



**Understanding the impact of a proactive telecare intervention
in supporting independence, health, and well-being in older
adults**

This thesis is submitted for the degree of Doctor of Philosophy in Health
Research

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Declaration by the student

I declare that all the work within this thesis is my own and has not been submitted elsewhere in the same format for the award of Doctor of Philosophy. The following sections of this thesis have or will be submitted for publication:

Chapter 3: 'Understanding the value of a proactive telecare system in supporting older adults' independence at home: Qualitative interview study among key interest groups'. This chapter has been published in the *Journal of Medical Internet Research* (Fothergill et al., 2023).

Chapter 4: 'How, for whom and under what circumstances can telecare support independent living in community-dwelling older adults: a realist review'. This chapter is formatted for and intended for submission to *BMC Geriatrics*.

Chapter 5: 'Does proactive monitoring of older adults' well-being allow for the detection of health deterioration? A retrospective cohort study of proactive telecare users in the United Kingdom'. This chapter is formatted for and intended for submission to a relevant academic journal.

Chapter 6: 'Using proactive telecare to support independence, health, and well-being in older adults: a randomised feasibility and acceptability study'. This chapter is formatted for and intended for submission to a relevant academic journal.

Statement of authorship

This thesis is presented in an alternative format, comprised of four papers. A statement of authorship for each multi-authored manuscript is provided, with written certification from the other authors to confirm authorship. The lead author for each chapter of this thesis was the PhD candidate, Lauren Fothergill (LF). This doctoral research was supervised by Professor Carol Holland (CH), Dr Yvonne Latham (YL) and Professor Niall Hayes (NH). Research in this thesis was supported by Dr Thomas Mason (TM), Jenny Hamilton (JH), and Saiqa Ahmed (SA). Author contributions to each chapter are detailed below:

Chapter 3: Understanding the value of a proactive telecare system in supporting older adults' independence at home: Qualitative interview study among key interest groups. LF, CH and NH contributed to the study design. LF completed the data collection and analysis, and write-up processes. CH, NH and YL provided feedback on the drafts of the paper and provided guidance throughout the study.

Chapter 4: How, for whom and under what circumstances can telecare support independent living in community-dwelling older adults: a realist review.

LF, CH and NH contributed to the study design. LF conducted the database searches, article screening, data extraction, analysis, and production of the manuscript. CH, NH and YL provided feedback on the analysis and each draft of the chapter. JH and SA supported the article screening and provided feedback on the analysis and the final draft of the chapter.

Chapter 5: Does proactive monitoring of older adults' well-being aid in the detection of increased hospital risk? A retrospective cohort study of proactive telecare users in the United Kingdom.

LF, TM and CH contributed to the study design. LF completed the protocol, data cleaning, data collection, analysis, and write-up processes. TM contributed to the design of the regression approach used and advised on the coding for the analysis. TM and CH provided feedback on the drafts of this study.

Chapter 6: Using a proactive telecare to support independence, health, and well-being in older adults: a randomised feasibility and acceptability study.

LF, CH, YL and NH conceptualised the study design. LF completed the data collection and analysis, and write-up processes. CH and YL supported the data analysis. CH, YL and NH provided feedback on each draft of the chapter.

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Glossary

A&E	Accident and Emergency
ADL	Activities of Daily Living
COPD	Chronic Obstructive Pulmonary Disease
COREQ	Consolidated Criteria for Reporting Qualitative Research
DALLAS	Delivering Assisted Living Lifestyles at Scale
GDPR	General Data Protection Regulation
GP	General Practitioner
HRQoL	Health-related Quality of Life
NHS	National Health Service
NIHR	National Institute of Health and Social Care Research
ONS	Office of National Statistics
PCP	Preventive and Corrective Proactivity Model
PERCS	Planning and Evaluating Remote Consultation Services
PIS	Participant Information Sheet
PRS	Personal Response system and services
RCT	Randomised Controlled Trial
SD	Standard Deviation
SOC	Selective Optimisation with Compensation
STAM	Senior Technology Acceptance Model
TECS	Technology Enabled Care Services
TIDieR	Template for Intervention Description and Replication
TSA	Technology Enabled Care Services Association
UK	United Kingdom
USA	United States of America
WHO	World Health Organisation
WSD	Whole Systems Demonstrator

Understanding the impact of a proactive telecare intervention in supporting independence, health, and well-being in older adults

Lauren Fothergill

Thesis abstract

Background

Telecare devices are remote care technologies used to monitor emergencies and lifestyle changes, to support independent living in older adults. There has been recent interest among policy makers in proactive telecare services, which provide well-being calls or encourage users to regularly confirm their well-being, to prevent crises. However, there could be better understanding into how proactive services support health and well-being. This research explores how using a proactive telecare service can support older adults' independence, and what potential health and well-being benefits may be elicited from its use.

Methods

An existing proactive telecare service was evaluated called OKEachDay, which offers users a device to confirm their well-being through pressing an OK button. Four studies were conducted: (1) a qualitative study exploring the experiences of key interest groups in using OKEachDay, (2) a realist review of how telecare can support older adults, (3) a cohort study assessing the association between OKEachDay user engagement patterns and hospital admissions, and (4) a feasibility study on OKEachDay.

Results

Older adults reported that using OKEachDay contributed to feelings of safety and reduced anxiety related to managing risks at home. Daily engagement in confirming well-being boosted autonomy in older adults. Participants valued being connected to an additional social network. However, individuals have differing needs, and varying levels of social and financial resources, which must be assessed to ensure older adults are best supported. The technology was found to be acceptable and feasible to evaluate, suggesting that this proactive telecare system may be a scalable intervention to older populations.

Conclusions

This research highlights the unique benefits of using a proactive telecare system to support independent living, such as promoting autonomy and offering social resources, which may promote health and well-being. However, OKEachDay must integrate into an individual's life and available resources. A future full scale randomised controlled trial is required to evaluate the effectiveness and cost effectiveness of this intervention.

1. Chapter 1: Introduction

1.1. Chapter overview

Globally, populations are ageing, which presents significant challenges. Ageing is commonly accompanied with a decline in health, such as increased risk of morbidity, reduced mobility, falls, and cognitive decline. Consequently, this increases the pressure on health and social care systems. There is substantial interest among policy makers and researchers in using telecare to support independence in older adults. Telecare is a type of monitoring technology that manages risks associated with independent living; examples include pendant alarms, fall detectors and ambient sensors. However, most telecare services available are predominately reactive in nature, meaning that devices are triggered following a raised alarm by the user or the detection of unusual behaviour by sensors, which may not be suitable for everyone. Reactive telecare has also been associated with stigma and ageism, and subsequently, often viewed by older adults as a last resort rather than as a technology used proactively.

Proactive telecare has received interest among policy makers and researchers; however, there could be better understanding of its potential benefits. Proactive telecare refers to providing proactive well-being calls or encouraging users to regularly confirm their well-being, with the aim of anticipating and preventing crises and facilitating strong social connections between older adults and social care services. Telecare that encourages active engagement from individuals to confirm their well-being, rather than using passive monitoring to detect ill-health may elicit a sense of autonomy, which may support someone's perceived goals of independence. Although proactive telecare may support older adults to remain independent, there could be better understanding of the potential impacts on independence, health, and well-being.

This thesis will explore how using a proactive telecare service can support older adults' independence, and what potential health and well-being benefits may be elicited from its use. To achieve this, an existing proactive telecare service, known as OKEachDay, was chosen as an example for this doctoral research due to its known long-standing use across

the United Kingdom (UK). The technology requires older adults to confirm their well-being by pressing an 'OK' button at an agreed time each day. If no contact is established, the call centre team contacts the older adult to confirm well-being, which gives the opportunity for social contact. If the older adult cannot be contacted, the call centre team escalate the situation and contact the user's nominated contact, normally relatives, neighbours, or carers.

A qualitative study was first conducted as a scoping study, to explore perspectives from different interest groups on the potential health and well-being benefits of using this technology, as well as its limitations (Chapter 3). Then a realist review of existing literature was conducted to explore how telecare interventions can support independent living, to gain deeper insights into the specific resources provided by telecare which help promote independence, health, and well-being (Chapter 4). To investigate the potential value of OKEachDay in supporting physical health, a retrospective cohort study using secondary data from the technology providers was conducted. This investigated the relationship between missed 'OK' button presses and hospital admissions, to explore the value of OKEachDay in highlighting an increased risk of hospital use (Chapter 5). Finally, findings from Chapters 3 - 5 contributed to the development of an initial programme theory of how OKEachDay may support older adults, and subsequently influenced the design of the feasibility study, which explored the acceptability and feasibility of evaluating this intervention (Chapter 6). Details of the thesis structure are illustrated below in Table 1.

Table 1. Thesis structure

Chapter	Description
Chapter 1: Introduction	Introduces the current challenges facing older adults in remaining independent, the potential of telecare (in particular, proactive telecare) in supporting independence, health, and well-being, and presents the research aims of this thesis.

Chapter 2: Methodology	Presents the philosophical position taken and the rationale for the use of methodologies in this research.
Chapter 3: Study 1 - Qualitative interview study	Presents the findings from Study 1, a qualitative interview study exploring the perceptions of different interest groups to understand the potential value of using OKEachDay.
Chapter 4: Study 2 - Realist review	Presents results from Study 2, a realist review investigating how, for whom, and under what circumstances telecare can support independent living in older adults.
Chapter 5: Study 3 - Retrospective cohort study	Presents the results from Study 3, a retrospective cohort study using secondary data, investigating whether using OKEachDay and missing the OK button is associated with increased hospital use risk, by analysing patterns of proactive telecare use and hospital use.
Chapter 6: Study 4 - Mixed methods feasibility study	Presents the findings from Study 4, a mixed methods feasibility study exploring the acceptability and feasibility of delivering OKEachDay to older adults, prior to a potential full-scale effectiveness trial.
Chapter 7: Thesis discussion	Presents a synthesis of the results from all four studies to provide a discussion of the impact of this particular proactive telecare intervention of interest, the strengths and limitations of this doctoral research, and recommendations for future research.
Chapter 8: Conclusion	Summarises the key conclusions and unique contributions to the literature from the thesis.

1.2. The challenges of an ageing population.

1.2.1. Demographic ageing: UK context

In line with global trends, the UK is undergoing a significant demographic shift toward a rapidly increasing older population. The Office of National Statistics (ONS) reported that between 2011 and 2021, the number of people aged 65 and above increased from 9.2

million to approximately 11 million (Office for National Statistics, 2023). This is predicted to increase by 32% (3.5 million people) by 2043 (Age UK, 2023a). This change in the demographic landscape is a result of increased longevity due to advancements in healthcare and overall quality of life, declining birth rates and the ageing post World War II baby boomer generation (Howdon & Rice, 2018). Indeed, the observed improvement in longevity is arguably one of the greatest achievements of the 20th century. However, it also presents significant challenges. Ageing is commonly accompanied with a decline in health, such as reduced physical strength (Peng et al., 2023), reduced mobility, increased risk of falls (Strini et al., 2021), and cognitive decline (Park et al., 2003). Consequently, health care expenditures in the UK have increased over time (Howdon & Rice, 2018), placing a strain on available resources.

1.2.2. Current challenges to health care services

The risk and prevalence of long-term conditions such as arthritis, dementia, and cardiovascular disease increases with age. Of note, health and social care needs are the highest for people aged 85 years and above, with demand projected to increase by 8.2% (126,000 people) by 2028 (Age UK, 2023a). In the UK, 26.1% of people aged 65-74 have no diagnosed long-term condition, which falls to 14% of people aged 85 years and over (Age UK, 2023a). The rise in demand for health and social care adds financial strain, with the Health Foundation estimating that the National Health Service (NHS) requires a 3.1% annual growth in funding to meet demand, while social care funding needs a 4.3% annual growth (estimates made from funding projections between 2018/2019 and 2030/31) (Rocks et al., 2021).

Older adults generally have high use of health care services, with people aged over 65 years old accounting for 62% of all hospital bed days and 52% of admissions lasting longer than one week (National Audit Office, 2016). However, with such a high need for care, it is likely that older adults have experienced unmet needs given the current pressures on the NHS and social care post-COVID-19 pandemic (The Health Foundation, 2022). In a recent Age UK survey in October 2022, 45% of older people felt concerned about not being able to access primary care (from a sample of 2,594 UK older adults aged 65+) (Age UK, 2023a). Of those

participants who experience long-term health conditions, the proportion of people who felt supported to manage their health condition decreased by 14% over 5 years in people aged 65-74 years old and 11% in those aged 75-84 years old. In 2023, the National Institute of Health Research (NIHR) published a report which investigated the unmet health and care needs for people aged over 60 years old and found that one of the key concerns of older adults was accessing care, including access to primary care, diligent referrals and streamlined routes to diagnosis and treatment (NIHR, 2023a). With older adults reporting issues with accessing health care, this may suggest that health needs are not being picked up early enough, resulting in health needs worsening and older people requiring hospital admission (Age UK, 2023a). Of note, rates of accident and emergency (A&E) visits in people aged over 80 have increased by 40% between 2012/2013 and 2021/2022 (Age UK, 2023b). As the proportion of people aged over 65 years old increases, it is crucial to focus on improving health and well-being, to reduce the negative implications of an ageing population for the NHS.

1.2.3. Current challenges to social care services

The social care sector in the UK has also come under increased pressure to respond to an ageing population. In England, the number of adult social care jobs is expected to increase by 29% by 2035 to match demand for services (Edwards et al., 2022). Of note, this increasing demand for adult social care may prove to be difficult to respond to, given the current challenges in recruiting and retaining social care staff. In 2022/23, the vacancy rate for adult social care roles was 9.9%, with a turnover rate of 28.3% (Skillsforcare, 2023). International recruitment of social care staff has become increasingly difficult since Brexit in 2016 (Edwards et al., 2022), coupled with the added impact of the COVID-19 pandemic, where social care staff experienced increased job demands and stress, and decreased work-related quality of life and well-being (Gillen et al., 2022).

Delayed discharge from hospital is also a key issue for both health care and social care providers. The National Audit Office reported that in 2016/17, 2.7 million hospital bed days were occupied by people aged over 65 years old who no longer required treatment, resulting in an estimated cost of £820 million to the NHS (National Audit Office, 2016).

Older adults waiting to be discharged from hospital may have complex needs, including frailty, multiple long-term conditions, and concerns about returning home or entering a care facility (Oliver, 2023). Of note, only 15% of patients waiting to be discharged require a permanent residency in a care home; the remaining patients are waiting for support at home which would enable them to regain or support their independence, including care at home, social care needs assessment or equipment, or general support to live at home (Oliver, 2023). Effective discharge requires successful co-ordination between health and social care, and adequate resources to support older adults to recover and remain at home (Rojas-García et al., 2018).

To combat current challenges in health and social care, health promotion strategies for older populations have been based on two goals: (i) improving lifestyle behaviours, and (ii) improving the living conditions in which the person resides (Teixerira-Santos & Bobrowicz-Campos, 2020). The latter strategy will be the focus for this thesis.

Living independently at home is often promoted as the best option for older adults (Yaylagul et al., 2022). Of note, the proportion of older people who require social care services has fallen over time. For example, in 2006, 32% of those aged 80-84 experienced ADL (activities of daily living) limitations, which fell to 25% in 2018, demonstrating the potential for older people to live longer and more independent lives (Raymond et al., 2021). ADL comprises of skills required by an individual to care for one's self and body, including personal care and hygiene, eating and mobility (Mlinac & Feng, 2016). Nevertheless, age-related conditions such as falls risk, isolation, and loneliness can present challenges to living independently at home (Yaylagul et al., 2022). The following section will explore the importance of ageing in place and maintaining independence, health, and well-being, and the current challenges faced by older adults in achieving this.

1.3. Independence, health, and well-being in older adults ageing in place

1.3.1. Ageing in place

Promoting ageing in place has become an important component of UK policy to support health and well-being in older people, but also to provide a cost-effective solution to

avoiding costly institutional care (Sixsmith & Sixsmith, 2008) and addressing shortages of social care services (Peek et al., 2016). According to Davey et al (2004), ageing in place can be defined as “*remaining living in the community, with some level of independence, rather than in residential care*” p. 133, or often referred to as ‘independent living’. Living at home is highly valued by many older adults, and is claimed to support autonomy, maintain social connections and promote health (Ahlqvist et al., 2016; Sixsmith & Sixsmith, 2008). Many older adults, particularly those aged 75 and over spend a large amount of time in the home environment (Gitlin, 2003), making it an ideal setting to promote health and well-being. The importance of ‘home’ has been long recognised in gerontology, with Lawton (1973) highlighting the role of the home environment in enhancing a person’s well-being and supporting independence. However, to live independently, older adults must evaluate their health to ensure they are safe to live at home, but also to ensure that their quality of life is upheld.

The following section will outline the key outcomes of interest related to independence, health, and well-being that are important in the context of telecare use and ageing in place. Independence, health, and well-being are interrelated concepts with some overlap, but also exist independently of each other. For example, a person can need assistance to live independently, but still have positive well-being. To define the focus of the thesis, these concepts will be described individually.

1.3.2. Independence in older adults

The concept of independence is crucial in promoting ageing in place (Rabiee, 2013). However, definitions are varied and understood in different ways, creating complexity in defining what independence means. In gerontology literature, independence is understood as functioning without help and not being reliant on others (Leece & Peace, 2010; Secker et al., 2003). But for older adults, meanings of independence are much broader and encompass maintaining a sense of control, self-esteem, self-determination, personal growth (Secker et al., 2003) and having access to resources to facilitate independence (Hillcoat-Nallétamby, 2014; Plath, 2008). Ball et al., (2004) conducted interviews with older adults living in assisted living facilities (a type of housing that offers care and support to

allow people to live independently) and found that maintaining the ability to conduct ADLs was a key indicator of independence, alongside broader concepts including autonomy, self-identity and experiencing meaningful activities. Similarly, Hillcoat-Nalletamby (2014) interviewed older adults on what they understood independence to be and having autonomy was a key finding. Autonomy can be defined as having the ability and opportunity to self-govern (Bölenius et al., 2019). Hillcoat-Nalletamby (2014) found that older adults valued being able to accept help from others but wanted to maintain a level of agency and self-determination. According to Ryan & Deci (2011), self-determination refers to a person's ability to have control over their life and make their own decisions. An increased sense of self-determination has been associated with higher levels of self-reported quality of life (Bölenius et al., 2019) and well-being (Liu et al., 2022). Of note, expectations for independence reduced as functional capacities reduced, demonstrating that perceptions of independence may shift overtime (Ball et al., 2004; Schwanen & Ziegler, 2011).

Another key marker of independence in the literature is identifying as independent, which Hillcoat-Nalletamby (2014) suggests is often integral to a person's self-esteem and sense of purpose. This desire to maintain an '*independence identity*' can happen as older adults wish to mask signs of physical and cognitive decline (Breheny & Stephens, 2012), as they do not want to be perceived as getting older (Kang & Kim, 2022). This may be a result of older people internalising age stereotypes by exposure to societal sources (Levy et al., 2022), where negative stereotypes related to ageing may lead to decreased self-esteem and confidence (Kang & Kim, 2022), increased stress levels and poorer physical and mental well-being (Bryant et al., 2012). In contrast, Levy et al. (2022) suggests that positive age stereotypes may support health.

Given that independence may have different meanings for individuals, this thesis adopted a broad concept of independence to understand how proactive telecare use can support feelings of autonomy, self-determination, self-identity, and access to resources.

1.3.3. Health and well-being in older adults

According to WHO (1946), health can be defined as *“a state of complete physical, mental and social well-being, and not merely the absence of disease and infirmity”* (p. 1315). Similarly, the World Health Organisation (WHO) recommends that older adults age well through maintaining physical and mental health, independence, and quality of life through maintaining their capabilities that enable them to do what they enjoy and value (Plácido et al., 2022). As populations age, early and appropriate disease management becomes paramount for health and well-being.

A key physical health indicator in older adults is reducing hospital admissions, and falls are a leading cause of hospitalisation. In England, approximately 1 in 3 older adults (aged over 65) have at least one fall a year, which rises to 1 in 2 in people aged over 80 (NHS, 2023). Older adults living at home may be unable to get up after a fall, with one study reporting that 30% of over 90 year olds were on the floor for over an hour following a fall (Fleming & Brayne, 2008). Lying on the floor for a long period of time unintentionally (also referred to as a long lie) is associated with muscle weakness, dehydration, pneumonia, and other serious injuries (Charlton et al., 2017), which could result in hospitalisation and subsequent transitions into care facilities (Fleming & Brayne, 2008). By detecting falls, accidents, or injuries by monitoring lifestyle behaviours, telecare may aid in improving quality of life and reduce hospital admissions. Hospitalisation in older people can be a cause of stress and lead to increased risk of mobility impairments, infections, falls risk and delirium (Mudge et al., 2019). Indeed, reducing hospital admissions in older adults could improve overall health outcomes, which would support their ability to remain independent and in turn, support their well-being. Therefore, this thesis will focus on how telecare can help to improve health through detecting risk-associated behaviours and promoting safety, and subsequently reducing hospital admissions.

Although a large proportion of the literature focuses on maintaining health and well-being through reducing falls and hospital admissions (Beswick et al., 2010; Martins et al., 2020), older adults also value the psychological and social aspects of health and well-being (Schwanen & Ziegler, 2011). The WHO definition of health encompasses three aspects of

well-being; physical, mental, and social, with the term 'well-being' simply referring to an individual's happiness and satisfaction (Schramme, 2023). Ryan & Deci (2001) delve deeper into defining well-being as a complex construct consisting of two perspectives: hedonic well-being, which emphasises happiness and pain avoidance, and eudaimonic well-being, which emphasises self-realisation and meaning.

Maintaining positive well-being is crucial in promoting independence and health in older people. Older adults with positive well-being and life satisfaction have lower morbidity, less self-reported health issues and greater longevity (Saadeh et al., 2020). When assessing older people's well-being, many concepts are used in the literature, such as physical health, mental health, emotional well-being, and quality of life (Bowling, 2007; Walters et al., 2017). Carr et al. (2001) describes quality of life as an individual's subjective standard of health and well-being, that enables them to lead a fulfilling life. One study considered the views of older people on what constitutes well-being and found that older adults emphasised the importance of health, financial security, access to social resources, autonomy, and mental health (anxiety and depression) (Hackert et al., 2019). This thesis will explore the impact of a proactive telecare system on well-being by focussing on how it affects emotional well-being, mental health, and quality of life.

1.3.4. Social connections in older adults

Social connection is crucial for independence, health, and well-being. Hillcoat-Nallétamby (2014) found in a qualitative study that social connections are important for older adults in eliciting a sense of belonging and providing a support network. Social isolation can be described as low or no social interactions or support, whereas loneliness encompasses negative emotions associated with a perceived lack of social connection (Fawcett & Karastoyanova, 2023). Social connections are a key social determinant of health, with social isolation and loneliness being associated with an increased risk of dementia, coronary artery disease and stroke, and all-cause mortality (Donovan & Blazer, 2020). Older adults who are socially connected are more likely to participate in activities, promoting healthy behaviours and improving overall health (Saadeh et al., 2020). Indeed, even the subjective perception of social support has been found to support immunity and cardiac health

(Donovan & Blazer, 2020), demonstrating the importance of social support in forming preventive strategies. Having a social network provides access to information and assistance to live independently. Social connections are a key enabler of positive health and well-being outcomes for older people (Morgan et al., 2021). When these social needs are not met, this can lead to poorer mental and physical health outcomes. When evaluating the impact of a proactive telecare system, the research in this thesis will delve into the social needs of older adults to ascertain whether a proactive telecare system can effectively bolster social connections.

1.3.5. Challenges to remaining independent at home

According to Sixsmith & Sixsmith (2008), as people age, the home environment can be a barrier to ageing in place and staying independent. Physical limitations, such as reduced mobility and chronic health conditions may increase the risk of accidents, falls, and injury at home, posing a threat to safety. Moreover, poor housing standards and obstacles such as stairs or uneven surfaces may increase safety-related risks at home (Lee, 2021), leading to disempowerment and reduced self-sufficiency in older people, as their home environment does not accommodate their needs (Liu et al., 2022).

Beyond these issues, social isolation emerges as a significant barrier to independence. Social circles often reduce as people age, increasing the risk of loneliness, which has been associated with adverse mental health outcomes such as depression (Fawcett & Karastoyanova, 2023). In recent contexts, COVID-19 lockdown periods and shielding measures increased social isolation in older adults, exacerbating existing issues and leading to poorer mental health and well-being within this population (Giebel et al., 2021). Of note, social isolation can also increase the risk of an older adult becoming ill unnoticed, increasing the risk of a long-lie or worsening health. Felber et al. (2023) conducted a systematic review that explored ethical issues related to using technologies to support older people in the home and found that some older adults feared that technology would replace human interaction and increase isolation. Whereas other studies in this review by Felber et al. (2023) highlighted the value of technology for socialising and building relationships.

Socioeconomic factors also pose barriers to independent living. Research has shown that factors such as low income, limited education and unemployment increases the risk of falls (Megalla et al., 2023). Low socioeconomic status has also been associated with older adults' loneliness, and while reasons for this are unknown (Fawcett & Karastoyanova, 2023), one study suggests that individuals with fewer financial resources are restricted in initiating and maintaining social relationships due to costs associated with transportation and participating in social activities (Wu et al., 2022).

1.4. Telecare use in older adults

1.4.1. The policy context: telecare as the solution?

Technology has the potential to support older people to live independently. There are a wealth of different technologies aimed at supporting older adults, including telecare, telehealth, mobility aids, telemedicine, telephone support and digital health (Greenhalgh et al., 2012), collectively referred to as Technology Enabled Care Services (TECS) (NHS, n.d.). Telehealth refers to the remote medical monitoring of individuals in their residences, as described by Greenhalgh et al. (2013). This includes monitoring vital signs such as blood pressure following a stroke and serves to encourage self-care while enabling distant patient monitoring (Greenhalgh et al., 2013). In comparison, digital health encompasses a broader range of technologies aimed at improving general health outcomes and healthcare delivery, including the use of mobile health (mHealth) apps, wearable devices, telehealth and telemedicine and utilising digital data to provide more preventative and personalised care (Giansanti, 2022). Digital health technologies are internationally recognised to support health and well-being, with the WHO, and supranational entities in Europe and America aiming to promote the adoption of such technologies to enhance the delivery of healthcare and improve diagnoses and treatment of disease (Giansanti, 2022). Telecare overlaps with telehealth and digital health, as reflected in the umbrella term 'Technology Enabled Care Services'. Telecare, within the context of other digital technologies, encompasses the use of technology to deliver support remotely, particularly to individuals with health or social care needs.

Since 1998, the UK government has produced 25 reports on advocating technology use in care, and between 2006-2012, over £160 million of government funds was invested to support technology uptake in health and social care (Barlow & Hendy, 2009). Telecare in particular has been recognised by the UK Government as potentially useful in tackling a number of health sector challenges by shifting the provision of care from hospitals to monitoring health status at home. Telecare is purported to promote independence, enhance self-management (Barrett et al., 2015), and contribute to disease prevention by providing support in emergencies.

1.4.2. Telecare definitions and origins

Telecare devices are remote care technologies, used to support safe and independent living (Barrett et al., 2015). Telecare definitions vary across the literature, although one widely accepted description by Brownsell & Bradley (2003) is: *'the continuous, automatic and remote monitoring of real time emergencies and lifestyle changes over time in order to manage the risks associated with independent living'* (p. 18). Telecare as known today originated from social alarm devices, which facilitate communication with a responder to support a person's well-being. Social alarm services were used primarily within sheltered housing, a specific type of housing run by local authorities designed to support older people, or people with additional care needs to live independently (Fisk, 2003). Social alarms, as described by Fisk (2003) include hard-wired technologies in a person's home, typically call systems in sheltered housing, or dispersed alarms, which include care phones (alarm devices that use a public telephone system) and radio units. Generally, when activated, social alarms facilitate communication with a responder. Social alarm systems in sheltered housing link the user to a warden or another contact who can provide support in the event of an emergency (Fisk, 2003). The use of social alarms in sheltered housing links directly with political agendas in providing suitable housing options that meet the needs of older people (Local Government Association, 2022), which is in response to the increasing number of older people in the population. By providing accommodation with on-site support services such as social alarms, sheltered housing helps older adults access the care they need while reducing pressure on health and social care systems and potentially

reduces the need for higher levels of social care. Social alarms are established in many places around the world, including Europe, Australia, New Zealand, Canada, and the United States (Fisk, 2003).

Telecare technologies were developed by building on the knowledge of social alarms. Although definitions of telecare vary, Fisk (2003) describes the term “telecare” as including support services which take place in an individual’s home, rather than in a clinical setting. Telecare technologies collect behavioural and environmental data, which can be used to facilitate remote recognition of critical situations and response. Telecare devices have evolved, giving rise to different characteristics of telecare services used within the UK and internationally. As described by Turner & McGee-Lennon (2013), the first generation of telecare mainly built on the knowledge of social alarms and provided services that signalled a call centre for help (for example, a personal alarm). As technology developed, telecare devices allowed more automated responses based on data collected from sensors, including automatic fall detectors, bed and floor sensors and smoke and flood detectors (Turner & McGee-Lennon, 2013). Newer technologies aim to provide additional support with lifestyle monitoring through the use of wireless technology, connecting users to a virtual network of health and social care professionals’ technologies (Turner & McGee-Lennon, 2013; Brownsell et al., 2008). These technologies can include ambient sensors which measure individual behaviour and report data back to health and social care professionals. It can also include devices that connect the user into a wider care network. Telecare often focuses on supporting social care at home, including monitoring for harmful situations such as having a fall. Telehealth on the other hand refers to remote support of health care at home, which may include remote consultations with healthcare providers, and monitoring vital signs (Turner & McGee-Lennon, 2013).

In the UK, telecare devices are commonly characterised by personal alarms or monitoring systems (NHS, 2022). Types of personal alarms that are used in the UK include alarms that alert a family member’s phone, monitored alarms which are associated with a 24-hour monitoring service, fall detectors and GPS tracking alarms (NHS, 2022). Types of monitoring systems that are used in the UK include systems that are connected to a monitoring centre,

and detect movement, doors opening, flooding, smoke, gas and appliances being used or that have been left on (NHS, 2022). Historically in North America, telecare use stemmed from using personal response systems and services (PRS), which provide response in personal medical emergencies (Fisk, 2003). Such systems originated mainly from the private sector to reduce healthcare costs (Fisk, 2003). Internationally, telecare users are now growing, with providers like Tunstall having a strong presence across Europe, Asia-Pacific, and North America (Tunstall, 2024). Tunstall provide monitoring services, personal alarms, and fall detection technologies, to help support independence in older people.

The majority of telecare users in the UK utilise first generation pendant alarms, despite recent technological advances as described by Barrett et al. (2015). As a result, telecare technologies are often associated with pendant alarms. However, as discussed previously, there are a variety of telecare devices with differing services available. Nevertheless, most telecare devices have common characteristics in the support offered. The Centre for Ageing Services Technologies report three domains of services offered through telecare; 1. safety, 2. health and wellness and 3. social connectedness (Alwan et al., 2007). According to Alwan et al. (2007), safety refers to reducing risk-related situations by monitoring the person and/or the environment. For example, telecare devices monitor an individual's movements to detect a fall. Ensuring safety at home may contribute to peace of mind and foster a sense of security. Health and wellness is the second domain, and refers to supporting self-management of a chronic condition or general well-being (Alwan et al. 2007). There is a growing literature on how technology can support self-management (Davis et al., 2020; Lukkahatai et al., 2020), although most of this research refers to telehealth and telemedicine, where users can monitor vital signs such as blood pressure or glucose levels. However, more general monitoring of ADLs, or a person's movements in the home is offered by telecare, which may enable detection of changes in health and wellness over time (Turner & Mcgee-Lennon, 2013). Providing social connectedness is the third domain, where the devices facilitate communication between social care/telecare staff, and caregivers, to provide a sense of connection to a wider social support network (Alwan et al. 2007).

1.4.3. Telecare implementation in the UK

In the UK, the majority of telecare devices are provided through local authorities, with a small proportion supplied by registered social landlords or private sector suppliers (Bentley et al., 2018). Older adults may be referred to telecare services in response to a significant event that may impede their independence, for example after having a fall or a decline in cognitive or physical health, following discharge from hospital, or bereavement (Bentley et al., 2018; Hamblin et al., 2017). An individual's needs are assessed by a telecare provider or social care provider in order to match an appropriate telecare device that will benefit the user. However, the devices available to older adults are limited by the technologies commissioned by local authorities, or offered by the provider (AKTIVE Consortium, 2013). Telecare will then be installed in the older adult's home, and the telecare staff will explain to the user how the telecare device works, and how to use it (AKTIVE Consortium, 2013). An estimated 1.6 million older adults currently use telecare in the UK, with the majority of users living in their own homes, rather than institutional settings (GOV.UK, 2022). Telecare is purported to make a significant contribution to supporting the health and well-being of older people and is promoted by policy discourse (AKTIVE Consortium, 2013). However, the evidence supporting telecare effectiveness is mixed, as the next section of this chapter explores in further detail.

1.4.4. Main drivers for telecare development in government policy and the evidence

The aim of telecare is to enable older adults to live independently without compromising their health and safety. This section will explore the political drivers for telecare development and the literature on how telecare can support independence, health, and well-being in older adults.

Drivers for telecare development in government policy

There has been long standing interest from UK policy makers in investing in telecare projects, with the Department of Health announcing a Preventative Technology Grant for English local authorities for telecare investment in 2006 (Department of Health, 2006). The key drivers behind this investment were to extend the length of time that older people could live independently at home and to reduce the cost of care (Wright, 2020). The UK

Government wished to move away from institutional care and towards support in the community through utilising telecare, contributing to both health and social care agendas, and also housing agendas. Among policy makers, there was high optimism about the impact of telecare on health and social care, resulting in an investment of £80 million in telecare to local councils in England between 2006-2008, originating from the Preventative Technology Grant (Wright, 2020). This investment triggered the launch of the Whole Systems Demonstrator (WSD) programme, to better understand the impact of telehealth and telecare on health and well-being, which is detailed later in this section. Additionally, the potential for cost reduction may have been another driver for telecare development. In 2016-17, a survey on telecare implementation across English Local Authorities (LAs) telecare staff was conducted and found that nearly half (47%) of adult social services directors saw telecare as a potential alternative to social care, while 97% regarded it as useful to postpone and reduce the need for care and support (Woolham et al., 2018).

Examples of current government policies and agendas that may underpin telecare use in housing and social care contexts include (i) the Care Act (2014) (Legislation.gov.uk, 2014), which emphasises the importance of promoting individual well-being and independence, (ii) the NHS Long Term Plan (NHS, 2019), which highlights the use of technology in supporting individuals to live independently for longer, and (iii) the Department of Health and Social Care white paper on 'People at the Heart of Care: adult social care reform' (GOV, 2022) which sets out a policy to commit at least £150 million of funding to drive technology adoption across social care, including telecare and other assistive technologies, to support independent living and improve care.

Whole Systems Demonstrator (WSD) and Delivering Assisted Living Lifestyles at Scale (DALLAS)

Following the political interest in telecare in the early 2000s, evidence began to emerge on telecare effectiveness in supporting the health and well-being of older adults (AKTIVE Consortium, 2013). One of the most significant studies conducted was the Whole Systems Demonstrator (WSD) project, which was launched in 2008 and funded by the Department of Health. The WSD programme remains the world's largest randomised control trial (RCT)

investigating telecare effectiveness and cost effectiveness (Bower et al., 2011). The programme aimed to provide robust evidence on the impact of telecare in promoting well-being and independence, improving peoples' quality of life, and being clinically effective and cost effective.

In this trial, 2,600 people with social care needs were recruited from General Practices across three areas in England and were randomly assigned to receive telecare or not (Steventon et al., 2013). The main outcome measures were admissions to hospital within 12-month, mortality, and other health care service use (contact with general practitioners (GPs), and weeks receiving domiciliary care). The Department of Health expected positive health results from the telecare trial (Stirling & Burgess, 2020). However, the trial concluded that telecare did not prove to be a cost effective addition to usual care (Henderson et al., 2014) and it did not lead to significant reductions in health service use (Steventon et al., 2013). In contrast, a second study within the WSD programme investigated the impact of telecare on psychological well-being and health-related quality of life (HRQoL) and reported small beneficial effects on mental HRQoL (usual care group reported a mental health score of 40.52, compared to 43.69 in telecare users, $p < 0.05$), which was suggested to be the result of increased perceptions of safety and security in telecare users (Hirani et al., 2014). No significant effect on anxiety was observed in this study, despite the potential motivation for using telecare being to reduce anxiety by providing reassurance of safety (Hirani et al., 2014). Regardless of the mixed and modest findings, the WSD was used by policy makers to promote and encourage telecare use. Of note, the WSD trial itself had shortcomings, despite being used as evidence of telecare effectiveness. Due to the nature of the research design (RCT), the trial focused on effectiveness and cost-effectiveness, and did not include issues around user experiences, or ethical considerations, which have been highlighted as important issues regarding telecare use in the literature (Mort et al., 2013; Greenhalgh et al., 2013). Further critical comment alighted on the lack of qualitative data in this trial (Eccles, 2020a), which limited exploration into wider implementation strategies and learnings around best practice.

In response to the shortcomings of the WSD trial, the government funded a later programme called the Delivering Assisted Living Lifestyles at Scale (DALLAS). The DALLAS programme delivered a broad range of digital health technologies to individuals between 2012 and 2015, including preventative and proactive technologies, which used individual's data to provide more personalised digital tools (Devlin et al., 2015). Technologies included digital portals, telecare, and person-centred mobile apps. A mixed methods evaluation of the digital technologies was conducted. This programme arguably moved beyond the limitations of the RCT focused WSD, by using qualitative methods to explore the complexities of delivering telecare, rather than just investigating on clinical effectiveness and cost effectiveness. A study from the DALLAS programme highlighted key challenges in implementing digital technologies, including maintaining multi-agency partnerships (between the NHS, local authorities, and technology organisations) to deliver digital technologies within healthcare, and enabling data sharing between services to allow for customisation of technologies to suit end user's needs (Devlin et al., 2015).

Health care use

Telecare evaluations have demonstrated mixed results regarding the impact of telecare use on health care use. A study used longitudinal data in Northern Ireland involving more than 2000 people using telecare and observed health care service use for 6 months before and after telecare installation (Al-Obaidi et al., 2022). Contrary to expectations, the findings reported an increase in non-elective hospital admissions, accident and emergency (A&E) visits and length of hospital stay (Al-Obaidi et al., 2022). This was suggested to be due to the increasing health needs of the observed population. In contrast, another study evaluated the Scottish Telecare Development programme by investigating hospital discharge over a 1-year period (2007-2008) (Beale et al., 2010). The findings suggested that within a one-year period, more than 500 delayed discharges were avoided by telecare use, which saved more than 5000 bed days. Furthermore, the study estimated that 1,200 emergency admissions were avoided, saving an estimated 13,000 bed days (Beale et al., 2010). A key disadvantage of these studies was that there was no control group available to use as a comparison, so causality cannot be inferred between telecare and the hospital

outcomes. Another disadvantage of these studies is that they did not explore any differences in hospital admissions among older adults with differing levels of health. For example, the studies did not distinguish any differences in health care usage in people with frailty or high falls risk, compared to healthy older adults.

Reducing falls

Using telecare to detect falls is a widely researched area, with many reviews reporting that telecare and monitoring technology can help detect and prevent falls (Nguyen et al., 2018; Rucco et al., 2018). Given the extensive literature in this area, Warrington et al. (2021) conducted a review of systematic reviews on the effectiveness of telecare devices for preventing falls. This study showed that wearable devices for fall detection are an effective, low-cost option for detecting falls and enabling older adults to signal for help at home (Warrington et al., 2021). However, the studies included in this review were mostly conducted under controlled settings. Another systematic review exploring the use of telecare devices in older adults reported similar findings, where only 7% of studies investigating telecare effectiveness in preventing falls were conducted in a real-world setting (Chaudhuri et al., 2014), demonstrating a need for further research in this setting.

Telecare impact on independence and well-being

Studies exploring the perspectives of older adults about using telecare devices report a mix of attitudes towards the technology (Charlton et al., 2017; Percival et al., 2009). Research has shown that some older adults are favourable to using telecare in order to stay at home and find that devices help promote well-being by providing a sense of security, reducing fear of falls and increasing confidence (Stewart & McKinstry, 2012). On the other hand, studies have also highlighted older adults' concerns about telecare and monitoring technologies, where some individuals found devices to be an invasion of privacy (Birchley et al., 2017; Karlsen et al., 2017). Issues with technological acceptance have been highlighted (López & Domènech, 2008), which could impede the effectiveness of telecare in detecting or preventing falls.

Telecare is considered by social services and policy makers as enabling autonomy by supporting older adults to self-manage virtually (López & Domènech, 2008), and potentially reducing the need for hands on care. However, studies exploring telecare users' perspectives on autonomy present mixed feelings (Percival et al., 2009). For some older adults, telecare enables individuals to feel that they have control over their home environment (López & Domènech, 2008), which may improve their well-being. On the other hand, some studies have shown that older adults may feel ashamed to use monitoring technology, as it may make them feel frail or needing assistance (Pirzada et al., 2021). Stigma has been highlighted as a barrier to telecare use, where older people view telecare as suitable for only frail vulnerable people. When older adults feel a lack of control over their life, and reduced autonomy and choice, this may impede the identity of an independent person, leading to reduced well-being (López & Domènech, 2008).

As telecare is designed to provide technological support to older adults with social care needs, the devices may have unintended consequences on social contact. Whilst some evidence argues that telecare increases autonomy and greater independence (López & Domènech, 2008), other studies discuss the potential for telecare to increase social isolation (Eccles, 2010b), and potentially increase the risk of loneliness and depression (Wu, 2020). Similarly, Percival & Hanson (2016) report concerns from some older adults about the possibility for telecare to reduce social contact, and subsequently increase the risk of social isolation and loneliness. Given that during the COVID-19 pandemic, older adults were exposed to increased levels of social isolation (Harden et al., 2020), and at risk of experiencing loneliness and subsequent negative mental health impacts (Latikka et al., 2021), ensuring social support is maintained and not reduced through telecare use is a necessity for promoting health and well-being.

A common approach in telecare evaluations has been to implement a telecare device in a 'plug and play' manner to a diverse population and expect the same outcomes without considering individual needs (Greenhalgh et al., 2013). Nevertheless, literature exploring the perspectives of telecare from older adults demonstrates differing opinions towards the technology, suggesting that a 'one size fits all' approach may not be appropriate

(Greenhalgh et al., 2015). Despite differing needs, the most commissioned telecare device by UK local authorities continues to be a pendant alarm (Barrett et al., 2015). The lack of variety in telecare technologies offered may limit the number of people that could benefit from using telecare.

A recent report by NIHR stated that older adults want further support with maintaining independence (NIHR, 2023a). In a report on exploring the unmet needs of older people, participants expressed their desire to avoid hospitalisation, but they also felt that more proactive support and early interventions were needed to support independence and daily well-being (NIHR, 2023a). The report concluded that further research is needed to *'explore the value and relevance of health technologies and models of care for prolonging independent living and wellbeing'* (NIHR, 2023a, p. 13). Extending choice to social care users has been a key component of the personalisation agenda, set out by the previous Labour Government in 2007 (Rabiee, 2013). There is a need to explore the value of other telecare devices, that can offer proactive and early support to older adults.

1.5. Proactive telecare

1.5.1. Proactive telecare definition

Contreras et al. (2022) describes Tunstall's different levels of telecare services, framed in Figure 1.

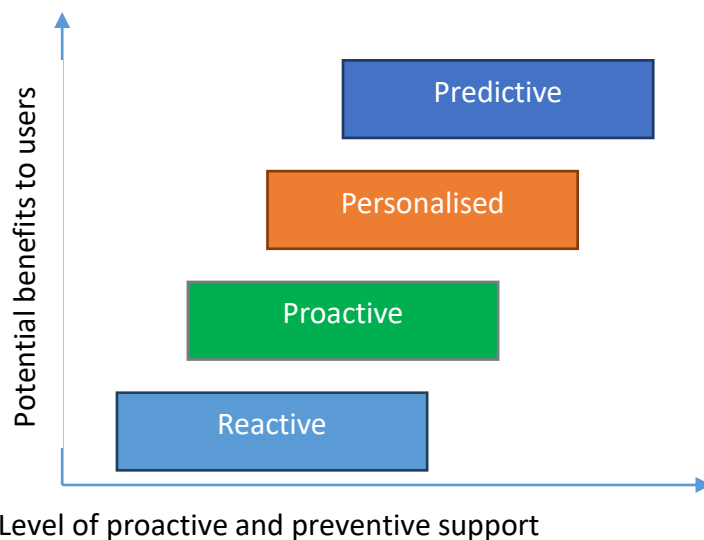


Figure 1. Different levels of telecare (Contreras et al., 2022).

Tunstall's four levels of telecare are also described in the Farr Point report (2020). The levels suggest that at the core of most telecare services is 'reactive' telecare, which provides support to individuals in an emergency through detection of unusual behaviour via sensors or via a pendant alarm (Contreras et al., 2022). Many telecare services in the UK operate with 24 hour staffed response centres, which can be accessed through technologies such as a fall detector, pendant alarm, or environmental sensors such as bed and chair sensors.

