the patient at the beginning of their rehabilitation journey. It is only then that they will invest in the time and effort to learn to use the required technology.
3. Time, education and training are essential to allow the older patient to fully engage with TR. Equally important is time, education and training for the clinician with an implementation framework, site/service specific training and prompt at-the-elbow support essential for clinician technology uptake.

Co-design of systems and rehabilitation apps has to include all end users, the patient, their carer and clinician, at every point of the design process. The patient requires support and positive encouragement to use the technology from their health professional.

5.3 Implications for Future Research

There are many aspects of TR and its delivery that warrant further research. Based on this study, the following areas for future research are suggested to provide a clearer understanding of what is essential in terms of rehabilitation service delivery, and patient and clinician preferences.

1. The delivery of TR to rural and remote dwelling patients without the addition of face-to-face home visits.
2. Evaluation of TR costs for equipment, implementation and support.
3. Strategies and training that may improve uptake of TR by clinician.
4. Pragmatic and collaborative research between technology developers and clinical service providers.

5.4 Conclusion

TR can be provided to frail older adults following hip or pelvic fracture, achieving equivalent functional gains to traditional rehabilitation service delivery. However, when introducing new technology to a patient, it is essential to provide the patient with a clear understanding of how the use of this technology can assist in achieving individual goals. The patients' age and gender, and the level of technology familiarity and/or anxiety should be considered. Provision of practical support, and motivational endorsement from peers, carers and from their professional team is indispensable. Additionally, to enable engagement with TR, clinicians need time, support and evidence of usefulness. Finally, clinicians and need to be involved with the design of the technology so that it suits their organisational work practices.

Appendix A Focus Group Guide

- intention to ask open ended questions to encourage discussion
- as themes arise other questions may be included.

Introduction

- Research background
- explanation of focus group process

Questions

1. Describe a typical day
- Probing Qs: how many patients would you see? how much travel time involved? how much time spent scheduling appointments ?

2. Describe any issues you have organising your schedule (or seeing each of your patients) each day/week.

3. How have you have been using the Anna Cares app?

4. Do you think there is a need for this type of app? Why?

5. Has the app assisted you in your work?
- Probing Qs: Eg save time, help coordination

6. Who do you think the app is most suitable for?
- Probing Qs: particular patient group, is age or cognition a factor

7. What would encourage you to use the app [or use more]?

8. How might the app be improved?

9. Have you had any difficulties using the app? (eg logging in, changing apt times, patients having difficulty using it/not liking it).

10. Describe what you have done in these instances.
- Probing Qs: Were solutions/work arounds provided? Did you have direct contact with the developer?

Appendix B System Usability Scale

		Strongly agree				Strongly Disagree
1	I think that I would like to use this system frequently					
		1	2	3	4	5
2	I found the system unnecessarily complex					
		1	2	3	4	5
3	I thought the system was easy to use					
		1	2	3	4	5
4	I think that I would need the support of a technical person to be able to use this system					
		1	2	3	4	5
5	I found the various functions in this system were well integrated					
		1	2	3	4	5
6	I thought there was too much inconsistency in this system					
		1	2	3	4	5
7	I would imagine that most people would learn to use this system very quickly					
		1	2	3	4	5
8	I found the system very cumbersome to use					
		1	2	3	4	5
9	I felt very confident using the system					
		1	2	3	4	5
10	I needed to learn a lot of things before I could get going with this system					
		1	2	3	4	5

Appendix C Participant Information and Consent Form

Government of South Australia
SA Health

Flinders UNIVERSITY

Participant Information Sheet/Consent Form

Non-Interventional Study - *Adult providing own consent*

Repatriation General Hospital

Title	Clinician Perspectives of Anna Cares™ - an electronic avatar-directed scheduling and memory aid.
Short Title	What do rehabilitation clinicians think of using an iPad app to arrange therapy appointments and issue reminders to their patients?
Coordinating Principal Investigator/ Principal Investigator	Claire Morris
Associate Investigator(s)	Dr Chris Barr
Location	Repatriation General Hospital, Adelaide

Part 1 What does my participation involve?

1 Introduction

You are invited to take part in this research project, Clinician Perspectives of Anna Cares™ - an electronic avatar-directed scheduling and memory aid.

This is because you are a rehabilitation clinician working in Home Rehabilitation or on Rehab V ward at Repatriation General Hospital.

The research project is aiming to determine the ease of use and usefulness of the Anna Cares app with a small number of rehabilitation clinicians.

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

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

Participation in this research is voluntary. If you don't wish to take part, you don't have to.

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

• Understand what you have read

• Consent to take part in the research project

• Consent to the tests and research that are described

• Consent to the use of your personal as described.