Proactive telecare extends this support by offering services to reduce occurrence of emergency situations. Services offered are broad but can include outbound calls (from telecare providers to users), follow ups, and information and advice. Personalised telecare uses data to respond to specific needs of the user, and predictive telecare goes further by providing data-driven insights to provide early indications of potential issues. However, the majority of telecare services available tend to be more reactive, where the verbal contact with a user is established when a person presses a button on a pendant or other device to indicate that they need help. Contreras et al. (2022) argues that there are key differences between the different levels of telecare; however, it could be argued that there is overlap in reactive and proactive services, and telecare devices that could be described as 'reactive', such as pendant alarms, pull cords, or bed/chair occupancy sensors do possess proactive elements in the service offered. For example, these services may conduct personal assessments, review a person's needs and preferences, ensure emergency contacts are up-to-date, make birthday calls or check in on a user after a period of illness. Installing a pendant alarm or fall detector could be perceived as a proactive action, as it is providing support in case of an emergency before it happens, i.e. if someone were to experience a fall, then they can call for help by using their pendant alarm. For this thesis, it is acknowledged that there is overlap in the support offered, and this thesis does not argue that different levels of telecare are vastly different. However, it is acknowledged that some telecare devices can offer more arguably proactive and preventative support than others. More proactive telecare devices may offer speech contact to check if users are ok, regardless of if there is an emergency or not. Some devices encourage users to confirm their well-being, to check-in if the person is OK, rather than waiting for a user to need help.

One of the main actors in this field is the Technology Enabled Care Services Association (TSA) (TSA, 2024), the main industry body for telecare and telehealth in the UK, which lobbies government on issues of technology in care, and operates a quality standards framework certification scheme. Its key functions include (i) advocating for the interest of its members and the telecare/telehealth industry, (ii) promoting standards of excellence and quality assurance, (iii) education and training opportunities for the technology-enabled care sector and (iv) promoting research and innovation in the sector, to enhance independence and well-being of users. The TSA represents over 370 organisations, including telecare companies, housing associations, charities, and government bodies.

When the TSA was first established around 30 years ago (previously known as the Association of Social and Community Alarms Providers) (Fisk, 2003), the typical service offer was a lifeline service, offering mostly reactive services in the form of a social/pendant alarm. Currently, similar technologies continue to be the most used. As described by the TSA, telecare acts as a 'crucial safety critical service, albeit in a reactive capacity in the vast majority of cases; in its current form' (TSA, 2023, p. 5). As technology has developed, the TSA now promotes more proactive and preventative services in their quality standards framework, to prevent the crisis from happening in the first place through using monitoring technologies, smart speakers and video devices, mobile devices and apps (TSA, 2023). The TSA recognises that reactive telecare services may add proactive elements into their service, going through an evolutionary journey to becoming more proactive and preventative. Some proactive elements recognised by the TSA are making scheduled well-being calls, providing health and well-being information to users, and utilising data to supporting individuals' health and well-being (TSA, 2023). For example, one TSA member called Ethel Care provide a tablet to users, which offers services such as check-ins, a facility to request well-being calls, and exercise videos (Ethel Care, 2023). Ethel Care also monitors vital signs and utilises technological elements that are aligned with telehealth interventions. Given the evolutionary nature of some of these technologies, proactive and preventative services may vary across different services. Telecare services are starting to utilise data collected to offer a blend of reactive and proactive services. Indeed, the TSA are developing

future models that combine proactivity elements to provide more personalised support (TSA, 2023). However, as recognised by the Farr Point report (2020), there is a need for a better understanding of the impacts of using proactive telecare on health and well-being (Farr Point, 2020).

Previous discussions in this thesis have described that more reactive telecare may not be suitable for everyone, as some older adults view this type of technology to be invasive (Berridge, 2017), disempowering (Mort et al., 2015), and associated with ageism (Sanders et al., 2012). Subsequently, reactive telecare is frequently perceived by older adults as a final option (Bentley et al., 2018), rather than a tool capable of actively promoting independence, health, and well-being. There is increasing recognition that telecare may offer greater potential in supporting health and well-being, by taking a more proactive approach. The focus of this research will be exploring the value of taking a proactive approach within the context of telecare.

The COVID-19 pandemic accelerated interest in increasing the availability, accessibility, and acceptability of digital technologies (Kickbusch et al., 2021), to improve the quality of health and social care services. In an attempt to make digital technologies more attractive to a larger audience, suggestions have been made to make more proactive, preventive, and personalised technologies that could help manage public health problems in a more effective way (Kickbusch et al., 2021). This has influenced the acceleration of research into proactive telecare.

There is no established definition of proactive telecare in the literature, which may be due to the evolutionary nature of this technology. Contreras et al. (2022) refers to proactive telecare as retaining aspects of reactive telecare by offering aid in an emergency. However, it extends to an integrated programme of outbound calls, follow ups, and proactive support to offer broader support. In 2020, a Farr Point report conducted a review into proactive telecare services and adopted the following definition of proactive telecare: *'Support to maintain or improve a person's health and wellbeing, or to anticipate and prevent crises, provided using an outgoing call made to a person's home (or home-like setting). Outgoing*

calls are made regularly based on a person's choice, or in response to a need or another trigger event. (p.3.)' (Farr Point, 2020). This Farr Point report recognised that outgoing calls and well-being checks have a loose definition, which encompasses different types of proactive telecare services, including services that encourage users to confirm their own well-being, through pressing a button for example, and services that make outbound calls to service users regularly at an agreed time. As a result, a broad range of technologies with differing elements were recognised by this Farr Point report (2020) as being 'proactive'. This report by Farr Point grouped services provided by proactive telecare services as (i) supporting independent living, (ii) promoting health and well-being, and (iii) reducing loneliness through increased social contact (Farr Point, 2020). Based on Farr Point's work and description of proactive telecare, Figure 2 summarises proactive telecare service offerings to service users.

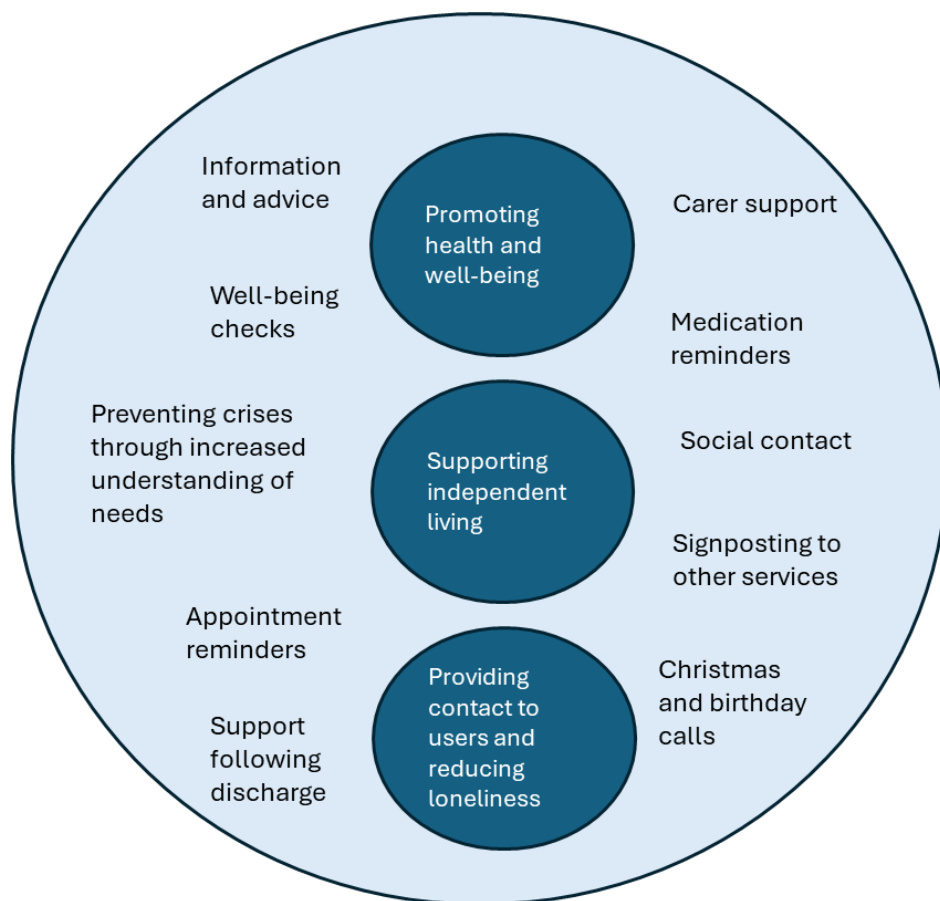


Figure 2. Potential services offered by proactive telecare services, based on the work of the Farr Point report (2020). Key potential benefits are highlighted in dark blue.

To encompass a broad range of services that could be defined as proactive telecare, this doctoral research defines proactive telecare as *'providing regular well-being calls or encouraging users to regularly confirm their well-being, with the aim of anticipating and preventing crises through an increased understanding of individuals' needs and building social relationships with older adults'*. Although the Farr Point report definition of proactive telecare did not include services that encourage users to confirm their well-being in their short definition, the report recognised proactive services that offered users to confirm their own well-being as proactive telecare and accepted that these kind of well-being checks can also be considered as proactive. The key definition point of proactive services is a device that offers a well-being check, so checking if someone is OK, whether that is initiated by the user (by confirming their well-being through a digital system) or achieved through an outbound well-being call (call centre staff calling a user). Although other telecare technologies such as pendant alarms and fall detectors have proactive elements to them, the definition used for this thesis excludes pendants, fall detectors, and monitoring care services that use devices in the home to monitor a person's wellbeing passively, without having the user engage with the system to confirm that they are OK.

There are existing examples of proactive telecare in the UK, but services vary in the support offered. For example, Bield and Wheatley Care (Property Management Services) check the well-being of residences using Jontek Answerlink and Alertacall systems respectively (Farr Point, 2020). Users respond by pressing a button on a phone or answering a call. Proactive services that encourage users to confirm their well-being are also seen internationally as described in the Farr Point report (2020), for example in the United States of America (USA), a service called the Senior Call Check Program offers a daily automated wellness check call and if a person fails to answer, their nominated contact is alerted. In contrast, some services focus on reducing loneliness, for example the Good Morning Service, a non-profit organisation, provides telephone befriending to around 350 older people in Glasgow and South Ayrshire by calling service users 3-4 times a week (Farr Point, 2020). A critique of

services that offer a non-speech element, like Alertacall, which involves pressing a button to confirm well-being, is that it can be considered a 'hands off' approach to conducting well-being checks and offers the service user a passive option to engaging with the technology, in just pressing a button to confirm their well-being. This passive option may reduce the capacity to support to maintain or improve a person's health and wellbeing, as it provides little opportunity to engage with the service user and obtain information about their health and wellbeing. However, technologies such as Alertacall arguably are still proactive, as the service user is confirming that they are OK, instead of calling for help in a reactive manner. Also, there may be benefit in offering a more 'hands-off' proactive service, as it may suit some people who do not wish to have a conversation with someone regularly. Moreover, there may be benefit in the service user taking ownership over confirming their well-being. Alertacall also offers the opportunity for a conversation, if the user wishes too.

As summarised in the Farr Point report (2020), various proactive telecare technologies are provided in Europe, North America, Asia, and Australia. However, there is a need for better understanding about the impact of these proactive technologies on health, well-being and independence, which provides the rationale for exploration into this area.

1.5.2. Rationale for exploring the value of proactive telecare.

Having regular engagement with older adults may facilitate early identification of needs and subsequently, act as an early warning system. This preventive approach may enable individuals to gain personal resources or receive appropriate health and social care at an earlier stage, rather than waiting for further deterioration through reactive monitoring. Moreover, encouraging older adults to proactively confirm their well-being may elicit a sense of control, and support autonomy and self-management.

Proactive telecare may provide additional social support that cannot be offered through reactive telecare. Harden et al. (2020) describes that as older adults experienced heightened levels of social isolation during the pandemic, some may have found solace in additional daily contact. Indeed, there is evidence to suggest that older adults became more familiar with using technology to support their health and well-being during the COVID-19

pandemic, through using technology to monitor their health (Reyes et al., 2023), or using telephones and computers to keep in contact with family and friends (Sixsmith et al., 2022). This suggests that technology such as proactive telecare might be well placed to provide older adults with social support. Research in this area is growing, with Cund and colleagues producing a report on their research, which involved conducting an independent evaluation of proactive telecare services in three pilot test sites in Scotland for 6 months (Cund et al., 2021). The proactive telecare systems differed between the three sites, but all involved well-being calls. Qualitative interviews were conducted with users, staff, and providers to understand the needs of users and their experience of using proactive telecare. Findings from the interviews suggest that well-being calls had a positive impact on users' mental health. However, this research is still in phase 1 of evaluation and is yet to be published in academic journals; to date, only a conference abstract on this study has been published (Cund et al., 2022). Further phases of the evaluation are incomplete/ or have not been published yet. More generally, the 2019 Farr Point report highlighted that there is *'limited existing evidence available that quantifies the benefits of proactive telecare services'* (Farr Point, 2020, p. 33), despite its existing use in the UK and internationally (Alertacall, 2023; Farr Point, 2020).

There are key uncertainties regarding the potential of proactive telecare for supporting older adults to live independently, and its value in promoting health and well-being. As previously discussed in this thesis, older adults' perceptions of independence can vary among individuals, and views towards using telecare are mixed. Given this, it is not clear *who* proactive telecare would be suitable for, whether it would be acceptable or not, and what aspects of health it may help support. Key areas of interest to explore in this doctoral research is understanding what impact a proactive telecare system could have on health, well-being, and independence, previously defined and established in this chapter. According to Clarke et al. (2019), the impact of an intervention can be defined as a *"positive or negative, direct or indirect, and intended or unintended change produced by an intervention"* (p. 1). This research aims to contribute to the literature, by exploring the

potential impact of proactive telecare on supporting independence, health, and well-being in older people.

1.6. Research setting: the proactive telecare service of interest

To gain insight into the potential impact of a proactive telecare service in supporting and promoting independent living, an existing intervention was chosen as an example for the research setting. A service called OKEachDay® was chosen as a focus point due to its known longstanding use across the UK. OKEachDay is run by the organisation Alertacall and is recognised by the Farr Point report as a proactive telecare service (Farr Point, 2020). Using OKEachDay as an example enabled investigation into the potential benefits and limitations of proactive telecare, which may translate across other technological interventions which promote proactive engagement. Since the service has been operating since 2004, the researcher was able to obtain secondary data of service use from the OKEachDay organisation and explore the experiences of longstanding users to gain deeper insights into the potential benefits of this intervention. This is an advantage over other studies which focus on evaluating telecare use over a short period of time.

OKEachDay is a proactive telecare service used in Britain, provided by a company called Alertacall (Alertacall, 2023). Alertacall is based in the Northwest of England and provides its services to over 15,000 individuals, including older adults (people aged 65 and over), people with learning disabilities, people with chronic health conditions or mental health conditions, or people staying in emergency accommodation. Although this service is available to a wide population, the focus of this thesis is to understand whether this proactive telecare service can improve independence in older people, and so, just older adults using this service were included in this research. This intervention is predominately provided by housing associations and utilised in sheltered housing; however, a small proportion of users pay for the service privately. The focus of this research was to understand the impact of the intervention, rather than evaluating the setting; therefore, older adults living in both housing association and private accommodation were included in the research.

The primary aim of this proactive telecare service is to provide daily well-being ‘check ins’ and to offer human contact to older adults. The device consists of three buttons; (i) an ‘I am OK’ button, used to confirm that the individual is safe, (ii) a customer service button to speak to a member of the call centre and (iii) a contact button to write messages to/receive messages from the service team. At the start of this doctoral research, two devices were offered including a portable touchscreen device and a telephone device with accessible large buttons (Figure 3).



Figure 3. Image of the OKEachDay devices; tablet device (on the left) and the telephone device (on the right).

When a service user adopts the intervention in their residence, the proactive telecare staff first agree a time with the user to confirm their well-being, once a day, or as often as desired (although approximately 90% of older adult users press their OK button once a day). Confirmation is made by pressing an ‘OK’ button or otherwise receiving a call from the specialist team at a chosen time, who are available every day of the year. The user can press their OK button up to six hours *before* their agreed time to press. An automated reminder is played through the device as a prompt fifteen minutes *before* the agreed time to press the button, if the user has not pressed it yet. If the ‘OK’ button is not pressed within fifteen minutes *after* the individual’s agreed time, the team will attempt to

contact the user multiple times to confirm the user's well-being, and to offer the opportunity to chat. If contact cannot be established, the call is escalated to the user's chosen nominated contacts, often family or friends. In the 'worst-case' scenario where nominated contacts cannot be contacted; emergency services are called if staff believe there are critical risks to the user. If the user has been admitted to hospital, proactive telecare staff will make a note of the date of admission to hospital as an inpatient, and subsequently pause the user's account. Staff acquire knowledge about hospital admissions through communication with the user's nominated contact, or through contacting local hospitals. Once the user has returned home, staff record the date that the individual returned home and activate the system again. Additionally, older adults can contact staff to set up reminders through the OKEachDay device, i.e. for hospital appointments or taking medication.

Separate to the proactive well-being check, users can also organise an additional well-being call, from once a day to once a week, if they wish. Call centre staff do not limit calls or restrict the time given to users to chat, which is a different approach to call centres for pendant alarms, where staff often do not have the capacity to offer social interactions (Percival & Hanson, 2016). Staff are given awareness training to provide low level psychosocial support for older adults. Training includes topics on supporting emotional needs, mental health awareness, suicide awareness, discrimination and domestic abuse, dementia awareness, learning disabilities awareness and safeguarding. Staff will signpost individuals if the issue goes beyond their knowledge or ability to help. Staff also send out Christmas and birthday cards to users.

This Alertacall service can be regarded as *untypical* of UK telecare services, as the most common telecare service provided in the UK is a pendant alarm (Bentley, 2015), which offers 24-hour monitoring and response services. OKEachDay may also be considered as a *specific* example of proactive telecare, as it encourages users to confirm their well-being, and offers the choice of engaging in a well-being chat with proactive telecare staff, giving users a degree of control. Therefore, the findings from this PhD thesis may not be generalisable across other types of telecare, or other types of proactive telecare. However,

this research will help to better understand the benefits of proactive well-being checks and providing users access to low-level psychosocial support.

The TSA Quality Standards Framework describes the norms of telecare provision to include 24/7 monitoring and response services, to ensure timely emergency assistance and intervention when needed (TSA, 2024), which diverges from the offering from OKEachDay, as this does not offer 24-hour support, which is a recognised limitation of this service as users may not be able to obtain help outside of Alertacall's working hours. In practice, Alertacall offer pendant alarms alongside OKEachDay for those who wish to use one, but the pendant alarms are a commissioned service and not owned by Alertacall. This research did not focus on the impact of the pendant alarm, it focused on understanding the impact of the OKEachDay service, despite the lack of 24-hour support. Although Alertacall diverges from the norms of telecare provision including for those practice norms associated with the TSA's Quality Standards Framework (24-hour monitoring and response services), Alertacall is a member of the TSA, and the TSA promotes more proactive telecare services to reduce crisis events from happening. Therefore, research which investigates the potential benefits of offering more proactive telecare services, may be useful for developing telecare services in the future.

Although Alertacall does offer pendant alarms, it is a stand-alone service, which makes it different to other telecare technologies that also provide 24-hour response. There are clear disadvantages to this approach as previously described; however, the Farr Point report highlighted that organisations who offer telecare services are interested in proactive services being offered as a standalone telecare offering as a reassurance only service, without other telecare technology (Farr Point, 2020). This research aims to explore the potential benefits of offering this particular stand-alone proactive service to older adults, which may provide better understanding to telecare providers on the potential benefits and challenges in offering a stand-alone proactive service.

Given that older adults are not a homogenous group and have differing needs and contexts, proactive telecare has the potential to serve a wide population. Proactive telecare may

provide a flexible and scalable intervention that can be utilised as much or as little as required by the individual. However, there needs to be a better understanding into the impacts of proactive telecare on health, well-being, and independence.

1.7. Relevant theories, models, and concepts

To understand how using a proactive telecare service could help support independence, health, and well-being, the researcher drew upon existing theories, models, and concepts to gain initial knowledge of important factors of ageing well and strategies used by older adults to age successfully.

1.7.1. Successful ageing

Successful ageing is an important concept which describes the quality of ageing, and focuses on how to extend healthy and functional years for the ageing population (Urtamo et al., 2019). The term ‘successful’ has been contested within gerontology, as it suggests that individuals who do not age successfully are ‘unsuccessful’, portraying an arguably unachievable goal of being a ‘successful ager’ (Katz & Calasanti, 2015). This has generated alternative terms such as ‘healthy ageing’, ‘positive ageing’, and ‘ageing well’ to promote a more positive characterisation of the ageing process. Nevertheless, successful ageing still holds a significant position in gerontology. One of the most prominent definitions of successful ageing was established by Rowe and Kahn, where they describe three key components: (i) low probability of disease and disease-related disability, (ii) high cognitive and physical functional capacity, and (iii) active engagement with life (Rowe & Kahn, 1997). Although Rowe and Kahn highlight the importance of the absence of disease and disability, other studies have suggested that people with chronic disease can also age successfully (Nosraty et al., 2015; Pruchno & Wilson-Genderson, 2015). Of note, Rowe and Kahn’s model of successful ageing mainly focuses on physical indicators of ageing, whereas other studies have shown the importance of psychological and social factors of ageing (Baltes & Carstensen, 1996; Kim & Park, 2017). According to Kim & Park (2017), successful ageing not only includes promoting physical health, but also includes psychosocial factors such as being socially active, good life satisfaction and a positive perception of ageing.

Previous discussions in this thesis have highlighted broad dimensions of health including physical, psychological, and social factors, which aligns well with a broad concept of successful ageing. Therefore, this research defined successful ageing to include both physical and psychosocial factors for a more holistic view of ageing well and how a proactive telecare service can support this.

1.7.2. Selective optimisation with compensation (SOC)

Selective optimisation with compensation (SOC) is a successful ageing theory which describes strategies older adults take to manage age-related challenges, yet still achieve their goals. According to Baltes & Baltes (1990), when older adults are faced with age-related challenges, decisions about how to best allocate resources must be made. Selection involves focusing on a goal in response to reduced resources, such as loss of functional health (Regier & Parmelee, 2020). Literature distinguishes two types of selection: loss-based selection which refers to involuntary abandonment of goals as a result of losing resources necessary to achieve goals (Ebner et al., 2006), and elective selection, which is driven by personal motivation and preferences rather than loss of resource (Karlsen et al., 2022). Optimisation refers to the process of acquiring and refining resources in order to pursue the goal of choice (Baltes & Carstensen, 1996), such as acquiring knowledge, skills or social support. Finally, compensation refers to the alternative external resources used to reach the goal.

The SOC model was used in this research to give initial insights into how older adults may utilise proactive telecare to maintain living at home independently. As older adults face challenges which may threaten their ability to live independently, individuals may adopt technologies such as proactive telecare, to achieve their goal of remaining at home.

1.7.3. Preventive and corrective proactivity (PCP) model

The preventive and corrective proactivity (PCP) model of successful ageing describes proactive behaviours that older adults may adopt in later life, to prepare for anticipated age-related losses. Presented by Kahana et al. (1996), the PCP model describes that older adults will likely face stressors as they age, such as social losses, poor health and frailty, and

functional limitations, which may ultimately result in reduced quality of life and poor psychosocial outcomes. Other models, such as the SOC model focus on behavioural actions *after* age-related challenges have occurred. However, the PCP model suggests that older adults may also engage in proactive adaptations, to prevent age-related stressors in the first instance. The model describes two types of adaptations: (i) preventive and (ii) corrective. Preventive adaptations are undertaken *before* an individual experiences an age-related stressor, to avert future issues and to build resources required to age well. Preventive adaptations may include health-promoting behaviour such as exercise, adopting technologies, and building social and financial resources. Corrective adaptations are behaviours activated after a stressor has been experienced, which involves older adults marshalling support to reduce physical decline and disability. The PCP model was used in this research to gain initial insight into the potential benefits of proactive behaviours in supporting successful ageing.

1.7.4. Senior technology acceptance model (STAM)

There is a wealth of literature on technology acceptance, and one of the most dominating models used to predict technology acceptance is the technology acceptance model (TAM) (Davis, 1989). The model posits that technology acceptance is determined by two key factors: (1) perceived usefulness and (2) perceived ease of use. Since the model's inception, a modified model has been developed, known as the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003), which is also used widely. This model highlights four key factors that influence acceptance: (1) performance expectation (2) effort expectation, (3) social influence, and (4) facilitating conditions. Although these models are useful, they do not consider the context of older people's acceptance of everyday technology. Older adults have been found to be more hesitant to using technology and can experience anxiety when using technology (Kim et al., 2023). The senior technology acceptance model (STAM) was developed to reflect older peoples' acceptance of technology, using both TAM and UTAUT, and considering age-related challenges and factors contributing to acceptance (Chen & Chan, 2014). The model includes self-efficacy, gerontechnological anxiety, health and ability, and social support as predictors of

technology acceptance (Chen & Lou, 2020). This model was used to help understand older adults' acceptance of the proactive telecare intervention of interest.

1.7.5. Socio-gerontechnology

Research that explores the possibilities and limitations of technology use in improving quality of life in older people is an established topic. However, some researchers argue that studies to date in this area are techno-optimistic (Peine et al., 2021), giving rise to more critical approaches to ageing and technology research, known as socio-gerontechnology. Socio-gerontechnology provides a critical perspective to ageing and technology and argues that ageing and technology are not separate domains, but are interconnected (Gallistl et al., 2023). This interdisciplinary field aims to understand how social, cultural, and material forces influence the connection between ageing and technology, to develop a more theoretical understanding of how ageing is intertwined with the design and use of technology (Peine et al., 2021). For this thesis, the researcher acknowledges that older adults have differing needs and contexts; therefore, exploring individual context is important in understanding how technology could help to support older adults. As socio-gerontechnology recognises the importance of context between ageing and technology, it is worth exploring as a potential theoretical approach to utilise.

Researchers within the field of socio-gerontechnology argue that traditional approaches to ageing studies focus on explaining ageing as an outcome of either biological processes or as entirely due to social constructs, potentially overlooking the significance of how social constructs come together and interact with the material aspects of ageing (Peine et al., 2021). Separating these domains may also oversimplify research questions, where technology is seen as the solution to age-related issues and ignores other crucial contexts. For example, during the COVID-19 pandemic, older adults were considered a high-risk group and were socially isolated to reduce infection risk. Where face-to-face contact was reduced, technology seems to be an obvious and optimistic solution to reduce social isolation. However, in viewing ageing and technology as separate domains, this may evade important contexts related to the sources of social exclusion and inequalities in older people, or what

older adults' views are towards technology, and how would they envisage using technology to their benefit. Moreover, socio-gerontechnology researchers such as Peine et al. (2021) criticise the assumption that age is an indicator of limited access to, interest or ability to use technology, and the assumption that advanced age is synonymous with physical decline. Whilst these issues are recognised in current research, socio-gerontechnology researchers argue that further investigation is required into the underlying social, political, cultural, economic and material contexts in which age-related problems are viewed, and subsequently how technologies are packaged as the solution to age-related problems.

The applicability of socio-gerontechnology in research spans across both age studies and science and technology studies. In socio-gerontechnology studies, researchers theorise how social, material and digital factors influence ageing and technology (Gallistl et al., 2023). Studies explore the importance of context, which is relevant to this PhD research, as context is crucial in understanding if telecare can help someone in their specific situation. For example, Berridge and Grigorovich (2022) explored the links between ageism and technology by investigating the algorithmic harms of surveillance technologies on older adults within the context of care homes (Berridge and Grigorovich, 2022). The authors wanted to investigate in detail the concept of digital ageism and used AI language in care homes as the context to explore this further. By choosing a specific context to research, the authors were able to uncover digital ageism within this context, as they found that AI surveillance technology design in care homes was driven by the assumed benefit for prevention of disease and further decline in older people, through more timely identification of poor health and personalisation of care (Berridge and Grigorovich, 2022). Berridge and Grigorovich (2022) critique the interventionist logic and theoretical assumption that ageing is a target for digital and medical intervention. Another example of socio-gerontechnology research is by Neven (2010), who used a qualitative approach to explore how researchers, older adults and technology developers imagined and designed a robot that would be used for supporting health and ageing (Neven, 2010). Neven found that the older adult participants imagined a prospective user to be frail, in need of care and potentially lonely, drawing upon their own stereotypes of ageing. In contrast, technology

designers imagined a potential user of the robot to have individual needs, preferences, and physical and mental abilities, regardless of age. The researchers and technology designers created a robot for older adults to test, and although older participants approved of the robot, they believed themselves to be independent and they perceived themselves as not needing technology like this, due to their belief that users had to be lonely and in need of care. Nevan's study utilised qualitative methods to explore how ageing and technology interact and demonstrated that age-based assumptions influenced older people's opinion of technology design (Nevan, 2010).

Noting and considering the applicability of the theoretical approach signalled under the label of socio-gerontechnology was a useful process, as research in this area considers the importance of context in shaping the experience of ageing, including the role of technology within social networks, individual contexts, and cultural norms. Socio-gerontechnology also utilises similar research methods to those the researcher used for this PhD research, including qualitative methods, to understand individual context and how technology can improve quality of life in older people. This perspective may contribute to a more comprehensive understanding of how telecare interacts with older adults wishing to age in place. Concepts from socio-gerontechnology also offer an interdisciplinary perspective, which may have enabled exploration into ageing and telecare from different disciplines. However, concepts from socio-gerontechnology were not utilised in this research on this occasion, as the researcher took a more applied approach and viewed OKEachDay as a public health intervention to be evaluated. This approach aligned with the researcher's academic background in public health. The researcher chose to utilise the theory of selective optimisation with compensation (SOC), the preventive and corrective proactivity (PCP) model, and the senior technology acceptance model (STAM), as these models and theories were deemed useful for answering the thesis research aim of exploring how using a proactive telecare service can support older adults' independence, and what potential health and well-being benefits may be elicited from its use. Viewing OKEachDay as an intervention may not have been compatible with arguments from socio-gerontechnology,

as socio-gerontechnology researchers critique the interventionist approach for conceptualising ageing as in need of biomedical and technological intervention.

1.8. Thesis aims

The overarching research aim of this thesis is to explore how using a proactive telecare service can support older adults' independence, and what potential health and well-being benefits may be elicited from its use.

Specifically, the research will consider:

1. How can using a proactive telecare system support various aspects of independence in older adults, including autonomy, maintaining social connections, and accessing support.
2. What health and well-being benefits and challenges are associated with the adoption of a proactive telecare in older adults, including the effect on well-being, mental health, and quality of life, and hospitalisation risk.

As previously discussed, OKEachDay was chosen as an example of a proactive telecare system. OKEachDay is an *untypical* telecare service in that it does not offer 24-hour monitoring, and it is a specific example of proactive telecare, so the findings may not be generalisable to other types of proactive telecare. Therefore, the findings from this PhD research will be limited to OKEachDay and services that utilise similar elements of this service, such as encouraging users to confirm their well-being and providing low level psychosocial support. However, this research aims to better understand the impacts of an example of proactive telecare, which may help develop future research on proactive telecare.

The aim of the thesis will be achieved through four studies. The aim of each study is described below, with the specific objectives outlined within each study chapter.

Study 1: Understanding the value of a proactive telecare system in supporting older adults' independence at home: qualitative interview study among key interest groups.

This doctoral research began by conducting qualitative interviews with older people (those with experience in using OKEachDay and those without), family members of proactive telecare users, and proactive telecare staff, to initially explore their perceptions and opinions on the value of a proactive telecare service (OKEachDay). Conducting this study addressed the aim of understanding the extent to which using a proactive telecare service could support older adults to live independently, what potential health and well-being benefits may be elicited from its use, and what the limitations are. This paper has been published in the Journal of Medical Internet Research: Fothergill, L., Holland, C., Latham, Y., & Hayes, N. (2023). Understanding the value of a proactive telecare system in supporting older adults' independence at home: Qualitative interview study among key interest groups. *Journal of Medical Internet Research*, 25. <https://doi.org/10.2196/47997>

Study 2: How, for whom and under what circumstances can telecare support independent living in community-dwelling older adults: a realist review.

Despite previous research demonstrating evidence of telecare efficacy for supporting independence, health, and well-being, it is still unclear *how* to adapt telecare to the individual needs and resources of older adults. Older adults have differing concepts of independence and varying views and acceptance of telecare. Therefore, telecare devices that support one person may not be appropriate for another. A realist review on existing literature was conducted, with the aim to understand how telecare technologies could support independence, health, and well-being, for whom telecare could support and under what circumstances. Understanding *how* reactive and proactive telecare devices support independent living would then inform decisions on who proactive telecare may benefit, and subsequently how to evaluate the impact of proactive telecare. This paper has been submitted to BMC Geriatrics for publication.

Study 3: Does proactive monitoring of older adults' well-being aid in the detection of increased hospitalisation risk? A retrospective cohort study of proactive telecare users in the United Kingdom.

An existing proactive telecare intervention, known as OKEachDay, encourages daily interaction from an older adult to confirm their well-being by pressing an OK button, which gives the opportunity to monitor older adults' well-being over time and detect changes in engagement with the system. With this technology, if users do not press their OK button, this could potentially be an indicator of increased hospitalisation risk, as forgetfulness and delirium in older adults can be an indicator of acute illness. This study was a retrospective study looking at patterns of proactive telecare use and hospital usage in a cohort of proactive telecare users between the period of December 2021 and November 2022, using routinely collected anonymised data provided by the proactive telecare company. This study aimed to assess whether using this example of proactive telecare could aid in detecting an increased risk of hospitalisation, by investigating patterns of older adults failing to press their OK button and being admitted to hospital as an inpatient. Investigating the association between patterns of behaviour in pressing an OK button and hospital use could provide an opportunity to investigate the potential of utilising a proactive telecare system for preventive measures to reduce impacts to health and well-being and prevent hospitalisation. This paper will be submitted to a relevant journal.

Study 4: Using a proactive telecare system to support independence, health, and well-being in older adults: a randomised feasibility and acceptability study.

Studies 1-3 gave some insight into how OKEachDay could support independence, health, and well-being in older adults. The findings from these studies suggested that this intervention could provide social and technological resources to help older adults preparing or adjusting to age-related challenges. However, the feasibility of evaluating OKEachDay and the acceptability of the system was still unknown. This study aimed to explore the acceptability and feasibility of delivering and evaluating a proactive telecare intervention to community-dwelling older adults prior to a potential full-scale effectiveness trial. This paper will be submitted to a relevant journal.

1.9. Chapter summary

This chapter highlighted the key challenges of the UK's ageing population and presented the rationale for supporting independence, health, and well-being in older adults. The

concept of independence was discussed, and the current challenges for older adults staying independent were considered. This chapter summarised literature surrounding the impact of telecare on supporting independence, health, and well-being, and subsequently presented the rationale for exploring the potential impact of proactive telecare. Overall, this chapter considered the potential benefits of proactive telecare for older people. However, further research is needed to understand if this kind of intervention may be helpful to older adults in supporting their independence, health, and well-being.

2. Chapter 2: Methodology

2.1. Chapter overview

This chapter provides a discussion of the philosophical approach that guided this research and aims to justify the methodological decisions taken. It will discuss the ontological and epistemological positions adopted and will explore the value of utilising quantitative and qualitative methods in addressing the research aims. This chapter will also provide consideration to rigour in qualitative research and reflexivity which serves to acknowledge the role of the researcher in the process. Finally, it will reflect on how patient and public involvement was used to enhance the research and considers how ethical issues related to this research were addressed.

2.2. Ontology and epistemology

Research is framed within underlying assumptions about the nature of reality and knowledge and how we understand the meaning behind knowledge obtained about a social phenomenon (Liamputtong, 2019). Ontology refers to the position taken toward the nature of reality, and epistemology considers the stances toward the nature of knowledge, how it is obtained and how it is used to understand phenomena (Liamputtong, 2019). Giving consideration to ontological and epistemological perspectives is crucial to guiding and understanding the research process (Alderson, 2022).

Ontological debates exist around the question of whether reality is independent of human experience or constructed through human consciousness (Levers, 2013). Historically, ontology has been centred on the concept of realism, which describes reality as an objective reality, independent of our perception or theories about them (Hugly & Sayward, 1987). In contrast, relativism argues that there is no objective reality, and that truth is subjective and constructed through human experience (Hugly & Sayward, 1987).

Epistemology explores the nature and justification of knowledge (Liamputtong, 2019). It is concerned with how researchers generate knowledge, to understand reality (Alharahsheh & Pius, 2020). Within epistemology, objectivism believes that reality is independent of human interpretation, and aims to remove human bias and observe the phenomena as it

exists (Levers, 2013). In contrast, subjectivism advocates that knowledge is constructed through human experience, culture, society, and other factors (Levers, 2013). Within subjectivism, the influence of the researcher is recognised, and knowledge cannot be separated from individual interpretations (Levers, 2013).

To help researchers make use of differing philosophical positions, research paradigms have been established in the literature to reflect a worldview of reality and knowledge, and to share a set of beliefs to be used by researchers (Liamputtong, 2019). Each research paradigm has different ontological and epistemological assumptions, which determines the appropriate research methodology and methods to conduct. Therefore, it is key for researchers to state which research paradigm their research aligns with, as this can influence the research methods, procedures and techniques used to collect and analyse data (Alharahsheh & Pius, 2020).

2.3. Philosophical position

There are many research paradigms discussed in the literature. However, key paradigms referred to by social scientists are positivism and interpretivism (Alharahsheh & Pius, 2020). Hammersley (1996) describes that positivism posits a single reality that can be scientifically measured and observed through testing hypotheses. This perspective is often adopted in health research and is based on the view that what is 'real' can be measured objectively. Researchers adopting this position often utilise quantitative methods (Alderson, 2022), which provides the opportunity to reduce confounding variables and generate generalisable findings which can be applied widely (Tariq & Woodman, 2013). In contrast, an interpretivist paradigm accepts multiple realities as influenced by personal viewpoints, experiences and meaning (Guba & Lincoln, 1994; Hammersley, 1996), and often utilises qualitative methods, including in-depth interviews which offer rich insights into a phenomenon (Braun & Clarke, 2006). For example, a positivist approach to investigating the effectiveness of telecare in supporting health and well-being may include conducting quantitative analyses on the number of falls detected and number of hospital admissions in telecare users and use these findings to generalise the impacts of telecare. In comparison, an interpretivist approach may include conducting interviews with telecare users to gain

rich insights into different perspectives on how telecare supports their health and well-being.

Paradigms significantly influence the research approach; therefore, it is important to recognise how the philosophical position adopted influences the research approach. This doctoral research aimed to gain new knowledge on the impact of an example of proactive telecare for supporting independence, health, and well-being in older adults by utilising evaluation methodologies (including both quantitative and qualitative methods). Although quantitative methods are commonly used in health research as suggested by Tariq & Woodman (2013), in evaluation research, a purely quantitative approach is suggested as inadequate in understanding complex interventions beyond investigating effectiveness (Skivington et al., 2021).

Proactive telecare interventions can be considered as inherently complex interventions, as it includes multiple interacting components and its success may depend on the suitability of the intervention to context, interactions between individuals and technology, and acceptability, which align with the description of complex interventions by Skivington et al. (2021). Using quantitative methods will allow for some investigation into the impact of a proactive telecare intervention on health and well-being. However, quantitative methods may not be suitable for understanding *how* or *why* a proactive telecare intervention may work to support independence in older adults, or how it may support different people in different ways. Qualitative methods would allow for exploration into how an example of proactive telecare could support older adults with different perceptions of independence and varying social contexts. Using both quantitative and qualitative methodologies was deemed appropriate to understand the impact of OKEachDay on the physical, psychological, and social dimensions of health and independence. However, adopting a purely positivist or interpretivist position was considered inappropriate.

2.3.1. Critical realism

Critical realism is an increasingly attractive stance among health researchers to help understand the 'observable' world and the 'real' world (Alderson, 2022). Critical realism

was initially conceptualised by Roy Bhaskar, who argued that positivism was limited to what could be empirically measured, and constructivism/interpretivism was limited to what could be constructed through experience (Bhaskar, 1979). To overcome these limitations, critical realism assumes a positivist ontology, where there is an objective world that is independent of human experience, whilst assuming an interpretivist epistemology, where knowledge is viewed as subjective and socially produced, and ultimately influenced by our beliefs and current understandings (Alderson, 2022).

Critical realists aim for a rich and detailed exploration of reality by exploring different experiences, contexts and beliefs, making this worldview well suited to mixed methods research, as suggested by Halcomb & Hickman (2015). Critical realism has become a popular paradigm to use for health research, particularly in evaluation research, as it focusses on explaining what works under specific contexts, and aids in exploring *why* interventions cause certain outcomes, in certain contexts (Koopmans & Schiller, 2022). Indeed, critical realism suggests that what we observe through research is caused by underlying, often unobservable mechanisms, which can include people's reasons, motivations, and intentions. By investigating various dimensions of a phenomena, critical realists aim to understand these potential mechanisms, in order to understand why, or how interventions work, for whom and under what contexts (Koopmans & Schiller, 2022). As previously highlighted in the introduction chapter for this thesis, the concept of independence is not homogeneous across individuals, and so proactive telecare may also support people in different ways (or not be able to meet everyone's needs). Adopting a critical realist stance provides a philosophical foundation to explore for whom the intervention could be a benefit, how and why, and what contexts are important for proactive telecare to support people in the best way.

One tool from critical realism that has influenced this research is ontological depth. Bhaskar advocates of a stratified ontology, suggesting that reality is comprised of three complex layers: the empirical level (captured by our experience, observations, and interpretations), the actual level (where events occur, but they may or may not be observed or experienced

by humans) and the real level (which refers to real powers and mechanisms that cause empirical and actual events to occur) (Bhaskar, 1979) (Figure 4).

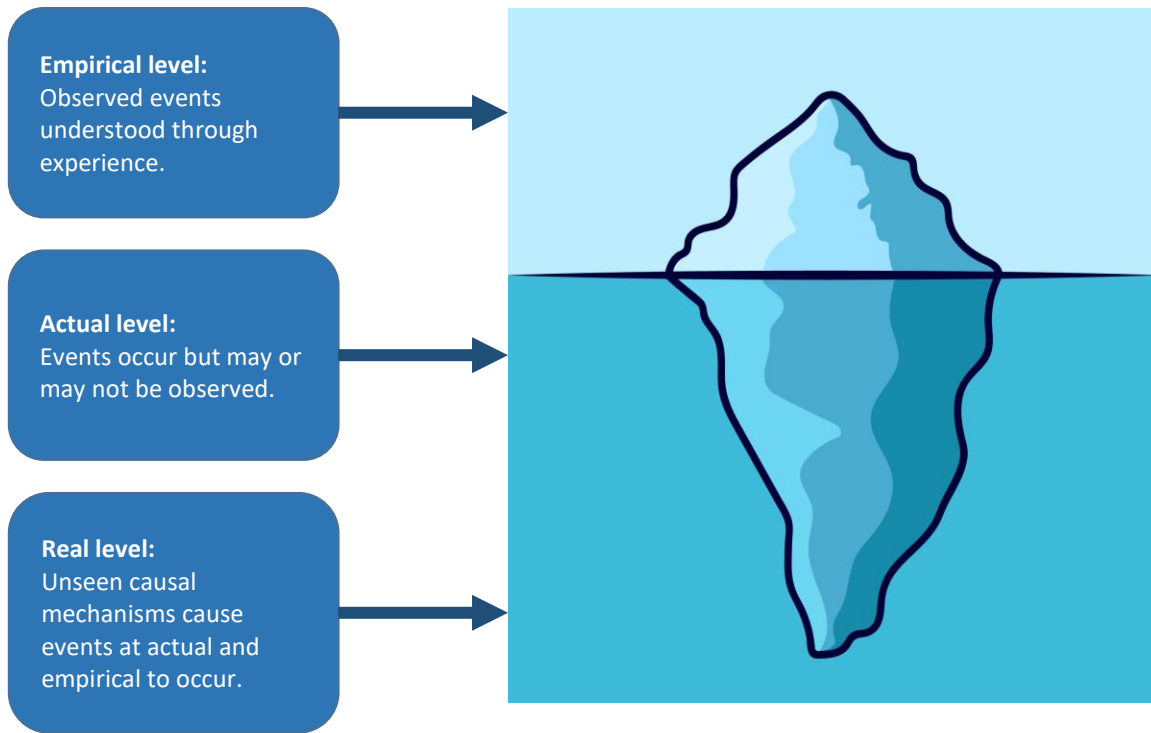


Figure 4. Iceberg metaphor representing ontological depth in critical realism.

Koopmans & Schiller (2022) describe that healthcare interventions may affect people in different ways or may produce different results depending on the context (person's physical, mental and social influences). This could be relevant to how proactive telecare may benefit (or not benefit) people. An individual's context exists in an open system of various interacting mechanisms, which may influence how proactive telecare could support independence, health, and well-being. Contexts may include social-economic status, social isolation, and health status (Alderson, 2022). Indeed, the researcher recognised that there might be multiple levels of reality, in terms of understanding the impacts of proactive telecare for supporting older adults. Older adults' experiences and perceptions of independence will be shaped by their underlying social, political, and environmental influences, which may impact how useful proactive telecare is in supporting their own

understandings of independence. Also, individual motivation for using telecare may differ, as some older adults may be willing to forgo some control over their life to prioritise maintaining their health and well-being. Therefore, drawing upon the principles of ontological depth will aid this research to understand the mechanisms which affect the extent to which a specific proactive telecare intervention may support older adults to live independently.

2.4. Medical Research Council framework for evaluating complex interventions.

The Medical Research Council's framework on evaluating complex interventions influenced the structure of this research (Skivington et al., 2021), due to its wide use in this area. The framework offers four key elements of complex intervention research: (1) development or identification of the intervention, (2) feasibility testing, (3) evaluation, and (4) implementation (Figure 5). The four empirical studies from this thesis are situated within the stages of Phase 1 and Phase 2; (1) identifying the intervention and (2) assessing feasibility, in preparation for future evaluation and implementation.