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

2 What is the purpose of this research?

Rehabilitation services are beginning to integrate the use of technology into usual practice. This technology can be used for videoconferencing, exercise prescription, chronic disease management, information dissemination, peer group support and activity monitoring. Intensive rehabilitation requires the scheduling of multiple therapy appointments and reminders each day. Traditionally, these have been paper-based and unable to be accessed remotely. Anna Cares™ was developed to suit patients or families who are capable of using an iPad at a basic level, with an interface in the form of an avatar called Anna who talks to the patients to remind them of an activity, important task or appointment. Appointments can be added by clinicians, family members or the patient themselves either via the iPad or via the website.

There are well documented difficulties with clinician uptake of technology (Wade et al., 2014). Ease of use and perceived usefulness are essential in the uptake of new technologies for clinicians (Schutte et al., 2012; Zheng et al., 2005) and a clinician's opinion is seen as an important influence in the uptake by the patient (Cimperman et al., 2013). Clinician involvement in technological design and content is also seen as essential for widespread adoption (Azevedo et al., 2015; Bergmann & McGregor, 2011).

The aim of the study is to investigate the likeability, usability and perceived usefulness of Anna Cares™ from a clinician perspective. The research hypothesis is that understanding the key factors necessary for clinician acceptance of this form of electronic diary will aid future clinical app development and facilitate uptake of electronic diaries and reminders in rehabilitation services.

This research has been initiated by Claire Morris

3 What does participation in this research involve?

After signing a consent form, you will be asked to take part in a focus group to discuss your impressions of the Anna Cares app that you will have been using as part of usual practice in your work. You will also be asked to complete two scales regarding ease of use and usefulness of the app.

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

4 Other relevant information about the research project

We will recruit approximately 10 clinicians for this study from Home Rehab Team and Rehab V ward. The project will be completed by June 2016.

5 Do I have to take part in this research project?

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

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

Your decision whether to take part or not to take part, or to take part and then withdraw, will not affect your working relationship with Repatriation General Hospital.

6 What are the alternatives to participation?

You do not have to take part in this research project. Other options are available; these include standard rehabilitation you are receiving as an inpatient or outpatient. The researcher will discuss these options with you before you decide whether or not to take part in this research project.

7 What are the possible benefits of taking part?

There will be no clear benefit to you from your participation in this research.

8 What are the possible risks and disadvantages of taking part?

There are no identified risks to taking part in this research.

9 What if I withdraw from this research project?

If you decide to withdraw from this research project, please notify a member of the research team before you withdraw. A member of the research team will inform you if there are any special requirements linked to withdrawing.

If you do withdraw your consent during the research project, the relevant study staff will not collect additional personal information from you, although personal information already collected will be retained to ensure that the results of the research project can be measured properly and to comply with law.

10 What happens when the research project ends?

At completion of the project you are not required to do anything else. If you would like a copy of the results you can request a copy from the researchers.

Part 2 How is the research project being conducted?

11 What will happen to information about me?

By signing the consent form you consent to the researchers and using personal information about you for the research project. Any information obtained in connection with this research project that can identify you will remain confidential. Your information will only be used for the purpose of this research project and it will only be disclosed with your permission, except as required by law. Data files will be managed using unique identification numbers for each

participant and no personal information will be made available to other researchers or third parties. Personnel with access to the non-identifiable data include the investigators. Upon completion of the study all information will be retained for 15 years in accordance with NHMRC guidelines. All personal data will be stored securely in a locked filing cabinet in the Department of Rehabilitation, Aged and Extended Care and there will be password protected access for computer data storage.

It is anticipated that the results of this research project will be published and/or presented in a variety of forums. In any publication and/or presentation, information will be provided in such a way that you cannot be identified, except with your permission. Publication of the results will be sought in peer-reviewed scientific journals.

In accordance with relevant Australian and/or South Australian privacy and other relevant laws, you have the right to request access to the information collected and stored by the research team about you. You also have the right to request that any information with which you disagree be corrected. Please contact the research team member named at the end of this document if you would like to access your information.

Any information obtained for the purpose of this research project and for the future research described in Section 16 that can identify you will be treated as confidential and securely stored. It will be disclosed only with your permission, or as required by law.

12 Complaints and compensation

You may feel some distress from participation in this study. If this occurs you may withdraw from this study if you wish and your care will not be affected in any way. By participating in this study you do not give up any of your legal rights.

13 Who is organising and funding the research?

This research project is being conducted by Claire Morris, Manager, Home and Outreach Rehabilitation

14 Who has reviewed the research project?

All research in Australia involving humans is reviewed by an independent group of people called a Human Research Ethics Committee (HREC). The ethical aspects of this research project have been approved by the HREC of SA Health.

This project will be carried out according to the *National Statement on Ethical Conduct in Human Research (2007)*. This statement has been developed to protect the interests of people who agree to participate in human research studies.

15 Further information and who to contact

The person you may need to contact will depend on the nature of your query.

If you want any further information concerning this project, you can contact the principal researcher Claire Morris.

For matters relating to research at the site at which you are participating, the details of the local site complaints person are:

Complaints contact person

Name	Southern Adelaide Clinical Human Research Ethics Committee
Position	Petrina Kasperski
Telephone	08 8204 7433
Email	Research.ethics@health.sa.gov.au

If you have any complaints about any aspect of the project, the way it is being conducted or any questions about being a research participant in general, then you may contact:

Reviewing HREC approving this research and HREC Executive Officer details

Reviewing HREC name	Southern Adelaide Clinical Human Research Ethics Committee
HREC Executive Officer	Petrina Kasperski
Telephone	08 8204 7433
Email	Research.ethics@health.sa.gov.au

Local HREC Office contact (Single Site –

Research Governance Officer)

Name	Bev Stewart-Campbell
Position	Research Governance Officer
Telephone	08 8204 4507
Email	Bev.stewart-campbell@health.sa.gov.au

Consent Form - *Adult providing own consent*

Title	Clinician Perspectives of Anna Cares™ - an
Protocol Number	
Coordinating Principal Investigator/ Principal Investigator	Claire Morris
Associate Investigator(s)	Dr Chris Barr
Location	Repatriation General Hospital, Adelaide

Declaration by Participant

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

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

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

I freely agree to participate in this research project as described and understand that I am free to withdraw at any time during the project without affecting my future working realtionships.

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

Name of Participant (please print) _____

Signature _____ Date _____

Under certain circumstances (see Note for Guidance on Good Clinical Practice CPMP/ICH/135/95 at 4.8.9*) a witness* to informed consent is required*

Name of Witness* to Participant's Signature (please print) _____

Signature _____ Date _____

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

Declaration by Study Doctor/Senior Researcher†

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

Name of Study Doctor/

Senior Researcher† (please print) _____

Signature _____ Date _____

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

Appendix D PU and PEOU Scales

Usefulness								
Using Anna Cares in my job enables me to accomplish tasks more quickly								
agree	absolutely	strongly	somewhat	neutral	somewhat	strongly	absolutely	disagree
Using Anna Cares improves my job performance								
agree	absolutely	strongly	somewhat	neutral	somewhat	strongly	absolutely	disagree
Using Anna Cares in my job increases my productivity								
agree	absolutely	strongly	somewhat	neutral	somewhat	strongly	absolutely	disagree
Using Anna Cares enhances my effectiveness on the job								
agree	absolutely	strongly	somewhat	neutral	somewhat	strongly	absolutely	disagree
Using Anna Cares makes it easier to do my job								
agree	absolutely	strongly	somewhat	neutral	somewhat	strongly	absolutely	disagree
I find Anna Cares useful in my job								
agree	absolutely	strongly	somewhat	neutral	somewhat	strongly	absolutely	disagree

Ease of Use								
Learning to operate Anna Cares was easy for me								
agree	absolutely	strongly	somewhat	neutral	somewhat	strongly	absolutely	disagree
It is easy to get Anna Cares to do what I want it to do								
agree	absolutely	strongly	somewhat	neutral	somewhat	strongly	absolutely	disagree
My interaction with Anna Cares is clear and understandable								
agree	absolutely	strongly	somewhat	neutral	somewhat	strongly	absolutely	disagree
I find Anna Cares to be flexible to interact with								
agree	absolutely	strongly	somewhat	neutral	somewhat	strongly	absolutely	disagree
It would be easy for me to become skilful at using Anna Cares								
agree	absolutely	strongly	somewhat	neutral	somewhat	strongly	absolutely	disagree
I find Anna Cares easy to use								
agree	absolutely	strongly	somewhat	neutral	somewhat	strongly	absolutely	disagree

Appendix E Original Publication

Article removed due to copyright restrictions.

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Appendix F Original Publication

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'Well, if the kids can do it, I can do it': older rehabilitation patients' experiences of telerehabilitation

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Abstract

Background and objective Although trials continue to emerge supporting the role of telerehabilitation, implementation has been slow. Key users include older people living with disabilities who are frequent users of hospital rehabilitation services but whose voices are rarely heard. It is unclear whether the use of technologies and reduced face-to-face contact is acceptable to these people. We report on a qualitative study of community dwelling participants who had received a home telerehabilitation programme as an alternative to conventional rehabilitation.

Design Thirteen older participants, three spouses and one carer were interviewed. All had participated in an individualized therapy programme, using a combination of face-to-face and video consults with therapists. The programme used 'off-the-shelf' technologies including iPads for videoconferencing and electronic FitBit^{R} devices. Interviews were recorded, transcribed verbatim and analysed using NVivo software.

Results Thematic analysis resulted in five emergent themes: (i) telerehabilitation is convenient; (ii) telerehabilitation promotes motivation and self-awareness; (iii) telerehabilitation fosters positive therapeutic relationships; (iv) mastering technologies used by younger relatives is a valued aspect of telerehabilitation; and (v) Telerehabilitation does not replace traditional face-to-face rehabilitation therapies.