Complex interventions are defined as having numerous potential outcomes, a degree of flexibility, and numerous target populations. Therefore, by this definition, proactive telecare can be considered as complex, as Craig et al (2008) describes complex interventions as having potential to have a positive impact on physical, psychological, and social dimensions of independence, health, and well-being. There is also a degree of flexibility in which the individual can interact with the proactive telecare intervention of interest, from minimal engagement of pressing the 'OK' button each day, to more active engagement in having a personal call.

The MRC framework complements critical realist principles, as the guidance refers to the importance of developing a refined programme theory to understand how the intervention might work. The updated 2021 MRC framework goes further than previous iterations (Craig et al., 2008), and calls for researchers to investigate the impacts of intervention resources, theorising how it works, how it interacts with contexts in which it is situated, and how it contributes to change (Skivington et al., 2021).

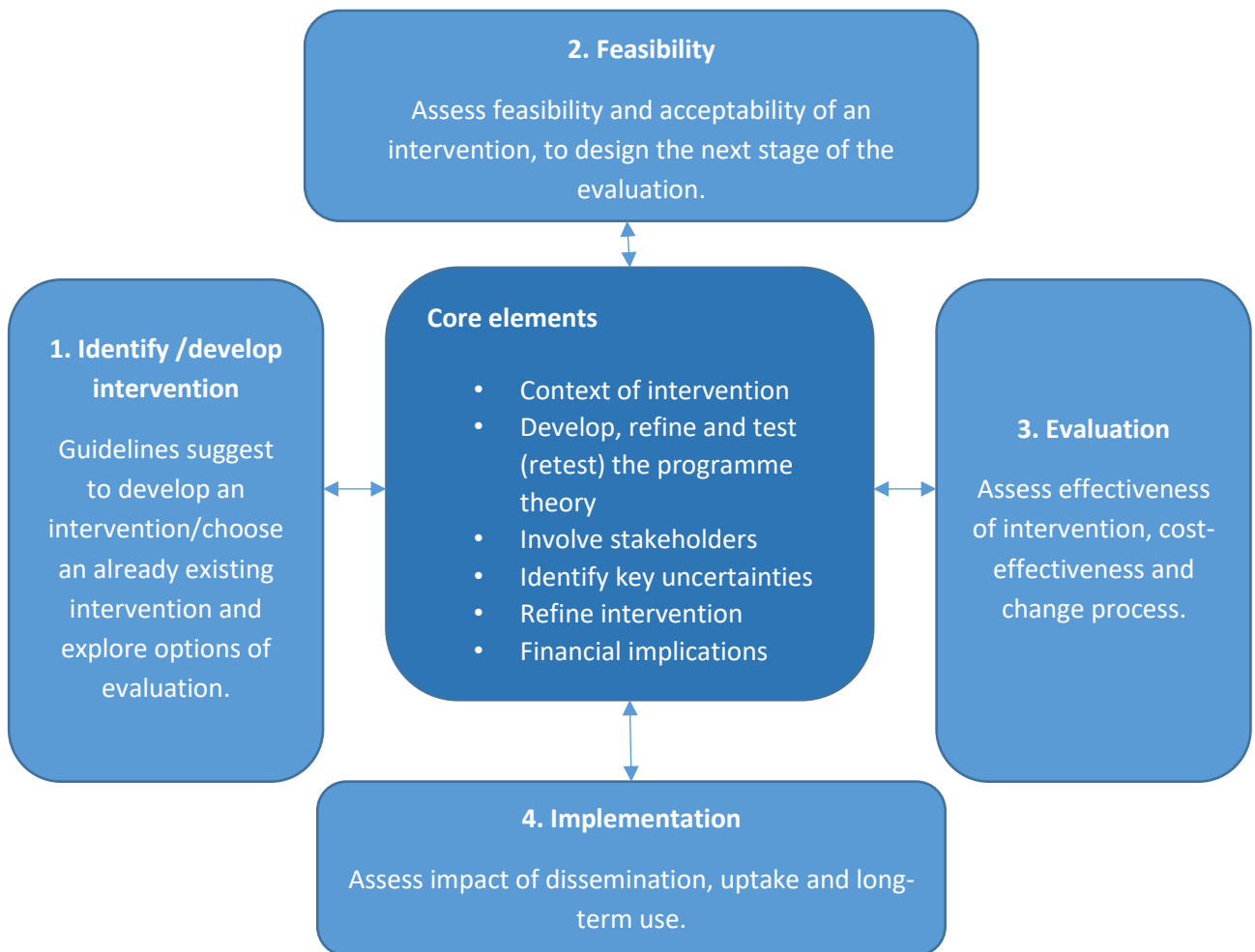


Figure 5. Framework for identifying and evaluating complex interventions, adapted from (Skivington et al., 2021).

2.5. Thesis methodologies

2.5.1. Overview of research methodology

The overall aim of this thesis was to explore how a proactive telecare intervention could support independence, health, and well-being in older adults. Following the MRC framework, the guidance first recommends identifying an intervention. The process of identifying the proactive telecare of interest has been outlined previously in the introduction chapter. This next section will summarise the overall approach taken for this research in relation to the MRC guidelines, followed by a detailed justification for the methodologies used in each study.

In the framework, each of the four phases have key elements to be considered: (i) understanding how an intervention interacts with its context; (ii) what the underpinning programme theory is (how and why is the intervention expected to work); (iii) involving stakeholders; (iv) identifying key uncertainties; (v) refining the intervention; and (vi) understanding the financial implications. This thesis used a variety of methodologies to unpick some of these key elements.

The research began by conducting qualitative interviews (Study 1), which explored the experiences, perceptions, and preferences of key interest groups on using the device to support independence, health, and well-being. This helped to understand in what context the intervention was currently used, how it might work to support health and well-being, and explore key uncertainties.

Although Study 1 gave initial insights into potential impacts of this proactive telecare system, there were still uncertainties around how the intervention was expected to lead to its effects and under what conditions. Therefore, for the second study, a realist review was conducted, which is a theory-driven review used to understand why telecare may or may not support independence, health, and well-being under what circumstances, and for whom.

Then, secondary data from Alertacall were analysed to investigate whether failing to proactively press the OK button is a predictor of incidences of hospitalisation, to investigate the potential physical health outcomes from using OKEachDay (Study 3). This study followed from Study 1, where participants reported that missing the OK button could be associated with an increased risk of hospitalisation, and so, this study was conducted to corroborate this finding.

The findings from Studies 1-3 gave initial insights into the potential benefits and limitations of the proactive telecare intervention of interest and informed an initial programme theory for OKEachDay. Finally, following the MRC framework, the next phase of the research involved testing feasibility of a future evaluation (Study 4), by assessing uncertainties

around recruitment, data collection, participant retention, and acceptability of the intervention (Skivington et al., 2021).

2.6. Justification of methodologies

This section aims to justify key methodological decisions made for each of the four studies and to relate the methodologies chosen to the underpinning philosophical approach. The focus of this section is to explore the reasons why decisions were made, rather than describe what was done. Detailed descriptions of the methods used for each study are situated in the study chapters.

2.6.1. Study 1: Qualitative interview study (Chapter 3)

Study design

Study 1 used qualitative interviews to understand the extent to which using a proactive telecare service could support older adults to live independently, what potential health and well-being benefits may be elicited from its use, and what the limitations are. Qualitative research methodology is deemed suitable for investigating emerging topics of interest, as described by Jamshed (2014).

There is no single critical realist approach in qualitative research, which enables flexibility (Given, 2012). Semi-structured interviews are a research method commonly used in health research, where respondents answer pre-designed open-ended questions, with flexibility for the researcher to ask follow-up questions, depending on the respondent's answer (Jamshed, 2014). DeJonckheere & Vaughn (2019) suggest that semi-structured interviews are appropriate to explore individual experiences, thoughts, and opinions, so this methodology was utilised to explore how the technology could benefit people's perceived concept of independence. Given that independence can have different meanings for individuals as reported by Hillcoat-Nallétamby (2014), semi-structured interviews enabled the researcher to delve deeply into personal accounts, and gave flexibility for unplanned follow up questions to reveal hidden information (DeJonckheere & Vaughn, 2019). A weakness of conducting semi-structured interviews is that some participants may be hard to engage in conversation (DeJonckheere & Vaughn, 2019). However, the researcher aimed

to overcome this limitation by recruiting from a wide pool of participants to obtain insightful data.

Participants, recruitment, and sampling

The researcher chose to explore accounts from four interest groups: (1) older adults who currently used OKEachDay; (2) family members of OKEachDay users; (3) OKEachDay staff involved in delivery; and (4) older adults who do not currently use OKEachDay (referred to as non-users). Exploring different framed accounts is consistent with a critical realist approach, as Given (2012) suggests it allows for exploration of human beliefs, meanings, and understandings, to maximise understanding of a layered reality.

The researcher invited older adults who currently used OKEachDay to explore their reasons for adopting the service and to understand how and why they used the technology. Of note, older adults who did not use the device were also invited to participate, as it was recognised that long-standing users may express more positive views toward the device. Therefore, it was crucial to gain outsiders' perspectives about the technology. The researcher chose to recruit older adults aged 65 and over, as health research often defines this age as the beginning of older age (Sabharwal et al., 2015). The proactive telecare of interest is commissioned by social housing providers. The staff who used the proactive telecare intervention in social housing and the staff who run the service were seen as important interest groups to understand how the intervention was used, how it works day-to-day and what the most common benefits and limitations of the service are. Finally, family members of OKEachDay users were invited to take part in the study, as a qualitative study by Cook et al. (2018) that explored reasons why older adults adopt telecare and found that family caregivers play a vital role in supporting older adults to adopt and use telecare. Family members were viewed as having a unique perspective on how this proactive telecare intervention could support older adults' independence.

Purposive sampling was used to ensure that perspectives from all identified interest groups were represented. Palinkas et al. (2015) describes that this type of sampling involves identifying individuals with knowledge and experience about the topic of interest. Snowball

sampling was also used, as Naderifar et al. (2017) suggests it helps to facilitate recruitment and identify previously inaccessible participants.

The researcher asked the managers at the proactive telecare organisation and housing associations who use the service to aid in disseminating the study invitation. Current OKEachDay users and family members of users were invited to participate in the study via notification through the smart device or email. Involving gatekeepers in research can lead to selection bias; however, to minimise this, managers were only involved in disseminating the study invitation, and were not able to select specific individuals to take part. Vinkenburg (2017) recommends to engage gatekeepers throughout the research, to increase diversity to minimise bias. Older adult groups were still not running face to face sessions due to COVID-19 at the time of this study, so older adults with no experience of using OKEachDay were recruited via email through two existing older adult networks linked to Lancaster University; (i) Lancaster University Centre for Ageing Research Panel, and (ii) the Continuing Learning Group for retired people.

Data collection

Data collection was conducted between July 2021 and November 2021, when COVID-19 restrictions were continuously changing at a national level, resulting in an unpredictable research environment. Given this, interviews were conducted via telephone or Microsoft Teams. As COVID-19 restrictions eased, participants were given the choice to attend an in-person interview; however, only a few participants opted for this. Although some researchers such as Carr & Worth (2001) argue that telephone interviewing can be limiting due to the lack of visual aids to facilitate communication and may impede rapport building, in this case, telephone interviewing offered a flexible option which Keen et al. (2022) suggest may have reduced the geographical and social barriers associated with in-person interviewing. For the older adult groups, research suggests that many people in this demographic were still self-isolating to reduce infection risk (Maral & Punetha, 2022), making telephone interviews a preferred method of data collection for participants.

Topic guides were developed by the researcher and reviewed by the supervisory team and two National Institute of Health and Social Care (NIHR) Public Advisors with experience of caring for older adults. Gaining feedback from both the supervisory team and public advisors ensured that the questions asked were tailored towards the research aims and were easy to understand for a wide audience. Interview guides were adapted for each interest group. For the older adults, interviews began with broad questions such as '*what does living independently mean to you?*' to understand individual perspectives of independence, followed by querying about their views towards the technology: '*why do you use OKEachDay/what do you think of OKEachDay?*' (for non-users). Topic guides for other interest groups followed similar topics.

Data analysis

The researcher aimed to use suitable analysis methods that were consistent with critical realist approaches. After consideration, it was deemed that thematic analysis offered a flexible, yet detailed and rich, analysis (Braun & Clarke, 2019). Braun & Clarke (2006) describe that thematic analysis is not associated with a specific philosophical approach, and can be used within a critical realist stance, in order to report on participants' experiences, meanings and contexts. The approach to thematic analysis in this thesis aligns with Braun and Clarke's *reflexive* thematic analysis, where the researcher's role in knowledge production is recognised. The researcher actively engaged with the data and developed interpretative stories about the data, rather than claiming themes *emerged* passively from the data or codes (Braun & Clarke, 2019). More detail about how the researcher engaged with reflexivity is detailed later in this chapter (section 2.9). The value of reflexive thematic analysis is that it provides a flexible analytical method which is not confined to pre-defined codes or themes, but allows for themes to be produced around relative commonality from the researchers interpretation (Braun & Clarke, 2019). This inductive approach was crucial in this study, given the varying concepts of independence, health, and well-being and differing experiences about the value of proactive telecare.

2.6.2. Study 2: Realist review (Chapter 4)

Study design

Study 2 aimed to understand *how* telecare could support independent living, for whom and under what circumstances. The findings contributed to the understanding of potentially how proactive telecare worked, but also added to the evidence on how to adapt telecare to suit individual needs and resources. A realist review is a theory-driven approach to evidence synthesis that aims to uncover how, for whom and under what circumstances interventions work (Pawson & Tilley, 1997). Indeed, this methodology was deemed appropriate to explore *how* telecare can support independent living in older adults, as realist reviews produce theories about how interventions may ‘work’ (in this case, how telecare supports independence, health, and well-being) through defining underlying processes, which operate in contexts to produce certain outcomes (Astbury & Leeuw, 2010).

A realist review was chosen, rather than a systematic review, as previous systematic reviews on the effectiveness of telecare had highlighted the need for research into *how* to match telecare interventions with individual needs and resources (Greenhalgh et al., 2013; Procter et al., 2014). The RAMESES publication standard for conducting realist reviews suggests a realist approach is well suited to reviews of complex social interventions that involve human motivations and actions (Wong et al., 2013). Telecare can be considered as a complex social intervention, as the use of telecare is embedded in the context of the user. Therefore, the success of telecare relies on a successful telecare-user interaction (Mort et al., 2013); hence, a realist review was deemed appropriate.

A realist review is consistent within a critical realist approach; however, the methodology draws on similar, but distinct, principles from Pawson and Tilley’s scientific realism. Pawson and Tilley’s scientific realism shares philosophical characteristics with Roy Bhaskar’s critical realism (Bhaskar, 1979), in which it accepts a positivist ontology, but favours a constructivist epistemology (Marchal et al., 2012) and aims to identify ‘*what works, how, under which conditions and for whom*’ (Pawson, 2013). However, a key difference in Pawson and Tilley’s take on realism is that research findings are presented as CMO configurations. CMO

configurations stand for context, mechanism and outcome (CMO), also written as *context + mechanism = outcome* (Pawson, 2013). These detail the contexts in which certain mechanisms, often hidden, elicit specific outcomes from using telecare (Wong et al., 2013). CMO configurations contribute to initial programme theories (IPT) which hypothesise how, why and for whom an intervention might work. Retroductive reasoning is used to unearth the causal forces which explain observed patterns in the data (Jagosh, 2020). Retroduction involves the researcher asking, ‘*why does this work like this?*’ Retroduction may use inductive reasoning (where specific data informs conclusions and theory building) and deductive reasoning (where existing theory is used to test patterns in specific data), as well as insights and logic to hypothesise how and why interventions might work (Jagosh, 2020). The IPTs will go through various iterations, until a refined middle-range theory (MRT) is produced, which identifies common patterns within reality and represents a refined IPT that has been tested in case studies (Gilmore et al., 2019). Further explanations for realist terminology can be found in Table 2.

Table 2. Glossary of terms.

Glossary of terms	
Context-mechanism-outcome (CMO) configuration	CMO configurations theorise how an intervention works, for whom and in what circumstances. A CMO configuration may focus on a particular aspect of an intervention, or the intervention generally (Kirsh et al., 2017).
Context	Context refers to the conditions in which the intervention operates. Context can refer to the individual taking part in the programme, or wider cultural, economic, and societal settings for programmes (Pawson & Tilley, 1997).
Mechanism	Explains how a programme works through defining underlying processes or structures, which operate in contexts to produce certain outcomes (Astbury & Leeuw, 2010). A mechanism includes the resources offered

	through an intervention <i>resource</i> , but also the individual’s reaction and <i>response</i> to these resources (for example information, advice, engagement, motivation) (Jagosh, 2020). Mechanisms go beyond understanding if an intervention is effective, and attempts to theorise “what happened, why, for whom, under what circumstances and how?”
Outcome	Outcome refers to the observed products following engagement with an intervention (intended or unintended) (Astbury & Leeuw, 2010).
Initial programme theory (IPT)	IPT refers to potential ideas to how and why an intervention may work. IPTs will include potential contexts, mechanisms, and outcomes of interest to test in further empirical research.
Retroductive reasoning	Retroduction refers to identifying underlying causal forces which lead to or explain the observed patterns in the data (Jagosh, 2020). This involves using inductive and deductive logic, alongside personal insights, and logic to understand how and why something appears as it does.
Middle range theory (MRT)	MRT is a developed theory that can be used to explain the cause of outcomes for interventions. ‘Middle range’ means that the theory can be tested with observable data and is not theorising an abstract social or cultural force (Astbury & Leeuw, 2010).

Although RAMESES provide reporting standards for realist reviews, there is no standard procedure to follow detailing how to conduct a realist review. The researcher chose to follow Pawson’s five stages for conducting realist reviews: 1) locating existing theories and concepts, 2) searching for evidence, 3) selecting data, 4) extracting data and 5) synthesising data. This method of conducting a realist review was followed due to Pawson’s significant contribution to the creation of the methodology (Pawson et al., 2005), and due to the wide use of this method in other realist reviews (Rycroft-Malone et al., 2012; Saul et al., 2013).

Data collection

Using selective optimisation and compensation as a theoretical starting point

Pawson recommends undertaking concept mining, which refers to exploring existing models or theories, or existing literature, about how the intervention of interest may work, in this case, how telecare might help older people remain living independently (Pawson et al., 2005). The researcher initially drew upon Baltes & Baltes (1990) well-established model of selective optimisation and compensation (SOC) to inform initial understanding of how older adults may utilise telecare, which presents everyday adaptations older adults engage in to maximise gains and minimise losses in response to age-related challenges (Baltes & Baltes, 1990).

The choice of using SOC as a theoretical influence was guided by several considerations. Firstly, this model is a well-established framework that has been used across ageing literature to understand how older adults use various resources to maintain positive health and well-being. Grant & Osanloo (2014) explains that using an established gerontological theory is considered to provide an appropriate 'blueprint', from which knowledge and interpretation would be constructed for the research. SOC enables the consideration of opportunities and constraints posed by ageing contexts, and aids in understanding how older adults may use resources to achieve later life goals, like maintaining independence. Of note, SOC has been used in a similar context to the topic of this thesis; Lindenberger et al. (2008) used SOC as a framework to discuss how older adults utilised assistive technology to help adjust to increasing functional loss, whilst wanting to maintain environmental support to stay living independently. Given that telecare uptake is often utilised to minimise functional losses (through falls) by ensuring safety at home, it was considered a well-suited theoretical starting point for the realist review.

Searching for and selecting evidence

To uncover relevant evidence for the realist review, formal literature searches were conducted using five databases (Medline, PsychINFO, Academic search ultimate, Web of Science, and CINAHL). Decisions to search these specific databases were informed by a University Librarian and by reviewing the relevance of the database's scope. Medline

includes evidence on biomedicine and health topics, PsychINFO includes literature on psychology, Academic search ultimate provides evidence in social science, science and psychology, Web of Science includes science and social science topics, and CINAHL includes health and social care literature. Search terms used were decided with a Lancaster University Librarian who had in-depth knowledge of how to obtain the most appropriate literature and evidence for the aims of this study. Search terms were kept broad due to the variation of telecare and independence definitions. Documents included as evidence were also kept broad to include reports and other grey literature, as Pawson (2007) argues that methodologically poor research can still yield useful detail to developing theory. Generally, the definition of an older adult in the UK is 65 years and older; however, to avoid missing useful evidence, an age limit was not placed on the definition of an older adult, given the variety of ages that can be considered as 'older' population. Studies investigating the impact of telecare on older adults with specific health conditions (such as heart disease, diabetes, dementia) were excluded. This pragmatic decision was made as telecare interventions designed to help people with chronic illnesses may require different functionalities and adaptations compared to telecare used generally by older adults at home. This decision was further justified by the presence of existing systematic reviews on the impact of telecare in supporting older people with chronic illness (Barlow et al., 2016; Bitar & Alismail, 2021). Publications from international countries were included in the search to broaden the scope of evidence considered. Realist reviews aim to understand how and why interventions work by examining the underlying mechanisms and contexts. Including research from other countries other than the UK may provide a broader perspective on the mechanisms and contexts required for interventions to work. It may also provide useful insights into how different implementation strategies, technological innovation, social determinants, and lifestyle factors impact how telecare can be used to support older adults. Incorporating publications from other countries may help capture different social, economic, and cultural contexts that might be crucial to understanding how telecare works and may improve the generalisability of findings to similar contexts and populations internationally.

Rycroft-Malone et al (2012) states that there should be a high-level of stakeholder involvement throughout a realist review to ensure expert framing of the problem. Following this, Patient and Public Involvement (PPI) was utilised in the screening process and the analysis for this review. Two public advisors were recruited through the NIHR Applied Research Collaboration (ARC) public advisor forum who had experience of caring for older adults. The advisors conducted a random 10% check on the title and abstract, and the full text to ensure consistency. Any discrepancies were resolved through discussions between the researcher and the advisors.

Traditional systematic reviews appraise the methodological quality of primary studies, usually through appraisal checklists. However, as methodologically poor evidence is viewed as potentially valuable in a realist review (Pawson, 2007), appraisal checklists were not used, as this could exclude useful data. Of note, there is no universal method for appraising evidence for a realist review. The researcher chose to use Pawson's approach to appraisal, which suggests assessing the relevance and rigour of the evidence. Relevance refers to whether the data contributes to theory building or testing, and rigour refers to whether a piece of data is credible and trustworthy by taking into account the methodology used (Dada et al., 2023). Documents were assessed for inclusion by scoring each evidence piece on its relevance and rigour using a scale of high, medium, or low, to highlight lower quality studies and explore whether further evidence was required to support data that was low in terms of trustworthiness (Dada et al., 2023). The researcher first focused on the documents which scored high on relevance and rigour to develop CMO theories and used the lower scoring evidence to confirm and test the initial CMOs, an approach recommended by Jagosh, a prominent researcher in the realist field (Jagosh, 2020; Jagosh et al., 2014).

Data synthesis

Details of the data synthesis are explained in the study chapter (Chapter 4).

2.6.3. Study 3: Retrospective cohort study (Chapter 5)

Following findings from Study 1 where participants suggested that OKEachDay use could help to detect health deterioration, the researcher used existing data obtained from

Alertacall to examine this further. Using information gathered from OKEachDay users to inform the design of follow-up studies is an advantage, as it allows for further analysis of findings to unpack the potential benefits of using this proactive telecare intervention.

As previously mentioned in the introduction chapter, OKEachDay staff are notified when an individual missed their 'OK' button, which initiates staff to investigate the individual's well-being. If staff uncover that a user has been admitted into hospital, this is recorded and monitored until discharge. In Study 1, interviews with family members staff revealed that when users forgot to press the 'OK' button, it was often an indicator of illness. Investigating such associations could further enhance our understanding into how using a proactive telecare intervention could support physical independence. Combining quantitative and qualitative methods in this thesis enables a more complete understanding of the phenomena, and arguably reveals different facets of reality, which aligns with critical realist approaches of getting close to understanding the 'real' domain (McEvoy & Richards, 2006).

Measuring hospital use

Among policy makers, there is substantial interest on whether telecare has the potential to detect hazards associated with independent living (GOV.UK, 2012), such as a fall or an accident, which would enable a faster response and in theory, reduce hospital admissions or facilitate faster discharge from hospital. However, the success of telecare on reducing hospital admissions is mixed. This study aimed to make a unique contribution to literature, by investigating the association between daily behaviour patterns and hospital use in OKEachDay users, to understand whether failing to proactively press the OK button is an indicator of health deterioration.

Cheng & Phillips (2014) describes that existing data can assist with data-driven research questions, where researchers observe the data available and decide what kind of questions can be answered using the existing datasets. For this study, the researcher used a data-driven approach to utilise existing longitudinal data within an emerging intervention of interest. Cheng & Phillips (2014) explains that utilising existing secondary data is a cost-effective approach to research, and using real-life data can test the impact of interventions

quickly, rather than implementing a new intervention to test. Inherent to the nature of existing data, a key disadvantage was that the variables were confined to the data collected by the company, so potentially important variables were not available for the analysis, which is a common disadvantage of using secondary data in analyses (Cheng & Phillips, 2014). However, given the lack of research on OKEachDay, the data was still deemed as valuable and insightful.

Study design

This study aimed to examine the relationship between missed 'OK' button presses and hospital admission in individuals who adopted the service in their residence, by using regression analysis of one year of observational data. The data captured information for the period December 2021-November 2022 for each proactive telecare user: (i) proactive telecare use (how often they missed their 'OK' button each day), (ii) total number of hospital admissions and total time spent in hospital (in days), (iii) age and sex.

Proactive telecare users

People aged 65 and above were included to ensure consistency across the studies. All users were living at home (not in a care home) and used proactive telecare during the year of investigation.

Data analysis

After developing familiarity with the dataset, the researcher observed that the outcome variables contained high numbers of zero values. This is potentially explained by the low hospital admission rate, suggesting that the population of older adults who use OKEachDay were relatively healthy. This excess of zero values results in overdispersion, which Hilbe (2011) describes as when the variance is larger than the mean, which can be problematic as it may cause standard errors to be underestimated using standard linear regression (which assumes that the observed values are normally distributed), increasing the likelihood of a type 1 error (where the null hypothesis is rejected despite being true, or otherwise known as a 'false positive' result). Standard linear regression approaches are not well-suited to analysis of non-normally distributed outcomes. The approach used in this

study needed to account for many features, in particular: (i) the skewness of the outcomes; and (ii) the overdispersion of the outcomes. When count data are over dispersed, Green (2021) recommends using a negative binomial regression, instead of attempting to transform data into a normal distribution, as it provides a better fit for data with over-abundant zeros. Therefore, the researcher chose to use a negative binomial regression to estimate the regression models. Further detail on the methods used can be seen in Chapter 5.

2.6.4. Study 4: Feasibility study (Chapter 6)

Study design

When initially assessing which methodological approach to take for this research, a realist evaluation was also considered as a potential option to take. Realist evaluation is a methodology that enables researchers to develop theories about *how* interventions work (Pawson et al., 2005). In this approach, the researcher aims to identify the underlying causal mechanisms which affect the outcome, under the appropriate conditions. Although a realist evaluation would have been a suitable methodology for this research, Salter & Kothari (2014) noted that it is a labour and resource intensive approach to evaluation and may not have been feasible within available time and resources. Therefore, a pragmatic decision was made to not conduct a realist evaluation. Moreover, there were multiple uncertainties around the feasibility and acceptability of the proactive telecare intervention of interest. Moreover, there were multiple uncertainties around the feasibility and acceptability of the proactive telecare intervention of interest, and how best to evaluate its impact on independence, health and well-being; therefore, a feasibility study was deemed suitable to test the integrity of the study protocol for a future randomised control trial (RCT).

MRC guidelines often describe feasibility as an important step of evaluating interventions that is often skipped, and subsequently interventions are undermined by issues related to acceptability, compliance, delivery of the intervention, and the recruitment and testing procedure (O’Cathain et al., 2015). A feasibility study sets out to answer a wide variety of questions, including assessing the feasibility of the evaluation design (e.g. recruitment uncertainties, data collection, retention, key outcomes and measures used) and assessing

the intervention (acceptability, optimal delivery, willingness to be randomised and understanding how the programme may elicit the behavioural and health changes expected) (Lancaster, 2015; Skivington et al., 2021).

Given the variety of inquiry laced within this study, a convergent parallel mixed-method design was employed for this study, where both qualitative and quantitative methods were collected and analysed separately, and then merged during the overall interpretation of the data, as described by Creswell & Clark (2018). Using both quantitative and qualitative methods enabled the investigation of different aspects of the same phenomena, yielding an enriched understanding and broadening analysis and consequent findings (Greene et al., 1989). (Morse, 1991) describes this mixed method approach as useful “*to obtain different but complementary data on the same topic*” (p. 122) and was deemed the most feasible given the short timeframe to collect and analyse the data.

Mixed method approaches align with a critical realist approach. Although quantitative methods within critical realism are often regarded as descriptive, since correlations alone cannot uncover generative mechanisms, such methods are still useful in understanding potential outcomes elicited from intervention use (Zachariadis et al., 2013). The addition of qualitative semi-structured interviews allowed for deeper exploration into the contextual factors which may influence outcomes, and gave capacity to identify potential mechanisms, including political, social, and environmental structures, to explain the observed domain.

This feasibility study used a mixed methods randomised control trial (RCT) design. The researcher chose a RCT design to inform the development of a larger trial through highlighting any significant issues that may limit a future successful trial. Poorly designed RCTs can result in systematic bias or poor retention rates (Blatch-Jones et al., 2018), so this study focused on determining any uncertainties prior to further research.

Participants and recruitment

The inclusion criteria were kept broad, as findings from Study 1 and Study 2 demonstrated that having choice and autonomy in using telecare was crucial for older adults. Therefore, the researcher prioritised recruiting older adults (aged 65 and above and living at home)

with an interest in using the technology, rather than having strict criteria of physical or psychological characteristics. Participants were recruited locally through older adult groups in the Northwest of England for ease of data collection. Where possible, the researcher presented in person to potential participants. This approach was taken to allow participants to ask questions about the research and ease any concerns that older adults had, as previous research has indicated that older adults may feel apprehensive about taking part in research (Fiordelli et al., 2021).

Tickle-Degnen (2013) describes that there is no requirement to conduct a sample size calculation for a feasibility study, as the main aim is to describe the feasibility of implementing a future full-scale trial, and so, null hypothesis testing is not appropriate. Nevertheless, (Lancaster et al., 2004) recommends aiming for a sample of 30 participants to estimate effect size which would be used later in a sample size calculation for a full-scale trial. Detail regarding the study procedure can be found in Chapter 6.

Data collection

Health, well-being, and independence outcomes

Key decisions for this feasibility study centred around choosing what to measure and how. The researcher designed a quantitative survey that measured outcomes associated with independence, health and well-being using standardised questionnaires. Standardised questionnaires were chosen due to their wide use across the literature, allowing for comparisons with studies evaluating other telecare technologies. Physical and mental health, health-related quality of life, and levels of loneliness were measured. Although ADLs are often associated with independence, these were not measured, as the proactive telecare intervention of interest does not provide support for performing everyday tasks. Additional outcomes were measured following the completion of Study 1, where participants reported feeling less fearful of falls, improved self-efficacy, and reduced anxiety from having additional social support.

To measure views about the participants' health-related quality of life (HRQoL), the SF-12 short form survey was chosen due to its wide use and reliability (Huo et al., 2018). Mental

well-being was measured using the Warwick-Edinburgh Mental Well-being Scale (WEMWS) (Tennant et al., 2007) because it covers the subjective experience of happiness and life satisfaction (hedonic well-being) and psychological functioning and self-realisation (eudaimonic well-being), which have also been associated with independence by Hillcoat-Nallétamby (2014). Quality of life was measured using the Quality of Life Scale (CASP-19), as it specifically measures control and autonomy (Hyde, Wiggins, Higgs, & Blane, 2003), which were highlighted as important outcomes in both Study 1 and Study 2.

Other standardised surveys were chosen due to their wide use across the literature: the Hospital Anxiety and Depression Scale (HADS) to measure depression and anxiety (Zigmond & Snaith, 1983), the General Self-Efficacy Scale (GSE) (Jerusalem & Schwarzer, 1979) to measure self-efficacy, and the Falls Efficacy Scale (FES) to measure fear of falls (Tinetti, Richman, & Powell, 1990).

Using standardised questionnaires may not be effective in adequately capturing the participants' experiences and understanding if the intervention was acceptable or not. To overcome this limitation, qualitative semi-structured interviews were also used to allow further exploration into the participants experiences of taking part in the trial and using the intervention. Semi-structured interviews were used to enable exploration into individual accounts and contexts.

Acceptability outcome

The Senior technology acceptance model (STAM) was chosen as a way of measuring acceptability, due to its appropriate consideration of older adults' contexts (Chen & Lou, 2020). A standardised questionnaire has been developed to assess older people's acceptance of technology using STAM, so this questionnaire was adopted in this study.

Data analysis

For the quantitative analyses, baseline characteristics of the intervention and control participants were summarised using descriptive statistics. Feasibility studies should only aim to descriptively assess the feasibility of the RCT plan and not aim to do further analysis, such as hypothesis testing (Tickle-Degnen, 2013). Suresh & Chandrashekara (2012)

recommends calculating standard deviations and effect sizes to be used in a future sample size estimation.

For the qualitative analysis, thematic analysis was used to analyse the data. However, a framework analysis was utilised at this stage of the research, using a deductive approach to organise and structure the data in line with existing knowledge obtained from previous studies (Gale et al., 2013). Framework analysis is a common method of analysis used in feasibility studies (O’Cathain et al., 2015), as the structure of the framework allows researchers to systematically map the data against the specific aims and objectives (Gale et al., 2013), and so this approach was utilised in this study.

2.7. Public and Patient Involvement

The National Institute for Health and Social Care Research (NIHR) is a government funded research body in the UK, with significant emphasis placed on involving patient and public groups in the programmes, to ensure research is focused on addressing the needs of patients (NIHR, 2023b). NIHR established INVOLVE, which supports active public involvement and engagement with public health and social care research (NIHR, 2023c). Involving the public in research attempts to create knowledge *with* the public, rather than *on* them (Jackson et al., 2020). This programme of research is funded by NIHR Applied Research Collaboration (ARC) and holds the same values of involving patient and public groups, to produce high quality research that may benefit this population. Previous research suggests that utilising PPI in research may improve the relevance and impact of the findings to service users (Brett et al., 2014; Crocker et al., 2018). This is being recognised in practice, as stakeholder involvement is now included as a core component of the MRC guidelines for conducting complex intervention evaluation research (Skivington et al., 2021). It was deemed appropriate to involve the public from the beginning of the research, to gain insight from informal carers, older adults, and members of the public.

The aims of public involvement were to better understand the health and independence needs and contexts of potential telecare users, gain insight into current issues and challenges in utilising monitoring technologies, and utilise their experience in shaping

research questions, designing appropriate methods, analysing, and disseminating findings. To achieve these aims, the researcher recruited two public advisors funded by NIHR Applied Research Collaboration (ARC). Both advisors were informal carers, with experience of caring for their ageing parents who were also dealing with independence challenges, including frailty and dementia. One advisor had previous experience in public involvement and one advisor did not. The researcher met with the public advisors periodically throughout the doctoral research and asked the advisors to review documentation related to the research, including research protocols, ethical applications, surveys, and interview guides. The public advisors were paid for their time by the NIHR ARC. As discussed previously in section 2.6.2, the advisors also played a significant role in the analysis for the realist review, by reflecting on their own experience of caring for older adults who wanted to age in place. The researcher also sought feedback from an existing older adults' group, the Sefton Older Adult group, to ensure the research engaged directly with end-users. To ensure quality of reporting of PPI involvement in research, the Guidance for Reporting Involvement of Patients (GRIPP2) checklist was utilised to guide a critical reflection on the public involvement in the study, to enhance quality, transparency, and context to how PPI members contributed to research (Brett et al., 2014). The GRIPP2 checklist is provided in the thesis discussion chapter (Chapter 7).

2.8. Rigour in qualitative research

Study 1 and Study 4 utilised qualitative methods, so steps were taken to conduct rigorous and relevant research to uphold quality throughout. Within quantitative research, validity, reliability, and generalisability are concepts used to ensure quality in research under objective and reductionist paradigms (Leung, 2015). However, such methods are not suitable for qualitative research, due to the subjectivity of interpretations. Lincoln & Guba (1985) developed assessment criteria to promote quality and trustworthiness (rigour) in qualitative research, which consists of four concepts: (i) credibility, (ii) transferability, (iii) dependability, and (iv) confirmability. This next section will outline the definitions of each concept and how this thesis research considered each concept.

2.8.1. Credibility

Lincoln & Guba (1985) described credibility as ensuring that the researcher's interpretation of the findings adequately reflect the raw data. As described by Johnson et al. (2020), credibility is crucial to trustworthiness, as it aims to ensure that the research findings accurately reflect the experiences of the participants. Credibility was considered for the research in this thesis by using semi-structured interviews in both studies, allowing for participants to clarify and add to their responses. During the analysis stage, the supervisory team double coded a percentage of the interview transcripts and discussed common themes. This helped to reflect on any individual influences and biases that may have affected the analysis, to increase credibility. Finally, the researcher used triangulation with different data collection methods in Study 4 to increase the chance of interpretations being credible.

2.8.2. Transferability

Transferability is comparable to generalisability in quantitative research, but instead of describing how findings from large sample sizes can extend to whole populations, transferability refers to how the reader may determine whether the findings are relevant to their own, or different context, setting and sample (Tobin & Begley, 2004). Transferability can be improved through providing detailed descriptions of the sample, including their geographical location, age, sex, socio-economic status, ethnicity, and the time frame in which the data was collected from participants (Johnson et al., 2020). The research in this thesis provided rich descriptions of the participants, the research context, setting and the intervention of interest to enhance the transferability of findings. Purposive sampling was used to ensure participants with in-depth knowledge of the phenomena were explored, and later, snowball sampling was used to gain insights into varied experiences and contexts which may not have been otherwise uncovered (Nowell et al., 2017), enhancing the transferability of findings.

2.8.3. Dependability

Dependability refers to ensuring that the research process was logical, and that decisions were clearly documented so that the research could be repeated (Nowell et al., 2017).

Lincoln & Guba (1985) emphasise the importance of providing detailed descriptions of the research process, to enable the reader to be able to judge the dependability of the findings. Similarly, Koch (1994) suggests that researchers should provide a decision trail of the research process, so that a different researcher with the same data could provide similar interpretations. This thesis research attempted to describe the methodological, theoretical and logical decisions made throughout the research, to ensure that the reader understood the justifications and rationale behind the research process.

2.8.4. Confirmability

Confirmability refers to the process in which the researcher ensures to the reader that the findings are reflective of the participants' experience, and not influenced by external bias (Johnson et al., 2020). Arguably, it is difficult to separate our own beliefs and assumptions from how we analyse information (Dodgson, 2019), and our subjective biases may ultimately be integrated into the process of qualitative research (Ahern, 1999). However, in an attempt to enhance confirmability, the researcher kept a reflexive journal to acknowledge any pre-conceived ideas and beliefs on the topic of investigation. By noting down this internal dialogue, the researcher was able to understand their own position and influence on the research process. An advantage of taking a mixed method approach is that multiple sources of data were used to confirm findings across the four studies through triangulation, increasing the confirmability. All interview transcripts, coding and data supporting each theme were kept, providing an audit trail from the raw data to the manuscript, enhancing study confirmability.

2.9. Reflexivity in qualitative research

Braun and Clarke's reflexive thematic analysis approach to qualitative analysis was utilised for developing, analysing, and interpreting the qualitative data for this thesis (Braun & Clarke, 2019). Within this approach, Braun and Clarke suggest that qualitative research that adopts a relativist epistemological stance, as suggested in the critical realist position, should accept that the researcher's position and assumptions cannot be separated from scientific inquiry and utilising such experiences and pre-existing knowledge is an integral part of the method (Braun & Clarke, 2013). Qualitative researchers are consequentially invited to

consider how, not if, their values, assumptions, and beliefs may influence interpretation of the data. This process is facilitated by reflexivity. Reflexivity refers to the practice of describing and reflecting upon our interpretations of our own experiences and our assumptions of the phenomena being studied and considering how such contextual influences may affect our understanding of the work (Dodgson, 2019). Reflexivity is often encouraged to ensure rigour and trustworthiness in qualitative research (Finlay, 2002). Guba & Lincoln (1989) suggest that qualitative research is credible if researchers check that the respondents' views have been accurately articulated through the researcher's representation, which can be increased by reflexivity (Dodgson, 2019). Reflexivity may include questioning the assumptions made in collecting, analysing, and interpreting the data.

Shaw (2010) suggests being proactive in reflecting on encounters with participants and actively exploring any underlying assumptions and beliefs that may impact understanding of the phenomena. There is also value in acknowledging the role of demographic factors of the researcher, such as gender, age, ethnic background, and education level, which may influence interpretation of the phenomena under investigation (Dodgson, 2019). These contextual factors may have a causal influence on the research findings within a critical realist frame, and represent the 'real' level of ontological depth which realism aims to unearth (Price & Martin, 2018). In response to this, the researcher took various steps to reflect on their own position. A reflexive journal was kept from the conception of the qualitative work to its completion. Reflective notes were taken after interviews were conducted and revisited before analysis. Interrogating the researcher's internal dialogue encouraged the documentation of key research decisions and rationales, and so increased dependability of the research. Reflexive notes proved to be useful in critiquing unarticulated assumptions made during analysis and exploring dimensions of interest or gaps in knowledge.

2.9.1. Reflexive statement

Throughout my undergraduate and postgraduate degrees, I have had formal training in both quantitative and qualitative methods, but whilst I was studying for my Public Health

masters, I became drawn to qualitative approaches as they afford us a unique, rich, and detailed insight into experience which we may not personally hold. Since then, I have been conducting qualitative research on the impact of different contexts on health, including climate change, COVID-19, and now ageing. This experience has provided me with a foundation of knowledge on how to engage with reflexivity as part of the research process. Nevertheless, prior to this doctoral research I had limited experience in ageing research and subsequently, had not reflected on my unarticulated assumptions on this topic.

I started to reflect on what feelings I had which may impact neutrality and then began to unpick where these feelings and assumptions originated from (Ahern, 1999). Approaching a topic such as ageing from the perspective of an individual in their twenties, I saw myself as having an indirect experience with the phenomena, through supporting my older relatives in managing age-related challenges and growing up with the cultural context of ageing in the UK. Through writing reflexive notes, I realised that these experiences had influenced my expectations of what topics would be prominent in the research. Namely, that older adults are fiercely independent and want to avoid moving out of their own home at all costs, which arguably, may be a consequence of the UK promoting an individualistic society where citizens are independent and self-reliant (GOV.UK, 2023). Subsequently, this can lead to older adults facing challenges, such as a fear of asking for help, social isolation, and loneliness, potentially influenced by the existence of loneliness stigma. Ahern, (1999) suggests that qualitative researchers cannot be totally objective, but researchers should attempt to put aside their values to accurately describe the individual's experience. My assumptions on ageing became apparent in an interview with an older adult, where I felt uncomfortable asking about their feelings of loneliness, due to my assumptions of loneliness stigma. My assumptions affected my questioning technique in an interview early on in the PhD, as I did not want to delve into sensitive topics like loneliness, but holding back on this topic may have hindered the potential of gaining detailed and rich data. In response, Ahern (1999) recommends to engage in bracketing, which involves noting these observations and attempting to put them aside in an effort to not allow previous assumptions to impose on the data collection, analysis and interpretation. I noted these

assumptions, which helped me feel more comfortable with asking about such topics in subsequent interviews. Although I found bracketing a useful process, I recognise that not all my assumptions and experience can be 'put aside'. However, such experience may enhance the research process. For example, coming from a public health background which strives to improve the health and well-being of populations, I may not have approached the research as a neutral observer. Rather, my perspective may have been that of someone aiming to enhance health and quality of life, wherever possible. This training, which focuses on unpicking the social determinants of health and understanding inequalities in health, arguably aided the critical lens applied to this research.

2.10. Ethical considerations

Studies conducted as part of this thesis received appropriate ethical approval from Lancaster University's Faculty of Health and Medicine Research Ethics Committee prior to commencement (see appendices for ethical approval letters). When involving human participants in research to gain understanding of a phenomena, researchers have a duty to ensure that autonomy of participants is respected, no harm is caused to participants and benefits are maximised, and participants have dignity and justice (Yip et al., 2016).

Obtaining informed consent is identified as crucial in the literature, to ensure participant autonomy (Yip et al., 2016). The process of informed consent is when a participant voluntarily confirms their willingness to participate in research, after receiving all relevant information about the research that may influence the person's decision to take part (Manti & Licari, 2018). For Studies 1 and 4, the researcher provided all potential participants with a Participant Information Sheet (PIS), which contained all relevant information regarding the study process, what was expected of the participant, and stated that the participant could withdraw at any time without giving a reason. The researcher ensured that potential participants understood the study process, and asked whether they had any questions. Written consent was obtained through the participant signing and dating a consent form (ICH, 2020).

Petrova et al. (2014) describes that maintaining confidentiality of research participants is crucial in protecting their privacy and dignity. To ensure participant confidentiality was protected, names were anonymised by replacement with a unique non-identifiable code. To further protect participant identity and confidentiality, interviews, transcripts, and quantitative data were stored in Lancaster University's OneDrive, compliant with General Data Protection Regulation (GDPR).

In health research, offering financial benefits to participants is common, to provide compensation for their time given to taking part in the research (Njue et al., 2015). Although, some researchers find payments to participants ethically controversial. Some incentives are problematic from an ethical position, for example, where the risk of harm of participating in the research are high, or the research is considered degrading (Grant & Sugarman, 2004). Nevertheless, this research was considered low risk to participants and not of a degrading nature, and so it was considered appropriate to offer compensation for participants' time but keeping it to a small amount to reduce risk of coercion. Participants were offered a shopping voucher valued at £15 for Study 1 and £20 for Study 4.

When planning the feasibility study, it was important to consider the potential to cause harm from the study inception, as the literature states the obligation of nonmaleficence (to do no harm) in research (Yip et al., 2016). Although intervention trials aim to investigate specific benefits of the intervention to inform future decisions on whether the intervention should be scaled up, participants may experience unintended consequences. Such consequences should be considered prior to the trial, to ensure the possibility of harm to trial participants is minimised (Smith et al., 2015). No direct harms were identified; however, the researcher contacted participants once a month to check-in on their experience and give participants the opportunity to voice any concerns. Risks to the researcher were also minimised by working in accordance with Lancaster University's Lone Researching Policy. This involved notifying the researcher's emergency contact of the time and location of a home visit and confirming the researcher's well-being 10 minutes before and after the home visit.

Of note, Smith et al. (2015) describes that one incidental consequence of taking part in a trial is that participants may receive better care in the trial than they would have done otherwise. Subsequently, a potential indirect harm is that once the trial is over, the intervention is subsequently stopped, and the participant can no longer use it. This example, unfortunately, occurred during the feasibility trial, where one participant found the intervention extremely useful in reducing their feelings of loneliness. The participant was purposefully not pressing their OK button each day to receive a phone call from the OK team to have daily social connection, and subsequently built a strong relationship with the call centre team. Once the 8-week trial finished, the participant expressed the enormous benefit of having daily contact and wished to continue using the intervention, but they could not afford to pay for it privately. This presented an ethical dilemma, as participants in a trial should not be worse off than when they began the research (Smith et al., 2015). Whitney & Evered (2022) recommends having protocols in place if participants become distressed, through offering a list of available resources such as crisis hotlines, to protect participant well-being. In response to this, the researcher produced a list of resources that could support older adults' health and well-being, and signposted participants to local and national befriending services, such as Age UK telephone friendship services (Age UK, 2023c).

2.11. Chapter summary

The methodology chapter described the researcher's critical realist philosophical position and explained how this approach informed the methodological decisions taken in this research. The chapter outlined the methods used for each of the four studies and justified why they were used. The chapter highlighted how rigour and reflexivity in qualitative research was upheld throughout the thesis. The involvement of patient and public groups in this research was explained and justified, and key ethical considerations during the research were explored. The following chapters (Chapters 3-6) present each of the four studies. This thesis is presented in an alternative format and adheres to the Lancaster University manual of academic regulations and procedures (2023). Consequently, the study

chapters are presented as individual papers that have either been published or are formatted ready for publication.

3. Chapter 3: Understanding the value of a proactive telecare system in supporting older adults' independence at home: a qualitative study among key interest groups

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3.1. Chapter overview

Chapter 3 presents a qualitative study with various interest groups to initially explore their perceptions and opinions on the value of a proactive telecare service. The aim of the study was to understand to what extent using a proactive telecare service could support older adults to live independently, what potential health and well-being benefits may be elicited from its use, and what the limitations are. This study contributes to existing literature on the impact of proactive telecare interventions on health, well-being, and independence. This study has been published in the Journal of Medical Internet Research.

3.2. Abstract

3.2.1. Background

Telecare is claimed to support people to live in their own homes for longer by providing monitoring services that enable responses to emergencies at home. Although most telecare technologies commissioned in the United Kingdom predominantly supply reactive services, there has been recent interest among policy makers to develop proactive telecare services to provide additional understanding of older adults' health and well-being needs to provide a means for more preventive interventions. Proactive telecare refers to providing regular well-being calls or encouraging users to regularly confirm their well-being to anticipate and prevent crises through an increased understanding of individuals' needs and by building social relationships with older adults. Such technologies have already begun to be introduced, yet more research is required to understand the potential value of proactive telecare.

3.2.2. Objective

This study explores the perceptions of different interest groups to understand the extent to which using a proactive telecare service can support older adults to live independently, what potential health and well-being benefits may be elicited from its use, and what the limitations are.

3.2.3. Methods

Semi structured interviews were conducted with older people (those with experience in using proactive telecare and those without), family members of proactive telecare users, and proactive telecare staff regarding their perceptions and opinions about the value of a proactive telecare service. Data were analysed using inductive thematic analysis.

3.2.4. Results

A total of 30 individuals participated in this study. Older adults described the value of the intervention in feeling safe and in control and appreciated feeling connected. Family members and staff valued the potential to detect health deterioration in older adults, and all participants highlighted the benefit of strengthening access to social networks,

particularly for socially isolated older people. However, telecare interventions are often viewed as a last resort, and so, this telecare intervention may not suit all populations, as demonstrated by the mixed acceptance of the technology among older adults who did not have experience using it. Participants also reported limitations, including the requirement for family, friends, or neighbours to assist older adults during an emergency and the need for financial resources to fund the service.

3.2.5. Conclusions

This study presents a qualitative inquiry about a proactive telecare system, which provides rich and detailed insights from different perspectives into the potential benefits of this intervention. This proactive telecare intervention may promote and facilitate the accumulation of social and technological resources as individuals prepare to cope with age-related challenges, thus helping to avoid negative outcomes prematurely. However, like more reactive telecare, this proactive telecare intervention must be matched to individual preferences and existing financial and social resources.

Key words: Older adults; telecare; independent living; health and well-being

3.3. Introduction

3.3.1. Background

The United Kingdom faces an aging population. In 2018, approximately 1 in 5 people were aged ≥ 65 years, with this figure expected to reach 1 in every 4 people by 2038 (ONS, 2019). In response, policy makers advocate for supporting older adults to live independently at home to avoid costly institutional care (Wiles et al., 2012). Studies suggest that maintaining independence is also a key desire of older adults (Strout et al., 2018; Wiles et al., 2012) as it facilitates people ageing well (Reich et al., 2020). Independence-related concepts refer to maintaining autonomy, making choices (Hillcoat-Nallétamby, 2014), preserving physical and cognitive function, being self-reliant (Plath, 2008), and having the necessary financial and social resources to cope with age-related challenges (Hillcoat-Nallétamby, 2014). Loss of independence contributes to reduced health-related quality of life (Marques et al., 2014), low self-esteem, depression, and feelings of worthlessness (Ball et al., 2004); therefore, the

public health benefits of promoting independence are substantial. However, interrelated factors threaten independence, such as physical and cognitive impairments, chronic diseases, and reduced social networks (Eloranta et al., 2008; Piau et al., 2013). In response, technology use is encouraged in older adults to support and maintain independence (Bell & Menec, 2013).

Telecare is reported to have great potential in supporting people to live in their own home for longer (Barrett et al., 2015). Telecare is characterised by monitoring technologies that manage the risks associated with independent living; examples include pendant alarms and fall detectors (Goodwin, 2010). Telecare is typically connected to a call centre, where assistance can be summoned, for example, if a person has fallen. Telecare is promoted by policy makers, who understand its potential in reducing hospital admissions and improving quality of life among older populations, and is routinely commissioned by most local authorities in England (Steils et al., 2019). However, there is evidence suggesting that the uptake of telecare is relatively low, as suggested by Bentley et al. (2018) and Wherton et al. (2015), and researchers question its utility to support independence (Greenhalgh et al., 2012).

Most telecare services available are predominately reactive in nature. Reactive telecare refers to sensors or pendant alarms that trigger an emergency response following an alarm raised by the user or detection of unusual behaviour by ambient sensors (Contreras et al., 2022). Reactive telecare has several limitations. First, pendant alarms are dependent on the individual to be activated during an emergency, which may not always be possible as devices may not be always worn (López & Domènech, 2008), users may not be able to react, or they might delay reacting to a situation because they do not wish to inconvenience others (Bentley et al., 2014). Second, ambient sensors may manifest in concerns about being monitored, affecting perceived control and privacy (Berridge, 2017). Passive monitoring may shift agency away from the older person, providing little opportunity for user engagement and resulting in reduced autonomy (Mort et al., 2015). Sanders et al., (2012) explored the barriers to adopting reactive telecare during the Whole Systems Demonstrator Program, a large evaluation of telecare effectiveness in England, and argued that older

adults in their study associated reactive telecare with stigma and ageism. Therefore, telecare is often viewed by older adults as a last resort (Astell et al., 2020; Bentley et al., 2018), thus reducing its potential to promote health and well-being in later life.

The concept of proactive telecare has received interest among researchers (Cund et al., 2022) and policy makers (GOV.UK, 2022); however, there needs to be better understanding into the impact of such technologies, given its existing use in countries such as Spain (Contreras et al., 2022) and the United Kingdom (Alertacall, 2023). Proactive telecare refers to providing proactive well-being calls or encouraging users to regularly confirm their well-being, with the aim of anticipating and preventing crises and facilitating strong social connections between older adults and social care services (Contreras et al., 2022). Having regular engagement with older adults may enable early identification of significant changes in needs (Eloranta et al., 2008), which could provide the user the opportunity to acquire resources to prolong independence or receive health care in a timely and preventive manner. Telecare interventions that encourages active engagement from individuals to confirm their well-being, rather than using passive monitoring to detect ill-health, may elicit a sense of autonomy, which may support someone's perceived goals of independence (Liu et al., 2022). Proactively supporting older adults' social care needs may act as an early warning system, which could provide a key mechanism to better assist older people to remain in their own homes; however, little research has explored its value in supporting independence.

3.3.2. Objective

This study aimed to understand the extent to which using a proactive telecare service can support older adults to live independently, what potential health and well-being benefits may be elicited from its use, and what the limitations are. This qualitative study explored the perspectives of four key interest groups to gain an in-depth understanding of how a proactive telecare intervention may meet older adults' independence needs, including older adults with or without experience of using proactive telecare, family members who support older adults to use the technology, or staff who deliver proactive telecare. Drawing on various experiences and perspectives from four participant groups ensured the

collection of rich and candid data and maximised the potential of understanding the value, limitations, and outcomes of using a proactive telecare service.

3.4. Methods

3.4.1. The proactive telecare service

To gain insight into the potential value of a proactive telecare service in supporting independence, we explored the experiences and perceptions among key interest groups about an existing intervention in the United Kingdom. For the purpose of this study, a service called OKEachDay was chosen owing to its known long-standing use across the United Kingdom. As the service had been operating since 2004, participants could reflect about their experiences of using the service over a long period, rather than restricted experiences during a pilot or trial. The technology consists of a touch screen smart device that is linked to a call centre (Figure 6).



Figure 6. Proactive technology of interest (OKEachDay).

The technology requires older adults to confirm their well-being by pressing an “OK” button at an agreed time each day, either once a day or up to 3 times a day. If no contact is established, the call centre team contacts the older adult to confirm their well-being, which gives the opportunity for information exchange or general social communication. If the older adult cannot be contacted, the call centre team escalates the situation and contacts the user’s nominated contact, normally relatives, neighbours, or carers. This proactive telecare system provides support on a scale according to need, starting from a light touch service where older adults simply press the OK button once or several times in a day to a more involved intervention where older adults may not press their OK button and consequently receive further support from the proactive telecare staff. Call centre staff are available from 8 AM to 10 PM every day of the year. Staff are given awareness training to provide low-level psychosocial support for older adults. Training includes topics about supporting emotional needs, mental health awareness, suicide awareness, discrimination and domestic abuse, dementia awareness, learning disabilities awareness, and safeguarding. Staff will signpost individuals if the issue goes beyond their knowledge or ability to help. The call centre also conducts additional well-being calls to help people who may feel particularly isolated. The intervention is used in either sheltered housing, where the cost of the service is included in the independent living service charge paid by residents, or it is paid for privately by users. New users are sent the technology and given simple instructions about how it works either in person or over the phone. Staff contact new users to explain how to use the system and answer any questions the users have. Systems are set up by plugging it into an electric socket, agreeing upon a convenient time for the user to press their OK button, and confirming the user’s nominated contact.

3.4.2. Study design

This study used semi structured interviews to conduct an in-depth exploration of different interest groups' perspectives about the value of proactive telecare. Individuals from 4 groups were invited to participate to explore the phenomenon from different perspectives: (1) proactive telecare users; (2) family members of proactive telecare users; (3) proactive telecare staff involved in delivery; and (4) older adults who do not currently use proactive telecare, referred to as non-users. The study design aligned with the COREQ (Consolidated Criteria for Reporting Qualitative Research) guidelines ([Appendix 1](#)) (Tong et al., 2007).

3.4.3. Ethical considerations

Ethics approval for the study was given by Lancaster University ethics committee in June 2021 (FHMREC20142) ([Appendix 2](#)). Participants provided consent either verbally or via a consent form. All participants were offered a shopping voucher worth £15 as appreciation for their time spent in the study.

Participants, recruitment, and sampling

Participants were sampled purposively to ensure perspectives from all identified stakeholder groups were represented. Snowball sampling was also utilised to identify previously unknown participants (Naderifar et al., 2017). The first author contacted managers at the proactive telecare organisation and housing associations who use the proactive telecare service to aid in disseminating the study invitation ([Appendix 3](#)). Current proactive telecare users and family members of users were invited to participate in the study via notification through the smart device or email. There were no relationships among the interviewees, that is, the recruited family members were not related to the recruited proactive telecare users. Older adults who did not currently use proactive telecare were recruited via local, older adult social groups. People who were interested in participating were sent a participant information sheet ([Appendix 4](#)) and asked to contact the first author. To meet the study's inclusion criteria, older adult participants had to be aged ≥ 65 years and live in the community. If the participant wished to proceed, an interview time was agreed upon and consent was obtained ([Appendix 5](#)).

3.4.4. Data collection

Data were collected between July 2021 and November 2021. Given the unpredictable nature of the COVID-19 pandemic at the time, interviews were conducted via telephone. A total of 30 semi structured interviews were conducted. Participants were assured that their participation was voluntary and were informed that they could withdraw at any stage. Interviews were conducted by the first author using an interview schedule. Interviews began by asking the participants about their views regarding independence, reasons for using proactive telecare, perceived health and well-being outcomes elicited, and limitations to use. Guides were adapted according to the specific interest group being interviewed ([Appendix 6](#)). After 30 interviews, it was deemed that new data from the 4 groups were no longer adding further insights or dimensions to the overall findings, and so, through discussions, the researchers concluded that data saturation had been reached (Saunders et al., 2018) and sufficient understanding of the emergent themes had been achieved. Interviews lasted between 25 and 80 minutes, with a mean time of 44 (SD 15.05) minutes. All interviews were audio recorded with permission from the participant and transcribed verbatim by the first author.

3.4.5. Data analysis

Data were analysed following Braun and Clarke's stages of thematic analysis (Braun & Clarke, 2006), which provided a flexible, yet detailed and rich analysis. The first author read the transcripts several times to facilitate immersion in the data. Inductive codes were recorded and grouped into potential candidate themes using NVivo (Version 12; QSR International) software. Triangulating codes and themes from multiple interest group perspectives provided additional contextual information, which improved the interpretation of the data. To ensure credibility of the data analysis, initial codes and emerging themes were discussed with the senior research team, allowing further refinements. Codes were subsequently grouped into candidate themes and reviewed to ensure that data cohered together appropriately and meaningfully. Comparison of themes across interest groups enhanced the reliability and richness of the analysis (Leung, 2015).

Each theme was clarified, with meaningful names and descriptions assigned. All researchers reviewed the final thematic outcomes.

3.5. Results

3.5.1. Participant characteristics

In total, 30 participants were interviewed from various interest groups, comprising 15 (50%) proactive telecare users, 5 (17%) older adults who did not currently use proactive telecare, 4 (13%) family members of users, and 6 (20%) staff members (managerial and call centre staff from the proactive telecare service and housing association staff who provide proactive telecare). The average age for the participant groups were as follows: proactive telecare users: 74.6 (range 65-87) years; older adults not currently using proactive telecare: 74.2 (range 67-81) years; staff involved in delivering proactive telecare: 39 (range 26-57) years; and family members of users: 65 (range 63-70) years. Overall, 3 (75%) out of 4 of the family members were female. Characteristics of the older adults and staff involved in proactive telecare delivery are displayed in Tables 3 and 4.

Table 3. Characteristics of proactive telecare users and older adults who are not currently using proactive telecare (non-users).

Characteristics	Proactive telecare users (n=15), n (%)	Non-users (n=5), n (%)
Sex		
Male	7 (47)	1 (20)
Female	8 (53)	4 (80)
Level of care		
Informal or formal care	6 (40)	0 (0)
No care	9 (60)	5 (100)
Level of mobility		
Partially affected or limited	9 (60)	1 (20)
No issues	6 (40)	4 (80)

Employment status		
Retired	14 (93)	5 (100)
Employed part time	1 (7)	0 (0)
Current or previous occupation		
Professional	1 (7)	4 (80)
Managerial	2 (13)	0 (0)
Clerical and service	6 (40)	0 (0)
Trade work	4 (27)	0 (0)
Unemployed	1 (7)	1 (20)
Prefer not to say	1 (7)	0 (0)
Living arrangements^a		
Private accommodation	10 (67)	4 (80)
Housing association	5 (33)	1 (20)

^aAll older adults lived alone.

Table 4. Characteristics of the staff involved in proactive telecare delivery (n=6).

Characteristics	Staff involved in proactive telecare delivery, n (%)
Organisation	
Housing association	3 (50)
Proactive telecare service (managerial and call center staff)	3 (50)
Sex	
Male	1 (17)
Female	5 (83)

Overall, four themes were interpreted from the combined data: (1) health and safety, (2) autonomy, (3) access to social networks, and (4) needs and resources.

3.5.2. Theme 1: Health and safety

Feeling safe and in control

All participants acknowledged the priority of older adults to live in their own home; however, a key concern across participants was safety. Approximately half of the proactive telecare users had experienced a stressful event that influenced their independence, including onset of illness, loss of partner, or previous experience of falling, which subsequently led users to adopt proactive telecare. The remaining half of older adults anticipated age-related losses and adopted proactive telecare as a risk management strategy. Although the non-user participants had not experienced a stressful event, all expressed fears of becoming dependent.

The proactive nature was viewed positively by most users and seemed to give both older adults and family members peace of mind that emergency action was not dependent on the user summoning help:

Well mentally, I think it helps anyway. Because otherwise you'd be worried all the time so mentally it's a very good thing.

[Proactive telecare user 12]

Of the five non-users, two felt that a proactive check-in may help to provide them with a network of social support that could help in case of future age-related deterioration. One participant lacked close relatives and highlighted the potential value of proactive telecare:

If I had one of those [proactive telecare], it would relieve some of my anxieties that I have when I wake up at 5am in the morning every morning, one of the things that if you don't have family around, you worry about. So, I do think OK, what do I do in the future and how do I organise ahead for this, is that something I may need as I get older, rather than waiting like my parents.

[Non-user 2]

Daily check-ins were particularly important to some users who felt that they lacked social contacts who check in on them regularly. In contrast, some users did not wish family

members to check on them physically and viewed the technology as a proactive check-in, which elicited feelings of self-efficacy.

Some proactive telecare staff and users reported that when users start using the service, they required a few weeks to develop a routine of pressing their OK button:

When we first install, most of them forget for a couple of weeks. We have a big embedding period where for two weeks we just will call them, it just takes a bit to get into the swing of the routine.

[Staff member 4; managerial proactive telecare staff]

Once a routine was established, all users found the technology easy to use and were reassured that help could be accessed.

Limits to safety element

For some participants, particularly non-users, the fact that proactive telecare did not provide 24-hour support was a significant limitation, given that many proactive telecare users adopted the intervention to use as a safety precaution. Some users used pendant alarms alongside proactive telecare to solve this issue; however, acceptance toward the pendant alarm was mixed:

The pendant alarm is OK if there's any emergencies. I mean two hours and 10 hours on the floor is a long time if you're not very well. So, I keep the pendant around my neck in case I need any help.

[Proactive telecare user 11]

Some users considered proactive telecare as a precursor technology to other monitoring technologies such as ambient sensors, as they perceived themselves as independent and viewed monitoring technologies as intrusive and disempowering.

Identifying health deterioration

According to a few family members and staff members, proactive telecare had the potential to detect health deterioration in the user. These participants postulated that a lack of

promptness of pressing the “OK” button over sustained periods may enable the detection of illness:

There have been significant periods where she had forgotten to press and it’s also always coincided with a period of when she hasn’t been so well, so I think it’s a good indicator.

[Family member 2]

This was considered as a significant benefit as family members suggested that older adults can find it difficult to ask for help, resulting in ill-health going undetected and consistent anxiety among some family members regarding older relatives’ health.

3.5.3. Theme 2: Autonomy

Maintaining autonomy was a key priority expressed by many older adults and was associated with positive well-being. Despite experiencing physical decline, approximately half of the older adults were highly determined to do things by themselves, even if this required overexerting themselves. However, other older adults were more willing to forfeit some control and receive help from others as a compensation for loss of physical function, so that they could remain living at home.

For proactive telecare users, proactively pressing a button evoked a sense of agency and autonomy. Staff members at housing associations saw the benefits of giving control to users, as it demonstrated that they were viewed as capable to be responsible for their own well-being, potentially boosting confidence and self-esteem:

I think there’s a lot of benefits to it. It gives you a sense of freedom, it gives you independence, because you’re in charge of doing that.

[Proactive telecare user 14]

A user spoke about how they were offered a daily call instead of pressing a button, but they wanted to continue engaging proactively, as it enabled their independence and sense of capability. However, some of the non-users still regarded proactive telecare use as signifying older age:

Friends of mine who have disabilities would not use services like this...because they wouldn't see themselves within the community of people who need them. I think there's an issue around people not identifying themselves as being part of the group of people who require this support.

[Non-user 2]

3.5.4. Theme 3: Access to social networks

Opportunity for social connectedness

The potential for social support was viewed favourably across the participant groups, as it was perceived to provide an avenue of communication, particularly for individuals who struggle to ask for help from close contacts. Proactive telecare staff members viewed the call centre as a valuable opportunity to check in with an individual's well-being:

We have people call us that are suicidal, and that's actually quite common now, we're seeing that more and more...people just calling for help, they don't know who else to call.

[Staff member 4; managerial proactive telecare staff]

Non-users acknowledged the benefit of the social connection that the technology gave to people and saw this as an accessible way for someone feeling isolated to reach out and talk to someone. Almost all older adults appreciated having the option to call somebody, as it created another contact to call for help, separate from family and friends, where some older adults voiced concerns of being a burden.

Connections with staff

Discussions with older adults highlighted the importance of the relationships built with the call centre staff. Older adults commonly mentioned the altruistic nature of the call centre staff as beneficial, as this created a sense of belonging and reduced the feelings of loneliness:

If I were really lonely, and I were feeling down, I could phone somebody at [proactive telecare] and talk to them, cos the lady who usually phones me when

I've missed the button, she's very, very nice.

[Proactive telecare user 8]

However, it was acknowledged by some staff members that relationships between staff and users can take time to form and that individuals may not benefit from connections to this social network immediately or at all, if they do not want to engage with the social aspect of the technology.

Feelings of burden

For some users, forgetting to press their button and receiving a call from the call centre brought feelings of shame and embarrassment for being forgetful:

When they ring me, they're very nice, but I feel like I've let myself down for forgetting to press the button.

[Proactive telecare user 10]

According to some older adults, forgetting to press their button was felt as being a threat to their perceived identity of being independent, as they wanted to be seen as able to cope by others. A few users spoke about feeling like a burden for forgetting to press their button, as they feared that the call centre staff would be worried about their well-being.

3.5.5. Theme 4: Needs and resources

Perceived need and acceptance

Approximately half of the participants suggested that for people to adopt and benefit from the technology, they needed to have a level of acceptance regarding their age and related physical deterioration. Most proactive telecare users were future-orientated people and wanted to plan for anticipated age-related deficits but recognised that not all individuals have this mindset and so, would not benefit from being proactive:

If you're getting older, you don't like to admit it. You still think you can do everything, until something happens.

[Proactive telecare user 2]

In contrast, two of the five non-users acknowledged that they would not want to identify themselves as requiring support to live independently and would not consider using proactive telecare.

Reliance on existing networks

Approximately half of the participants voiced the concern that existing social networks were required for proactive telecare to be effective in providing safety. A non-user highlighted that certain people who are socially isolated may struggle to give an emergency contact, and so, this type of intervention may not be appropriate. In addition, for most family members, it was important to be geographically close to their relative, so that they could provide support:

It would be more worrying if people were much further away, I would think, maybe it's not the right system for them. Because first port of call really needs to be someone within easy reach or easy getting to the person that hasn't pressed the button.

[Family member 1]

The remaining half of participants did not mention the need for social networks, but most of these users had relatives or friends close by and may not have realised this reliance. A few users mentioned feelings of uncertainty and anxiety in anticipation of an emergency, as their contacts did not live close. Some users and a family member had purposively established relationships with neighbours, to use them as a primary contact during an emergency; however, participants acknowledged this may not always be possible.

Financial resources

Financing the intervention was seen as a key barrier to access by most. It was acknowledged that the financial commitment required may prevent older people from being proactive, and they may engage with it only after it becomes a necessity:

Well, it's not free, is it, that's the thing. And until you need it [proactive telecare], I guess you don't realise it's important...and I think a lot of people probably put it

off.

[Family member 4]

In housing associations, proactive telecare was included in the package of living in the accommodation, which was seen by staff and users as a significant benefit and reduced economic barriers to access.

3.6. Discussion

3.6.1. Principal findings

This study collected data from various interest groups to understand the extent to which a proactive telecare service could support independent living in older adults. Overall, our findings demonstrate benefits that overlap with those of reactive telecare, such as contributing to feelings of safety and providing reassurance of assistance in times of need. Nevertheless, this particular proactive telecare service presented unique benefits and challenges worth discussing. Giving the user the opportunity to confirm their well-being proactively facilitated autonomy and generated data with the potential to identify health deterioration. Moreover, well-being calls presented the telecare staff with the opportunity to engage meaningfully with vulnerable service users and offered an additional source of social connection. However, our study suggested that forgetting to engage with this proactive telecare system may elicit feelings of burden, and individuals may have varying levels of social and financial resources, which must be assessed to ensure that older adults are best supported.

The desire to feel safe at home has been previously cited as a core motivation for adopting telecare (Cook et al., 2016), as older adults are more likely to be exposed to risks threatening independence (Kahana et al., 2012). Reactive telecare is often utilised *after* an age-related incident, and subsequently can symbolise negative stereotypes associated with ageing (Bentley et al., 2014). In contrast, in this study, approximately half of the older adults adopted this particular proactive telecare system *before* they had experienced an age-related stressor but anticipated this risk and saw the value in planning for the future. In addition, two of the five non-users were concerned about the anticipated age-related

challenges and did not want to age at home without adequate technological provisions. The preventive and corrective proactivity model describes the value of proactive adaptations in both anticipation of and in response to age-related changes, to accumulate resources to avoid and ameliorate the adverse effects of stressors (Aspinwall & Taylor, 1997; Kahana et al., 2014). Proactive telecare services that encourage uptake before age-related issues arise may facilitate the accumulation of social and technological resources to ensure safety at home. When individuals prepare to confront and cope with age-related challenges, it can help to maintain well-being and quality of life (Aspinwall & Taylor, 1997). However, some non-users still associated the intervention with the stigma of aging; therefore, it is acknowledged that not all older adults may be receptive to adopting telecare before they perceive a need for it. Our findings emphasise the need to offer a variety of interventions to suit different coping styles, which, in turn, may improve access to telecare and serve a wide population of older adults.

Recently, interest has grown in using proactive telecare to track patterns of behaviour to monitor health in the home environment (Cund et al., 2022). In this study, family members and housing association staff reported that tracking forgetfulness patterns of when a user had forgotten to press their OK button may help to detect health deterioration, such as a urinary tract infection (UTI), which can cause confusion quickly (Dutta et al., 2022) and may present as an individual forgetting to press their button over a short period. Detecting indicators of illness may offer the potential to inform early and more tailored interventions to support well-being and resilience (Cund et al., 2022) and avoid age-related stressors (Contreras et al., 2022). In contrast, tracking forgetfulness patterns may also diminish well-being owing to the stigma associated with memory loss (Ballard, 2010), as demonstrated in our data by the dismay expressed by users when they forgot to press the button. Our findings contribute new knowledge about the potential benefits and unintended consequences of proactive engagement with telecare and emphasise the need for further studies into the psychological implications of forgetfulness tracking.

Most older adults maintained the desire to sustain autonomy, which was associated with well-being (Berridge, 2017; Hillcoat-Nallétamby, 2014). In this study, older adults reported

feeling self-sufficient by engaging proactively with the technology. Being self-reliant may bolster self-esteem and subsequently increase perceived sense of control (Sánchez-García et al., 2019), which is associated with better physical and psychological health (Hong et al., 2021). Reactive telecare has focused on surveillance, which treats older adults as passive recipients of care and reduces their sense of control over technological use. In contrast, our findings highlight the potential of a proactive telecare intervention in promoting self-management and, subsequently, independence, rather than conveying the need to be continuously monitored, thus signifying the value of proactive technologies in supporting independence. Notably, this proactive telecare system provided support according to the user's level of independence, that is, if an older adult required further support, this was detected by the individual not pressing their OK button, or if an older adult pressed their OK button, it is assumed that no additional support was required. As the system monitored individuals according to their level of independence, this proactive approach may aid in ensuring that the right level of support is available during times when independence levels may change, for example, during periods of illness or following a hospital discharge. Further studies are required to understand the extent to which proactive telecare interventions can detect the changing levels of independence across individuals and the potential benefits to health and well-being. Moreover, further studies are needed to understand the value of proactive telecare for individuals with high levels of cognitive dependency, as none of the participants in this study were living with dementia.

Participants saw social connections as important in maintaining independence, which has also been seen in a systematic review of lay perspectives of successful ageing (Cosco et al., 2013). Recent studies suggest that delivering outbound calls to older adults may foster strong relationships between users and service providers, helping to identify changes in people's circumstances and provide more tailored support (Contreras et al., 2022). Similarly, in our study, proactive telecare users appreciated being connected to a network of support and valued the opportunity to disclose well-being issues, such as anxiety and loneliness. Gradual deterioration in mobility that accompanies aging may expose older people to social disconnection and loss of key social relationships (Morris et al., 2014),

further highlighting the need to provide additional avenues of support to this population. There were limitations to proactive telecare. Some participants reported concerns regarding safety, as this service did not provide 24-hour support. Interestingly, some users had accepted this limitation as they saw other reactive telecare services as a symbol of older age, whereas other users chose to use additional technologies such as a pendant alarm for obtaining help faster in a crisis, thereby demonstrating the importance of assessing a person's needs to best allocate telecare devices, which has been demonstrated in other studies (Woolham et al., 2021). Another limitation was the reliance on the availability of family, friends, or neighbours to assist during a time of need, a limitation that also exists in reactive telecare (Greenhalgh et al., 2015). This further emphasises that telecare devices are not "one" solution but should work to complement people's needs and resources (Mort et al., 2015). Financial resources have also been identified as key barriers to telecare and monitoring technology access (Baig et al., 2019). However, little has been suggested to overcome these barriers. In this study, respondents commented about the benefit of having proactive telecare included in the package of living in sheltered accommodation, which relieved the burden of financial stress, thus demonstrating the potential advantages of package telecare systems.

3.6.2. Limitations to the study

This study has several limitations worth noting, particularly regarding the transferability of the findings. It is recognised that some participants may have expressed more positive views toward the intervention as a long-standing recipient or staff member, despite the interviewer asking participants to reflect about both positive and negative experiences. Although non-users were invited to provide an outsider's perspective about the technology and to give critical insights, these participants were recruited through an opt in method and may be more socially engaged, and so, their views may not be representative of this age group. All participants were White British, and thus, these findings may lack transferability across different ethnic groups. Furthermore, this study only explored the experiences and opinions of one proactive telecare system and arguably, the example explored in this study asks individuals to confirm their well-being daily by pressing an OK button and offers a

relatively low level of psychosocial support, which may not translate across to other interventions which use higher level support methods of proactivity (such as initiating call centre-to-user phone calls to check on the user's well-being). Although these findings may provide useful insights to direct further studies, there needs to be further investigation into the value of other proactive telecare interventions with differing elements and levels of support.

3.7. Conclusions

This paper presents a qualitative inquiry about a proactive telecare system and provides insights into how this type of telecare may support older adults to live independently. Engaging proactively with telecare provides older adults access to social networks and support, if required. Having control over engagement with the technology helped bolster individual confidence and self-reliance, thus supporting independence and well-being. Daily engagement with technology offered opportunities for families to detect health and well-being deterioration. As with other telecare, individual preferences and social and financial resources must be considered to maximise benefits.

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Authors' Contributions

LF led on the design, data collection and analysis, and write-up processes. CH and NH were involved in the design, provided feedback about the drafts of the paper, and provided

guidance throughout the study. YL gave feedback about the drafts of the paper and provided guidance throughout the study.

Conflicts of Interest

None declared.

4. Chapter 4: How, for whom and under what circumstances can telecare support independent living in community-dwelling older adults: a realist review.

4.1. Chapter overview

Chapter 4 presents a realist review of existing literature on how telecare devices can support health, well-being, and independence in older adults. This study aims to understand how telecare technologies could support older adults living independently, for whom, and under what circumstances. This study contributes to existing literature as most research to date has focused on the effectiveness of telecare interventions, rather than unpicking *how* the technology can support older adults with different health and well-being needs, resources, and preferences. This study will be submitted for publication to *BMC Geriatrics*.

4.2. Abstract

4.2.1. Background

There is substantial interest amongst policy makers in using telecare to support independence in older adults. However, uptake remains relatively low. This realist review aims to understand the contexts in which telecare can support independence and for whom, to aid older people to remain living at home.

4.2.2. Methods

This realist review is consistent with the RAMESES quality and reporting standards. We followed a five-step process to conduct the review: (1) locating existing theories and concepts, (2) searching for evidence, (3) selecting data, (4) extracting data, and (5) synthesising data. We analysed 31 studies published between 2004 and 2023 to identify core mechanisms of how telecare may lead to positive or negative impacts in the form of context-mechanism-outcome (CMO) configurations. CMOs were grouped into overall domains and contributed to an overall programme theory of how telecare works.

4.2.3. Results

Four key domains across 12 CMO configurations were identified, which suggest how telecare can support independence. (1) Telecare services should support older adults' goal of staying at home by providing reassurance of help in an emergency and aid in detecting age-related deterioration. (2) Telecare that supports autonomy by enabling choice over technological resources may support self-reliance and control over one's life, including choosing the level of monitoring, freedom to call for help if needed, and having the ability to customise technology to suit needs. (3) Telecare that enables connections to existing or new social networks may reduce loneliness and social isolation for those who lack social resources. Finally, (4) telecare must integrate into everyday life, by fitting with people's existing context, skills, resources, and identity. To improve telecare implementation, consideration must be given to these mechanisms, otherwise interventions risk being abandoned or under-utilised, and as a result, may not adequately support older adults to remain living at home safely, creating a false sense of security.

4.2.4. Conclusions

Assessments of an individual's needs and preferences should be carried out to ensure telecare enables autonomy, supports the goal of remaining at home, facilitates connections to social support, and promotes integration into everyday life.

Study registration

PROSPERO CRD42021292384.

4.3. Introduction

Globally, populations are ageing, with data predicting that by 2050, one in six people will be aged over 65 in the world (United Nations, 2023). Increased prevalence of chronic illnesses in older populations results in an increased need for health care support (Peng et al., 2023). In the United Kingdom (UK), an estimated 2.2 million people over 65 require support with at least one activity of daily living (ADL) (Nuffield Trust, 2023). In order to reduce the pressure on health and social care, the home environment is becoming an increasingly important setting for the delivery of social care interventions. Remaining in one's own home has become synonymous with independence, which most older adults wish to preserve, as reported by Hillcoat-Nallétamby (2014). Nevertheless, being able to stay at home is not the only dimension of independence highlighted in the literature; studies suggest a range of meanings of independence for older adults, including being self-reliant, maintaining a sense of control, having social relationships and obtaining help if needed (Boldy et al., 2011; Hillcoat-Nallétamby, 2014). Telecare use continues to be promoted to support people to remain at home (GOV.UK, 2023). It is characterised by various forms of monitoring technologies that manage risks associated with independent living; examples include pendant alarms, fall detector sensors (Goodwin, 2010), and other behavioural and environmental sensors (Peng et al., 2023). Telecare has the potential to support older adults to live at home by detecting potential accidents, injuries, and ill-health, thus facilitating a safe environment and protecting individuals from avoidable harm (Greenhalgh et al., 2012).

An estimated 1.7 million people currently use telecare in the UK, mostly older adults (Fisk et al., 2020). Telecare is purported to support independent living by supporting quality of life (Barrett et al., 2015; Greenhalgh et al., 2015). However, evidence to support these claims is mixed. A literature review on telecare use in older people showed that some older adults perceived telecare to promote health and well-being by providing a sense of security, reducing fear of falls and increasing confidence (Stewart & McKinstry, 2012). On the other hand, studies have also highlighted older adults' concerns about a lack of privacy when using telecare and monitoring technologies (Birchley et al., 2017; Karlsen et al., 2017), which may reduce autonomy and well-being. Despite these findings, telecare continues to be offered by local authorities across England as a way of preventing or delaying the need for care (Steils et al., 2019).

Woolham et al (2019) suggest that the locus of the problem is not the technology itself, but how it is implemented and utilised. Despite the varying contexts in which telecare is used, the technology is often deployed in a 'plug and play' manner, which may not be suited to individuals (Greenhalgh et al., 2013). Although research to date has offered insights into the potential efficacy of telecare devices, there has been little research into developing and refining theory on how the technology can support independence, health, and well-being and under what conditions, which would allow for better targeting of telecare to contexts where it is likely to be effective in promoting health. Given that older adults are not homogenous, telecare may support people in different ways or may not be able to meet everyone's needs.

A realist approach enables the exploration of what works for whom and how. This methodology is well suited to address the recognised need for further research on matching telecare devices to individual needs and resources. Therefore, the aim of this realist review is to develop and refine theory about how telecare use can support independence, health, and well-being in older adults, for whom and under what conditions.

4.4. Methods

4.4.1. Study design

A realist review was conducted, a theory-driven approach to evidence synthesis that aims to uncover how, for whom and under what circumstances interventions work (Pawson & Tilley, 1997). The RAMESES quality and reporting standards on reporting realist reviews were adhered to (Wong et al., 2013). The purpose of this review was to explore *how* telecare might support older adults who wish to use technology to support their independence through defining underlying processes, which operate in contexts to produce certain outcomes. Programme theories are formed during a realist review, which are typically presented as evidence-based context-mechanism-outcome (CMO) configurations. These detail the contexts in which certain mechanisms, often hidden, elicit specific outcomes from using telecare. This review followed Pawson's five stages for conducting realist reviews: 1) locating existing theories and concepts, 2) searching for evidence, 3) selecting data, 4) extracting data and 5) synthesising data (Pawson et al., 2005). The research team, and two National Institute for Health and Social Care Research (NIHR) Public Advisors with experience of caring for older adults, were involved in the process.

Step 1: Locate existing theories and concepts.

The research began with an exploratory search to explore initial programme theories (IPTs) about how telecare might work, by identifying models or theories associated with supporting the health and well-being of older adults. We initially drew upon Baltes & Baltes (1990) well-established model of selective optimisation and compensation (SOC), which presents everyday adaptations older adults engage in to maximise gains and minimise losses in response to age-related challenges (Carpentieri et al., 2017). When older adults are faced with age-related challenges, individuals select a goal to focus on, optimise their resources (by acquiring and refining resources), and compensate existing resources for alternative ones, to pursue their goal (Baltes & Carstensen, 1996). The SOC model has been used across ageing literature to understand how older adults use various resources to maintain health and well-being. This was considered as a well-suited theoretical starting point, given that telecare uptake is often utilised to minimise functional losses (through

falls, accidents, and other health-related risks) by ensuring safety at home (Bentley et al., 2018). However, the SOC model was not specific to the programme architecture of telecare, so literature on telecare was searched to understand how it is used by older adults to achieve goals of independence. Studies of any design and grey literature were included in the search. Pawson et al., (2005) describes this process as concept mining to draw out key concepts, terms, and ideas to develop and test.

Enabling security and facilitating ageing in place were key features of telecare recognised in the literature as important to supporting older adults at home (Karlsen et al., 2017). Other key concepts included the use of telecare in promoting autonomy, and fitting into a person's everyday life (Yaylagul et al., 2022). The lead researcher used findings from the literature to develop IPTs in the form of if-then statements. These IPTs were then grouped into three overarching concepts: 1) security at home 2) autonomy and choice and 3) integration of telecare into everyday life, which were used to develop a theoretically based evaluative framework to use for data extraction (Pawson et al., 2005).

Step 2: Searching for evidence.

Formal literature searches in five databases were conducted in August 2023 (Medline, PsychINFO, Academic search ultimate, Web of Science, and CINAHL), with search terms assisted by a University Librarian ([Appendix 7](#)). Telecare definitions are fraught with contradictions, and outcomes associated with independence vary considerably; therefore, the search criteria were kept broad to ensure all potentially relevant sources were identified. This involved using various search terms such as “telecare”, “telehealth”, and “assistive living technology”. If the intervention was considered ‘monitoring technology’, and monitored factors in addition to safety, such as ‘health’, these were included given that the data on monitoring health was separated from monitoring safety (i.e. falls). Citation details were stored and managed using Rayyan. A title and abstract screen, followed by a full-text screen were conducted against the inclusion and exclusion criteria (Table 5). The NIHR Public Advisors (JH and SA) conducted a random 10% check on the title and abstract, and the full-text to ensure consistency. Any discrepancies were resolved through discussions between the lead researcher (LF) and the NIHR Public Advisors (JH and SA).

Forward and backward citation tracking was utilised to reduce the risk of missing a significant document (Greenhalgh & Peacock, 2005).

Table 5. Formal literature search inclusion and exclusion criteria.

Intervention	Telecare interventions, referring to emergency help systems and fall detection systems.
Population	People described as older adults who live in their own home/community-dwelling. An age limit was not placed on the definition of an older adult, given the variety of ages that can be considered as 'older' populations.
Document type	Qualitative, quantitative, reviews, mixed methods research, or grey literature.
Outcome	Physical health (hospital admissions), mental health (anxiety/depression), loneliness and social isolation, quality of life, general well-being, autonomy, resilience.
Exclusions	Studies not written in English will not be included due to lack of resources required to translate studies. Interventions that focus on monitoring vital signs (such as blood pressure) and report information back to a healthcare professional. Studies which focus on specific illness diagnoses (e.g. diabetes, dementia, chronic obstructive pulmonary disease (COPD)). Article corrections or retractions, book reviews, and abstracts that only reference talks.

Step 3: Selection of articles.

Thirty-seven papers were included at the appraisal stage. Traditional systematic reviews appraise the methodological quality of primary studies, usually through appraisal checklists. However, realist reviews also utilise emerging data across different document types that contains relevant data for theory development, refinement and testing (Wong et al., 2016). Pawson (2007) argues that methodologically poor research can yield useful detail to

developing theory. Although there is not a universal method for appraising documents for a realist review, Pawson et al (2005) suggests assessing the '*relevance*' of the information, which can be defined as whether the data contributes to theory building or testing, and the '*rigour*' of the information, which refers to whether a piece of data is credible and trustworthy (Dada et al., 2023), by taking into account the methodology used (Williams et al., 2016). Papers were assessed for inclusion by scoring each document on its relevance and rigour (Dada et al., 2023) using a scale of high, medium or low, to highlight lower quality studies and explore whether further evidence was required to support data that was low in terms of trustworthiness (Dada et al., 2023).

Step 4: Data extraction.

Data extraction was carried out on 31 papers, using the theoretical framework template developed specifically for this review. A separate excel spreadsheet was used to detail study characteristics with full citation details, study design, data collection methods, results and the relevance and rigour score ([Appendix 8](#)). Data were extracted that contributed to theory development and refinement ([Appendix 9](#)). A section for notes was used in the template to record specific contexts, reported and perceived outcomes, and potential mechanisms to start to identify demi-regularities (patterns of mechanisms) and to facilitate further theory refinement and development of new theories at the data extraction phase (Astbury & Leeuw, 2010).

Step 5: Data synthesis.

Data analysis was undertaken by the lead researcher (LF) with concepts and theories discussed with the wider research team (CH, YL and NH) and the NIHR Public Advisors (JH and SA) in an attempt to ensure credibility and trustworthiness of inferences made. The data were read and re-read for familiarisation and patterns of contexts, mechanisms and outcomes were explored by iterative coding and grouping. Retroductive reasoning was used to explore how telecare works, by attempting to identify hidden causal forces that explain why things appear as they do (Jagosh, 2020). Retroduction involved using both inductive and deductive logic to form initial ideas and theories about what underlying powers might be producing the observed patterns in the data. An additional domain called 'connection to

social resources' was added to the theoretical framework as this was a reoccurring theme. Initial CMOs were created and an iterative process of revising and refining CMOs then took place. The first author conducted realist review training for the Public Advisors, and following this, refinements and additions were made through discussions with the NIHR Public Advisors in two 2-hour long meetings. Subsequently, the CMOs were then further revised by going back to the data and actively extracting additional relevant information. The mechanism in the CMO configurations was presented in two parts; mechanism *resources* (what is offered by the telecare intervention) and mechanism *response* (how older adults respond to telecare resources), to further explore the generative causation of *how* telecare works (Dalkin et al., 2015). Additionally, the lead researcher drew upon middle-range theories (a developed theory that can be used to explain the cause of outcomes from an intervention) (Astbury & Leeuw, 2010) to provide more theoretically informed explanations of mechanisms. Final discussions took place with the wider research team to finalise the CMOs.