Conclusions Participants found telerehabilitation convenient and motivating, coped well with the technology and developed positive therapeutic relationships. The learning and practice aspects sat well in the context of a rehabilitation programme. The use of commercially available technologies may have contributed to respondents' high levels of acceptability. The perception of telerehabilitation as complementary to in-person care and the expectation of technological support have implications for the implementation and delivery of telerehabilitation services to older people.

Introduction

Telehealth technologies have been promoted as a solution to the challenges created by an ageing population with long-term complex healthcare needs, by enabling provision of cost-effective, quality and flexible health and social care.[1,2] In Australia, the Productivity Commission Inquiry Report *Caring for Older Australians* acknowledges that 'fundamental reform is required' to respond to current and future challenges that exist in Australia's aged care system. These challenges include a significant increase in the number of older people, an increasing incidence of age-related disability and disease and rising expectations about the type and flexibility of care that is received. Proposed reforms include the development of 'new, cost-effective assistive and information technologies that offer opportunities for productivity gains and higher quality care' and the choice, where appropriate, for older people to receive care at home.[3]

Telehealth involves the 'remote exchange of data between a patient and healthcare professionals as part of the patient's diagnosis and healthcare management'.[1] Telecommunication technologies enable transfer of information in the form of voice, data and images between patients and healthcare providers. Some examples include remote monitoring of blood pressure, blood glucose or activity levels (using an electronic pedometer device), or consultations conducted via videoconference from the patient's home, instead of travelling to an appointment. Telehealth in the home interventions often target older people as they offer promise for improving quality of life, more independent living and providing cost-effective services.[4]

Whilst telehealth interventions have been shown to improve clinical indicators, successful implementation and adoption of telehealth has been slow and fraught with failure.[1,4,5] Evidence from efficacy trials is not sufficient to guarantee successful implementation and adoption of new models of care and, if not context specific, may not be able to predict uptake and outcomes of an intervention 'in a complex, dynamic context such as home care for older people'.[6–8]

Telerehabilitation is defined as the delivery of rehabilitation services using telecommunications technology.[9] As for telehealth applications overall, the success of telerehabilitation interventions has been demonstrated by efficacy trials.[10–12] However, it is unclear whether the use of technologies and reduced face-to-face contact with therapists is acceptable, particularly to older rehabilitation patients, due to the paucity of studies examining patient viewpoints in the context of telerehabilitation.[9] A systematic review of telerehabilitation research found a high level of patient satisfaction with telerehabilitation.[12] Crotty *et al.*[13] investigated the feasibility of providing home-based rehabilitation to older people using 'off-the-shelf' technologies and found that patients and clinicians were generally positive about this form of service delivery, whilst gains could be made in access, frequency and intensity of therapy. There are, however, very few in-depth explorations of patient experiences with home telerehabilitation programmes, with most patient-centred studies focussing on patient satisfaction using quantitative surveys.[9] Of three recent qualitative studies identified in the literature, one explored the viewpoints of patients who had not experienced telerehabilitation.[14] All three examined telerehabilitation in the context of a specific condition: chronic pain, total knee arthroplasty and shoulder joint replacement.[9,14,15] This study addresses the paucity of qualitative literature examining patient experiences of home-based telerehabilitation programmes. We aimed to address the following research questions: (i) How do community dwelling older people experience rehabilitation programmes using telehealth technologies? and (ii) How acceptable are telehealth technologies to older people in the context of rehabilitation?

Methods

The study was nested within a larger evaluation of telehealth in the home being conducted from the Repatriation General Hospital, South Australia. Participants were provided with 'off-the-shelf' technologies including an iPad equipped with videoconferencing technology, as well as a

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FitBit[R] activity monitor. Participants were visited by a physiotherapist and shown how to use the technology. Goals were developed each week, and patients were provided with an 8-week individualized therapy programme including a range of exercises. Each week of the intervention period, patients received a visit at home and an additional videoconference via iPad from therapists. Activity data from the FitBit[R] (i.e. number of steps taken per day) were visible to both therapist and patient via the iPad and discussed during video consultations. The study was conducted in a peri-urban area some 50 km from the city of Adelaide and 40 km from the Repatriation General Hospital. All participants who had at the time completed the telehealth in the home programme were given the opportunity to participate in the qualitative study. Of a total of 15 participants who had completed the rehabilitation programme, 13 agreed to participate. The study was approved by the Southern Adelaide Clinical Human Research Ethics Committee.

Thirteen qualitative interviews were conducted with a total of 17 (six male, 11 female) participants. Of these, 13 were patients, three were spouses of patients, and one was a carer. Spouses and carer were interviewed jointly with the patient. Patient participants were aged between 60 and 92 years and were receiving treatment predominantly for problems with mobility.

The semi-structured interviews were conducted in participants' homes and took between 0.5–1 h. Participants were asked about their experiences with the programme, prior experience with computer and iPad technology, usability of the technology, motivations for participation, challenges of receiving health care via telehealth, the quality of the care, their preferences between traditional and telehealth models of health care, and any other input they had regarding telehealth.