4.5. Results

4.5.1. Study characteristics

The findings are organised across four domains that explain how telecare might work and for whom. 31 studies were included in the review, as these documents contained relevant data needed to develop and refine theories. Figure 7 depicts the PRISMA flow diagram. The majority of sources were published in the UK (n=13). The remaining sources collected data in the United States of America (USA) (n=4), Australia (n=4), New Zealand (n=1), Hong Kong (n=1), as well as six European countries; (Netherlands (n=1), Finland (n=1), Norway (n=2), Spain (n=2), France (n=1), and Switzerland (n=1)).

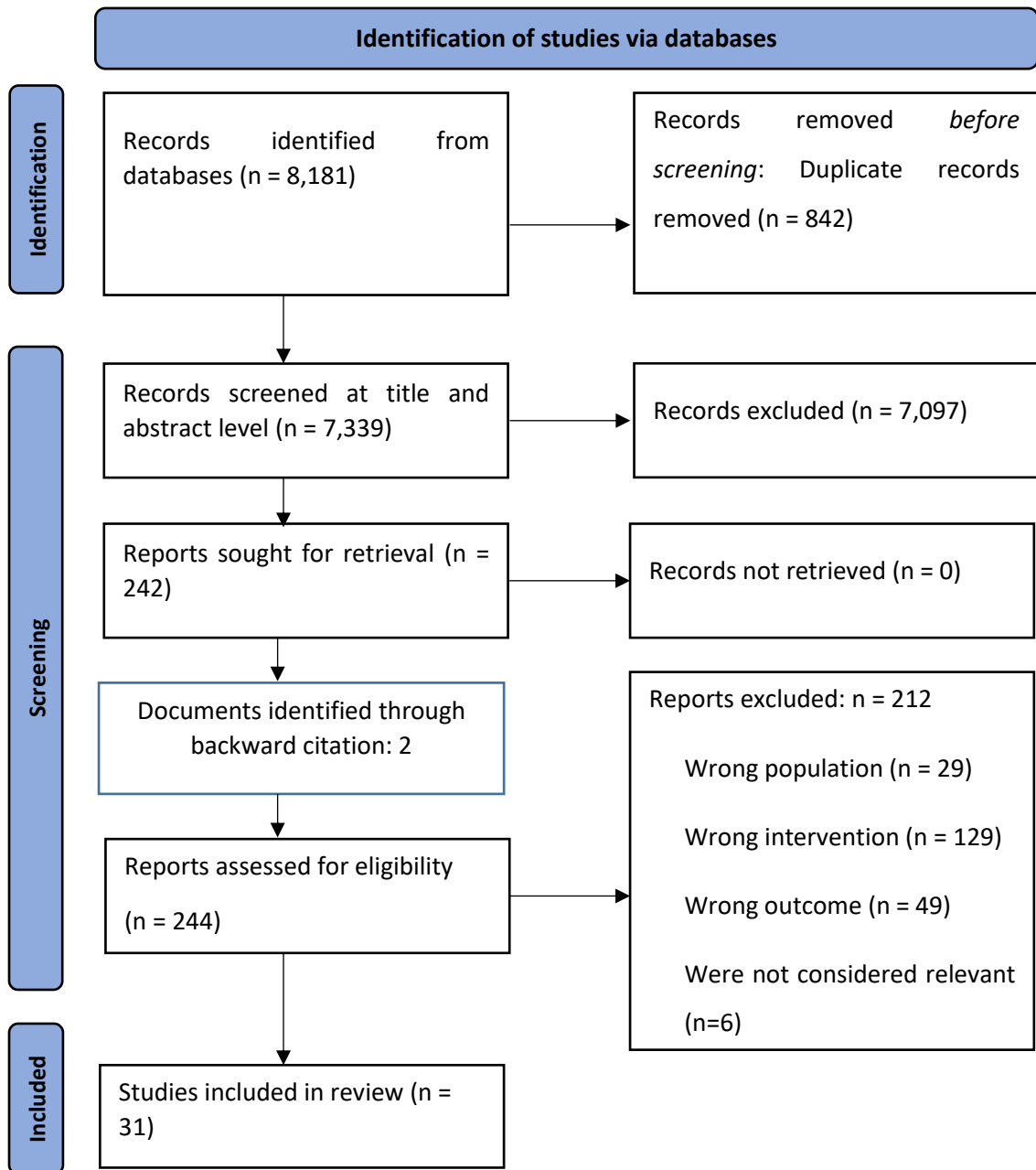


Figure 7. PRISMA flowchart of included articles (Page et al., 2021).

Papers were excluded if they did not meet the criteria previously highlighted in Table 5. The main reasons for exclusion were studies which looked at older adults living in care homes, interventions that focused on monitoring vital signs such as blood pressure, rather than general safety and well-being of the individual, and studies that focused on gait analysis.

Twelve CMOs were constructed from the included studies by the lead researcher and reviewed by the research team and NIHR Public Advisors, based on interpretations of data extracts in the context of the initial programme theory and evidence. Table 6 provides a summary of the 12 CMOs, which are structured into four domains: 1) security at home, 2) autonomy and choice, 3) connection to social resources, and 4) integration into everyday life.

Table 6. Summary of the 12 CMO configurations.

CMO	Context	Mechanism	Outcome
Security at home			
CMO1: Connection to help	1) Perceived risk of losing independence 2) Feeling vulnerable 3) Concern from family	Having telecare that offers a connection to reliable help in an emergency (mechanism - resource) will allow the user to gain trust and faith in the technology to keep them living at home for longer, which will provide peace of mind and reassurance (mechanism - response) that they will receive the help they need.	1) Reduced anxiety related to risk management at home. 2) Increased confidence to live at home.
CMO2: Ensuring privacy	Perceived poor health/high risk of losing independence	Passive monitoring which provides 24-hour monitoring (mechanism-resource) may provide additional support and peace of mind and reassurance to people willing to give up some privacy and control for additional safety support (mechanism-response)	Increased confidence in detecting risk/emergencies
CMO3: Detecting subtle changes in health	Conscious about declining health	If telecare detects health and cognitive decline through data collection and informing users/carers of potential decline (mechanism-resource), this may provide opportunity to users to change their lifestyle or intervene at an earlier stage (mechanism-response)	Increased sense of active ageing Likely to enhance ability of individuals to avoid disease/frailty.
CMO4: Meeting	People who want to	Telecare that is installed to meet <i>anticipated</i> future needs (mechanism-resource) may help older adults feel	Preparedness for ageing

future needs	plan for the future	reassured that they have resources already in place (mechanism-response)	Reassurance of support Proactive support
2) Autonomy and choice			
CMO5: Assessing needs	Perceived risk of losing independence Access to social services for assessment	Conversations with telecare provider to assess individual needs and customise/match the telecare device to the individual needs (mechanism-resource) may increase sense of self-care (mechanism-response)	Increased control over perceived health-risk
CMO6: Choice in using telecare	Feels open towards using telecare	Giving users the choice to use telecare and what kind of device they can use (mechanism – resource) may help the person feel empowered to self-govern oneself (mechanism-response)	Increased confidence to make decisions about own independence
CMO7: Choice in <i>how</i> telecare is used	Fear of being framed as frail or vulnerable	Telecare that encourages control and choice in how it is used before and after an incident (mechanism-resource) may reduce feelings of being “burdensome” to those who provided support, and reduce the perceived image of being frail and needing support (mechanism-response)	Sense of control Supporting personal and social identities
3) Feeling connected to social resources			
CMO8: Providing social connections	Limited social resources	Having telecare that provides continual reassurance of connection to a wider system of support (mechanism – resource) may increase feelings of connectedness (mechanism – response). Having access to a social network that is accessible, friendly and welcoming (mechanism – resource) may help empower individuals to ask for help and use the network for social interaction (mechanism – response).	Reduced loneliness and social isolation
4) Integration into everyday life			

CMO9: Understanding telecare	Anxious about losing independence	Ensuring understanding of how telecare works, how it can support independence and what will happen in the event of an alarm being raised (mechanism – resource) will enable trust in telecare to support independence and peace of mind (mechanism – response)	Reduce anxiety around losing independence/having a fall
CMO10: Customising telecare	Individual expectations and needs	If the telecare technology can be customised and personalised to suit individuals need and preferences (mechanism-resource), then it will be more appropriate to a wider population with differing needs (mechanism-response)	Improved integration into everyday life Improved ease of use
CMO11: Familiar design	Anxiety related to technology	If the telecare technology has a design that the user is aware of and used to using (mechanism-resource), then the user will feel more confident that they can use it and help integrate better into daily routine (mechanism-response)	Improved efficiency in use.
CMO12: User expectations	Older adult wishes to use telecare to achieve a specific goal	When telecare matches user’s expectations (mechanism-resource), this will increase trust in technology to support the user to live independently (mechanism-response)	Increased feeling of safety. Increased confidence to live at home.

The 12 CMOs were summarised in an overall programme theory, which highlights key components of how telecare works, and the likelihood that telecare may be enhanced by ensuring these domains are met. Figure 8 provides a diagram of the overall programme theory, which highlights the mechanisms of importance that explain how telecare works to produce outcomes (intended or unintended) under specific contexts.

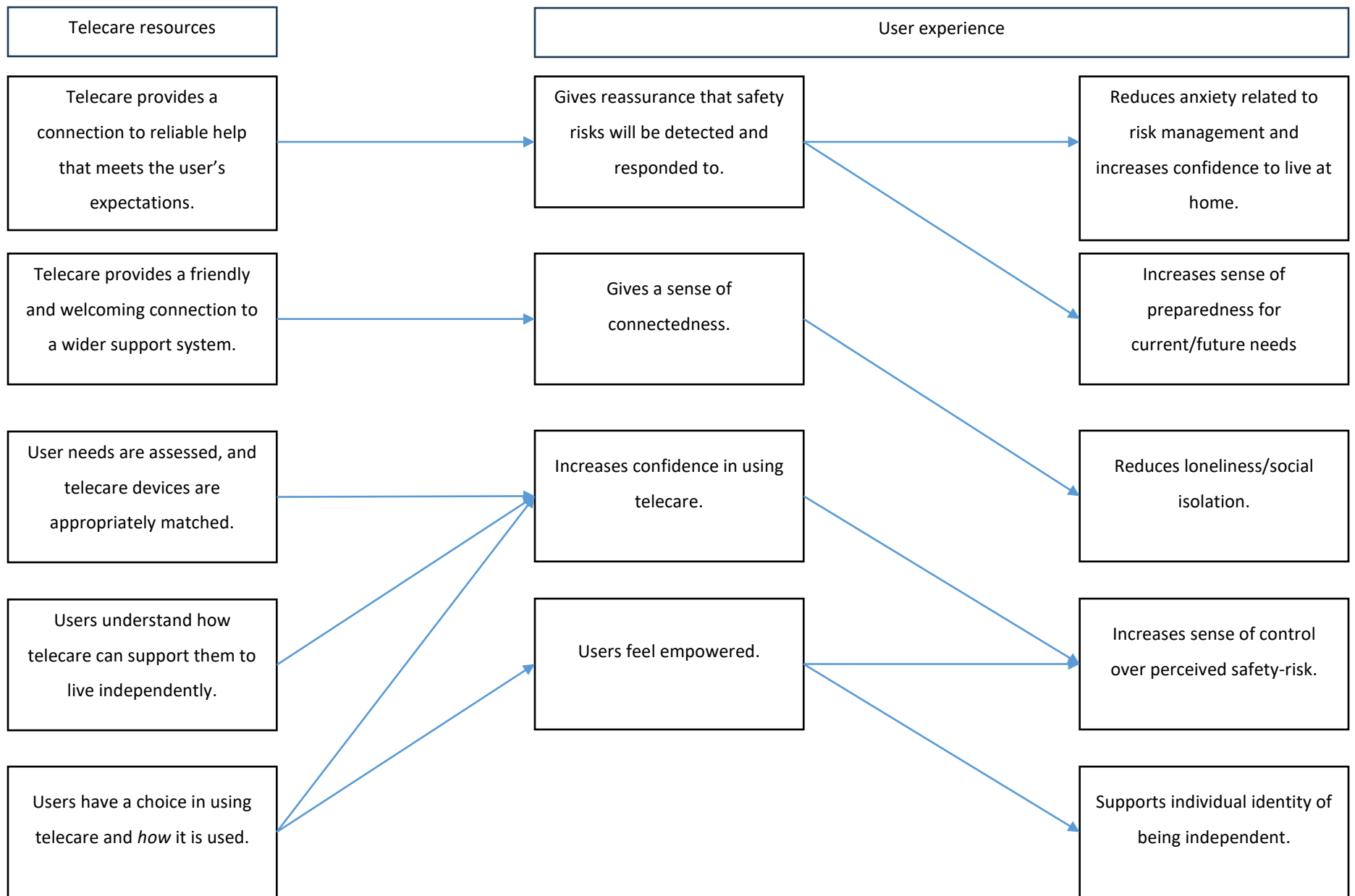


Figure 8. Diagram of the overall programme theory on how telecare can support independence in older adults.

4.5.2. Domain 1: Security at home

CMO1: Providing a connection to help.

Our analysis highlighted that older adults overwhelmingly wished to use telecare to feel safe, to remain living in their own homes (Aceros et al., 2015; Brownsell et al., 2008; Elers et al., 2018; Hamblin, 2016; Johnston et al., 2010; Karlsen et al., 2017; Watson et al., 2021; Wild et al., 2008), and delay transfer to institutional care (Berridge, 2017; Bowes & McColgan, 2012; Elers et al., 2018). Increased perceptions of safety from telecare use may improve well-being (Hirani et al., 2014). Most older adults recognised the increased risk of injury following a fall if care was delayed. To provide reassurance, users wished to be connected to a source of help in an emergency (Berridge, 2017; Brownsell & Hawley, 2004; De San Miguel et al., 2017; Fawcett & Karastoyanova, 2023; Lynch et al., 2022; De San Miguel & Lewin, 2008; Nyman & Victor, 2014; Pol et al., 2016; Karlsen et al., 2019), which was a key factor for telecare use and acceptance. The need to be connected to a source of help is mostly aligned with a perceived risk of losing one's independence (Bowes & McColgan, 2012; Pol et al., 2016). Reliability of telecare was seen as an important mechanism to ensure help could be sorted quickly (Leikas & Kulju, 2018; De San Miguel & Lewin, 2008; Watson et al., 2021). Our findings also highlighted that trust in telecare was crucial for reducing anxieties related to having a fall (Hamblin et al., 2017; Karlsen et al., 2019). Previous negative experiences with telecare, where help was not delivered in a timely manner led to distrust in telecare services, which increased the risk of discontinued use, or increased anxiety in anticipation of a critical event.

CMO2: Ensuring privacy.

Our findings revealed that older adults with a high perceived risk of losing their independence were more willing to relinquish some control over their lives, in return for feeling safe. These users were more willing to use more 'invasive' monitoring telecare services, such as passive and ambient sensors (Berridge, 2017; Camp et al., 2022; Felber et al., 2023; Karlsen et al., 2017, 2019; Pol et al., 2016), whereas for others who did not perceive a high risk of losing independence, passive monitoring was more likely to impact on identity, autonomy, and self-efficacy to live independently. This finding highlights the

importance of involving users in the assessment of the appropriateness of telecare given. Understanding what data is collected from devices, who views it and how it is used was seen as important in increasing trust in telecare and reducing fear (Camp et al., 2022). Ensuring that older adults understand how data is used and giving individuals the choice over what data is shared with others may reduce anxiety related to privacy.

CMO3: Detecting subtle changes in health.

A few studies discussed the perceived value of telecare in detecting health deterioration. Older adults appreciated that monitoring technologies could detect changes in behaviour that may have gone unnoticed by themselves or others around them (Camp et al., 2022; Watson et al., 2021; Pol et al., 2016; Karlsen et al., 2017; Wild et al., 2008). Cognitive decline was of particular interest, particularly from those who had witnessed the perceived undesirable impacts of dementia in relatives or friends (Wild et al., 2008). However, not all older adults held this interest, and some were resistant to the notion of detecting subtle changes in their daily behaviour patterns as it was viewed as invasive (Chaudhuri et al., 2017; Pol et al., 2016). For some, detecting early deterioration, particularly cognitive decline was associated with negative stereotypes of dementia and memory loss, which was viewed as a threat to their identity and the future of their independence.

CMO4: Meeting future needs.

Our findings revealed that some older adults used telecare in anticipation of meeting future security needs that they were anticipating or wanting to have a more proactive approach to meeting needs (Fawcett & Karastoyanova, 2023; Hamblin, 2016). Having telecare resources already available in their home environment provided reassurance of security and was viewed as enhancing the sustainability of living in their own home (Hamblin, 2016; Aceros et al., 2015). This CMO refers back to our initial theoretical foundation, where older adults acquire new technological resources in order to achieve their goal of remaining at home (Baltes & Carstensen, 1996).

4.5.3. Domain 2. Autonomy and choice

CMO5: Assessing needs.

Our findings highlight that telecare is often offered without fully understanding the preferences of the older adult (Greenhalgh et al., 2013; Percival & Hanson, 2016), which often results in non-use, discontinuation, or adaptive use, or negative outcomes, which supports the users' priorities, such as control, autonomy, privacy, safety and connection to social resources (Berridge, 2017; Greenhalgh et al., 2013; Karlsen et al., 2019; De San Miguel et al., 2017). Pre-defining users' needs and ignoring individual context may elicit a sense of not being heard. Our findings emphasise the importance of understanding users' needs and preferences, to match the type of telecare, and to inform decisions about how their support network are involved (Greenhalgh et al., 2013; Karlsen et al., 2017;) Greenhalgh et al., (2013) reported in their ethnographic study that some older adults may have poor understanding of how to access help, compounded by other inequalities such as low technological confidence, and low social support to support telecare use. If telecare is not matched to an individual's needs and preferences, unintended consequences may occur, such as personal safety concerns not being met (Karlsen et al., 2017), or feeling an intrusion of autonomy and privacy (Johnston et al., 2010; Karlsen et al., 2017; Percival & Hanson, 2016) as the individual did not perceive the need for telecare (Nyman & Victor, 2014), which is particularly common with passive monitoring. Older adults have different illness experiences and varying levels of social and financial resources hence a standardised approach to telecare implementation may not be appropriate.

CMO6: Choice of telecare.

Studies revealed that older adults who actively chose to use telecare felt more in control and more empowered to use the device (Hamblin et al., 2017; Karlsen et al., 2017; Percival & Hanson, 2016). Reasons for choosing telecare mostly stemmed from the desire to remain living at home. Some older adults felt that this was a decision that had to be made in order to stay living at home and accepted that some control would have to be traded to accomplish this goal (Hamblin et al., 2017; Karlsen et al., 2017), whilst others felt pressure from social services and relatives to take on telecare (Karlsen et al., 2017). Feeling pressured

to use telecare enforced a perceived identity of becoming frail and constantly at risk of decline (Karlsen et al., 2017). Therefore, enabling choice is a key mechanism that may elicit a feeling of control (López & Domènech, 2008), empowering people to maintain behaviours such as utilising telecare, that will allow them to stay at home for longer.

CMO7: Choice in *how* telecare is used.

Choice in the *way* that telecare is used was a salient theme for older adults. Findings suggest that people who are becoming frail but wish to remain in their own home may be hesitant to share their daily behaviours or publicise difficulties by engaging with telecare (Berridge, 2017). Brownsell & Hawley, (2004) found that older adults do not always want falls to be known about, due to fear of being pressured to move into institutional care or being hospitalised. Older adults may also be concerned with maintaining the social identity of being independent and want to avoid the stigma of identifying as frail or dependent (Chaudhuri et al., 2017). Enabling control is a key mechanism to support older adults' self-esteem, which is considered a hallmark of older people's sense of independence (López & Domènech, 2008). Indeed, ensuring safety in this context may prove difficult, and some older adults may not feel ready to relinquish some control for safety.

4.5.4. Domain 3: Feeling connected to social resources

CMO8: Providing social connections.

Older adults in these studies highlighted the importance of maintaining and securing a connection to social resources through using telecare (Fawcett & Karastoyanova, 2023; Hamblin, 2016). This manifested in the fear that telecare may increase social isolation through decreased face-to-face interaction (Camp et al., 2022; Elers et al., 2018; Leikas & Kulju, 2018; Watson et al., 2021). Felber et al. (2023) reported that telecare could not replace human connection, as it could not provide the same level of relationship which is possible with face-to-face communication. It was highlighted that those who use telecare may be at risk of social isolation, particularly if they are housebound or live alone, and as a consequence, telecare could provide an avenue for social connection (Berridge, 2017). Of note, Percival et al. (2016) reported how older adults pressed their alarm button purely for human interaction, rather than using it for its 'designed' purpose to help in emergencies. In

this example, telecare could provide an avenue for social support; however, the need for social connection should be recognised as a legitimate use of telecare. Indeed, a level of empathy and care would be needed by telecare providers to empower users to reach out for emotional support, and to help build strong relationships.

4.5.5. Domain 4: Integration of telecare into everyday life

CMO9: Understanding telecare.

Findings revealed that older adults wanted to understand exactly *how* telecare worked, and what was required of them to cope and manage in an emergency event (Hamblin et al., 2017; Leikas & Kulju, 2018; Lynch et al., 2022). Research has identified challenges for older adults in understanding how telecare works, for example if the person has cognitive or memory impairments, they may not retain information easily (Leikas & Kulju, 2018). Other instances may be uncertainty around the workings of telecare, and the processes of what happens when an alarm is triggered, i.e. who will come to help, and how will they access the property (Lynch et al., 2022). When older adults lack understanding of how telecare works and are anxious about losing their independence, this may result in feelings of uncertainty around the perceived reliability of telecare (Hamblin et al., 2017), reducing the likelihood of gaining reassurance of safety.

CMO10: Customising telecare.

Telecare devices were described as an extension of that person and their values, and thus, needed to fit into the user's current life. The importance of assessing the needs of the user to implement appropriate telecare devices has already been covered. However, individual needs and preferences may change over time and if the technology no longer 'works' in this new context, it may lose its value and interfere with the individual's life, leading to disengagement and non-use (Brownsell et al., 2008). It was highlighted that telecare devices that involved pragmatic customisation in which devices were adapted and combined with existing technologies already in the home were better suited to individual's needs and preferences (Chaudhuri et al., 2017). Being able to customise telecare may help to align the technology with the individual's needs. Ensuring the telecare device matched the person's identity, social influence, and culture was found to be critical to adoption of telecare and

continued use (Felber et al., 2023; Reyes et al., 2023; Karlsen et al., 2017; Pech et al., 2021; Percival & Hanson, 2016; Berridge et al., 2019).

CMO11: Familiar design

Positive experiences were elicited when telecare did not interfere with the person's daily routine, and the technologies were not noticeable in their home environment (Brownsell & Hawley, 2004). For older adults who experience anxiety towards new technologies, having a technology that has a familiar design to that individual may reduce anxiety related to technology and facilitate better 'fit' into that person's environment, for example implementing a tablet-style device for someone who is familiar with using tablets (Peng et al., 2023).

CMO12: User expectations

Our findings highlighted the need to meet user expectations to ensure continued use and benefits to well-being. Where telecare devices were inaccurate, for example where sensors were too sensitive or not sensitive enough, older adults would stop using them (Hamblin, 2016). User expectations of what telecare should provide may differ, as some older adults may wish to have a quick response time in an emergency, whilst others may prioritise reducing false alarms (Lynch et al., 2022). Providing information on the efficiency and effectiveness of telecare devices to users may enable individuals to choose devices that meet their expectations.

4.6. Discussion

This study contributes to the literature on the key mechanisms into how telecare may support different preferences and needs, which may be useful in improving the uptake and use of telecare.

A key independence goal for older adults was to remain living at home, and feeling secure at home was critical. Telecare that provided a connection to help, meeting an individual's expectations of the device, led to reassurance of safety and reduced anxiety. Reasons for using telecare to improve safety at home differed across individuals, as some recognised their personal need for the device, whilst others wanted to feel prepared for anticipated

needs (Karlsen et al., 2017; Wild et al., 2008). Some older adults wanted to use telecare to detect potential declines in their health to ease anxiety. The programme theory developed (Figure 8) highlights the importance of assessing individual needs when matching telecare devices to individuals. These findings align with the SOC model presented at the outset of this research (Baltes & Baltes, 1990), in regards to how older adults select goals based on preferences, personal motivation, and age-related losses, and adapt accordingly to achieve these goals, which in turn, improves quality of life and well-being. These findings also align with the results from a realist evaluation by Berge (2017), who found that when telecare matches the user's needs, abilities and contexts it enables them to feel safe. Despite this, research involving an online survey of English local authorities revealed that telecare was often provided without prior assessment of the person's preferences or needs (Woolham et al., 2019). Telecare tends to be installed very quickly after an emergency, or following a hospital discharge (Bentley et al., 2018), which creates challenges in conducting initial assessments.

Having personal choice in using telecare facilitated personal decision making and autonomy, a crucial component of the programme theory. An important context for choosing to use telecare was recognising their own risk of losing independence. Research has demonstrated reluctance from older adults to adopt telecare devices, as it can often be associated with perceived stigma (Yaylagul et al., 2022). When older adults had a perceived risk of losing their independence, using telecare which gave them access to help in a hypothetical emergency led to positive outcomes, including peace of mind, reduced anxiety, and increased control over the perceived health-risk (Hamblin, 2016; Percival & Hanson, 2016). On the other hand, if older adults had a fear of being framed as frail or did not perceive themselves as at risk of losing their independence, the mechanism of feeling forced to adopt telecare led to feelings of being stigmatised and impacted self-identity (Hamblin, 2017; Wild et al., 2008). Studies suggest that self-perceived stigma is associated with widespread negative consequences, including lower quality of life, premature mortality, and poorer physical health (Sun et al., 2022). The need to feel eligible for telecare aligns with Dixon-Woods et al. (2006) theory of candidacy, which describes how people

assess their own eligibility for using health and social care interventions. Misalignments between telecare implementation by social services and a user's perceived eligibility should be minimalised to ensure access to telecare across diverse populations.

Ensuring that telecare is integrated into a person's life was another key area highlighted in the programme theory. A barrier to use was a lack of understanding from the older adult's perspective of how telecare worked and how it would support independence. Ensuring understanding may require different approaches, given the varied contexts among older adults who adopt telecare, including anxiety towards new technologies, existing cognitive impairments or individuals experiencing personal issues, that led to the need for telecare (hospitalisation, illness, bereavement). This finding relates to the ecology of ageing, which posits that in order for environments to enhance opportunities for ageing well, environmental resources like telecare should match personal competence (Lawton, 1973). Telecare staff should adapt their communication style accordingly when implementing telecare to ensure older adults understand how it works. To help match technologies to individuals and their personal context, staff should also be aware of personalised solutions, for example, giving someone who may be anxious about using new technologies a device that has a design that is familiar to the individual. However, recent literature has highlighted issues with telecare training which may impact telecare staff knowledge. Woolham et al. (2019) reported varied levels of knowledge and awareness about telecare in staff. Greenhalgh et al. (2015) found that social workers and care managers saw the need for personalised technological solutions but lacked the means to deliver them. Our findings suggest the impact of telecare on supporting independence is influenced by user understanding of telecare and the extent to which technology is matched to the individual. However, this is highly dependent on the telecare staff's knowledge and awareness of telecare and the useability of the device. Further research should investigate how to improve and standardise telecare training to ensure integration of telecare into the recipient's environment.

The programme theory highlighted potential for telecare devices to provide social connections to older adults with limited social networks. Older adults may benefit from

additional sources of social connection, as within their context, older adults are more likely to have limited mobility, and may not be able to form and maintain new contacts outside the house (Sen et al., 2022). Telecare offers an accessible route to social interactions, as most telecare devices do not require the internet and are based in the home environment. However, within social care, telecare is not currently used to supply social support. The utilisation and feasibility of telecare in providing this service may require further research.

4.6.1. Limitations

Despite the inclusive search strategy, people from minority ethnic backgrounds remain underrepresented in this study. This is partly due to the lack of literature focused on the experiences of minority ethnic groups using telecare. This impacted our ability to fully explore ‘for whom’ telecare works. We suspect that telecare may not work for every cultural group, as individuals may have vastly different contexts in which telecare would be situated. However, the lack of research in this area prevents researchers from testing hypotheses. Following this review, new research may be designed to address this gap in knowledge. Although a few studies included longitudinal data, most studies did not evaluate older adults use of telecare and changing needs over time. Further research is required to understand how to retain telecare usefulness for long-term use.

4.7. Conclusions

Our findings in this realist review highlight the importance of understanding not only physical needs but psychological and social needs of older adults to be able to implement telecare impactfully. Telecare assessments should be conducted in a way to support autonomy by enabling choice over technological resources, including the level of monitoring, freedom to call for help if needed, links to social support, and ability to customise technology to suit needs. Telecare devices should support older adults’ goal of staying living at home and feeling secure, which may look different among individuals. To support this, telecare should provide reassurance of help in an emergency, enable connections to existing/new social networks, and help detect age-related deterioration to prevent further loss. Finally, telecare must integrate into everyday life, by fitting with people’s existing environment, skills, capacity, and identity. A realist approach enabled us

to unpack hidden mechanisms which may enable social care professionals to tailor their approach to implementing and utilising telecare, to support older adults.

5. Chapter 5. Does proactive monitoring of older adults' well-being aid in the detection of increased hospitalisation risk? A retrospective cohort study of proactive telecare users in the United Kingdom.

5.1. Chapter overview

In Chapter 3, family members of OKEachDay users and staff members postulated that tracking instances of when a user forgot to press their daily OK button could serve as an indicator of health deterioration. This was highlighted when one family member explained that when their mother forgot to press her OK button consecutively over a few days, it would sometimes coincide with a period of illness. This was considered highly beneficial for family members and staff members in detecting illnesses which may have gone undetected or presented later after progressing further.

This chapter follows up on these initial findings, and uses routinely collected secondary data, obtained from Alertacall, to investigate whether there is an association between older adults not pressing their OK button and being admitted to hospital as an inpatient. This study aims to improve understanding of the potential benefits of using a proactive telecare system to support health and well-being in older adults. Chapter 5 will be submitted for publication to a relevant journal and is presented below.

5.2. Abstract

5.2.1. Background

OKEachDay is a proactive telecare intervention that encourages daily interaction from individuals to confirm their well-being, giving the opportunity to monitor behaviour over time and detect changes in engagement with the system. Changes in daily habits may indicate health deterioration.

5.2.2. Aims

This study aimed to examine the relationship between missed 'OK' button presses and hospital use [(i) inpatient hospital admissions and (ii) total days spent in hospital] to assess whether not pressing the OK button each day was associated with hospital usage.

5.2.3. Design

A retrospective cohort study using negative binomial regression.

5.2.4. Setting and intervention

This study included 6,265 current proactive telecare users aged ≥ 65 years old and living in the community. Data include linked information on telecare use and hospital use between December 2021 – November 2022. The example of proactive telecare in this study provides an 'OK' button to users, to confirm that the individual is safe daily. Assistance is provided if an individual is unable to proactively press the 'OK' button.

5.2.5. Measurements

Predictor variable: counts of missed daily 'OK' button presses. Outcome variables: (i) monthly counts of hospital admissions and (ii) annual number of days spent in hospital. Covariates: age, sex, and calendar month.

5.2.6. Findings

On average, a 10% increase in the number of missed OK button presses per month was associated with monthly hospital admissions that were 2.16 times higher than compared to those who press their button everyday (IRR=21.6; 95% CI [15.33; 30.52]).

5.2.7. Conclusion

Missing the OK button was associated with an increased risk of hospital use, which may be a useful tool in promoting health; however further research is needed to understand this association. Appropriate preventive strategies following detection of behaviour changes require further research, to best promote health and well-being in older adults.

5.3. Introduction

Ageing populations pose significant challenges to health care systems internationally, as increasing prevalence of age-related illness, such as arthritis, dementia, and cardiovascular disease, contributes to growing healthcare demands and subsequent rising costs (Gokalp et al., 2018). Health care needs are the highest for people aged 85 years and above, with demand projected to increase by 8.2% (126,000 people) by 2028 (Age UK, 2023a). Subsequently, as the number of older people in the population increases, associated healthcare costs are also expected to rise, with the Health Foundation estimating that the NHS requires a 3.1% annual growth in funding to meet these demands (Rocks et al., 2021).

Hospitalisation in older adults is associated with higher mortality and institutionalisation (Freiberger et al., 2020). Thus, reducing hospital admissions may be beneficial to preserving health in older adults (Boyd et al., 2008), and reducing associated costs. Strategies that focus on illness detection may offer an effective solution, as failing to detect illness among older adults may lead to worsening health and increased hospital use (Stijnen et al., 2013). Detection of declining health in older people may aid in the implementation of preventive solutions (Pol et al., 2016), such as additional care and monitoring, or support through primary care, before the progression of illness (Stijnen et al., 2013).

Monitoring technologies in the home environment may offer the possibility of early detection of functional decline. Telecare in particular has been recognised by the UK Government as potentially useful in reducing hospital admissions and days spent in hospital by shifting the provision of care from health care settings to monitoring health status at home. Telecare is a type of monitoring technology that is often used to support the needs of vulnerable older adults, by identifying hazards associated with independent living, such

as detecting falls, accidents, or the onset of ill health. Telecare may enable faster responses to functional decline and subsequently reduce hospital admissions and associated costs.

Observing an association between a change in behaviour and an increased risk of hospital use by monitoring well-being may enable timely intervention to avert hospitalisation, which could help to improve overall quality of life (Hirani et al., 2014), reduce costs of treatment and extend the period of independent living (Gokalp & Clarke, 2013). However, evidence evaluating the impact of telecare in reducing hospital admissions is mixed. In 2012 a large randomised control trial (RCT) investigated telecare effectiveness, and findings suggested that telecare did not lead to significant reductions in health service use (Steventon et al., 2013), and did not reduce overall healthcare costs compared to usual care (Henderson et al., 2014). In contrast, in 2008 a Scottish longitudinal study evaluated the impact of telecare by investigating hospital discharge rates over a 1-year period in telecare users and found that more than 1,200 emergency admissions were avoided (Beale et al., 2010). However, this study did not have a control group comparison.

Proactive telecare aims to provide more proactive and preventive support. In this study, we focused on a specific type of proactive telecare, known as OKEachDay, which encourages users to regularly confirm their well-being and offers low level support to help older adults remain at home. Tracking individual behaviours may provide vital information on a person's overall well-being, and detecting changes in daily habits may be an indicator of increased risk of illness (Gokalp & Clarke, 2013). This technology may help to observe an increased risk of hospital use in monitoring daily behaviours and provide an opportunity for timely intervention to prevent hospitalisation. However, there is a need for better understanding of the impact of OKEachDay on healthcare usage.

Prior to this study, we conducted semi-structured interviews with different interest groups (OKEachDay users, family members of users, and telecare staff) to understand to what extent a proactive telecare system could support independence in older adults (Fothergill et al., 2023). Users of this intervention developed a daily habit of pressing an 'OK' button to confirm their well-being, and when they are not able to press their OK button, staff contact

users to offer assistance, if required. In this initial study, family members of users and telecare staff postulated that when users forgot to press the OK button, it was a useful indicator of illness and suggested that tracking forgetfulness patterns may help to detect health deterioration. Indeed, forgetfulness and delirium in older adults can be indicative of illness (Ballard, 2010).

To integrate this finding further, we obtained routinely collected data from the proactive telecare company, Alertacall, between December 2021-November 2022 to assess whether proactive telecare could aid in detecting illness by investigating patterns of failing to press the OK button and being admitted to hospital. Specifically, we examined the following research questions: Is failing to press the OK button associated with a change in the rate of:

1. Hospital admissions.
2. Total days spent in hospital.

5.4. Methods

5.4.1. Intervention

OKEachDay is a proactive telecare service intervention that was created in 2004 and has been increasingly adopted in domestic settings in England, Scotland, and Wales. It provides its services to over 15,000 individuals, including older adults (aged 65 and over). The primary aim of the intervention is to provide daily well-being 'check ins' and to offer human contact to people. The device consists of three buttons: (i) an 'I am OK' button, used to confirm that the individual is safe, (ii) a customer service button to speak to a member of the call centre, and (iii) a contact button to write messages to/receive messages from the service team. The service is predominately provided by housing associations; however, a small proportion of users pay for the service privately.

When a service user adopts the intervention in their residence, call-centre staff agree a time with the user to confirm their well-being, once a day. Confirmation is made by either: (i) pressing the 'OK' button, or (ii) otherwise receiving a call from the specialist team at a chosen time. If the 'OK' button is not pressed within fifteen minutes of the individual's agreed time, the team will attempt to contact the user multiple times to confirm the user's

well-being, and to offer the opportunity to chat. If contact cannot be established, the call is escalated to the user's nominated contacts (typically family or friends). In the 'worst-case' scenario where nominated contacts cannot be contacted, emergency services are called if staff believe there are critical risks to the user.

When users are not at home, staff ensure records of the user's location are kept up to date. If an older adult does not press their 'OK' button and is admitted into hospital as an inpatient, a record of the date of admission is made by staff. Staff acquire knowledge about hospital admissions through communication with the user's nominated contact, or through contacting local hospitals. If a user has been admitted to hospital, staff pause the user's account so that missed button presses are not recorded whilst the individual is in hospital. Once the user has returned home, proactive telecare staff record the date that the individual returned home and activate the system again.

5.4.2. Ethics

The study was approved by the Lancaster University Research Ethics Committee (FHM-2023-3249-RECR-2) on the 16th January 2023 ([Appendix 10](#)).

5.4.3. Design

To examine the relationship between missed 'OK' button presses and hospital admission, we used regression analysis of one year of observational data on individuals who adopted the service in their residence.

Proactive telecare users

All proactive telecare users were aged 65 and above, were living at home (not in a care home) and used proactive telecare during the year of investigation. All proactive telecare users live in the UK. There was no opt-out option for proactive telecare users, but as the data were anonymised, there was no requirement for older adults to provide consent for this specific study. Moreover, when people signed up to the service, they agreed that anonymous data could be used for research and service improvement analyses.

Data

To conduct the analyses in this study, routinely collected data from existing proactive telecare users were obtained from the company running the intervention of interest. Data captured information for the period December 2021-November 2022 on each proactive telecare user for the following variables: (i) proactive telecare use (how often they missed their 'OK' button at least once on a given day), (ii) total number of hospital admissions and total time spent in hospital (in days), (iii) age and sex.

Outcome variables

Two datasets were collected, each providing one outcome of interest:

- (1) Inpatient hospital admission data.
- (2) Total days spent in hospital over a year.

Two datasets were provided by the company, due to availability of information.

Dataset 1: The data for inpatient hospital admissions consisted of the monthly proportion of days the OK button was missed, and inpatient hospital admissions per proactive telecare user during the 1- year study period (December 2021 and November 2022). Examination of monthly data allowed for exploration of potential seasonal patterns in hospital activity.

Dataset 2: The data for total days spent in hospital consisted of the yearly proportion of days a button press was missed, and total days spent in hospital for each proactive telecare user during the 1- year study period (December 2021 and November 2022). Yearly data were used as monthly data on total days spent in hospital were unavailable.

Predictor variable

Initially, we had information on the number of times a proactive telecare user failed to press their daily OK button. We used this information on whether service users press their OK button at least once in a given day to create measures of the proportion of days missed in a given time period. First, we created a monthly measure of the proportion of days missed:

Proportion of days missed per month:

$$= \frac{\text{days without at least one OK button press in the month}}{\text{total days in the month}}$$

Second, we created an equivalent annualised measure corresponding to the measurement of the second outcome (total days spent in hospital per year):

Proportion of days missed per year:

$$= \frac{\text{days without at least one OK button press in the year}}{\text{total days in the year}}$$

The predictor variable is defined as the proportion of days missed in a given period. Therefore, the predictor variable is referred to as ‘proportion of days missed’ throughout this study.

Covariates

Information on proactive telecare user demographics (including age and sex) were collected as these factors may affect the risk of hospitalisation or the length of time an individual is in hospital (GOV.UK, 2020). Type of residence was collected; however, it was not used as a covariate as only 1.54% of proactive telecare users did not live in a housing association, which was deemed too small a sample and lacked statistical power. This demographic information is collected routinely by Alertacall. No other covariates were collected as the company had limited data on each user.

Data cleaning

115 proactive telecare user entries were removed from the dataset as there were missing data on their age. Proactive telecare users who had more than 365 daily button misses were removed from the dataset, as in this data, individuals should only have one missed button press a day, which totalled one person. Checks were also made for people with hospital days >365, and monthly missed button presses exceeding the days in a calendar month, but no errors were found. There were 46 people who had missing information on their sex, which were removed. Figure 9 demonstrates how the sample was constructed.

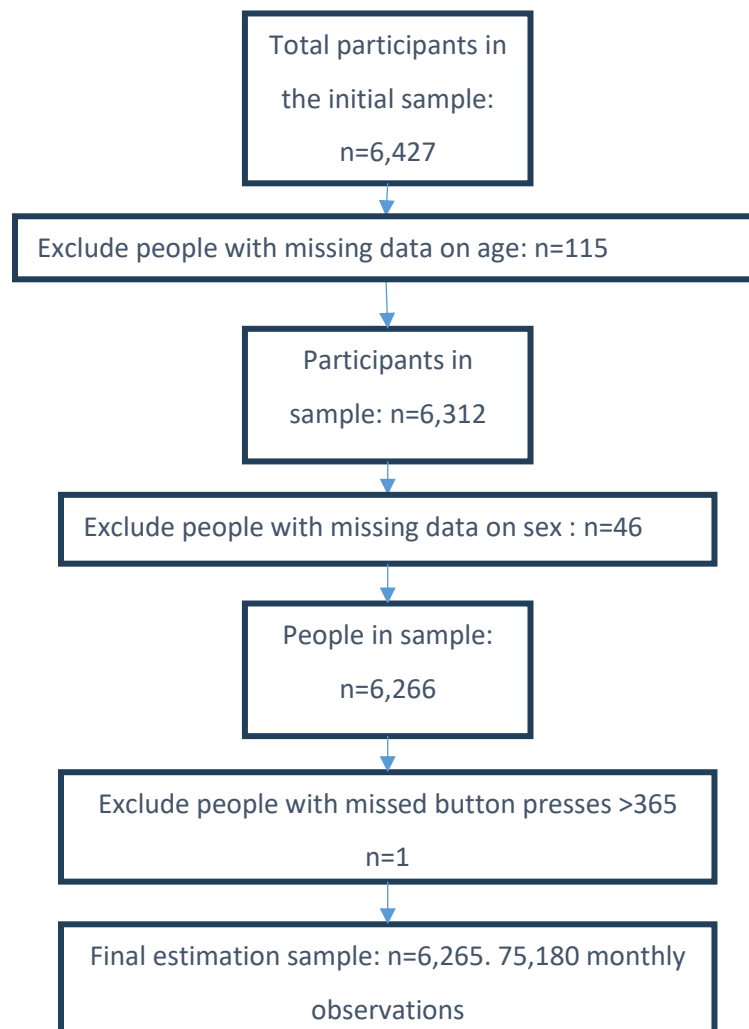


Figure 9. Flowchart demonstrating the sample construction.

Both inpatient hospital admissions and total days in hospital exhibit marked skewness (i.e. there were a large number of people with zero hospital admissions), which can be typical

in health care use data, in which a small number of high use individuals comprise a large share of overall activity, as suggested by Malehi et al. (2015). For this reason, outliers were not removed from the dataset, as this may have deleted key information.

5.4.4. Data analysis

Descriptive analyses

Descriptive statistics for characteristics were presented using frequencies (percentages), mean and median, and standard deviation (SD).

Regression analyses

Both outcome variables contained many zero values. This reflects the fact that the hospital admission rate was low, suggesting this population of older adults was relatively healthy. Hilbe (2011) describes this excess of zero values results in overdispersion, which can be problematic as it may cause standard errors to be underestimated if using standard linear regression, increasing the likelihood of a type 1 error. Therefore, using a standard linear regression may not be well-suited to analysis of non-normally distributed outcomes. The approach used in this study needed to account for many features, in particular: (i) the skewness of the outcomes; and (ii) the overdispersion of the outcomes. When count data are over dispersed, Green (2021) suggests using a negative binomial regression, instead of attempting to transform data into a normal distribution, as it provides a better fit for data with over-abundant zeros. Negative binomial regression is frequently used for modelling count variables, which are often over dispersed. Therefore, we estimated all regression models using negative binomial regression.

Analyses were conducted at the individual-level using either monthly or annual counts of inpatient hospital admissions and total days spent in hospital respectively. Age and sex were included as individual-level controls, as these characteristics may influence health. GOV.UK (2020) data demonstrates that hospital admissions and days spent in hospital increases with age. GOV.UK (2020) data also suggests that men are more likely to be admitted into hospital at ages 75 to 84, but then this pattern shifts to women being more likely to be hospitalised aged 85 years and older. For the model investigating monthly counts of inpatient hospital

admissions, calendar month fixed effects were included as an individual-level control, as seasonal variation is a known variable that affects hospital admissions (Khan & Halder, 2014). Age was grouped into intervals (i) 65-74, (ii) 75-84, (ii) 85-94, and (iv) 95+, to account for non-linear patterns in activity according to age. Female proactive telecare users aged 75-84 acted as the reference group in analyses, as these were the most common characteristics in the population and were the ‘typical’ proactive telecare user.

Incident rate ratios (IRRs) and estimated marginal effects (MEs) were calculated. The IRR provides a relative measure of the effect of missing the OK button on hospital use (Sedgwick, 2010). As IRRs only provide a *relative* measure of effect, MEs were also calculated to provide predictions of how hospital use changes when the incidence of OK button presses change.