Interviews were recorded, transcribed verbatim and analysed using NVivo qualitative data analysis software by the researcher WS. Thematic analysis was undertaken to develop predominant themes that reflected participants' experiences of the telerehabilitation programme.[16] An inductive approach to the thematic analysis was taken, with themes derived from the data itself, rather than related or linked to any pre-identified theories or coding frameworks. As telerehabilitation experiences of older people are currently not well understood, this was an exploratory study, with the aim of providing descriptive insight rather than theorised analysis. A data driven approach enabled rich, unconstrained thematic description of participant experiences. A process of 'topic coding' served to organize the data. Derivative categories were created from each transcript, which were treated as a provisional framework for 'analytic coding' and 'coding on'. These processes involve interpretive review of the material and the on-going development of overarching themes and conceptual categories.[17] Emerging themes were explored for the connections between them, drawing out patterns in the data and reflecting on their meanings. A number of strategies were employed to increase the authenticity of the findings. A sufficient number of interviews were conducted to achieve saturation. Transcripts were sent to participants for member verification, comment and clarification prior to analysis. Categories and themes were discussed and verified with a second researcher (MK) following both the initial and coding on phases.[18] These verification processes included consideration of not only predominant themes, but also variations and exceptions, which have been included in the presentation of results.

Results

Most participants reported positive outcomes in terms of the experience, activity levels, fitness, functioning and well-being. Whilst a small minority did not feel that they obtained any benefit in terms of improving mobility, no participant was outright negative about the programme. Motivations for participation in the programme included the opportunity to get some exercise, social contact and learn how to use an iPad.

Patients' experiences of the telerehabilitation programme have been grouped into five emergent themes: (i) Telerehabilitation is convenient; (ii) Telerehabilitation promotes motivation and self-awareness; (iii) Telerehabilitation fosters positive therapeutic relationships; (iv) Mastering technologies used by younger relatives is a valued aspect of telerehabilitation; and (v) Telerehabilitation does not replace traditional face-to-face rehabilitation therapies.

Telerehabilitation is convenient

The time-saving and convenience of not having to travel to appointments or exercise classes afforded by video consults was a consistent theme, especially for services located further distances away, such as in the city. The increase in convenience was perceived as less important in relation to the local GP (except when patients did not drive, accessing local services could still be problematic):

> Because I don't drive at all, it's really difficult, transport-wise, and it would've involved me in lots of time more than I needed to be spending doing that. [Patient 2]

> [For] people who are rehabilitating after an operation and are away from the central areas, I think it's going to be a wonderful system. [Patient 5]

Physical discomfort and illness associated with travel could be a reason for preferring a video consult:

> [Specialist is] the other side of Adelaide and just to get an appointment to go and talk to him, we felt, was ridiculous! [Patient is] not comfortable in a van and to drive all the way over to there just to have a little talk that could be over Skype – why not use Skype if we can? [Carer 7]

Telerehabilitation promotes motivation and self-awareness

Using telerehabilitation entailed reduced face-to-face visits. FitBit^{R} technology in combination with scheduled video consults motivated participants to keep up with their exercises/movement. No participant expressed a concern that the programme was invasive:

> I found because I was doing [steps] that I was really conscious of it. So I was doing perhaps more steps than I normally would. And I found that if you have to go out for everything, you can get around 8,000 ... The best things would be... they keep you in line. You don't slack off at all because you know that on the Monday, on the Wednesday or Friday, there's going to be someone there to talk to you. So you keep up with everything that you've been doing so you can give a report on those days. [Patient 1]

Telerehabilitation fosters positive therapeutic relationships

Participants commented on the social contact the relationships with therapists and technical staff provided:

> We just talked about anything and everything – what I've been doing that week, have I gone walking, riding, or whatever, and just had a general chat about anything... it was great. 'Coz once you get to know the person at the other end ... The physios were really warm and close and talked about anything and everything, not just what's wrong with you, but how you've been today and what you've been doing. [Patient 6]

Some participants felt telerehabilitation afforded therapists more time with them:

> I found it easier to ask questions. Easier than when I go to a doctor. I usually come out without answers because I don't ask the right questions ... I think it's probably the process of waiting in a waiting room for your turn and it's always later than it should've been and you go in there and you'd better hurry up because the next one's going to run late, too. I think a lot of that comes into it when you go to clinics and that sort of thing. [Patient 5]

Privacy and confidentiality were not identified as concerns, and there was generally a sense of trust that the therapist would protect patient privacy by ensuring the security of the video consult transmission:

> [Privacy issues] didn't even cross my mind. I think she established trust personally ... you do have a sense of trust. [Patient 2]

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Mastering technologies used by younger relatives is a valued aspect of telerehabilitation