Marginal effects were calculated to demonstrate estimates of the magnitude of the effect of increasing proportion of missed presses on the number of inpatient hospital admissions, and the annual total of days spent in hospital. Following the regression analysis, marginal effects were calculated for a typical proactive telecare user in the population (i.e. aged 65-74 and female, as 75–84-year-olds were used as a comparison in the regression model) and then hospital admissions and total days spent in hospital were predicted in relation to a proactive telecare user missing 25%, 50% and 75% of their monthly or yearly ‘OK’ button presses.

Regression models were estimated using the *nbrreg* command in Stata version 16. Marginal effects were calculated using the *margins* postestimation command in Stata, as described by Williams (2012).

5.5. Results

5.5.1. Descriptive statistics

In total, n=6,265 proactive telecare users were included in the analysis (Table 7). Overall, the mean age was 78.80 [SD 7.57], with a range between 67 and 103. 60% of proactive telecare users were female, and 98% lived in a housing association.

5.5.2. Prevalence of missed button presses

Most proactive telecare users pressed their 'OK' button on the majority of days within the year period (2021-2022), as the mean percentage of missed button presses per month was 4.8% (Table 8). The proportion of days missed was approximately the same in men (5.0%) and women (4.7%). The proportion of days missed increased with age, as the percentage of button misses in a year increased by 2.4% in proactive telecare users over 95 compared to those aged between 65-74. The proportion of OK button days missed showed marked skewness, with the standard deviation at least three times larger than the mean. The proportion of days missed increased slightly towards the end of the study period. Hospital admissions stayed relatively consistent throughout the year.

Table 7. Population structure.

Population structure (N=6,265)		
	N	%
65-74	2,055	32.76
75-84	2,715	43.28
85-94	1,330	21.44
95+	158	2.52
Female	3,762	59.97
HA*	6,182	98.55

*HA=Housing association

Table 8. Proportion of monthly missed button presses, monthly and yearly hospital admissions, and annual days in hospital.

	Prop. of monthly missed button presses		Monthly hospital admissions			Yearly hospital admissions			Annual days in hospital		
	Mean (%)	SD	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD
All ages	0.048 (4.8%)	0.131	0	0.024	0.174	0	0.284	0.800	0	2.78	12.89
65-74	0.040 (4.0%)	0.107	0	0.021	0.165	0	0.256	0.801	0	2.22	11.04
75-84	0.049 (4.9%)	0.137	0	0.024	0.177	0	0.287	0.815	0	2.64	13.13
85-94	0.055 (5.6%)	0.147	0	0.026	0.179	0	0.310	0.762	0	3.67	14.22
95+	0.063 (6.4%)	0.146	0	0.034	0.197	0	0.406	0.829	0	5.22	17.75
Female	0.046 (4.7%)	0.130	0	0.024	0.176	0	0.286	0.792	0	2.83	12.84
Dec-21	0.047 (4.7%)	0.126	0	0.024	0.182						
Jan-22	0.042 (4.2%)	0.126	0	0.022	0.174						
Feb-22	0.042 (4.2%)	0.124	0	0.022	0.163						
Mar-22	0.044 (4.4%)	0.126	0	0.027	0.187						
Apr-22	0.044 (4.4%)	0.124	0	0.019	0.1575						
May-22	0.046 (4.6%)	0.126	0	0.023	0.172						
Jun-22	0.046 (4.8%)	0.129	0	0.024	0.172						
Jul-22	0.050 (5.0%)	0.131	0	0.024	0.169						
Aug-22	0.051 (5.1%)	0.136	0	0.025	0.182						
Sep-22	0.051 (5.1%)	0.136	0	0.022	0.164						
Oct-22	0.055 (5.5%)	0.141	0	0.025	0.179						
Nov-22	0.055 (5.5%)	0.141	0	0.026	0.187						

5.5.3. Inpatient hospital admissions

In total, 1,054 proactive telecare users (16.8%) were admitted to hospital as an inpatient at least once within the 1-year study period. Of those who were admitted to hospital, the mean age was slightly higher at 79.95 [SD 7.79] compared to 78.53 [SD 7.51]. However, yearly inpatient hospital admissions were approximately the same in male sex (0.28 [SD 0.81]) and female sex (0.29 [SD 0.79]). Monthly inpatient hospital admissions increased as age increased, as the mean monthly hospital admission in people aged between 65-74 was 0.021 [SD 0.165], which slightly increased to 0.034 [SD 0.197] in proactive telecare users aged 95 and over (Table 8).

We estimated regression analyses on n=6,265 proactive telecare users. Table 9 outlines the estimated effects of the proportion of days missed on monthly inpatient hospital admissions within the 1-year study period (December 2021-November 2022). In the regression analysis, the number of monthly inpatient hospital admissions significantly increased with age, as proactive telecare users aged 95+ were shown to be associated with 1.37 times more monthly hospital admissions compared to those aged 75-84 (95% CI [1.036; 1.811], $p=0.027$). Female sex and calendar month did not show a statistically significant impact on monthly inpatient hospital admissions; however, these were still included in the model as they were previously identified as individual-level controls. When adjusted for age, sex and calendar month, the model estimated that a 10% increase in the number of days per month with a missed OK button press was associated with monthly hospital admissions that were 2.16 times higher, compared to those who pressed their button everyday (IRR=21.6; 95% CI [15.33; 30.52], $p<0.001$). The IRR of 21.6 represents the relative increase in hospital risk, comparing going from never missing the OK button, to always missing; therefore, to calculate the relative risk of hospital admissions following a 10% increase in OK button misses compared to never missing, the IRR was divided by 10.

Table 9. Full regression results for monthly inpatient hospital admissions (between December 2021 and November 2022). In the monthly analyses, November 2022 was used as a comparison.

Inpatient hospital admissions					N=6,265 , R ² =0.0193	
	IRR	SE	P	95% CI		
Proportion of missed button presses (per month)	21.631	3.797	<0.001	15.333	30.516	
Female sex	1.003	0.056	0.948	0.899	1.119	
Age 65-74	0.934	0.060	0.294	0.824	1.060	
Age 85-95	1.082	0.075	0.256	0.944	1.241	
Age 95+	1.370	0.195	0.027	1.036	1.811	
Per month						
Dec-21	1.225	0.170	0.143	0.933	1.610	
Jan-22	1.123	0.160	0.415	0.848	1.488	
Feb-22	1.127	0.158	0.396	0.855	1.486	
Mar-22	1.399	0.189	0.013	1.072	1.824	
Apr-22	1.175	0.162	0.242	0.896	1.542	
May-22	1.240	0.170	0.117	0.947	1.623	
Jun-22	1.214	0.166	0.156	0.928	1.587	
Jul-22	1.296	0.178	0.060	0.989	1.698	
Aug-22	1.112	0.158	0.454	0.841	1.470	
Sep-22	1.259	0.172	0.093	0.962	1.647	
Oct-22	1.321	0.178	0.039	1.013	1.721	
Constant	0.015	0.001	<0.001	0.012	0.019	

IRR=incidence rate ratio, SE= standard error, CI= confidence interval.

Marginal effects were calculated for a typical proactive telecare user (female, aged 65-74) to investigate the impact of missing 25%, 50% and 75% of button presses within a month period on hospital admissions (Table 10). Of note, it was estimated that those who missed 25% of button presses within a month had 0.038 hospital admissions per month (95% CI[0.033;0.044], $p < 0.001$), which equates to approximately 4 admissions per 100 of the study population. Those who missed 75% of button presses within a month were estimated to have 0.181 hospital admissions per month (95% CI[0.132;0.229], $p < 0.001$), which equates to approximately 18 admissions per 100 of the study population.

Table 10. Estimated marginal effects for monthly inpatient hospital admissions for a typical proactive telecare user (female, aged 65-74).

Prop. of missed button presses per month	ME	SE	P value	95% CI	
25%	0.038	0.002	<0.001	0.033	0.044
50%	0.083	0.008	<0.001	0.067	0.100
75%	0.181	0.024	<0.001	0.132	0.229

ME=marginal effect, SE=standard error, 95% CI=95% confidence interval.

5.5.4. Annual total length of stay in hospital

Of those who were admitted, the mean length of stay was 2.78 days [SD 12.89] within the 1-year period. However, the median length of stay was 0 days, reflecting the skewness of the data. The total length of time spent in hospital varied greatly, with the lowest total stay at 0 days and the highest at 264 days. Mean length of stay in hospital was approximately the same in male sex (2.71 [SD 12.96]) and female sex (2.84 [SD 12.84]). The mean total of days spent in hospital during the one-year period increased with age, with proactive telecare users aged 65-74 spending an average 2.22 days [SD 11.04] in hospital in a year, compared with 5.22 [SD 17.75] for those aged over 95 (Table 8).

We estimated regression analyses on n=6,265 proactive telecare users. Table 11 outlines the estimated effects of the proportion of days missed for total days spent in hospital over a one-year period (December 2021-November 2022). The number of days spent in hospital within a one-year period increased with age, as proactive telecare users aged 95+ were predicted to have 2.052 times more days in hospital compared to those aged 75-84 (95% CI [1.132;3.721], p=0.018). Female sex did not show a statistically significant impact on total days spent in hospital but was included in the model as an individual-level control. When adjusted for age and sex, the model estimated that a 10% increase in the number of days per year with a missed OK button press was associated with yearly total days spent in hospital that were 47.4 times higher, compared to those who press their button everyday (IRR=473.5; 95% CI [92.66; 2419.72], p<0.001).

Table 11. Full regression results for annual total days spent in hospital.

Annual inpatient hospital stays				N=6,265, R ² =0.0055	
	IRR	SE	P value	95% CI	
Proportion of missed button presses (yearly)	473.524	394.096	<0.001	92.666	2419.721
Female sex	1.026	0.136	0.847	0.791	1.33
Age 65-74	0.792	0.117	0.114	0.593	1.057
Age 85-95	1.417	0.215	0.022	1.052	1.908
Age 95+	2.052	0.623	0.018	1.132	3.721
Constant	1.747	0.269	<0.001	1.291	2.365

IRR=incidence rate ratio, SE=robust standard error, CI=confidence interval.

The marginal effects for annual total days spent in hospital were calculated for a typical proactive telecare user (female, aged 65-74) (Table 12). For those who had missed 25% of OK button presses over the year, it was estimated that that they would have 7.39 days in hospital per year (95% CI [4.23;10.55], p<0.001). This rises to 34.49 days in hospital per year

when a typical proactive telecare user misses 50% of their OK button presses (95% CI [7.15;61.82], p=0.013).

Table 12. Estimated marginal effects for annual total days in hospital for a typical proactive telecare user (female, aged 65-74).

Prop. of days missed yearly	ME	SE	P value	95% CI	
25%	7.392	1.6121	0.001	4.232	10.552
50%	34.485	13.948	0.013	7.147	61.823
75%	160.869	97.350	0.098	-29.934	351.671

ME=Marginal effect, SE=robust standard error, CI=confidence interval.

5.6. Discussion

This study investigated the association between engagement with a proactive telecare system and hospital use. Findings suggest that monthly inpatient hospital admissions and annual days spent in hospital were differentially higher for proactive telecare users who had high proportions of days missed. Results indicated that tracking daily habits of pressing an OK button was associated with a relative increased risk of incidence in monthly inpatient hospital admissions and total days likely to be spent in hospital over a 1-year period. These findings translated to significant marginal effects in those who had large proportions of monthly or yearly days missed (25% -50%).

This study estimated that a 10% increase in the proportion of days missed resulted in an increased relative risk of hospital use. Of note, the marginal effects demonstrated significant increased hospital use in proactive telecare users who had high levels of missed button presses, estimating that those missing 25% of OK button presses would equate to approximately 4 hospital admissions per 100 of the study population and 7.39 days in hospital per year. These findings indicate that there may be an association between missing the OK button and an increased risk of hospital use, although further research is required to explain this association. Given the lack of data on the user's health in this study, it is hard to determine the processes that are occurring when missed button presses is associated

with increased hospital risk, which makes it difficult to know the appropriate action required when a person's missed button presses increase.

Further research into the correlation between missed button presses and hospital use may be useful, as there are benefits to having an indicator of potential illness, as it opens the opportunity for early intervention, which may delay or reduce frailty and ill health. This potential has led to a recent surge of interest in developing preventive strategies to proactively identify health and well-being issues in older people (Lette et al., 2015). Whilst prevalence of hospital use in this study population was low, the estimated marginal effects nonetheless demonstrate the potential scalable impact of the intervention. Policy makers support the uptake of digital telecare systems, as it may lead to reducing costly hospital admissions and care home usage by supporting older people to stay at home, ambulance call outs and home care visits (GOV.UK, 2022). Implementing this intervention to even a small percentage of the national population could help to monitor daily behaviour and associated hospital use risk, present opportunities for preventive strategies, and potentially reduce hospital use and subsequent costs. However, there is little research exploring the acceptability of the intervention. Of note, our previous qualitative work suggested that acceptability of this proactive telecare was mixed among older adults who did not have prior experience of using it. Future research should examine the acceptability of OKEachDay among older adults living in the community and explore suitable implementation strategies to maximise its scalability.

An existing challenge in implementing preventive strategies is ensuring older adults needs and preferences are met (Van Kempen et al., 2012). Some older adults prefer personal contact with health and social care professionals, rather than just using digital technologies to monitor health at home (Chen et al., 2023). In our previous qualitative research, findings highlighted that older adults formed strong social connections with the OKEachDay staff (Fothergill et al., 2023). Proactive telecare staff monitor missed presses and contact older adults if they miss their OK button, so if an older adult had an increased proportion of missed presses in a week, follow-up phone calls offer the opportunity for staff members to discuss support needs. Proactive telecare staff are trained on topics including mental health

awareness, suicide awareness, dementia awareness, and safeguarding (Fothergill et al., 2023). The social connections established between proactive telecare staff and users facilitate open discussions about health needs and provide opportunities to direct individuals for additional tailored support. Findings from this study and our previous research suggests that OKEachDay may provide an opportunity for a well-being check, to proactively identify and address health and social care needs.

Determining the appropriate follow-up interventions after detecting an increased proportion of missed OK button presses is key to maximising benefits of using this system. Missed button presses may be associated with an increased risk of hospital use, but as mentioned previously, the causal link between missed button presses and hospital use is still unclear and requires further investigation. As people age, slight increases in episodic memory decline are common, and is considered as normal in the ageing process (Ballard, 2010). However, forgetfulness patterns may also be associated with illness, such as delirium, thyroid dysfunction, vitamin B deficiency, or more long-term conditions such as cognitive impairment and dementia (Ballard, 2010; Ranjit et al., 2020). Future research should explore common reasons for an increase in missed button presses and identify appropriate preventive measures to address such issues. This could include services such as home care, assessments in primary care or additional health monitoring (Lette et al., 2015). Farr Point reviewed current proactive telecare interventions and suggested that proactive calls to users should be logged, and information stored about the calls. Information that should be stored, as suggested by the Farr Point report (2020), included previous contact with the service user, and any information or actions that resulted from these calls. Information on the user's health and well-being, medical conditions, social situation (whether they are living alone, or have a support network) could be useful in taking appropriate action in a situation where a user's health and well-being has deteriorated. Understanding the potential reasons for missed presses and consequential hospital admissions may help guide appropriate interventions to reduce hospital admissions.

5.6.1. Limitations

This study had several limitations. Firstly, this study used existing secondary data for the analysis, and whilst this is a cost effective approach (Cheng & Phillips, 2014), the variables were confined to the data collected by the company. Further information on the proactive telecare users may have provided useful variables to understand any differences in hospital use between proactive telecare users (e.g. deprivation-index, education level, health conditions/health status, and lifestyle factors such as alcohol consumption, smoking history, physical activity). Future research should investigate additional covariates. Secondly, it was not possible to assess whether using proactive telecare impacts overall hospital admissions due to the absence of a comparison group and limited data on the population's health status, which makes it difficult to find a suitable comparison group. Thirdly, this dataset only included users who were actively using proactive telecare and did not include users who had passed away or moved away during the study period. This presents a potential for bias, as the users active on the system may be systematically different to those who stopped using the service during the study period. Fourthly, this study only investigated one specific example of proactive telecare. OKEachDay offers individuals the opportunity to confirm their well-being by pressing an OK button; however, not all proactive telecare systems utilise this feature, so the findings from this study may not be transferable to other proactive telecare interventions. Finally, as the rate of hospital use was low in this population, the effectiveness of proactive telecare in detecting changes in behaviour for a population with high hospital use is unknown. Arguably, this type of intervention may not be useful for a high-risk population if they have high incidences of annual hospital days and are frequently away from their property.

5.7. Conclusions

This study presents an analysis of older adults using a proactive monitoring intervention to protect well-being. The findings suggest that monthly inpatient hospital admissions and annual days spent in hospital were differentially higher for users who had a high proportions of days when they missed pressing their "OKEachDay" button. Therefore, missing the OK button may be associated with an increased risk of hospital use. This could be potentially

beneficial in offering an opportunity to implement early interventions to delay or reduce illness, and consequently, reduce hospital use and associated costs. However, further research is required to understand the association between missing the OK button and increased hospitalisation risk to ensure appropriate support is offered. Furthermore, appropriate preventive strategies following the detection of behaviour changes require further research, to best promote health, independence, and well-being.

6. Chapter 6. Using a proactive telecare system to support independence, health, and well-being in older adults: a randomised feasibility and acceptability study.

6.1. Chapter overview

Studies 1-3 gave initial insight into how a proactive telecare system could support health, well-being, and independence in older adults. Findings from Study 1 highlighted that older adults felt safe and in control of their home environment and valued the connection to social resources. This corroborated with the findings from Study 2, where reassurance of help in an emergency and aiding detection of age-related deterioration were priorities for older adults. Telecare that promoted autonomy could also support well-being and self-reliance. Additionally, having social contact was highlighted as important. The realist review reported that telecare should integrate into everyday life, by fitting with people's existing context, skills, resources, and identity. If telecare did not match an individual's needs and preferences, it would not provide the appropriate support, and likely be abandoned. Study 3 suggested that missing the OK button may be associated with an increased risk of hospital use.

Overall, OKEachDay could provide an effective intervention for promoting health, well-being, and independence in older adults. However, the feasibility of evaluating this proactive telecare and the acceptability of the system was still unknown. This study aimed to explore the acceptability and feasibility of delivering and evaluating a proactive telecare intervention to community-dwelling older adults prior to a potential full-scale effectiveness trial. Findings from Studies 1-3 were integrated into an initial programme theory (a blueprint of how proactive telecare might support health, well-being, and independence) which is described in this chapter. Chapter 6 will be submitted for publication to a relevant journal and is presented below.

6.2. Abstract

6.2.1. Background

Policymakers have shown interest in proactive telecare services, which aim to provide proactive care by prompting users to regularly confirm their well-being or offer daily contact with older adults. Regular engagement with users may provide social connections to older adults and enable the detection of changes in needs, resulting in timely intervention. Telecare systems that promote active participation among older adults may foster feelings of autonomy and self-management. This research aims to understand the acceptance of OKEachDay.

6.2.2. Aim

This study aimed to explore the acceptability and feasibility of delivering and evaluating a proactive telecare intervention to community-dwelling older adults prior to a potential full-scale effectiveness trial.

6.2.3. Methods

An 8-week randomised pre-post feasibility study was conducted. Using a mixed methods approach, questionnaires and semi-structured interviews were used to explore the feasibility and acceptability of the study. The proactive telecare system consisted of either a telephone or a touchscreen device where participants were asked to press an OK button once a day to confirm their well-being. If they did not respond, participants received a well-being check, and emergency contacts were notified if required. Outcomes associated with independence, health, and well-being were measured using standardised questionnaires, including health-related quality of life, mental health, loneliness, fear of falls, and self-efficacy.

6.2.4. Results

30 older adults were recruited, with 13 randomised into the intervention group and 17 into the waitlist control group. This study had high retention rates (90.9%); however, the expression of interest rate was low (17.6%) indicating changes to recruitment strategies are required. Participants expressed high acceptance of the proactive telecare intervention;

however, most believed the intervention to be beneficial to more vulnerable older populations, suggesting more research is required to promote this system as a proactive intervention. Some participants experienced anxiety about using the technology due to a lack of understanding and uncertainty in their perceived need for the device. Preliminary data indicate that this proactive telecare intervention may improve mental well-being and perceived physical health, but also it may increase the fear of falling.

6.2.5. Conclusions

This proactive telecare system is feasible to deliver within a cohort of older adults living in the community. However, changes to recruitment approaches and implementation are needed to ensure acceptability and target numbers are achieved in a larger trial.

6.3. Introduction

The global population of adults aged over 60 years has doubled since 1980 from 480 million to 962 million in 2017 (ONS, 2019). This demographic shift towards older ages may increase the number of people living with ill health, or disability, increasing the need for care of older people (The Government Office for Science, 2016). As a result of the increasing pressure on health and social care, policymakers in the United Kingdom (UK) favour supporting older adults to remain living in their own homes, to reduce unnecessary care home and hospital admissions. However, ageing presents physical, psychological, and social changes that may reduce health and well-being (such as functional decline, disability, widowhood, or higher risk of social isolation (Chen, 2020)) which may, in turn, reduce an individual's quality of life and ability to be independent (Alnajjar et al., 2019). Therefore, older adults may require support to remain at home.

One approach to fostering independent living involves the utilisation of telecare (Goodwin, 2010). Telecare encompasses technologies that use monitoring to manage risks associated with independent living, such as fall-detectors (Cook et al., 2018) or pendant alarms that enable older adults to seek assistance during emergencies (Gathercole et al., 2021). However, despite significant investment from industry and government, benefits achieved to date have been modest. A concern highlighted in previous research is the apprehension

among older adults that telecare might be used to as a cost-cutting measure to replace face-to-face interactions (Mort et al., 2015), increasing social isolation and loneliness. These factors increase the risk for all-cause morbidity and mortality (Fakoya et al., 2020). Telecare is often adopted after an accident or injury has occurred (such as a fall), thereby linking telecare use with ageing and frailty.

The COVID-19 pandemic has accelerated interest in developing preventive health and social care technologies aimed at managing public health problems more effectively (Kickbusch et al., 2021). This growing trend has led to increased interest in proactive telecare. Proactive telecare offers regular well-being calls or encourages users to regularly confirm their well-being. The system increases contact with older adults, improves understanding of individual needs, and offers the opportunity to implement additional support to prevent poor health and well-being. Research suggests that older adults experience heightened levels of loneliness due to involuntary social isolation (Harden et al., 2020), which further emphasizes the need for additional contact in daily life. Of note, during the COVID-19 pandemic, older adults became increasingly familiar with using technologies to manage their health and well-being, such as using technology to measure vital signs (Reyes et al., 2023), or using tablets or their mobile phones to communicate with family and friends (Sixsmith et al., 2022). Therefore, it can be argued that technology is well placed to provide additional social resources to older adults. Older adults report positive outcomes from socially connected technologies, such as an increased sense of belonging, confidence, and feeling more socially active, and these technologies tend to be accepted due to the familiarity of the technology (i.e. tablets and telephones) (Cattan et al., 2011).

There are existing examples of proactive telecare and befriending services for older adults (Farr Point, 2020; Siette et al., 2017), but there needs to be better understanding into the potential health and well-being benefits of these technologies, as suggested in a 2020 report, which reviewed existing types of proactive telecare interventions (Farr Point, 2020). Prior to this study, we conducted semi-structured interviews with people who used a proactive telecare service in the UK called OKEachDay and found that the system could provide beneficial low-level support for people wanting to stay in their own homes

(Fothergill et al., 2023, see Chapter 3). Findings suggested that this intervention could provide social and technological resources to people as they prepared or adjusted to age-related challenges, promoting autonomy, and potentially helping to avoid negative outcomes prematurely. These initial findings are promising; however, further research is required to understand the potential value of this intervention.

The intervention of interest, OKEachDay[®], provides well-being monitoring and encourages daily active engagement from the user to confirm their well-being by pressing an 'OK' button. Well-being checks are provided to those who do not press their OK button, or to those who request additional well-being calls. Evidence suggests that enhancing social support and increasing opportunities for social contact are effective strategies for reducing loneliness (Masi et al., 2011). Therefore, an intervention that provides an opportunity for daily contact may be an effective strategy for reducing loneliness. The intervention encourages daily active engagement from the user to confirm well-being and is proactive, rather than reactive, which may elicit feelings of autonomy and control. In one of our previous studies, we conducted a realist review on how telecare could support independence in older adults, and autonomy was found to be an important concept in enhancing independence and well-being (Fothergill et al., 2024-in prep).

The proposed intervention is inherently complex, as it includes multiple interacting components. Its success may depend on the suitability of the intervention to the context, interactions between individuals and technology, and acceptability across stakeholders. As described by Lancaster (2015), there are multiple uncertainties in relation to conducting a larger effectiveness study, including the acceptability of the intervention and study procedures, adherence to the intervention, willingness to be randomised, choice of outcomes (for this study, this includes physical health, mental health, fear of falls, loneliness, self-efficacy, and quality of life). Also, there are uncertainties around the best methods of collecting these outcomes, and understanding how the programme may elicit the behavioural and health changes expected. Therefore, a feasibility study was conducted to test the integrity of the study protocol for a future randomised control trial (RCT).

This study aimed to explore: (i) the acceptability and feasibility of delivering and evaluating OKEachDay to community-dwelling older adults prior to a potential full-scale effectiveness trial and (ii) to estimate the appropriateness of the proposed eligibility criteria and investigate the potential effect size of OKEachDay use on health and well-being outcomes, to enable an appropriate sample size calculation for a future trial.

Objectives were to:

1. To evaluate the usability and acceptability of the intervention for participants.
2. To determine the acceptability of trial procedures (e.g. randomisation, assessment measures, compliance of intervention daily use).
3. To investigate the appropriateness of the outcome measures used to assess the impacts following OKEachDay use.
4. To refine the preliminary intervention theory around using OKEachDay for this population.

The findings will be used to justify and refine the design and delivery of a larger randomised control trial to understand the impact of OKEachDay on health and well-being.

6.4. Methods

6.4.1. Participants and recruitment

Older adults aged 65 and above, who lived in their own home (not a care home), and who spoke English were invited to take part. A sample of 30 participants was aimed for to estimate effect size as recommended by Lancaster et al. (2004) who provided a methodological framework in which to conduct a pilot/feasibility study, which would subsequently be utilised in a sample size calculation for a full-scale trial.

Participants were recruited through various channels in the Northwest for ease of data collection. Avenues included Burnley Council, Lancaster University Centre for Ageing Research Panel older adult research volunteer group, and local community groups. Posters were distributed to community centres, and the lead researcher presented the research

study at local older adult social groups ([Appendix 11](#)). Staff at local councils aided in recruiting participants who had been identified as at risk of loneliness and social isolation during the COVID-19 pandemic and so, acted as gatekeepers. Vinkenburg (2017) suggests engaging gatekeepers to increase diversity in participants, which may help reduce bias. Therefore, gatekeepers were briefed on the aims and objectives of the study and were briefed on the importance of recruiting a range of participants with differing characteristics. All participants were offered a £20 shopping voucher as an appreciation for taking part in the study.

6.4.2. Study design and procedure

Ethical approval for the study was given by the Lancaster University Ethics Committee in September 2022 (Ref: FHM-2022-1011-SA-1) ([Appendix 12](#)). This study was a mixed methods randomised control trial design. Both quantitative and qualitative techniques were employed to best address the research questions. Participants were randomised 1:1 into either the intervention group where they received the proactive telecare intervention straightaway for 8 weeks or the control group waiting list, where participants could receive the intervention after 8 weeks minimum if they were still interested. Participants in the control group were offered use of proactive telecare at a delayed stage to avoid ethical issues associated with withholding a potentially beneficial intervention from participants. The trial length of 8 weeks is in line with previous research investigating the feasibility of technologies to support independence in older adults (Kramer et al., 2021; Sattar et al., 2021).

Data for the randomised pre-post feasibility study were collected between October 2022 and August 2023. Participants who wished to take part were given an information sheet about the study ([Appendix 13](#)) and then given the opportunity to ask questions. Participants were then asked to give written consent to take part in the study ([Appendix 14](#)). All participants completed a pre-trial survey with the lead researcher (LF) 1-week prior to commencing the trial ([Appendix 15](#)). The survey measured physical health, psychological health, and other independence-related outcomes (detailed in the data collection section). Surveys were repeated directly after participants had completed the 8-week trial.

Participants were randomly allocated into the two groups by the lead researcher using computer-generated random numbers. It was not possible to blind participants or the lead researcher.

6.4.3. Proactive telecare intervention of interest

This study adheres to the Template for Intervention Description and Replication (TIDieR) checklist ([Appendix 16](#)) to ensure accurate and detailed reporting of the intervention being assessed (Hoffmann et al., 2014). The proactive telecare service consisted of either a telephone or touchscreen device with an OK button clearly displayed for participants to press daily to confirm their well-being. Once consented to the study, participants receiving the intervention were contacted via telephone by the proactive telecare staff. During this set-up call, each participant chose a preferred device (tablet or telephone), agreed on a time to press their OK button, and identified a nominated contact, often family or friends, who could be contacted if staff believed there were risks to the user. An automated reminder to press the OK button was played through the device 15 minutes before the participants agreed time. Participants could press their OK button six hours before their agreed cut off time. If the participant did not press their 'OK' button by the agreed cut off time, the call centre team would attempt to contact the participant to confirm their well-being, which gave an opportunity for social interaction. If staff could not reach the participant via telephone, staff contacted the participant's nominated contact. In the event where nominated contacts could not be contacted, emergency services were called if staff believe there were critical risks to the user.

Both devices have a button to press if the participant wishes to speak to the call centre team, which could be used to call for help, to have a chat, or to raise other issues. On the touchscreen device, participants could write a message to the call centre staff to raise issues or notify the team of planned absences from home (i.e. holidays, and hospital appointments). Proactive telecare staff were available from 8 a.m. to 10 p.m. daily to support participants with general well-being and safety concerns. Proactive telecare staff are routinely trained in dementia awareness, suicide alertness, domestic abuse awareness, learning disability awareness, mental health awareness, and safeguarding. The service also

offers additional courtesy calls to help people who may feel particularly isolated, which was offered to participants prior to taking part.

6.4.4. Development of the initial programme theory

Prior to this study, we conducted three studies exploring the value of OKEachDay, which informed the initial programme theory: (i) a qualitative study, (ii) a realist review, and (iii) a retrospective cohort study. Firstly, we conducted qualitative interviews with older adults who currently used this proactive telecare system to understand the perceived value of this kind of support (Fothergill et al., 2023). Older adults described the reassurance of having virtual check-ins, which enabled them to feel safer. Proactively confirming well-being improved self-efficacy and autonomy, which improved individual confidence to live independently. Additionally, older adults appreciated feeling connected to an additional source of support. Secondly, the realist review explored how telecare worked to support independent living and found that telecare should align with the individual's context and skills, which influenced the decision to offer participants in this study the choice in using the telephone device or the tablet, to best suit individual preferences. Thirdly, the cohort study used secondary data collected from existing OKEachDay users and investigated the association between individuals forgetting to press their OK button, and hospital admissions. This study suggested that missing the OK button may be associated with an increased risk of hospital use. These three studies informed the preliminary programme theory exploring how the intervention might work (Figure 10).

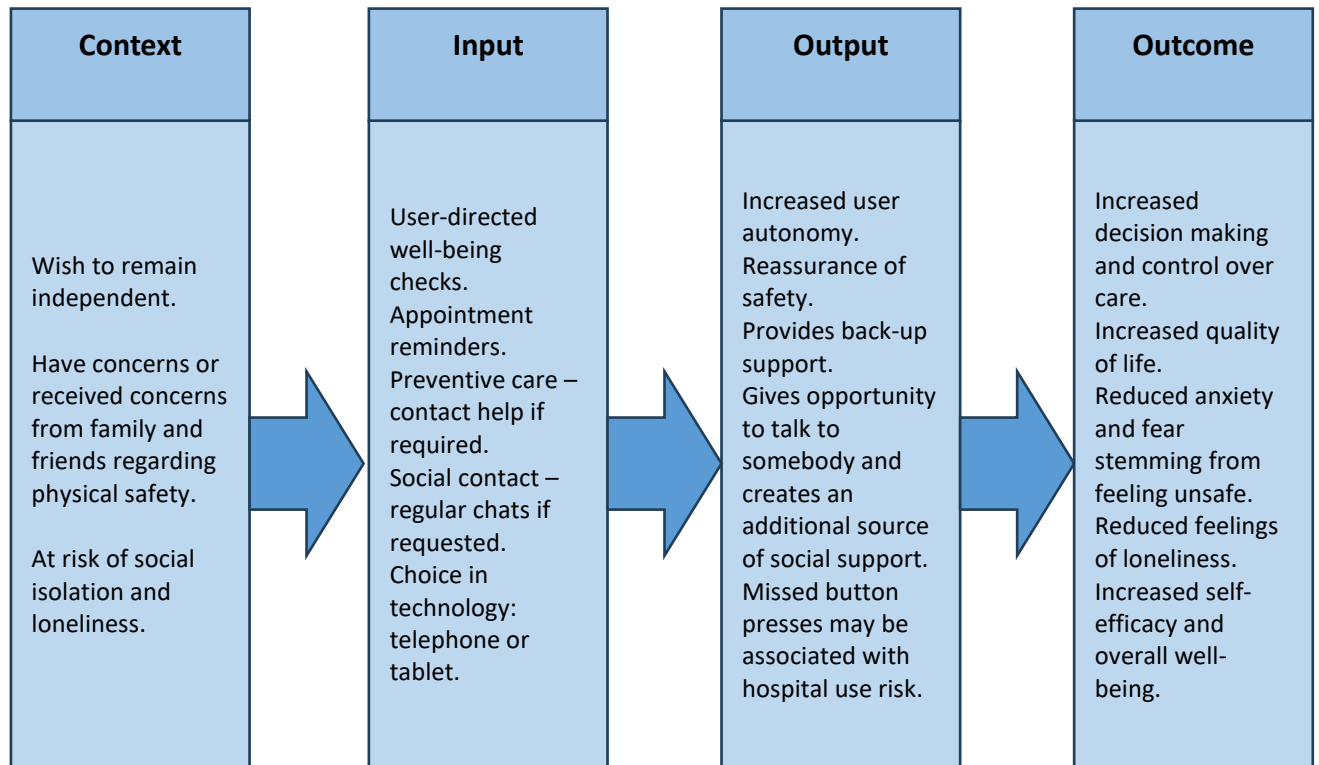


Figure 10. Preliminary programme theory for OKEachDay, developed from prior research.

OKEachDay may be acceptable for older adults who would like support to remain independent whilst also maintaining a sense of control. Other contexts might include a concern from the individual or family and friends regarding their safety in the home and the desire for connection to low-level social support. We propose that providing a service that is user-directed where the user chooses the time to engage and is proactive in encouraging users to confirm their own well-being, will promote autonomy and control over their environment. By providing an avenue for low-level social support, users may feel reassured that they can call for help or general social support if required. Providing an intervention that participants perceive to be easy to use and a technology that they are responsible for engaging with, may improve self-efficacy (Pan, 2020). Receiving additional courtesy calls may reduce feelings of loneliness for those at risk. Knowing that key contacts will be contacted if needed may help older adults feel more secure and safe, and less anxious or worried about anticipated future events, such as a fall.

6.4.5. Data collection

Recruitment, retention, and attrition

The uptake of participants on initial approach, and retention of participants recruited onto the study were recorded. Participants' engagement/adherence with proactive telecare was recorded, which included the number of times a participant did not press their OK button, the number of times primary contacts were contacted, the number of calls between proactive telecare staff and participants, and the length of these calls.

Quantitative data collection

All participants completed a quantitative survey 1-week before the study and immediately after they had completed the trial. The survey recorded demographic data (age, gender, education level, ethnicity, current/previous occupation, living arrangements, current levels of care/future care plans, and health conditions), and then used standardised questionnaires to measure physical and mental health outcomes associated with independence which may be aided or hindered by proactive telecare. This included health-related quality of life, mental well-being, anxiety, self-efficacy, loneliness, and social isolation, fear of falls, and quality of life (further detail below).

Health and well-being outcomes

Health-related quality of life, mental health and levels of loneliness were measured. Additional outcome variables were added following the preliminary qualitative research conducted, where participants reported feeling less fearful of falls, improved self-efficacy, and reduced anxiety from having additional social support (Fothergill et al., 2023).

Physical and mental health

To measure views about the participants' health-related quality of life, the SF-12 short form survey was chosen due to its wide use and reliability (Huo et al., 2018). The SF-12 measures eight health domains, which are summarised into two scores, the Physical Component Summary (PCS) and the Mental Component Summary (MCS). The PCS domains include General Health (GH), Physical Functioning (PF), Role Physical (RP), and Body Pain (BP). The MCS domains include Vitality (VT), Social Functioning (SF), Role Emotional (RE), and Mental

Health (MH). Mental well-being was measured using the Warwick-Edinburgh Mental Well-being Scale (WEMWS) (Tennant et al., 2007) which is a 14-item scale developed to enable the monitoring of mental wellbeing. This measurement tool was chosen because it covers the subjective experience of happiness and life satisfaction (hedonic well-being) and psychological functioning and self-realisation (eudaemonic well-being) and was chosen to measure 'positive well-being' outcomes, which may be associated with independence (Hillcoat-Nallétamby, 2014). The Hospital Anxiety and Depression Scale (HADS) was chosen to measure depression and anxiety (Zigmond & Snaith, 1983) as it is a widely used self-rated scale, allowing comparisons with other telecare technologies.

General self-efficacy

To measure self-efficacy, the General Self-Efficacy Scale (GSE) was used (Jerusalem & Schwarzer, 1979) as it has been used in many studies, giving the ability to compare across the literature.

Loneliness

The UCLA Loneliness Scale measured participants' subjective feelings of loneliness (Russell, Peplau, & Ferguson, 1978). The UCLA scale is a valid and reliable tool used across the literature that employs thoughtful questioning to provide useful insight into the subjective feeling of loneliness.

Fear of falls

The Falls Efficacy Scale (FES) will measure fear of falls (Tinetti, Richman, & Powell, 1990), as it is a widely used measurement tool, which allows comparisons across the literature.

Quality of Life Scale

Quality of life will be measured using the Quality of Life Scale (CASP-19), which uses four domains (control, autonomy, pleasure, and self-realization) to assess the quality of life in early older age (Hyde, Wiggins, Higgs, & Blane, 2003). This measurement tool was chosen as it is designed specifically for the population of interest, and it includes topics of interest such as autonomy and control, which in previous research was suggested to be improved following proactive telecare use.

Acceptability of OKEachDay

Participants in the intervention group were invited to complete an acceptability questionnaire to measure perceived usefulness, satisfaction, and ease of use of this proactive telecare using the senior technology acceptance model (STAM) 14-item scale (modified to fit the context of the intervention of interest) (Chen & Lou, 2020). This measurement tool was used as it was designed to consider the needs of older adults, and it used the well-established technology acceptance model (TAM) (Davis, 1989) to underpin the questionnaire.

Qualitative data collection

Participants in the intervention group were asked to take part in a short semi-structured interview upon completion of the trial. Participants from the control group who chose to use the intervention for 8-weeks after the initial waiting list period were also asked to complete a semi-structured interview. The semi-structured interviews were used to explore the feasibility outcomes, including the useability and acceptability of OKEachDay, how acceptable the trial procedures were, and exploring the participant's experiences with the proactive telecare intervention to refine the programme theory (interview guides can be found in [Appendix 17](#)). The interviews were conducted in person, or over the phone if the participant preferred. All interviews were recorded (with permission) using an encrypted digital recorder and transcribed verbatim by the lead researcher and anonymised.

6.4.6. Data analysis

Quantitative analyses

Baseline characteristics of the intervention and control participants were summarised using descriptive statistics. Effect sizes were calculated using Hedges' g for future use in a sample size calculation. Hedges' g was used as it is considered to be more accurate than Cohen's d when analysing small sample sizes < 20 (Hedges, 1981). Hedges' g was calculated for the intervention group, by taking the mean of the pre-intervention measurements from the mean of the post-intervention outcomes, and then dividing by the pooled standard deviation (SD), to infer how much the pre-intervention group differed from the post-intervention group.

$$Hedges' g = \frac{M_1 - M_2}{SD_{pooled}}$$

Where SD_{pooled} :

$$\sqrt{\frac{SD_1^2 + SD_2^2}{2}}$$

Hedges' g was interpreted using the recommended values: 0.2=> small effect, 0.5=> medium effect, or 0.8=> large effect (Hedges, 1981). In keeping with the aims of a feasibility study, no inferential statistics were reported.

Qualitative analyses

Interview data were analysed using the Framework Analysis method, as described by Gale et al. (2013). This approach was chosen to enable comparisons between participants and to systematically map the data against our specific aims and objectives. The first author (LF) led the analysis, and a second researcher (YL) was involved in coding 20% of the interviews and inputting into the development and refinement of the framework matrix. The analysis began with the two researchers reading and re-reading two initial transcripts to gain familiarity. These initial transcripts were independently coded by the two researchers. The team made comments and initial codes on segments that were related to the research objectives and/or provided useful insight. After the two researchers coded the initial transcripts, codes were discussed for relevance and meaning. Following this discussion, the first author developed a preliminary analytical framework. A further two transcripts were coded by both researchers using the preliminary framework, taking care to note any new themes or codes that had not been previously included. Follow-up discussions resulted in revisions to the framework to incorporate new and refined codes. The lead researcher coded the remaining transcripts, following a process of refining the framework as new or edited codes were generated. The final analytical framework consisted of 13 concepts, organised into four categories, each defined by a brief description (Table 13).

Table 13. Framework analysis for feasibility and acceptability objectives.

Concept	Description
1. Acceptability and useability of proactive telecare	
Perceived usefulness of intervention	The extent to which the individual feels that technology will help them stay independent, improve well-being, and quality of life, make them feel safer/give reassurance to family, or feel in control. Other uses may include providing help when needed, (contact key contacts), providing a link to social resources and reducing loneliness, and overall usefulness.
Perceived ease of use of intervention	The extent to which the individual feels that using the technology will be free of effort, or that the technology is clear and understandable, and does not require a lot of mental effort, and is easy to use.
Technology anxiety	Describes hesitancy towards using technology, due to unfamiliar design, they may feel anxious to use it in fear of making a mistake, they may be afraid that the technology may suddenly stop working, or the individual does not identify with the technology.
Resistance to using technology	Describes individuals who may benefit, but do not wish to use the technology. Reasons may be financial, or lack of perceived need, or they may already use other technology/other resources that fulfil this need.
Improvements	Describes any improvements participants suggested.
2. Appropriateness of eligibility criteria and study process	
Eligibility criteria	Describes identifying factors that highlight the appropriate people who may benefit from this technology.
Interest in taking part	Describes reasons for wanting to take part.
3. Acceptability of trial procedure	

Study process	Describes views on the study procedure, including randomisation, the information given on the study, study design, and check-ins by the researcher.
Assessment measure	Describes opinions on filling out the surveys, any other outcome measures that should have been measured, and any additional help needed to fill out assessments.
Compliance	Describes the daily use of proactive telecare and any issues experienced.
4. Refining the programme theory	
Proactive engagement	Describes any information given on the benefits/downfalls of engaging proactively.
Connection to social resources	Describes any benefits/downfalls of having a connection to social resources.
Initiating help	Describes any additional information on having access to help if required.

6.5. Results

6.5.1. Recruitment and retention

Of the 295 people who received recruitment emails and attended a talk about the study conducted by the lead researcher, 52 people (17.6%) expressed an interest with 50 people eligible (eligibility rate = 96%). Potential participants were sent more information about the study and asked to confirm with the lead researcher whether they were interested in taking part. Of the 50 eligible participants, 33 (recruitment rate = 66%) were recruited and consented to the study. Reasons for declining to take part included poor health at the time (n=5), not thinking that they would benefit from having proactive telecare (n=5), and not responding to follow-up emails (n=7). Out of the 33 consented participants, 17 were randomised to the control group and 16 were randomised to the intervention group. 30 participants completed the trial (retention rate = 90.9%), with two participants in the

intervention group withdrawing as they did not like the intervention, and one participant passed away during the trial. The participant flowchart is demonstrated in Figure 11.

6.5.2. Participant characteristics

The mean age of participants was 75.4 years and all participants identified as White British (Table 14). The majority of participants were female (80%) and most participants lived alone (63%). A small proportion of participants had informal carers (17%) and just 10% of participants currently used reactive telecare. The majority of participants (80%) had at least one chronic disease or health condition.