Most patients had little or no first-hand experience with computers and technology, and only one had previously used an iPad. Patients were generally positive about using the technology, with the small number who were initially apprehensive about it becoming quite comfortable, in some cases enthusiastic, with experience. Indeed, the opportunity to learn how to use technology usually associated with younger people (i.e. an iPad) was a factor in the decision for some participants to take part in the programme:

> Well, if the kids can do it, I can do it. [Patient 1]

> Well, I say to my grandchildren, when I was born, TV wasn't even invented! And you see all these things now. This wasn't invented, that wasn't invented, we didn't have this, we didn't have that, but you've got to embrace technology. [Patient 13]

One patient felt daunted at the prospect of using technology, and this was a factor in his original decision to decline participation:

> [Before the programme] I wouldn't have had anything to do with an iPad … [wife] had a laptop and a computer down there but I never went near them … I just didn't want anything to do with it. The thing is that I've got no electronic or knowledge or anything like that … I thought I'd get through life without it. [Patient 7]

He eventually did take part, and he and two other participants purchased or were looking to purchase their own iPads after participating in the programme and had a growing awareness of what they can be used for (e.g. Skyping family, taking and storing photographs, accessing the internet).

There was however an expectation that the therapy team would provide technical support and respond rapidly to problems:

> It's just that if something goes wrong, I don't know… As long as you've got phone numbers to ring, I think that would be the biggest thing to have and to let people know that the system's not working, what can I do? Or can somebody come and fix it? Or when? So you've got some peace of mind that you have done something about it, let somebody know about it. [Patient 4]

Whilst patients were generally enthusiastic about using the technology, some usability issues were highlighted and suggestions for improving the usability of the iPad, particularly for people with significant disabilities. These related to positioning of the iPad, provision of instructions and turning the iPad off and on:

> The iPad was easy. The only trouble … the iPad was on a stand which looked up this way, so I'd have to sit somewhere and the person at the other end of the iPad had to see what they were doing. I tried it with a chair out there and the iPad on the floor – that's the only way they could really see [me demonstrate my exercises]. But if someone that's incapacitated or can't bend down or if you're older – 80 or 90 – you've got to find some way of putting that iPad so the person at the other end can see what you're doing. [Patient 6]

Telerehabilitation does not replace traditional face-to-face rehabilitation therapies

Despite a generally positive reception, there was a strong view that video consults cannot entirely negate the need or desire for face-to-face consults. Although the convenience of telehealth was consistently appreciated, there were some instances when a face-to-face consult was preferred. Moreover, although telerehabilitation was not seen as detrimental to the therapeutic relationship, it was felt that the absence of the physical presence of the therapist limited what could be done at distance. This limitation encompassed the subthemes of physical examination, patient safety and intimacy:

> Well, no, because one thing, if you're going through video link, they can't take your temperature or your pulse or anything else or really sort of check any symptoms. It's purely verbal. [Patient 3]

Although some participants were not concerned about safety, others thought that patient safety may be an issue with video consults:

> If you're not one-on-one and they do something wrong with a dumbbell or something, hit themselves on the head, you've really got to get

> someone there in a hurry or make sure that someone else is in the house … When they're one-on-one, like a person here, they're doing exercise and the physio's right there with you, if you just stumble or whatever, they can grab you. [Patient 6]

Some participants also preferred the more personal nature of a face-to-face consult rather than a video consult, although others saw little or no difference between a face-to-face and video consult. One patient thought that videoconferences alone would be too isolating for a person largely confined to the home due to disability, and that some human contact is important. Another acknowledged that some people would be uncomfortable talking to a screen rather than in person.

Although the carer acknowledged that some of the limitations associated with 'distance' health care could be alleviated by having someone with the patient to support the videoconference (i.e. by helping with exercises under the guidance of the therapist), participants generally felt that it was important to intersperse face-to-face consults with video consults, in order to mitigate some of these concerns. Thus, the value of videoconferences was seen as supplementary to face-to-face consults:

> I don't think I'd go too long on just videoconferencing. I think we've got to intersperse it somewhere along the line to be personal. [Patient 5]

> But I think also, having met the person in person and then relating to them is the advantage … But certainly having contact with [therapist] and seeing her … in the early stages on a regular basis set the stage … with this iPad. [Spouse 7]

Discussion

This study builds on the limited in-depth literature examining patient viewpoints and experiences of telerehabilitation. The findings presented here align with previous literature, which reports that telerehabilitation approaches are acceptable to older rehabilitation patients.[12,19] In support of the authenticity of the results, the themes outlined in this study mirror many of those found by other qualitative studies investigating patient experiences with telerehabilitation programmes, including the convenience of not having to travel to appointments, supportive therapeutic relationships, a preference for telerehabilitation in combination with in-person consults and usability of technology.[9,14,15]

Participants in this study were very positive about the programme and could see value in this model of service. In particular, participants described increased self-efficacy as a response to the coaching approach provided by therapists through telerehabilitation. It has been argued that telehealth can both undermine individual agency or empower and foster independence, and that this can depend on the form the telehealth care takes.[8] The participants in the present study did not experience telerehabilitation as disempowering. Instead, the programme fostered an awareness and interest in their activity levels, and in some cases also of new technologies. Video consult and activity monitoring were not seen as invasive, but rather appreciated and experienced as motivating. This study supports findings in a study by Eriksson *et al.*[15] where participants reported a feeling of capability and independence on the telerehabilitation programme.

The current study suggests that provision of a FitBit^{R} device and distance monitoring of adherence to exercise through videoconferencing is acceptable and motivating for participants. Systematic reviews of randomized trials show that higher doses of exercise are associated with better outcomes in people after stroke and hip fracture, and greater falls prevention effects in older people.[20–23] The learning and practice aspects of this programme sat well in the context of a rehabilitation programme, suggesting that telerehabilitation is an acceptable way of encouraging increased activity levels and higher exercise uptake in older people.

Participants appreciated the convenience of not having to travel to appointments for rehabilitation services and recognized the value of telerehabilitation for people living in rural and remote areas, when travel is a significant barrier

to accessing services. Yet most did not consider telerehabilitation to be an adequate substitute for traditional face-to-face models of service. In other words, participants saw telerehabilitation as complementary to face-to-face service delivery, rather than as an alternative. This could be a function of the way the telerehabilitation service was delivered. Beul *et al.*[24] suggest that patients tend to prefer the model of service they have experienced. Telerehabilitation participants still received regular home visits from the therapist and also lived within reasonable distance of a rehabilitation facility, local hospital and their GP, thus were less limited in their service options than people living in more remote areas. Although it is persuasive to consider that had they received telehealth consults alone, participants' views may have changed, previous research contradicts this notion. Investigations of telerehabilitation programmes that have not interspersed video consults with face-to-face contact also expressed a preference for telerehabilitation in combination with face-to-face therapy, rather than a substitution for the latter.[9,14,15]

The results from these and the present study suggest that telerehabilitation is readily accepted by older patients in a supplementary capacity, but only as substitution to traditional models of service delivery when there is no other option. This has implications for the delivery of rehabilitation services, particularly to country and remote areas. Increasing access to healthcare services to rural and remote communities is a recognized benefit of telehealth.[25] Research examining group-based telehealth programmes indicates that people living in areas remote from healthcare services would also ideally prefer in-person health care, but pragmatically recognize that options for this are limited and that telehealth has value as an alternative.[26,27] There is a paucity of research investigating telerehabilitation as a substitution to home visits for older people.[28] Further research specifically investigating older patient experiences with home-based telerehabilitation as a substitution to traditional therapy would give greater insight into the acceptability of telerehabilitation to remote areas where alternatives are limited, and possibly provide insights into the best method of delivery to increase acceptability.

Patients in this study were happy with the therapeutic relationship established with the therapists on the telerehabilitation programme; however, this may not have been as effective without the initial and intermittent face-to-face appointments which may have laid the foundation to the relationship. The regular social contact, easy communication and on-going support were seen as positive aspects of the programme. In addition, participants were confident that the videoconference transmission was safe and their security was ensured. This mirrors the findings of Kairy *et al.* and Eriksson *et al.*, yet contrasts those of Cranen *et al.* who reported that participants had concerns that the physical alienation from the therapist in telerehabilitation would be detrimental to the therapeutic relationship.[9,14,15] However, the participants in Cranen *et al.*'s study had no first-hand experience of telerehabilitation and were asked about it in a hypothetical sense. The contrast with patients experienced in telerehabilitation, including those in this study suggests that these fears may not be realized in practice.

Despite having little to no direct experience with iPad technology, the older people in this study were willing or even keen to give it a try. Initial apprehension, felt by some, was overcome with experience. Participants showed a willingness to experiment with iPad placement and room set-up within their home to allow the coaching to occur efficiently. All were able to use the iPad for videoconferences. The use of 'off-the-shelf' technologies in this programme may have contributed to the high levels of acceptability among participants through seeing their children and grandchildren using such technology. This was cited by some as a motivating reason to enrol in the trial. Although older people use technology less than do younger people, particularly more recent technological innovations, little is known about older peoples' perceptions of modern touchscreen devices.[29,30] There is some evidence that the touchscreen interface of iPads and other tablets is acceptable

and even preferred by older people, and that iPad use can have a positive impact on older peoples' social interaction and intergenerational communication.[4,29,31] This study concurs with other research, which shows that older people can be interested in modern technology and successfully use it, particularly if it is perceived as useful.[4,29,30,32] Also relevant to telerehabilitation interventions with older people, although cognition can have a significant impact on ability to use iPad technology, there is evidence that some people with dementia are able to do so.[29,33]

Limitations

This study, as for qualitative work in general, is highly context specific. Whilst this has the advantage of providing rich, contextual insight into telerehabilitation experiences, it does pose limitations in terms of the extent to which its insights are applicable to other communities. Previous qualitative work examining patient experiences of telerehabilitation programmes was conducted in north-western Europe and Canada.[9,14,15] The alignment in results suggest that the experiences of patients in the present study are similar to those of people in other Western countries. However, a review of health informatics (including telehealth) research in relation to the delivery of care to older people indicates that the majority of studies are conducted in Western countries; thus, there is limited information on cultural factors that may impact on experiences and acceptability of telerehabilitation.[34] Further research in a range of contexts and cultures will contribute to a broader picture of experiences and acceptability of telerehabilitation to older people.