Table 14. Participant descriptive characteristics

Characteristic		Intervention group n=13 Mean (SD) or n (%)	Control group n=17 Mean (SD) or n (%)	Total N=30 Mean (SD) or n (%)
Age		76.7 (5.9)	74.4 (5.1)	75.4 (5.2)
Gender	Female	10 (76.9%)	13 (76.5%)	23 (76.6%)
	Male	3 (23.1%)	4 (23.5%)	7 (23.4%)
Lives alone	Yes	9 (69.2%)	10 (58.8%)	19 (63.3%)
	No	4 (30.8%)	7 (41.2%)	11 (36.7%)
Living arrangement	Private accommodation	10 (76.9%)	15 (88.2%)	25 (83.3%)
	Housing association/sheltered accommodation	3 (23.1%)	2 (11.8%)	5 (16.7%)
Education	No qualifications	4 (30.8%)	3 (17.6%)	7 (23.4%)
	Vocational qualification	4 (30.8%)	4 (23.6%)	8 (26.7%)
	GCSE/equivalent	0	2 (11.8%)	2 (6.7%)

	A level/equivalent	1 (7.7%)	3 (17.6%)	4 (13.3%)
	Degree	3 (23%)	2 (11.8%)	5 (16.6%)
	Postgraduate	1 (7.7%)	3 (17.6%)	4 (13.3%)
Has an informal carer	Yes	3 (23.1%)	1 (5.9%)	4 (13.3%)
	No	10 (76.9%)	16 (94.1%)	26 (86.7%)
Diagnosed health condition	None	1 (7.7%)	0	1 (3.3%)
	One	2 (15.4%)	6 (35.3%)	8 (26.7%)
	More than one	10 (76.9%)	10 (58.8%)	20 (66.7%)
	Prefer not to say	0	1 (5.9%)	1 (3.3%)
Current/previous occupation	Professional	7 (53.8%)	5 (29.2%)	12 (40%)
	Managerial	0	2 (11.8%)	2 (6.6%)
	Clerical	1 (7.7%)	4 (23.6%)	5 (16.7%)
	Service and sales	4 (30.8%)	1 (5.9%)	5 (16.7%)
	Skilled agricultural	0	1 (5.9%)	1 (3.3%)
	Trade work	1 (7.7%)	4 (23.6%)	5 (16.7%)

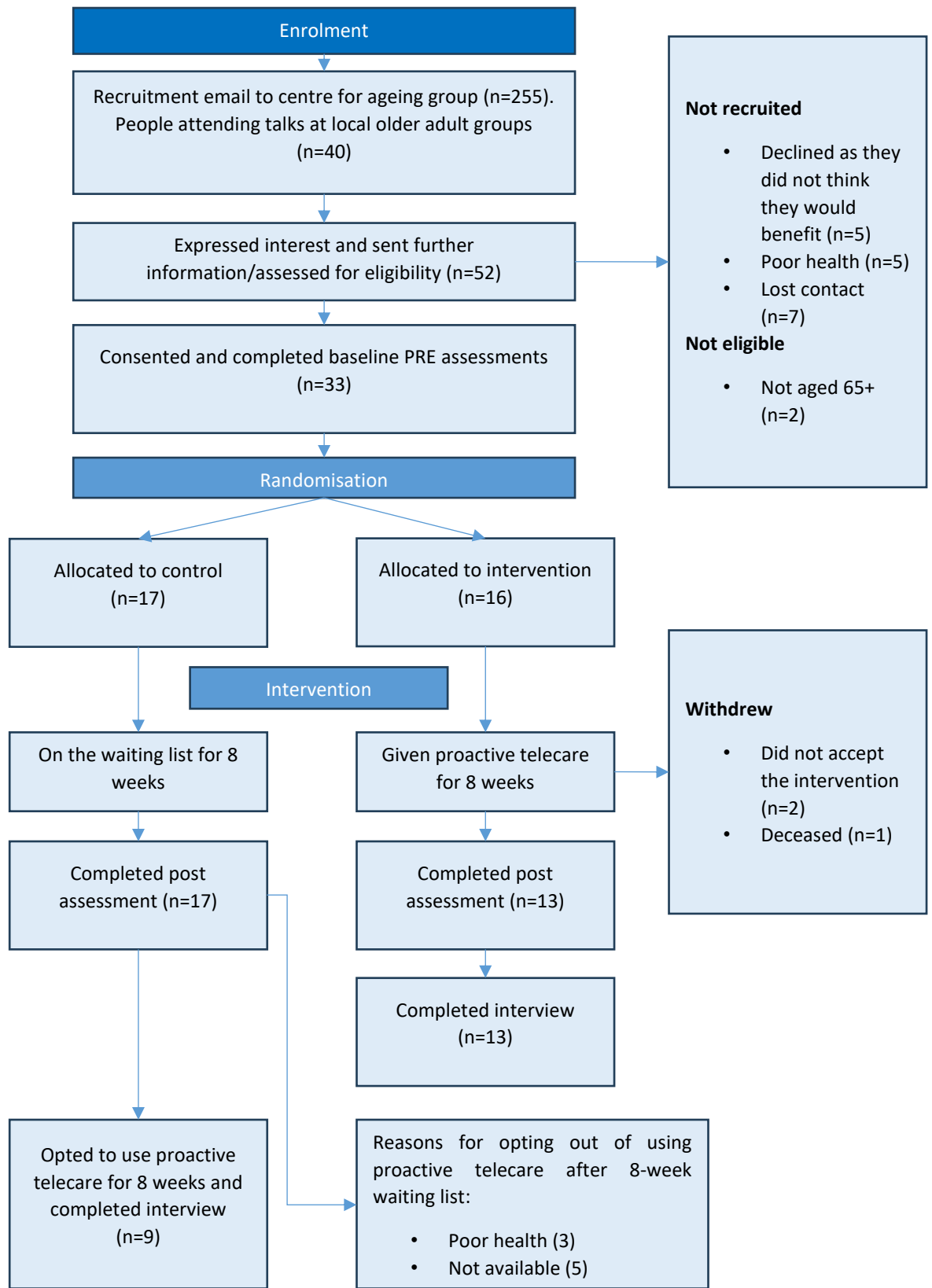


Figure 11. CONSORT flowchart of study recruitment, retention, and data collection.

6.5.3. Acceptability and useability of OKEachDay

From the quantitative technology acceptance survey and the qualitative interviews, perceived acceptance was generally good. Using a scale from 1 to 10, where 1 means ‘strongly disagree’ and 10 means ‘strongly agree’, participants were asked 14 questions about how acceptable proactive telecare was for them (see Table 15 for questions). On average, participants found proactive telecare to be useful (mean: 7.3) and agreed that the technology helped them to live independently (mean: 7.7). On average, participants found the technology easy to use (mean: 9.5). On average, participants disagreed with the statement on feeling some apprehension about using proactive telecare (mean: 3.1). However, on average, participants agreed with the statement about the cost of proactive telecare being a concern (mean: 6.7).

Table 15. Technology acceptance survey findings.

Using a scale from 1 to 10, where 1 means ‘strongly disagree’ and 10 means ‘strongly agree, please indicate how much you agree or disagree with the following statements	Mean scores
Attitudinal beliefs	
Using proactive telecare enhanced your ability to live independently	7.7
You found proactive telecare useful in your daily activities	7.3
You like the idea of using proactive telecare	8
Control beliefs	
Proactive telecare was easy to use	9.5
You could complete a task using proactive telecare if there was someone to demonstrate how	9.1
Your financial status does not limit your activities in using proactive telecare	6.7

When you want or need to use proactive telecare, it is accessible to you	9.4
Technology anxiety	
You feel apprehensive about using proactive telecare	3.1
You hesitate to use proactive telecare for fear of making mistakes you cannot correct	2.7
Health conditions	
How are your general health conditions? (with 1 being 'very poor and 10 being very good	6.7
How well are you able to concentrate? (with 1 being very uneasy and 10 being very easy).	7.8
How satisfied are you with your personal relationships? (with 1 being very unsatisfied and 10 being very satisfied).	8.3
How satisfied are you with the support received from friends and family? (with 1 being very unsatisfied and 10 being very satisfied).	8.4
How satisfied are you with your quality of life? (with 1 being very unsatisfied and 10 being very satisfied).	8.1

The findings from the quantitative acceptance survey were corroborated with the qualitative findings, where participants reported mostly positive experiences of OKEachDay, despite some stating that they did not see themselves as requiring such technology to promote and support independence at this stage. Three themes were interpreted from the data: 1) perceived usefulness of OKEachDay, 2) perceived ease of use, and 3) technological anxiety and resistance.

6.5.4. Perceived usefulness of OKEachDay

Most participants reported that the most useful component of the proactive telecare system was the reassurance of having an additional remote social network monitoring their physical and mental well-being and having an avenue to call for help if required.

I would describe it really as a comfort blanket, you just know that it's as though somebody's looking out for you and I think that's a nice feeling when you're getting older, just that you don't want to be alone.

[Participant 18; waitlist control group]

Although some participants stated that they thought they were slightly too young for a proactive telecare system, a few were surprised at how beneficial it was to have a remote team looking out for them and if they experienced any issues such as a fall, and they had not pressed their OK button, action would be taken to check on their well-being. Nevertheless, a few participants expressed negative views towards the usefulness of this particular proactive telecare system in ensuring safety in the home and highlighted that if they had a fall, they would prefer to use alternative technology to call for help, such as a pendant alarm or a mobile phone. Around half of the participants suggested having a pendant alarm as well as proactive telecare to ensure help could be called for.

I do think that people who are in danger of falling need a falls alarm as well.

[Participant 3; intervention group]

Proactive telecare staff were described by most as friendly, empathetic, and supportive, which resulted in participants feeling cared for.

It was nice. It felt to me as if they really cared about me, it felt personal, I could feel as if that lady or that young man was ringing me because they were concerned about me.

[Participant 4; intervention group]

Two participants reported feelings of loneliness before entering the study, and subsequently opted for additional courtesy calls by the proactive telecare staff at a time of convenience to the user. These participants described forming positive relationships with proactive telecare staff and found that human contact was more valuable than the reassurance of safety.

The people at Ambleside are beautiful people who are lovely, I think it has helped and, like I say, them ringing me twice a week, it's really been nice. I'll miss it really; you don't feel as lonely.

[Participant 10; intervention group]

Although the majority of participants chose not to utilise the courtesy calls as they perceived themselves to have adequate existing levels of social interactions, most saw the value in connecting socially isolated older adults to a source of social support.

6.5.5. Perceived ease of use

All the participants indicated that the proactive telecare intervention was easy to set up and use. The majority of participants chose to use the touchscreen device, which involves plugging into a socket, and two participants opted to use the telephone version out of personal preference. The telephone devices were set up in person by the proactive telecare staff, whereas the touchscreen was sent in the post and then participants were instructed on its use over the phone.

I'm a technophobe, I'm useless with things like that, but no it didn't bother me at all. It was simple to use. I plugged it in in the dining room and just did it every morning in the allotted time and it was just very, very, very simple to use, it wasn't intrusive.

[Participant 9; intervention group]

The majority of participants reported that the device was not intrusive and was not burdensome, which was viewed as positive and facilitated the development of a routine for pressing the OK button.

I just got up, you just press the button once a day, wasn't a big task.

[Participant 7; intervention group]

However, a few participants stated that the task of having to engage with proactive telecare each day was cumbersome, and became tedious, particularly when the participants forgot to press their button and received follow-up calls.

I actually feel quite relieved, I haven't got to do it anymore. So perhaps I felt, it did tie me down - that I've got to remember to do it.

[Participant 5; intervention group]

Most participants forgot to press their button at some stage but found the automated reminder useful as a soft push to press their button. Participants commented on the benefits of being able to choose the time they pressed the button to suit their schedule, and the ability to press the button six hours before the scheduled time.

it didn't matter if I did sleep a bit longer, if I didn't wake up til nine o'clock I could still press it and it was alright. [User's cut off time was 10am].

[Participant 21; control group]

This flexibility helped participants to remember to press their OK button and made the system accessible to varying daily timelines.

6.5.6. Technological anxiety and resistance

Although most participants found the technology easy to use, some participants expressed apprehension in first using OKEachDay and explained that they felt fearful of pressing other buttons in fear of making a mistake. One participant chose to use the telephone for this reason, as they viewed it as more familiar.

I'm not good with a tablet, I thought at least with the telephone I know there were them three things and that's all I needed to press.

[Participant 11; intervention group]

Some participants stated that their lack of understanding of how the technology worked enhanced their anxiety about making a mistake, and more of an explanation of how the technology worked would have helped. For some, it was the unfamiliar design of a tablet that caused confusion and apprehension.

In the early days, I touched it in the wrong place to try and bring the screen back up again. And because I wasn't familiar with the screen, I touched the alert call. And then I couldn't see in my panic, how to cancel it. And, you know, felt really quite stupid. [Participant 5; intervention group]

A few participants stated that they would have preferred face-to-face explanations of how the technology worked, as they learned better when they were able to have visual demonstrations; however, most participants were satisfied with an over-the-phone introduction to proactive telecare.

Some participants reported that they would only consider using OKEachDay once they felt that they needed it after experiencing functional decline, partly due to the cost of the device, but also due to users relating using this proactive telecare system to ageing and poor health.

I'm only eighty and I can still get about, but somebody who couldn't get out of the house or needed help, it would be ideal for them.

[Participant 18; control group]

In contrast, other participants highlighted that this proactive telecare system could be a potential precursor technology to a pendant alarm, as they did not have to have the technology on their body all the time and they did not feel 'ready' for a pendant.

One participant mentioned that they would have liked to continue using this intervention, but, as they were paying for other telecare services, they could not afford both devices.

I'd have liked to have kept it, you know, but now I've got this to pay for this pendant, it's too expensive to have both.

[Participant 13, intervention group]

6.5.7. Appropriateness and acceptability of trial procedures

Eligibility criteria

The inclusion criteria were broad for this study, as it was assumed older adults over 65 may have differing physical and emotional needs and so putting in a restricted inclusion criteria may have prevented suitable participants from taking part. Participants were asked about their motivations for taking part in the research, and the majority were interested in taking part in research more generally and wanted to give something back to their local community. Other participants wanted to try telecare technologies to see whether they could benefit.

I thought I'd like to test a system where I could make contact if I did inadvertently fall or, in any way become unsafe at home, and it came up.

[Participant 2; intervention group]

Participants agreed with having a broad eligibility criterion as they viewed it as up to the individual whether they thought they would benefit from having the technology. Participants mentioned various situations where they thought people might benefit from using OKEachDay, including if someone was housebound, had chronic conditions, or was living with a disability, if they had a history of falls, or if they lacked social resources. Some participants mentioned that people living alone would benefit; however, others saw the value in having a proactive telecare system when living with someone else, particularly if both people had chronic conditions.

I think it fits with us quite well because we've both got problems and you don't know if we're going to finish up in hospital and then the other's on their own all of a sudden, it's an insurance.

[Participant 13; waitlist control group]

Randomisation and assessment measures

Most participants were happy to be randomised into either the intervention or control group. A small number of participants preferred to be in the intervention group so they

could use the technology straight away. One participant who felt extremely isolated was keen to start straight away and mentioned that if they had been in the control group, they would have felt anxious.

Many participants reported that the trial questionnaires were acceptable and easy to complete. Nevertheless, a few participants described difficulty in answering some of the questions due to the subjectivity of some questions. One participant described difficulty in answering questions that asked them to remember feelings over the last few weeks:

they asked you to remember the last week or the last four weeks. And at my age, you don't remember the last week or the last four weeks very clearly.

[Participant 8, intervention group]

Generally, participants reported that the length of the survey was not burdensome, and the questions were deemed relevant to the study subject.

Intervention daily use

In the intervention group, most participants missed pressing their 'OK' button at least once in the 8-week trial. The average number of missed button presses for the intervention group was 7 (range: 1-49). One participant did not press their OK button purposefully every day, to receive a call from proactive telecare staff, as they felt socially isolated and wanted daily contact. The average number of general calls between participants and proactive telecare staff was 10 (range: 3-57), with an average length of two minutes and 27 seconds. General calls could be made from participants to inform proactive telecare staff of absence, to call for a chat, or calls could be made by proactive telecare staff to check on the participant after a missed button press. For the two participants who requested courtesy calls, the average call length was four minutes and 38 seconds. In the waitlist control group, the majority of participants missed pressing their 'OK' button at least once, and the average number of missed button presses was 2 (range 1-6). The average number of general calls in the control group was 5 with an average length of two minutes and four seconds. No waitlist control group participants opted for a courtesy call.

Outcome measures

There were no missing data over the two time points; however, the lead researcher who led on the data collection either read the survey to the participant or checked the survey responses for missing data whilst with the participant.

There were two instances of participants in the control group receiving the intervention. The contamination occurred due to human error by the proactive telecare company. These participants were kept in the control group to calculate the outcome measures to adhere to the intention to treat principles (Gupta, 2011).

The health and well-being outcomes are presented in Table 16. In the intervention group, self-reported physical health (PCS) improved slightly compared to the control group (unadjusted between group difference=4.92). In comparison, self-reported mental health (MCS) reduced slightly in both intervention and control groups. Anxiety and self-efficacy levels remained approximately the same in both groups. Quality of life (CASP-12) decreased slightly in both groups. Mental well-being (WEMWBS) improved slightly in the intervention group, compared to the control group where mental well-being decreased (unadjusted between group difference=2.54). Feelings of loneliness increased in both groups and fear of falls increased in the intervention group (unadjusted between group difference=7.02), compared to the control group where fear of falls remained the same. The effect sizes for all outcomes were small.

Table 16. Health and wellbeing outcomes at the start (pre) and after 8 weeks of the intervention (post) and control trials (mean \pm SD, the within-group difference in mean \pm std. error difference. Hedges' *g* presents the effect size for the intervention group.

		Control group (n=17)		Within-group differences	Intervention group (n=13)		Within-group differences	Intervention group Hedges' <i>g</i>
		Pre	Post		Pre	Post		
Self-reported health (SF-12)	PCS	45.16 [10.38]	43.24 [10.69]	-1.87 [9.28]	39.15 [9.01]	42.08 [10.19]	3.05 [5.58]	0.305
	MCS	50.10 [11.35]	46.95 [12.25]	-3.15 [9.32]	46.92 [10.49]	43.62 [9.42]	-3.34 [6.08]	0.331
Mental well-being (WEMWS)		52.76 [11.26]	51.76 [11.68]	-1 [6.72]	46.38 [11.42]	47.92 [8.87]	1.54 [7.38]	0.151
Anxiety and Depression (HADS)		9.18 [7.34]	9.76 [7.28]	0.58 [3.89]	13.16 [7.03]	13.23 [6.76]	0.07 [3.82]	0.010
Self-efficacy (GSE)		33.06 [5.39]	32.71 [4.43]	-0.35 [4.44]	29.92 [2.69]	30.38 [3.54]	0.46 [2.69]	0.146
Fear of falls (FES)		20.59 [18.62]	20.65 [20.54]	0.06 [11.24]	19.92 [12.19]	27.00 [18.00]	7.08 [11.76]	0.461
Loneliness (UCLA)		29.47 [11.76]	31.47 [13.34]	2.00 [9.40]	38.69 [17.51]	40.69 [16.17]	2.00 [10.90]	0.119
Quality of life (CASP-19)		42.71 [8.53]	41.12 [10.65]	-1.59 [7.87]	39.15 [8.41]	37.77 [7.59]	-1.38 [7.433]	0.172

6.5.8. Programme theory refinement

Participants' descriptions of their experiences of using OKEachDay mostly aligned with the preliminary programme theory, although some areas of importance were confirmed, and the theory was subsequently refined (Figure 12). The proposed contextual factors were echoed in these interviews; however, some changes are needed to further represent the context.

Participants needed to have a perceived need for technological support in maintaining or promoting independence, due to a lack of resources elsewhere in their environment, such as a lack of social resources. People having chronic conditions or disabilities was also viewed to be an important context for benefitting from this proactive telecare intervention.

I think it would be very handy for those who aren't quite, very well. There is knowing that there's a backup there if anything starts to go wrong.

[Participant 17; control group]

Participants echoed the importance of proactive engagement in providing reassurance of safety. Participants also emphasised the benefit of being proactive in promoting self-initiation and self-regulation.

It's reassurance, isn't it, I think it's a psychological trigger. I think it's a good thing, I really do.

[Participant 12; control group]

One participant highlighted the value of the flexibility of the intervention, because users had choice and control over the level of support provided if they missed their OK button, in comparison to a pendant alarm where activating it indicates an emergency in an 'all or nothing' approach to support.

you press that [pendant alarm] for help, that's like saying it's an emergency, do I really need it? Just to say like in the morning yeah, I'm OK today, that's better I think.

[Participant 30, control group]

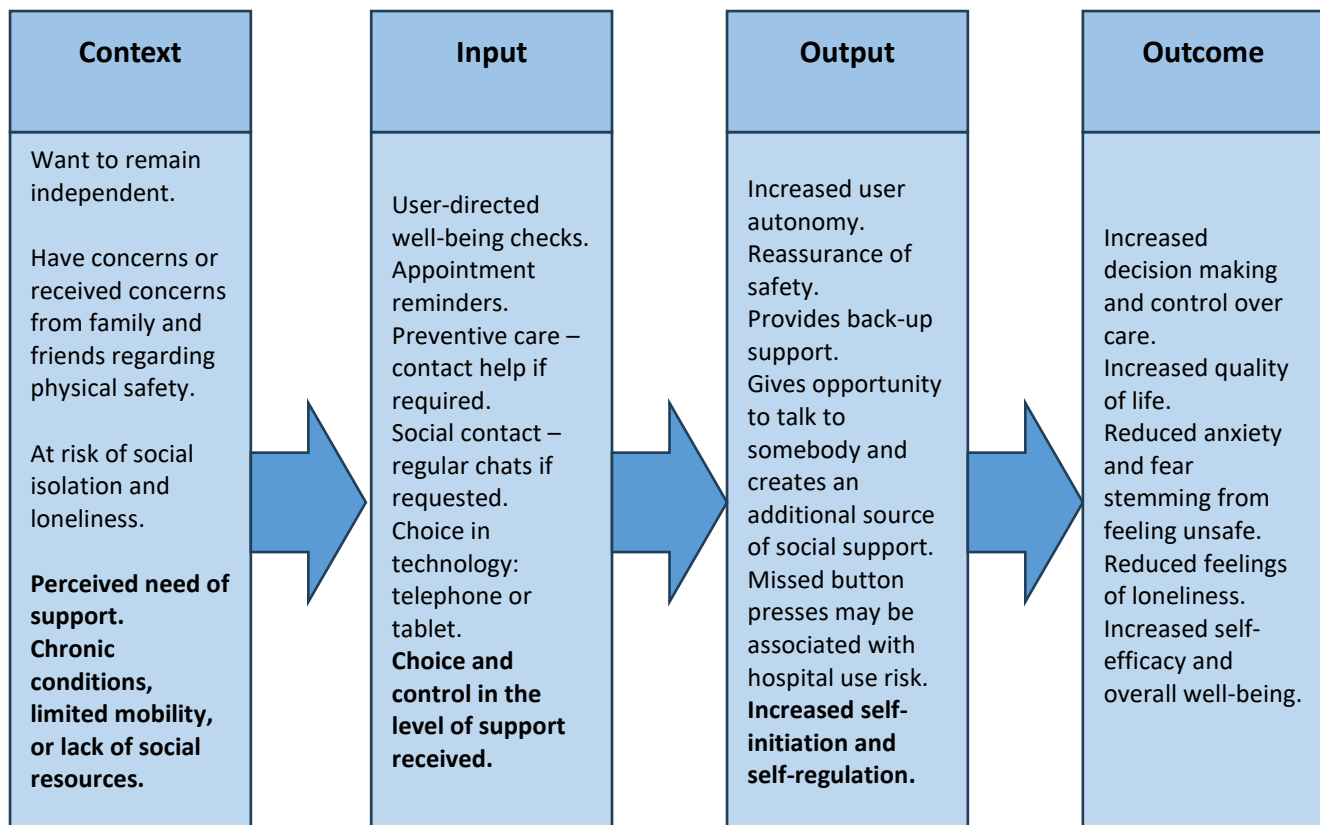


Figure 12. Refined programme theory. Areas of refinement are highlighted in bold.

6.6. Discussion

This study assessed the acceptability and feasibility of evaluating a proactive telecare intervention in older adults living in the community. The trial sustained low dropout rates and successful collection of outcome variables. However, initial expression of interest in the study was low. Indeed, some participants indicated hesitancy as to whether this intervention was beneficial to them, so adaptations to the recruitment process should be explored. The proactive telecare intervention was deemed acceptable to participants, with many indicating it was useful and easy to use, although some participants experienced hesitancy and mild anxiety when first introduced to the intervention, suggesting further support may be needed for some. Trial procedures were feasible and acceptable by participants, including randomisation, and completing questionnaires. However, there were two instances of contamination in the randomisation, which suggests different procedures may be required in a future full-scale trial.

There was uncertainty around who would benefit from the use of OKEachDay, so this study implemented broad eligibility criteria; (i) living in the community and (ii) be over 65 years old. The eligibility rate was unsurprisingly high at 96%, but only 17.6% of people contacted expressed an interest in the study. This was likely to be in part due to utilising an older adult group mailing list in the recruitment strategy, which may have included people aged under 65, or there may have been low engagement with emails. Face-to-face presentations at older adult groups were more effective at yielding higher recruitment numbers than emails. Research has observed similar patterns of success in using face-to-face contact for recruitment (Auster & Janda, 2009), but research suggests that the feasibility of this strategy must be considered. For a full-scale trial where more participants would be required, face-to-face recruitment may not always be possible. Clemson et al. (2007) found that direct mail to potential participants was cost-effective and successful in recruiting older adults. Chatters et al. (2018) found that recruiting through primary care was effective in recruiting older adults. Such methods should be considered in a larger trial.

Once participants consented to the study, the retention rate was high (90.9%). However, two participants withdrew as they did not like the technology. One participant could not form a routine of remembering to press the OK button and another was anxious about getting up to press the OK button due to falls risk. Further support from proactive telecare staff in the first few weeks of use may help to retain participants.

Most participants deemed the study processes to be feasible and acceptable. Participants were happy to be randomised, although there were a few participants who preferred to be in the intervention group rather than the control group. Of note, these participants were still happy to take part and understood that being randomised was part of the research process. There were two instances of contamination, where two participants who had been allocated to the control group were given the intervention straight away. This was due to human error by the proactive telecare staff. The participants remained in the control group to comply with intention to treat analysis (Pitkala & Strandberg, 2022); however, in a full-scale RCT this may dilute the differences between groups. In a full-scale trial, Pitkala & Strandberg (2022) suggest performing cluster randomisation in a defined environment, for example, a housing association may

overcome this problem. Many participants perceived the outcome measures to be appropriate to the study and found the trial questionnaires easy to complete. However, some did find the questions to be subjective and at times difficult to answer. Indeed, participants found completing the questionnaires with a researcher beneficial to be able to clarify meanings of the questions, suggesting a researcher should be present with participants when filling out outcome measures in a future trial, although this may not be possible in a larger study. These findings suggest that optimisation for the measurement tools may be required to simplify the questionnaire and create clearer questions for participants to understand.

Most participants thought that the eligibility criteria were feasible, as participants believed it was up to each individual to assess their situation and consider whether this proactive telecare intervention was appropriate for them or not. Of note, participants did highlight specific groups that may benefit, which included people who were housebound or had limited mobility, had chronic conditions, were living with a disability, or lacked social resources. Participants highlighted that more vulnerable populations would benefit from OKEachDay, but arguably this technology could be used as an early intervention to be used by older adults who have not yet developed chronic conditions. An evaluation of proactive telecare interventions by Farr Point found that proactive telecare devices offer a broad range of support, and so, these technologies could be offered in different ways, for example, proactive telecare could be offered to all existing telecare users or offered as a stand-alone, more personalised service (Farr Point, 2020). Offering proactive telecare in different ways may improve acceptability, for example, existing telecare users may be more receptive to using proactive telecare, as they already use technology to support their independence. Best practice around offering services to people who will most benefit from them may require further research. Some participants mentioned that they would have liked to continue using the intervention. However, financial resources were a barrier. Further work needs to be done in promoting proactive telecare as an early intervention.

Descriptive analyses found small improvements in mental well-being between the intervention group and the control group, which are similar to results that have been noted in other studies on telecare interventions (Hirani et al., 2014). Small

improvements were also observed in the physical component score (PCS-12) in the self-reported HRQoL. Previous research suggests that such changes may be due to increased perceptions of safety and security which in turn may improve perceived health and mental well-being (Hirani et al., 2014). Although the improvements seen in well-being in this study are similar to those in telecare interventions such as a pendant alarm (as demonstrated by Hirani et al., 2014), it must be highlighted that OKEachDay is untypical of telecare devices used in the UK, as it does not offer 24-hour monitoring, and so direct comparisons to telecare must be taken with caution. It may be the 24-hour monitoring element of pendant alarms that offer a sense of safety, which would not be the case for OKEachDay. A larger scale trial would be required to understand the impacts on well-being from using a proactive telecare system like OKEachDay.

Findings saw an increase in the fear of falls in the intervention group compared to the control group. One potential explanation is that filling in the questionnaire may have increased feelings of vulnerability, as individuals may not have contemplated before what would happen if they did have a fall at home. In contrast, research has reported a reduction in the fear of falls following reactive telecare use (Brownsell & Hawley, 2004); therefore, further exploration into this finding would be required in a full-scale trial. Little or no difference was observed in the remaining outcome measures. Only descriptive statistics were calculated, and these results should be interpreted with caution as they lack statistical power. A full-scale RCT is required for further analyses. Hedge's g was calculated for each outcome measure to be used for sample size calculations in a future trial. With a small effect size of 0.2, and 80% power, a sample size for an RCT would be 150 participants based on suggestions by Faul et al. (2007).

Both the quantitative acceptability questionnaire and the qualitative insights from participants suggested that OKEachDay was acceptable and feasible to deliver to this population. The most reported benefit of using proactive telecare by participants was having a sense of reassurance. Although some participants stated that they did not see themselves as requiring a proactive telecare device yet as they perceived themselves to be independent, older adults still felt reassured that someone was looking out for them, and some may consider using it as a precursor to a pendant alarm. Proactive engagement was described as a psychological trigger and promoted self-regulation. The

proactive nature gave more control to the older adult over the response given by staff, as they could request as little or more support as required. Hillcoat-Nallétamby (2014) suggests that independence often refers to the need to be able to do something for oneself and maintain a sense of control. A report by Farr Point (2020) suggests that proactive well-being checks could be used as an introductory telecare service for someone who wishes to have that peace of mind that someone is checking in on them. The report suggests that proactive well-being checks may be accepted by people who are resistant to other telecare devices due to associated stigma (Farr Point, 2020). Being proactive may enable individuals to perceive themselves as self-sufficient, improving their sense of independence. Despite feeling reassurance, some participants felt that those with high fall risk should also have other telecare devices to gain a quick response in an emergency.

For those participants who felt lonely, the most beneficial component of this proactive telecare system was the opportunity to engage with another social network. Courtesy calls were seen as a valuable source of social interaction, where participants indicated that the support and caring nature of proactive telecare staff helped to reduce feelings of loneliness. Despite these findings, preliminary quantitative findings showed no changes in loneliness, although findings should be interpreted with caution. This could suggest that this proactive telecare intervention could go further in providing support to socially isolated people. Smallfield & Molitor (2018) conducted a systematic review found that community-based groups and electronic social groups were effective in promoting social participation. Indeed, proactive telecare staff could include signposting to local social groups as part of the support on offer to older adults. This study only investigated one type of proactive telecare, which mostly offers low level psychosocial support based on need, so if an individual wishes to talk to someone, they can. If not, they can just press their OK button. However, other types of proactive telecare may offer higher levels of social support. For example, a study by Cund et al. (2021) evaluated proactive telecare services in Scotland by conducting qualitative interviews with older adults who received proactive well-being calls every week or daily that lasted approximately 20 minutes. This study found that the calls led to positive impacts on individual mental well-being, suggesting that longer well-being calls may be beneficial.

However, further research is required to understand what levels of support are the most impactful, and how/why proactive well-being calls may be beneficial in reducing loneliness and promoting well-being.

Most participants reported that the intervention was easy to set up and use and that it would be appropriate for older people who may not have experience in using similar technologies due to the simplicity of the system. There were a few participants who felt some apprehension towards the technology and would have benefited from having an in-person demonstration, which should be considered in a future trial. Wu et al. (2015) suggests that older adults often report a lack of knowledge of technology which can result in apprehension. Product demonstrations are suggested to enable participants to trial and test out devices, to gain further knowledge and confidence about the useability and usefulness of technologies. Most participants found it manageable to press their OK button each day, although most participants did forget to press their button at least once during the trial. A few participants felt a sense of relief when the trial ended and they did not need to press their button anymore; however, these participants also saw no perceived need for the technology, suggesting perceived benefit is an indicator of continued use.

6.6.1. Strengths and limitations

A key strength of this study was the use of both quantitative and qualitative methods in evaluating the feasibility and acceptability of this proactive telecare system, which enabled researchers to gain further insight into the participants' experiences with the intervention. Standardised measurement tools were utilised to measure independence outcomes, which can be compared across the literature. This study was not without limitations. Firstly, all the participants were White British, which suggests changes to the recruitment strategy are required to create a more diverse sample population in a future trial. Secondly, this trial was conducted over 8 weeks, and so may not have been long enough for participants to gain benefit from it. Future trials should consider longer follow-ups; however, maintaining high retention rates with a longer study may introduce new challenges. Thirdly, this study only focused on the acceptability and feasibility of one particular type of proactive telecare, so the findings may not be transferable to other types of proactive telecare. Finally, this study did not record the

reasons why participants were not able to press their OK button. Future trials should aim to record this information, as it may allow further investigation into if behaviour changes in more vulnerable individuals has an impact on hospitalisation risk.

6.7. Conclusions

This study has identified pragmatic considerations for conducting a future RCT for a proactive telecare system in older adults living in the community. The intervention was perceived positively by most participants, with older adults describing feeling reassured by having additional safety resources in the house. For those who felt socially isolated, additional well-being checks were viewed as a significant help in reducing feelings of loneliness. Study procedures were feasible and acceptable, with changes required in the recruitment and implementation strategy to maximise take-up and the benefit to participants and reduce technology anxiety. Messaging of the intervention may require development to be promoted as a preventive intervention, rather than an aid used once functional decline has begun. The data from this study have provided valuable considerations for refining and justifying the design of a future effectiveness trial.

7. Chapter 7. Thesis discussion

7.1. Chapter overview

This chapter summarises the key findings across the four studies conducted for this doctoral research (Chapters 3-6) and discusses their contributions to existing literature and theory. It will discuss the implications of findings for future research and evaluation, health and social care and policy. This chapter also discusses the involvement of the public in this research and outlines the dissemination plans for the studies conducted within this thesis. The strengths and limitations of the studies will be reviewed, and the final conclusions drawn from this thesis will be presented.

7.2. Review of key findings

The preceding chapters present findings related to the thesis aim of exploring to how using a proactive telecare service can support older adults to live independently, and what potential health and well-being benefits may be elicited from its use. Specifically, the research explored:

1. How can using a proactive telecare system support various aspects of independence in older adults, including autonomy, maintaining social connections, and accessing support.
2. What health and well-being benefits and challenges are associated with the adoption of a proactive telecare in older adults, including the effect on well-being, mental health, and quality of life, and hospitalisation risk.

The aims and key findings for each study are presented below.

Study 1: Understanding the value of a proactive telecare system in supporting older adults' independence at home: a qualitative study among key interest groups.

Chapter 3 was a qualitative interview study exploring the perceptions of different interest groups to understand the extent to which using a proactive telecare service can support older adults to live independently. 30 interviews were conducted in total. Older adults highlighted that using OKEachDay enabled them to feel safe and in control of their environment. Both family members and telecare staff reported the potential of proactive telecare to be used to detect health deterioration. All participants described

the value of being connected to an additional social network, particularly for socially isolated older people. Nevertheless, there was mixed acceptance of the technology among older people who did not have experience using it, with the requirement of social and financial resources often cited as potential barriers. This highlighting the need to match this proactive telecare intervention to individual preferences and resources.

Study 2: How, for whom and under what circumstances can telecare support independent living in community-dwelling older adults: a realist review.

Chapter 4 was a realist review of existing literature which aimed to understand the contexts in which telecare can support independent living in older adults and for whom. 31 studies were analysed to identify core mechanisms of how telecare may lead to positive or negative impacts on older adults. Findings highlighted that telecare services should support older adults' goal of remaining at home by providing reassurance of help in an emergency and aid in detecting age-related deterioration. Telecare devices that actively promote autonomy by enabling choice over technological resources may support self-reliance and control over one's life. Telecare that enables social contact may reduce loneliness and social isolation for those who lack social resources. Findings highlighted that telecare must integrate into an individual's life, personal context, and available resources. To maximise the health and well-being benefits of using telecare, consideration should be given to these findings.

Study 3: Does proactive monitoring of older adults' well-being aid in the detection of increased hospitalisation risk? A retrospective cohort study of proactive telecare users in the United Kingdom.

Chapter 5 used quantitative methods to assess whether missing the OK button was associated with hospitalisation risk by investigating patterns of failing to press the OK button and being admitted to hospital. Negative binomial regression was used to analyse secondary data from the proactive telecare intervention of interest, OKEachDay. Findings suggested that a 10% increase in the number of days per month with a 'missed OK button press' was associated with monthly hospital admissions that were 2.16 times higher, compared to those who pressed the OK button everyday (IRR=21.6; 95% CI [15.33; 30.52]). Yearly incidence rates of number of days spent in hospital were estimated to increase by 47.4 times per 10% increase in OK button missed compared to

those who did not miss (IRR=473.5; 95% CI [92.66; 2419.72], $p < 0.001$). Consequently, findings suggest that missing the OK button may be associated with increased risk of hospital use. Further research is required to investigate this association.

Study 4: Using a proactive telecare system to support independence, health, and well-being in older adults: a randomised feasibility and acceptability study.

Chapter 6 used mixed methods to explore the acceptability and feasibility of delivering and evaluating a proactive telecare system to community-dwelling older adults. 30 older adults were recruited, with 13 randomised into the intervention group and 17 into the control group. The study had high retention rates, but the expression of interest rate was low. Older adults expressed high acceptance of the intervention, but most believed OKEachDay to be beneficial to more vulnerable older populations. Some participants experienced anxiety about using the technology due to a lack of understanding and uncertainty in their perceived need for the device. Preliminary data indicate that this proactive telecare intervention may improve mental well-being and perceived physical health, but also it may increase the fear of falling. Overall, this study suggested that OKEachDay is feasible to evaluate, and acceptable to older adults who were able to consider whether it was an appropriate intervention for them, although vulnerable older adults (i.e. housebound, socially isolated) were highlighted as potential key beneficiaries.

7.3. Integration of research findings with existing literature

This section integrates the research findings from the four preceding chapters with existing literature. Research findings were grouped into four key themes that run throughout this thesis and contribute to the thesis aim of exploring how using a proactive telecare service can support health, well-being, and independence in older adults. These themes consist of (i) managing risk and promoting safety, (ii) facilitating autonomy, (iii) enabling social contact and (iv) integrating with personal context. Previous chapters are referred to as follows in this discussion chapter:

- Chapter 3: interview study
- Chapter 4: realist review
- Chapter 5: quantitative study
- Chapter 6: feasibility study

7.3.1. Managing risk and promoting safety

In Study 1 and 4, using OKEachDay contributed to promoting safety in the home, by providing reassurance of help if required. This is consistent with existing literature on telecare. Indeed, the desire to feel safe in one's home has been described as a key reason for telecare use (Cook et al., 2016). Of note, the realist review conducted for this thesis highlighted that specific reasons for using telecare differed among individuals, as some used telecare to support declining capabilities (Greenhalgh et al., 2013), whilst others used it for risk management (Hamblin, 2017). This finding was similar to that in Chapter 3 (interview study) which demonstrated that older adults adopted proactive telecare in both anticipation of, and in response to age-related changes, to accumulate resources in order to avoid further health deterioration (Fothergill et al., 2023). Although individual contexts for telecare adoption may differ between users, the key goal to remain living at home was consistent across the studies in this thesis.

Literature has highlighted telecare use and monitoring technologies as a strategy used by older adults to prevent transfer to nursing homes and to enable people to stay living in their homes for as long as possible (Yaylagul et al., 2022). Prior research indicates that telecare contributes to feelings of safety as it is believed to protect older adults against injury and insecurity (Johannessen et al., 2019). Literature on pendant alarm users highlights that it may enable a sense of safety, as it enables them to request help when necessary (Karlsen et al., 2017; Mckee et al., 2012; Peek et al., 2014). This research indicates that OKEachDay may also offer reassurance of safety (Chapter 3 - interview study and Chapter 6 - feasibility study). However, OKEachDay can be regarded as an untypical telecare service in the UK, as it does not offer 24-hour monitoring like more traditional reactive telecare services. Therefore, OKEachDay may provide feelings of safety for different reasons to other types of telecare services. The requirement of people to press an OK button proactively may have contributed to feelings of safety, as receiving emergency support was not dependent on the user summoning help, unlike pendant alarms (Fothergill et al., 2023). The fact that this intervention did not provide 24-hour support was still reported as a significant limitation to safety reassurance and a cause of anxiety. Consequently, some users opted to utilise other forms of telecare alongside OKEachDay, while other users accepted this limitation, as they did not

perceive the need for 24-hour support. This demonstrates that telecare requirements may differ among individuals, and as highlighted by the realist review, assessment of needs is important when matching telecare to individuals, to prevent adverse effects to well-being.

Previous quantitative work on telecare has highlighted its potential to enhance perceived safety at home among older adults, offering reassurance to telecare users, their families, carers, and others. This, in turn, can contribute to improved health and well-being (Hirani et al., 2014). Similarly, in Chapter 6 (feasibility study), small improvements were observed in health-related quality of life and mental well-being, which could be due to increased perceptions of safety, as seen in the research by Hirani et al. (2014). Of note, the feasibility study only demonstrates descriptive statistics, indicating that further research is needed to ascertain improvements in health and mental well-being, as the current results lack statistical power. Moreover, this proactive telecare system did not offer 24-hour monitoring like the telecare used by Hirani et al. (2014), so further research is required into *why* changes in health and well-being might be observed, as they cannot be directly compared to other telecare interventions which use different safety elements (such as 24-hour monitoring). Nevertheless, the preliminary findings from the feasibility study suggest potential in improving health and well-being outcomes, indicating the potential utility of a future RCT in exploring these outcomes.

In this research, missing the OK button was found to be associated with an increased risk of hospital use (Chapter 3 - interview study and Chapter 5 - quantitative study). In current literature, the evidence on telecare use and reducing hospital admissions is mixed. Research suggests only small reductions in admissions to hospital and length of hospital stays (Steventon et al., 2013), whilst other research reports high numbers of admissions avoided and estimate significant healthcare savings associated with telecare use (Beale et al., 2010). In Chapter 5 (quantitative study), hospital use was found to be higher in those who did not press their OK button daily. However, this study only assessed the association between missing the OK button and hospital risk, and not any subsequent effect on reducing hospital admissions. Investigating the association between missing the OK button and hospital risk was still seen as beneficial, as in

Chapter 4 (realist review), some studies suggested that some older adults recognised the importance of monitoring health through using telecare, as it allowed them to identify changes that they might not have noticed on their own (Pol et al., 2016; Wild et al., 2008). On the other hand, some studies suggested that older adults viewed monitoring as invasive (Chaudhuri et al., 2017) and saw it as a threat to their identity and independence (Yaylagul et al., 2022), which suggests the need to understand individual preferences when implementing telecare. Moreover, studies suggest that tracking forgetfulness patterns may reduce well-being due to the stigma associated with memory loss (Ballard, 2010). This was demonstrated in Chapter 3 (interview study) and Chapter 6 (feasibility study) by the dismay expressed by users when they forgot to press the button. This highlights the need for psychoeducation on the range of causes of forgetfulness (such as UTIs, drug reactions, or nutrient deficiencies (Dutta et al., 2022; Jatoi et al., 2020; Lavan & Gallagher, 2016)), so that individuals may be more accepting of being monitored, if proactive telecare interventions were to be implemented more widely. Further research into the psychological implications of monitoring forgetfulness is necessary. Future research should also explore appropriate preventive strategies following detection of behaviour changes, and the effectiveness of OKEachDay use in reducing overall hospital use.

7.3.2. Facilitating autonomy

Findings from this research found that older adults reported feeling in control by engaging proactively with the technology (Chapter 3 - interview study and Chapter 6 - feasibility study). In the interview study, OKEachDay users reported that proactively pressing a button enhanced self-efficacy and personal capability (Fothergill et al., 2023). Moreover, staff members in this study saw the benefits of being proactive in confirming well-being, as it demonstrated that users were viewed as independent and able, which was suggested to boost confidence and self-esteem. This can be highlighted by this quote from an OKEachDay user: *“It gives you a sense of freedom, it gives you independence, because you're in charge of doing that”* (participant 14, interview study). In the feasibility study, engaging proactively with the technology was described as a ‘psychological trigger’, which promoted self-regulation and self-initiation, as they were in control of their own well-being confirmation, eliciting a sense of doing something for

themselves and maintaining control. In contrast, existing literature on other telecare interventions, particularly regarding more invasive monitoring technologies such as ambient sensors, emphasises older adults' concerns regarding privacy when using telecare and monitoring technologies (Birchley et al., 2017; Karlsen et al., 2017). This concern stems from the perception of older adults as passive recipients of care, which can reduce autonomy (Loader et al., 2009). This research demonstrates the potential of OKEachDay to promote autonomy and self-management. The findings from this research may be useful for understanding the potential value of other proactive telecare systems that require the user to engage with the system. However, as OKEachDay is a specific example of proactive telecare, not all systems will have this element and so, the findings may not be generalisable across all types of proactive telecare. Further research may help to understand whether autonomy is facilitated in other 'proactive' telecare technologies, such as systems that provide appointment and medication reminders, or proactive telecare systems that provide more social support in the form of outbound well-being calls (call centre to user calls). Work by Cund et al. (2021) suggests that proactive call handlers who call users on a regular basis may enable users to take control of the conversations (Cund et al., 2021), which could empower users and facilitate a sense of autonomy, but further research would improve our understanding on this topic.