Although clearly the telerehabilitation technology was acceptable, usable and convenient, it is difficult in this study to isolate the impact of telehealth on therapeutic relationships and service model preferences, as participants' experiences were grounded in both telehealth and in-person care.

It was planned to include people in this study who declined participation in the larger telerehabilitation trial. This was considered an important design consideration in terms of the generalizability and validity of insights into the acceptability of telerehabilitation, as it would increase the sample size and ensure that decliners were also given a voice. However, all trial decliners also declined participation in this qualitative study, although the study did include insights from 'converts' who were initially reluctant to participate but changed their minds. Information from trial refusers can provide important insights into the reasons for non-participation, which help to better understand the slow adoption of telehealth services.[2] Qualitative research with telehealth trial decliners has revealed that factors influencing refusal to participate relate to apprehensions about technology, loss of independence and changes to existing services.[2]

Conclusions

This study provides additional insights to previous research indicating that telerehabilitation is acceptable to older people from Western cultures. Participants in this study perceived telerehabilitation positively, found it convenient, coped well with the iPad and FitBit^{R} technology and developed positive relationships with therapists. The insights from this study highlight some important implications for the ongoing provision of rehabilitation services to older people into the future. Specifically, our results indicate that the expanding use of technology to provide such services at distance is workable and acceptable to older people, and a viable way of translating evidence into practice by increasing exercise dosage. However, there are a number of caveats that should be considered and addressed in the development and establishment of telerehabilitation services. Insights from this and previous research indicate that rehabilitation patients value face-to-face contact with their therapist, even when they are very positive about their telerehabilitation experience. This perception of telerehabilitation as complementary rather than a substitute to in-person care indicates that an ideal telerehabilitation service would continue to provide traditional therapy options by interspersing

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face-to-face contact with at distance therapy wherever possible.

Use of 'off-the-shelf' technologies, or technologies that are similarly featured, may decrease apprehension and increase usability due to previous exposure through younger family members. Provision of technological support and rapid resolution of technical problems, along with clear instructions, adequate training and support and further, tailored technological developments (such as adjustable stands and high visibility controls) could further increase ease of use and diminish safety risks. Future areas of research that will build on these insights and further inform the development of viable telerehabilitation services include examinations of the conditions under which at distance only telerehabilitation is acceptable, the feasibility of using telehealth technologies to support the rehabilitation of older people with cognitive impairment, and giving a voice to older people who decline telerehabilitation services.

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Conflict of interests

No conflict of interests to declare.

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Appendix G Links for Tool Kit and Videos

Tool Kit for Providing Home Based Tele-rehabilitation Services Using an iPad
http://www.flinders.edu.au/mnhs/telehealth/telerehabilitation/toolkit.cfm

Tele-Rehabilitation in the Home – Introduction
https://www.youtube.com/watch?v=6N0Gq12GN3w

Tele-Rehabilitation in the Home - iPad set up in the patient's home
https://www.youtube.com/watch?v=Sl8WQmTH1LU

Tele-Rehabilitation in the Home - Clinical examples
https://www.youtube.com/watch?v=h4EbzgcPO1M

Tele-Rehabilitation in the Home – Brian's stroke
https://www.youtube.com/watch?v=1JhhmUQ-6oc

Technical Aspects for Clinicians – Introduction
https://www.youtube.com/watch?v=d70n-VvOIKw&index=6&list=PLJSboi7Yt2OBDscM7CgTh-8K03Y1Bu7Qo

Technical Aspects for Clinicians - Using an iPad for clinical video conferencing
https://www.youtube.com/watch?v=nsIJuHaGXf8&index=8&t=0s&list=PLJSboi7Yt2OBDscM7CgTh-8K03Y1Bu7Qo

Technical Aspects for Clinicians – Using a video conferencing suite to deliver tele-rehabilitation
https://www.youtube.com/watch?v=bwtoh1yqIe8

Technical Aspects for Clinicians - Using a Mobile Device Manager to streamline use of iPads/apps
https://www.youtube.com/watch?v=W-4YzSPwGp0&list=PLJSboi7Yt2OBDscM7CgTh-8K03Y1Bu7Qo&index=9

Tele-Rehabilitation in the Home - Remote clinical monitoring
https://www.youtube.com/watch?v=2jUHJtSfv5s

Tele-Rehabilitation in the Home - Offsite iPad videos conferencing
https://www.youtube.com/watch?v=6dAnH0ijmJo

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