Findings from Chapter 4 (realist review) revealed that some older adults with a high perceived risk of losing their independence were more willing to relinquish control when using telecare, as a trade-off for feeling safe and were more open to using ambient sensors, which has also been observed in other studies on monitoring devices such as those by Camp et al., (2022) and Felber et al., (2023). On the other hand, for others who did not perceive a high risk of losing independence, passive monitoring was more likely to impact on autonomy (Berridge, 2017), suggesting that ambient sensors may not be appropriate for all. Although some older adults were more willing to give up some control, users still valued choice and control in *how* telecare was used before and after an incident, as some feared the consequences of triggering an emergency alarm (moving into institutional care or hospitalisation). Of note, the findings from this research highlight that OKEachDay may provide more choice and control than passive telecare, as the system provides support according to levels of independence, meaning that if an

older adult requires further support, this will be detected by the individual not pressing their OK button. If an older adult pressed their OK button, then it is assumed that no support is required. This was highlighted in the following quote from Chapter 6 (feasibility study): *“you press that [pendant alarm] for help, that’s like saying it’s an emergency, do I really need it? Just to say like in the morning yeah, I’m OK today, that’s better I think”* (participant 30, feasibility study). This flexibility provides individuals with greater control and the opportunity to receive tailored support during periods when their level of independence may change, for example, during periods of illness. This presents a potential advantage over first generation telecare systems, which rely on individuals activating an alarm – a task that may not always be possible due to accident or injury.

7.3.3. Enabling social contact and communication

Previous research has indicated that older adults’ wish to maintain and secure avenues for social connection through the use of telecare, ensuring that human communication is not lost despite adopting the technology (De San Miguel et al., 2017; Felber et al., 2023; Leikas & Kulju, 2018). A study by Berridge (2017) suggests that older adults who use telecare may be at risk of social isolation. This risk may be increased if they live alone or are housebound and may not be able to form or maintain social connections outside of their home environment, as suggested by Sen et al. (2022). Of note, Chapter 4 (realist review) uncovered that older adults would like to use telecare for human interaction, yet most reactive telecare devices are designed for emergency purposes only, and so telecare staff may not have adequate resources to support this kind of support (Percival & Hanson, 2016). On the other hand, the research from this thesis suggests that OKEachDay may provide a valued connection to a network of support for older adults. Previous research has suggested that delivering outbound calls to older adults may help to foster strong relationships between users and service providers and may enable tailored support to help people remain independent. Cund et al. (2021) conducted a study investigating the impact of proactive telecare across Scotland and found that outbound well-being calls led to positive mental well-being in some users. Although this study only investigated pilot proactive telecare sites over 6 months and did not investigate long term use. In both Chapter 3 (interview study), which explored the views

of long standing OKEachDay users, and Chapter 6 (feasibility study), which recruited new users, older adults appreciated having another source of social support, where individuals could disclose well-being issues like feelings of anxiety and loneliness (Fothergill et al., 2023). OKEachDay staff highlighted the importance of having additional social networks through the service, where users can disclose information about their well-being, and staff could intervene, if appropriate. As older adults age, gradual deterioration in mobility and loss of key social relationships may exclude individuals from social opportunities, increasing their risk of social isolation and loneliness (Morris et al., 2014). In Chapter 6 (feasibility study), having an additional social network was described as *“a comfort blanket, you just know that it’s as though somebody’s looking out for you, and I think that’s a nice feeling when you’re getting older, just that you don’t want to be alone”* (participant 18). Despite these findings, the feasibility study demonstrated no changes in loneliness levels in the preliminary quantitative results, although this data was not powered and should be interpreted with caution. For the participants who requested additional well-being calls, the average length of a conversation between users and staff was just under five minutes, which may not be sufficient to reduce feelings of loneliness. Other proactive telecare interventions offer longer well-being calls. For example, in an evaluation of three proactive telecare services conducted by Cund et al. (2021), well-being calls varied in length, from 6 minutes to 24 minutes. Qualitative data from this evaluation suggested that older adults valued the calls, with one participant reporting that a 20-minute phone call with the proactive telecare staff was very useful when their social contact was limited (Cund et al., 2021). For further research in this area, Cund et al. (2021) highlighted the need to adopt flexible and tailored approaches for different people, so understanding who the service is for, when they need it, how long calls should be and at what frequency (Cund et al., 2021). Moreover, literature evaluating befriending services suggest positive impacts on psychological well-being in socially isolated older adults (Cattan et al., 2011; Zamir et al., 2018), but, it is not clear exactly how these services work to produce positive outcomes; for example, what the ideal length of a call should be, which technology is preferable (video vs telephone support), or whether it matters if it is the same volunteer who chats to the beneficiary. Proactive telecare systems such as OKEachDay may need to be adapted and provide a more flexible approach to different people to meet their needs.

For example, offering longer well-being calls for people who may benefit from them, or having the same person call each time to help facilitate strong relationships between users and staff. Further research is needed to understand how to improve the social support offered by OKEachDay and different proactive telecare providers, to amplify the positive impact on well-being.

7.3.4. Integration with personal context

Ensuring that telecare is integrated into a person's individual context was a key theme across Chapters 3, 4 and 6 (realist review, interview study and the feasibility study). This research highlighted differing personal contexts in older adults who may adopt telecare, including variations in health conditions, anxiety towards technology, access to social and financial resources, and individual self-perceptions.

Chapter 3 (interview study) suggested that people with varying health needs may prefer different types of support based on their requirements and preferences. For instance, people who perceived themselves to have poor health opted to use a pendant alarm alongside using OKEachDay, to ensure they could receive immediate assistance in critical situations. Similarly, previous research has shown that people with health concerns may be more willing to use ambient sensors to gain help in an emergency (Camp et al., 2022; Felber et al., 2023). However, studies have also shown that telecare must align with older adults' ability to manage and understand the device (Leikas & Kulju, 2018). For example, if an individual does not understand how to use telecare, this could result in anxiety rather than reassurance (Lynch et al., 2022). When telecare is viewed as too difficult to use, or unreliable, older adults may be more likely to discard them (Johannessen et al., 2019). Chapter 6 (feasibility study) found that older adults saw OKEachDay as easy to use due to its simple design. Nevertheless, telecare devices (both reactive and proactive) should be matched with the physical and cognitive needs of older adults.

Chapter 4 (realist review) outlined the importance of matching telecare to individual technological preferences. Previous research suggests giving someone who may be anxious about using new technologies a device that has a design that is familiar to the individual (Greenhalgh et al., 2015; Woolham et al., 2019). Similarly, in Chapter 6 (feasibility study) older adults expressed appreciation for having the option to use either

a telephone or tablet device, as this allowed participants to choose the device most familiar to them, and subsequently reduced anxiety.

Another important context in accepting and using OKEachDay was the older adult's self-identity (Chapter 3 - interview study and Chapter 6 - feasibility study). Some participants in the feasibility study stated that they did not see themselves as requiring a proactive telecare system yet as they identified as independent, and similar findings were seen in the interview study (Fothergill et al., 2023). This aligns with existing research on how older adults adopt technologies that are consistent with their individual self-image, as suggested by Astell et al. (2020). Research by Bentley et al. (2014) suggests that older adults may reject technology in attempt to distance themselves from negative stereotypes associated with using devices. Chapter 3 (interview study) found that some older adults associated OKEachDay with the negative stereotype of ageing, similar to reactive telecare (Bentley et al., 2018). Research indicates that self-perceived stigma is associated with adverse outcomes, including decreased quality of life, early mortality, and poor physical health (Sun et al., 2022). This emphasises that an older adult's self-image and identity should be considered when offering interventions to individuals.

Chapter 3 (interview study) and Chapter 6 (feasibility study) identified that existing social resources were important in utilising OKEachDay to support independence, health, and well-being. This aligns with current studies on telecare, which highlight that social resources are required to assist in an emergency (Greenhalgh et al., 2015). Of note, Chapter 3 and 6 showed that some individuals with limited social resources preferred to talk to someone on the phone each day, whereas others opted to confirm their well-being digitally by pressing the OK button. Differing social needs have been highlighted in telecare users previously (Percival & Hanson, 2016); however, most telecare devices do not offer well-being chats to users, demonstrating a potential advantage of OKEachDay to provide social resources according to need. Other examples of proactive telecare systems provide longer well-being chats than OKEachDay, and do not offer the option of pressing an OK button instead of talking to someone, as reported in the Farr Point report (2020). Future research could explore how the different elements of proactive telecare may suit people with differing social needs, to best adapt and tailor services to individual needs. The Farr Point report (2020) suggests that where

personalisation is possible in proactive telecare, including the nature or frequency of support offered, an assessment process would be useful to ensure that the user's needs are met (Farr Point, 2020). This also correlates with the findings from the realist review, which highlighted the importance of assessments in telecare.

Previous literature has recognised financial constraints as a significant barrier to accessing telecare and monitoring technologies (Baig et al., 2019), which was also seen in the feasibility study on OKEachDay. In this study, several participants expressed a desire to continue using the intervention, but they could not afford it. Although these are common barriers to telecare use, practical solutions have yet to be developed and require further research. Chapter 3 (interview study) highlighted the benefit of having a proactive telecare system included in a package of care within sheltered accommodation, demonstrating that deploying a proactive telecare intervention in this setting may benefit those living in those settings.

This research demonstrates a wide range of individual contexts in which telecare may be implemented. Despite this, previous research suggests that telecare is often deployed in a 'plug and play manner', which may not suit individual contexts (Greenhalgh et al., 2013). Of note, there are barriers to matching telecare devices to users, including telecare staff's knowledge and awareness of the telecare devices, resources to deliver personalisation, and availability and customisability of devices. Greenhalgh et al., (2015) recognised these barriers to tailoring telecare to individuals, and developed a framework for ensuring effective telecare services, which highlighted key considerations that require attention for telecare to help tailor to needs: (i) understanding what matters to the individual, (ii) creating, evolving, and adapting solutions with users and (iii) ensuring connection to social networks to facilitate strong relationships. Similarly, Fisk et al. (2020) recommends involving older adults in choosing appropriate telecare systems to help determine which device will best match their needs, to optimise safety. This underscores the importance of involving older adults in the implementation of telecare and equipping telecare personnel with the necessary skills and expertise to offer suitable technological devices that promote independent living.

7.4. Theoretical implications

This section will discuss the findings of the research in the context of two important theoretical concepts: the preventive and corrective proactivity (PCP) model and the senior technology acceptance model (STAM). Chapter 3 (interview study) was inductive, and thus the PCP model was not used as a framework for analysis. However, this section will demonstrate the relevance of the PCP model and suggest further research. The STAM was used to assess older adult's acceptance of OKEachDay, and thus, this research adds to the growing body of literature utilising this model.

7.4.1. Preventive and corrective proactivity (PCP) model

In Chapter 3 (interview study), existing OKEachDay users adopted the intervention for various reasons; some adopted the technology after experiencing a stress exposure, such as chronic illness, loss of a partner, or through the influence of others, whilst others adopted it before they had experienced a stress exposure but anticipated these age-related risks and wished to plan for the future. These proactive motivations align with the PCP model, which is illustrated in Figure 13. As previously discussed in the introduction chapter, this model moves away from just considering older adults' corrective behaviours *after* age-related stressors have occurred, and also focuses on preventive motivations behind proactive behaviour *before* stressors (Kahana et al., 2014). The model proposes that proactive adaptations at earlier stages may delay disability, and enhance physical health and other health related outcomes (Kahana et al., 2005). This is because proactive behaviours, such as adopting proactive telecare helps to build up resources that prepare older adults to cope with future stressors. In both the interview study and the feasibility study, OKEachDay was shown to provide useful social resources to older adults, in which individuals had access to additional support if needed and elicited a sense of feeling cared for. Even participants who did not see themselves as benefitting from the proactive telecare system spoke of the benefits of being connected to social resources, demonstrating the potential value of planning ahead and putting resources into place before having a perceived need (feasibility study).

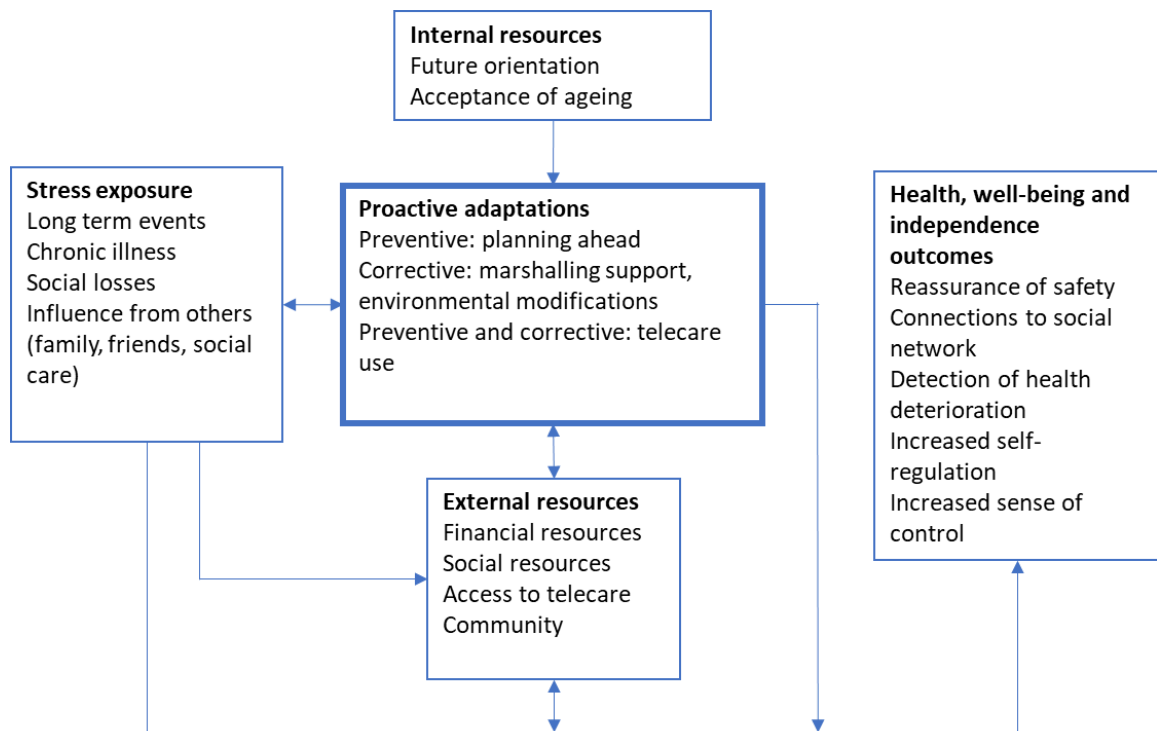


Figure 13. Adapted model of preventive and corrective proactivity (PCP) for proactive telecare use in the context of using OKEachDay (Kahana et al., 2005).

On the other hand, some older adults viewed OKEachDay differently, and still associated the proactive telecare system with the stigma of ageing; therefore, it is acknowledged that not all older adults may be receptive to adopting this type of intervention before they perceive a need for it (Kahana et al., 2005). This suggests that those who have accepted ageing may be more likely to recognise future age-related challenges and be more open to planning for the future. Further research may be required to understand the association between age acceptance and preventive and corrective behaviours within the constructs of the PCP model. Of note, acceptance and telecare use was also dependent on an individual's external resources (social and financial resources, and access to telecare). Future research would help to understand whether the PCP model is useful for other proactive telecare technologies, as examples of proactive telecare differ in the services offered.

7.4.2. Senior technology acceptance model (STAM)

In an attempt to broaden the relevance of the technology acceptance model (TAM) to older populations, the Senior Technology Acceptance Model (STAM) was developed to

include dimensions of acceptance specific to older people, including changes in physical and cognitive health, and technology anxiety (Chen & Chan, 2014). Previous studies exploring the acceptance of technology in older adults often use the TAM (Mital et al., 2018; Partala & Saari, 2015; Shore et al., 2020); therefore, this thesis adds to the growing body of literature using STAM to explore acceptance of gerontechnology (Yu-Huei et al., 2019).

In Chapter 6 (feasibility study), most participants found the technology easy to use, although some older adults felt apprehension and anxiety at first, in fear of using the device incorrectly. Some participants stated that their lack of understanding about how the technology worked enhanced their anxiety about making a mistake. Participants suggested that a more comprehensive explanation of how the technology worked would have reduced their concerns. For others, having a choice between a traditional telephone or tablet was useful, as it enabled them to choose the technology that they were most familiar with, reducing gerontechnology related anxiety. This can be seen in this quote: *“I’m not good with a tablet, I thought at least with the telephone I know there were them three things and that’s all I needed to press.”* (Participant 11, feasibility study). It was not clear if age-related health differences, such as falls risk or mobility, affected OKEachDay acceptance. Although many participants saw the potential usefulness of the technology, some stated that their physical health would need to be poor to adopt the technology. Using STAM was useful to highlight problems for older adults specifically in accepting OKEachDay. Research suggests that there is a gap between perceived usefulness of technologies and adoption in older adults (Yu-Huei et al., 2019), so identifying population-specific issues may provide insight into improving technology acceptance.

7.5. Future research directions

As described previously, this thesis has contributed to the literature exploring the impact of a proactive telecare service on health, well-being, and independence. This next section summarises key areas that require further investigation.

7.5.1. Differing needs of sub-groups of older adults

The realist review highlighted the lack of literature focused on the experiences of minority ethnic groups using telecare, suggesting significant gaps in knowledge about

the perceived needs, preferences, and barriers and challenges in using telecare for this specific group. The older adult population in the UK is becoming more ethnically diverse, increasing the need for further research into how to support this population to live independently. Research has suggested that older ethnic minority adults experience wider discrepancies in access to technology than older adults from White ethnic groups (Choudrie et al., 2022). Of note, emerging evidence suggests that older people from minority ethnic groups are more likely to experience health-related inequalities (Zhang et al., 2019). In particular, Watkinson et al. (2021) conducted a large cross-sectional study of General Practice (GP) surveys in England found that inequalities in older adults were widest for Gypsy or Irish Travellers, Bangladeshi, Pakistani, and Arab ethnic groups, with larger inequalities noted in women than men. Inequalities in these groups included poorer health-related quality of life, multimorbidity, lack of support and access to primary care, and low confidence in managing health conditions, compared to the White British older adult group. Although some research has reported commonalities across ethnic groups' experiences with using telecare and other assistive devices (Greenhalgh et al., 2013), the disparities in health inequalities and access to technology across different ethnic groups suggests that older adults from ethnic minority groups may have different motivations, beliefs, and resources, which may impact the usefulness and adoption of telecare. Chapter 3 (interview study) and Chapter 6 (feasibility study) predominately involved White British older adults. Moreover, there was no data available on ethnicity in Chapter 5 (quantitative study), and so further research is required to understand the potential benefits of using this proactive telecare service for minority ethnic groups.

The studies in this thesis also lack representation from older adults living with dementia. Existing research suggests that telecare use in people living with dementia may be beneficial in enhancing dementia care, by providing additional safety checks, reminders for users, and emotional support (Chou et al., 2012; Yaylagul et al., 2022). Recruitment information for Chapter 3 (interview study) and Chapter 6 (feasibility study) were sent to older adults living with dementia, but no participants living with dementia were recruited to either study. Moreover, information on participants' clinical characteristics was not available for Chapter 5 (quantitative study). Of note, proactive telecare staff

reported that people living with dementia do use OKEachDay, and staff are trained in dementia awareness, so the intervention may be useful to this population. This thesis research did not target recruitment at older people with specific characteristics or health conditions due to time constraints. Further research should be conducted focusing on the impact of proactive telecare systems on health, well-being and independence for older people living with dementia, given that existing research on other telecare systems demonstrate positive effects.

7.5.2. Enhancing the impact of proactive telecare

There is recent interest within the NHS to promote technology enabled care services (TECS), which refers to the use of telehealth, telecare, telemedicine, tele-coaching, and other self-care technology services, in an attempt to support people in health management and to deliver more cost-effective services. Of note, there is currently a lack of integration between these services, with each service offering a unique contribution to care, but standalone technologies cannot support every aspect of health. The research from this thesis found that this example of proactive telecare (OKEachDay) is no different; the system may be useful in identifying risk-associated situations, but its impact on supporting older adults may be enhanced if combined with existing/new innovative services. For example, Chapter 5 (quantitative study) highlighted that missing the OK button may be associated with an increased risk of hospital use, which could provide an opportunity for timely intervention in order to prevent hospitalisation. But it is not clear what the appropriate follow-up strategies would be to promote health and well-being. There is potential for this proactive telecare system to be integrated with existing services, so for those with known chronic illnesses, if hospital risk can be highlighted by using a proactive telecare device, additional support to manage their chronic condition could be provided through existing telehealth or telemedicine interventions. Fisk et al. (2020) suggests that telecare staff should understand how the service fits into a wider context of support and know when to signpost people or gain specialist guidance to help with specific issues. If telecare services are to become integrated into a wider network of care, it may be necessary to assess whether proactive telecare staff possess adequate knowledge and skills to facilitate this shift.

To support the incorporation of proactive telecare technologies into current services, frameworks could be employed to provide essential considerations required for implementation. Following the covid-19 pandemic, changes to healthcare consultations in the UK were introduced to manage the spread of the virus, and remote technologies were used to provide services including GP appointments, outpatient services, and phone and video consultations (Greenhalgh et al., 2021). Greenhalgh et al. (2021) highlighted key challenges in delivering remote consultation services to patients, including ensuring high quality of care, and challenges associated with the implementation of new services within organisations. In response, Greenhalgh et al. (2021) developed a framework to provide effective remote care known as the Planning and Evaluating Remote Consultation Services (PERCS), developed from existing literature and ongoing research. PERCS encompasses seven domains: the consultation reason, the patient, the clinical interaction, the home and relatives, technologies, staff, and the healthcare organisation. Although this framework is focused on providing effective remote clinical care, some of the elements could be applicable to providing care through other technologies, such as telecare, telehealth, and other digital health technologies. The framework highlights the importance of the patient in providing remote care, including the patient's identity, socio-cultural background, health beliefs and health status. Depending on the person's background, they may need further remote support, which could be applied to the context of using a proactive telecare system, or combining the use of proactive telecare devices with telehealth or other digital services. For example, someone with a disability or chronic health condition may require additional proactive monitoring, to prevent a crisis event, through additional well-being calls, or utilising a telehealth device/mhealth app to monitor their vital signs. The framework also highlights the importance of the functionality and performance of the technology (Greenhalgh et al., 2021). Some technologies such as a phone provide dependable technology but may lack functionality. As telecare develops, devices may become more complex in order to be more proactive and preventative. However, it is important that technologies are still easy to use and dependable.

Ensuring that technologies are appropriate, acceptable, and supportive to individual context is crucial to enhancing their potential impact (Greenhalgh et al., 2015).

Greenhalgh et al. (2015) also created a framework of guiding principles for ensuring quality in telecare, telehealth, and other digital health technologies called the ARCHIE framework. The acronym ARCHIE stands for anchoring what matters to the user, being realistic about a person's health and illness, co-creating solutions with users, supporting users through human networks, integrated knowledge sharing; and evaluating to improve care (Greenhalgh et al., 2015). The framework highlights key elements that may help to ensure a user-centred approach to technology design and delivery, including understanding what matters to the individual, adapting solutions to problems with the user, and evaluating individual contexts to ensure continued support (Greenhalgh et al., 2015). Given there is a wide range of proactive telecare technologies available (Farr Point, 2020), as well as other telehealth, and digital health devices, there is potential to match technologies with a user's diverse needs. If technologies become more prevalent in the home and embedded into health and social care practices, frameworks such as the PERCS and ARCHIE could be utilised to inform the implementation of proactive telecare, ensuring that the user's context is taken into consideration to maximise positive impacts.

OKEachDay in this research was found to provide low-level social support to older adults, but for those who were extremely isolated, this proactive telecare system may not have gone far enough to reduce feelings of loneliness. Further research should investigate how this system could be integrated with social prescribing services, or befriending services, to provide more holistic and integrated care. An additional strategy for future research would be to investigate if appropriate moderations could be added to this proactive telecare service to enhance its effectiveness. For example, health promotion messages could be sent through the device, or users could receive additional emotional support from staff through training, as seen in other existing proactive telecare systems (Cund et al., 2022). As previously discussed, the Farr Point report (2020) highlighted that existing examples of proactive telecare offer a broad range of proactivity and engagement. Some services offer daily outbound well-being chats lasting 20-30 minutes, while others offer a more hands off approach to checking well-being, like pressing an OK button in the Alertacall system, or receiving automated calls with requests for assistance like an example from the USA called Towne Care, as described in the Farr Point report

(2020). Proactive telecare services may differ in engagement levels with the user, but not all older adults may need or wish to have a 30-minute conversation each day and may prefer a more hands-off approach, or vice versa. Cund et al. (2021) also highlighted uncertainties around proactive telecare, including how it could be adapted for different groups with specific needs, when the optimal time for proactive telecare implementation was, and how long did users need it for. Indeed, the Farr Point report (2020) illustrates the dynamic and flexible nature of proactive telecare in supporting older adults, suggesting potential for personalisation where telecare devices cater to individual needs. However, further research may help to understand how proactive telecare services could be tailored to suit individuals, and provide enhanced support.

Although this proactive system was generally accepted in an older adult population (feasibility study), some participants thought it would be more beneficial to vulnerable groups (housebound or socially isolated people), which may limit the scalability of this intervention. Further research should be conducted into understanding if the service is being targeted at the most appropriate population and also how to promote this intervention more widely in older populations, if possible.

7.5.3. Future evaluation research

This thesis research followed the MRC framework for evaluating health interventions and completed the first two phases (i) identifying the intervention and (ii) testing the acceptability and feasibility. Within these two phases, this research considered key elements, including understanding how proactive telecare interacted with its context, developing a programme theory, involving stakeholders, and identifying key uncertainties. Recommended by the MRC framework, the next step is to conduct a full-scale effectiveness evaluation of this proactive telecare intervention, to understand how it may improve health, well-being, and independence in older adults (Skivington et al., 2021). Randomised controlled trials (RCTs) are often argued to be the gold standard for effectiveness research (Hariton & Locascio, 2018). This is because randomisation reduces bias and provides a method to observe potential causality between the intervention and outcome of interest (Hariton & Locascio, 2018). The feasibility study demonstrated that with a few modifications to the recruitment strategy and procedure, a full-scale RCT is feasible. It may be important to note that the updated MRC guidelines

for evaluating complex interventions suggests going beyond asking whether an intervention works (in achieving the intended outcomes), to understanding what other impacts it may have, how it works, and how it interacts with its context (Skivington et al., 2021).

This proactive telecare intervention (OKEachDay) may be useful within a system of health and social care support, for example, if used alongside sensor telecare/pendant alarms, telehealth, or social prescribing interventions. Previous research has identified issues with integrating telecare and technology in the community, including lack of coordination across health and social care, issues concerning funding, and uncertainty about the effectiveness of telecare systems (May et al., 2011). Therefore, a future evaluation should consider how this proactive telecare could be integrated into a wider network of support and look to provide robust evidence about the adequacy of other examples of proactive telecare. Taking this into account, further research may benefit from additional elements alongside an RCT, such as a process evaluation which enables the use of qualitative methods to explore research questions beyond effectiveness outcomes (Skivington et al., 2021). Cund et al. (2021) suggested key considerations when designing their next proactive telecare evaluation, which included considering how proactive telecare could be integrated into local health systems, measuring benefits to users, and exploring whether offering proactive services requires trained staff, or a generic approach that can be offered by all staff. Similar considerations may be useful for a future evaluation of OKEachDay. A cost-effectiveness analysis of the proactive telecare system would also be useful, as telecare use is often argued to lead to cost reductions to health and social care services (Lynch et al., 2019).

Further research could also take a different approach to an RCT or process evaluation. One of the barriers to acceptance of OKEachDay was that older adults associated the technology with 'being older', and age-related challenges, such as frailty and social isolation. As previously discussed in the introduction chapter of this thesis, socio-gerontechnology offers a critical perspective to ageing and technology and may provide a useful dimension for exploring the perceived stigma by older adults towards OKEachDay and other proactive telecare interventions. Previous qualitative research by Nevan (2010) has suggested that older adults' opinions on technology may be influenced

by their own age-related assumptions (Nevan, 2010). Unpicking these age-related assumptions towards OKEachDay and other proactive telecare interventions could help to shape best practice in referring people to using OKEachDay or other proactive services and may help tailor technology to the user's preferences.

7.6. Implications for policy and practice

This research has highlighted several benefits of OKEachDay use in older adults on health, well-being, and independence. This next section will explore the potential of this proactive telecare system in supporting policy and practice in health and social care services.

Chapter 4 (realist review) outlined the need to match telecare services to the needs and resources of the older adult. Telecare that is offered as a standard package without understanding individual preferences may result in discontinuation, which may compromise a person's safety at home and connection to social resources. Research has indicated that telecare is often provided without assessment, as it is commonly installed after an emergency (Bentley et al., 2018). This research recommends that telecare assessments are conducted, to avoid unintended consequences on health and well-being.

Telecare technologies available are limited to the devices commissioned by local authorities or offered by the provider (AKTIVE Consortium, 2013), which may limit the possibility of matching telecare devices to older adults' needs and preferences. The realist review outlined the importance of choice for older adults in using telecare. If more telecare devices were available through local authorities, older adults may feel empowered to choose technologies that align with their perceived risk of losing independence, and their perceived needs. This thesis suggested that the proactive telecare intervention of interest offered similar feelings of reassurance of safety as reactive telecare, whilst also offering flexibility where the user could receive more support if they wished, promoting autonomy. Findings suggested that OKEachDay offers low-level social support, an advantage over more reactive services. Providing more options may improve access to telecare, and in turn, support population safety and well-being.

Recently, the priority of policy makers has been managing the UK telecommunications switch from analogue to digital, which is expected to be completed by the end of 2025 (GOV.UK, 2022). This impacts telecare users, as most devices are provided through analogue equipment and will not be compatible with digital networks. Although this transition may be cumbersome, it presents an opportunity to update telecare services. The government proposes that digital systems will provide more personalised and preventive interventions, which may detect signs of health deterioration. Policy makers support the uptake of digital telecare systems, as it may lead to reducing costly hospital admissions, care home usage by supporting older people to stay at home, ambulance call outs and home care visits. The findings from Chapter 6 (feasibility study) suggest that OKEachDay is acceptable to some older adults and may be particularly beneficial to those who are more vulnerable and at increased risk of hospitalisation (older adults with chronic illnesses, disability, or socially isolated). Chapter 5 (quantitative study) suggests that missing an OK button may be associated with an increased risk of hospital use. These findings suggest that this proactive telecare system may be a scalable intervention, to help identify older adults in need of additional support. In general, proactive telecare use in local authorities could help shift the focus from reactive telecare (responding to falls, early signs of illness and frailty), to preventing or reducing their impact, and as a result, creating opportunities for early intervention and reducing hospital use. Historically, local authorities have utilised social alarms, providing a lifeline to emergency services (Fisk, 2003), which can be described as more reactive services as they facilitate a response after a crisis event has occurred (TSA, 2023). However, there is interest within the industry to shift to a more proactive service model, to provide more personalised care outcomes, and to help to avoid costs associated with emergency responses (TSA, 2023). The TSA is interested in offering more proactive and preventive telecare, which includes platforms that generate alerts about changes in a user's behaviour, platforms that collect and analyse data to predict if a user requires further support and can detect patterns of trends and anomalies (TSA, 2023). The adoption of such technologies may be expedited as a result of the digital transition. Utilising more proactive and preventative approaches to telecare and digital health more broadly may align with the Government's initiative to support older adults to remain living in the community. This may help to avoid institutional care and to postpone the need for costly

care and support. The Government's recent white paper on 'People at the Heart of Care: adult social care reform' (GOV, 2022) highlights the Government's commitment to driving the adoption of technology across social care. Moving towards a model of proactive and preventative technologies may support this Government agenda, to support independent living and improve the quality of care.

In the Northwest of England where this proactive telecare service originates, Lancashire County Council have called for a more proactive and preventive digital strategy, in response to the analogue to digital switchover: "*Our current telecare service acts as a reactive alarm response service, with limited integration to other health and social care services. Moving forward, we will significantly widen the scope of this service to become preventive, proactive, and fully integrated*" (p. 3) (Lancashire County Council, 2020). This strategy sets out Lancashire's aim to provide advanced data through integrating digital telecare with telehealth devices and using data analysis tools to predict and prevent incidences and assess future needs. The strategy also aims to provide proactive services involving making outgoing calls to people to improve their well-being. Although OKEachDay only provided outgoing calls to people who did not press their OK button, this research highlighted the benefit of asking individuals to confirm their own well-being (by pressing an OK button in this case) for promoting a sense of autonomy in individuals. It also highlighted the value of having an opportunity to have an outgoing call if required, as older adults appreciated being connected to another source of social support. Utilising a proactive telecare service like OKEachDay in local authorities could be a timely recommendation, given the current digital switchover and call for more proactive and preventive services. Further research is required to understand how this proactive telecare system could work to support health, well-being, and independence within these political, organisational, and technological contexts.

7.7. Strengths and limitations

The following section will discuss the strengths and limitations of the research completed for this thesis.

7.7.1. Design

This thesis took a critical realist approach to mixed methods research. A strength in this approach is that it focuses on understanding why interventions lead to certain

outcomes, and under what circumstances. In doing so, this research gave insights into how a proactive telecare system may support older people's health, well-being, and independence, within the context of their individual needs, motivations, and resources. Critical realism also provides a useful theoretical foundation for future evaluation research on proactive telecare, as understanding what interventions work (to produce intended outcomes), for whom and under what contexts is an emerging priority, to produce meaningful knowledge that is relevant and transferable to policy and practice (Skivington et al., 2021). Using the MRC framework to guide the research was a strength, as it provided a detailed and iterative framework to follow. The use of mixed methods was also a strength, as it helped to explore different research questions and understand a more holistic picture of the impact of this proactive telecare system on health and independence, i.e. using qualitative interviews to explore different interest groups perspectives of the device in supporting independent living, and then using quantitative regression analysis to investigate the associations between proactive telecare use and hospital admissions. A disadvantage of this research is that it only focused on one proactive telecare intervention, so the findings may lack transferability to other proactive telecare systems which may differ in functionality. Additionally, this study specifically concentrated on the intervention alone, rather than evaluating it within the environment where it is typically implemented (in housing associations or sheltered accommodation). This choice was made because the service was also utilised by individuals residing in private accommodations and was found to be advantageous for them. Thus, this research aimed to assess the intervention's effects across various settings to be relevant to a broader population. Given the lack of research in this area, and the political backing for proactive and preventive technologies to support independent living, this research is timely and provides some insights into the potential benefit of proactive telecare interventions.

7.7.2. Sampling

A strength of the sampling strategy in Chapter 4 (interview study) was that it explored the accounts from four different interest groups, to gain understanding of different perspectives: (i) older adults who currently used proactive telecare; (ii) family members of proactive telecare users; (iii) proactive telecare staff involved in delivery; and (iv)

older adults who do not currently use proactive telecare. Another strength was that a broad approach was taken to recruitment, using both purposive sampling and snowball sampling to identify participants with knowledge on the topic of interest, but to also recruit people who may have been inaccessible previously. As noted, the sample itself was White British, which may limit the transferability of these findings to people from ethnic-minority groups.

Chapter 4 (realist review) focused on older adults living in the community and telecare use but excluded literature specifically exploring participants with chronic illnesses, as interventions designed to help people with chronic illnesses may require different functionalities compared to telecare used more generally. Nevertheless, restricting the sample in this way may have limited the exploration of the context of chronic conditions.

In Chapter 6 (feasibility study), the inclusion criteria were kept broad to reflect the importance of autonomy and choosing to use technology to support independence (reported in Chapter 3 - interview study and Chapter 4 - realist review). As a result, older adults with an interest in using OKEachDay were more likely to take part, rather than recruiting based on strict criteria that may have limited the number of people who could take part. The advantage of this approach was that it widened the pool of potential participants to people with differing physical and psychological characteristics. On the other hand, the broad criteria may have limited the analysis, as more healthy participants were recruited, but these participants reported that older adults with poorer health than themselves may have significantly benefited from using a proactive telecare system. Older adults with poor health such as co-morbidities and cognitive impairments may experience barriers to taking part in research, for example if they are experiencing fatigue or reduced mobility (Goodwin et al., 2023). Home visits were offered to participants to reduce the need to travel for data collection, but some potential participants still did not feel well enough to take part. Further evaluations should aim to improve recruitment of older people with poorer health.

Chapter 5 (quantitative study) used secondary data and was limited to the current OKEachDay users. Given the lack of research into OKEachDay use, the sample provided data on long-term use of the intervention, providing useful insights into the benefits and the kind of population it is currently used by.

7.7.3. Data collection and analysis

A key strength of this investigation was the use of different data collection and analysis approaches, enabling a broad understanding of what aspects of health, well-being and independence could be supported by a proactive telecare system. Using qualitative interviews and thematic analysis enabled an inductive approach to understanding differing concepts of independence and varying experiences of the proactive telecare system in the interview study. Conducting a realist review allowed for detailed exploration of *how* telecare works to support health and well-being, but also added to the evidence on how to adapt telecare to suit individual needs and resources.

Chapter 5 (quantitative study) was directly influenced by the participants in Chapter 3 who suggested that OKEachDay may be useful in highlighting ill health if users forgot to press their OK button. Following up on initial findings is a strength of this study, as it helps to ensure that the research is beneficial to participants. The use of quantitative methods in this chapter complimented the findings from the previous studies, as it investigated the association between proactive behaviours on hospital admissions and length of stay. Chapter 5 offered novel indications that missing the OK button could be associated with an increased risk of hospital use. However, this study did not have a comparison group, so it was not possible to assess whether using OKEachDay leads to a reduction in hospital admissions, compared to non-proactive telecare users. Moreover, the data did not include proactive telecare users who had stopped using the service since the time of data collection (due to moving, or passing away), suggesting that the participants included could be systematically different to those who stopped using the service. Further research is needed to investigate the association found between missed button presses and hospital risk.

Using mixed methods in Chapter 6 (feasibility study) enabled the investigation of different aspects of health impacts and feasibility outcomes, such as self-reported health-related quality of life, mental well-being, and the acceptability of OKEachDay from the quantitative survey. Using semi-structured interviews allowed for exploration into more subjective aspects of independence and feasibility outcomes, including feeling safe, and supported, and how it acceptable it was to be randomised etc.

7.8. Patient and Public Involvement (PPI)

Table 17 presents a summary of the Patient and Public involvement (PPI) during this research. The guidance for reporting involvement of patients and the public (GRIPP2) framework was used to guide this reflection (Staniszewska et al., 2017). GRIPP2 aims to improve the reporting of PPI in research, by providing a transparent account to how PPI were involved and what was contributed. The table below reflects on how the NIHR ARC public advisors, Jenny Hamilton and Saiqa Ahmed were involved in this thesis research. The GRIPP2 short form was used as presented by Staniszewska et al. (2017), as this is recommended for studies where PPI is utilised, but not the primary focus of the study.

Table 17. GRIPP2 Short form.

Section and topic	Item
1: Aim	The aim of involving the NIHR public advisors in this doctoral research was to ensure that the research was relevant to understanding how proactive telecare may benefit older people.
2. Methods	<p>Public advisors who had experience of caring for older telecare users were involved in the following aspects of this research:</p> <p><u>Research protocol:</u></p> <ul style="list-style-type: none"> - The public advisors read through my research protocol and gave feedback. <p><u>Chapter 3 - Interview study:</u></p> <ul style="list-style-type: none"> - The public advisors provided feedback on all information sheets and interview guides. <p><u>Chapter 4 - Realist review:</u></p> <ul style="list-style-type: none"> - The public advisors screened 10% of the abstracts and documents included in the realist review. They were also involved in providing feedback on preliminary results during the analysis of the data. Prior to their involvement, I provided training to the advisors on what a realist review was, how to

	<p>screen documents, and how to analyse documents.</p> <p>The public advisors also read and provided feedback on the final draft of the manuscript for this study.</p> <p><u>Chapter 6 - Feasibility study:</u></p> <ul style="list-style-type: none"> - The public advisors provided feedback on all information sheets, surveys, and interview guides.
3. Study results	<p>Involving the public advisors ensured that inequalities were considered (for example, ensuring that both the phone and tablet device were offered to older adults to promote inclusion). The advisors also helped to ensure that the language used in the information for participants was simple and accessible. Their involvement was particularly useful as one advisor's first language was not English, so they helped ensure that the information sheets were comprehensive and clear. Having feedback from people with experience of being carers and observing how their family used telecare was useful in considering how telecare fits into older adults' social resources, and how important the influence of family is in using telecare.</p>
4: Discussion and conclusions	<p>Feedback from the public advisors helped in making the recruitment materials and information sheets appropriate for older adults, which in turn may have improved recruitment and relevance of the studies. Involving the public advisors was particularly useful as it helped me consolidate my realist knowledge through explaining this complex methodology to the advisors. Training the advisors also provided them with research skills. Their input into the screening helped improve the credibility of the process, and their reflections on the analysis brought useful insights from a carer's perspective (for example,</p>

	<p>considering the motivations of an older adult to use telecare, in respond to family concerns of safety).</p>
<p>5. Reflections/critical perspective</p>	<p><u>Summary reflection</u></p> <p>Overall, I thought that involving public advisors enhanced this research. Regular meeting with the advisors gave the opportunity for them to provide a different perspective on the research. Hearing their lived experience of caring for older adults was invaluable and gave me perspective of the ‘big picture’ of how telecare fits within a network of support.</p> <p><u>Future PPI</u></p> <p>Although the original advert for public advisors was sent to a large pool of people, and older people over the age of 65 were encouraged to apply, no older adults expressed an interest in being a public advisor. It would have been beneficial to have had an older person advise on this research, to help identify research priorities for older adults in this area. At the beginning of my doctoral research, I presented an overview of my research to the Sefton Older Adult group to hear their thoughts on proactive telecare. This was a useful exercise and it helped shape the direction I took with this research. Older adults had mixed feelings towards the technology, which inspired me to involve more interest groups in the interview study to gain further insight into why there might be mixed opinions. I did not involve this group further due to time constraints of the PhD and a lack of interest from the group. However, on reflection I should have made time to engage with other older adult groups. Involving older adults in the PPI work would be a priority in future research.</p>

7.9. Implications of findings and recommendations for future research

This section provides key implications of findings for policy and practice and recommendations for future research.

7.9.1. Implications for policy and practice

Table 18. Implications of findings for policy and practice.

	Implications of findings	Relevant stakeholders
Matching telecare services to individual needs	Telecare assessments should be conducted to ensure that services are tailored to individual needs and preferences. A person-centred approach may help avoid discontinuation of services and ensure the safety and well-being of older adults wishing to age in place.	<p>Policymakers</p> <p>Local authorities</p> <p>TSA</p> <p>Healthcare providers</p> <p>Technology developers</p> <p>Older adults and their families/friends.</p>
Increasing telecare device options	Increasing the variety of telecare devices available through local authorities, the private sector or other bodies may offer more choice to older adults and empower them to choose devices that suit their needs and preferences. This may promote autonomy and improve access to telecare.	<p>Policymakers</p> <p>Local authorities</p> <p>TSA</p> <p>Healthcare providers</p> <p>Technology developers</p> <p>Older adults and their families/friends.</p>
Promoting more proactive telecare services	There is growing interest in promoting proactive telecare models within local authorities and the TSA. Proactive telecare may be useful in improving social contact between users and telecare staff, facilitating better understanding of individual needs. Proactive approaches may offer further	<p>Policymakers</p> <p>Local authorities</p> <p>TSA</p> <p>Healthcare providers</p> <p>Technology developers</p> <p>Older adults and their families/friends.</p>

	<p>data on an individual’s well-being, which may enable staff and relatives to detect indicators of health risks, enabling early intervention and reduce the need for emergency responses.</p> <p>This shift aligns with the UK Government’s agenda to support independent living and improve the quality of care.</p>	
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Key stakeholders who may be impacted or interested in these implications include policymakers, local authorities, the TSA, healthcare providers, technology developers, older adults, and their families. These stakeholders will need to be involved in shaping policies around implementing such practices and developing technologies further, to promote digital health solutions in supporting health, well-being, and independence among older adults.

7.9.2. Recommendations for future research

1. **Explore differing needs of older adults:** Further investigation is needed into the experiences of minority ethnic groups using telecare. Research should focus on understanding the perceived needs, preferences, barriers, and challenges specific to this group, considering the widening ethnic diversity among older adults in the UK. Further investigation is also required into understanding how older adults living with dementia could benefit from using more proactive telecare approaches.
2. **Enhancing the impact of OKEachDay:** Further research should seek to understand how OKEachDay could be integrated into existing services. This integration could involve combining OKEachDay with telehealth or other digital services to provide comprehensive health management and support. Staff training and understanding of the broader context of care are essential for effective integration.

3. **Future evaluation research:** Conducting a full-scale effectiveness evaluation of OKEachDay is recommended to understand its potential benefits on health, well-being, and independence among older adults. This could be achieved through conducting an RCT or utilising more mixed methods and realist approaches. Cost effective analyses may help to understand if more proactive approaches can reduce costs to health and social care over time. Further research could also examine the benefits of different elements of proactive telecare systems (regular outbound calls to check on health and well-being, further social support etc.), to understand what works best for whom, in order to best tailor services to individuals.

7.10. Dissemination

One of the key methods of dissemination for this research is publishing the results in peer-reviewed journals, of which one has already been published. The researcher has also presented the results from this thesis at academic conferences and symposiums. Further papers are planned to be published. Currently, the research has mostly been shared within the academic community, which limits the potential reach and impact. Of note, the researcher has shared the results from this thesis with the company Alertacall (owner of OKEachDay) and plans to present the findings to the company at a later date. The researcher will also look to share the findings with the public, through presenting at public events (through Lancaster University or the NIHR). The TSA may also provide a suitable avenue for disseminating research.

7.11. Thesis conclusion

This thesis presents a mixed method investigation of the impact of a proactive telecare system on health, well-being, and independence. Results highlight the potential of engaging in proactive behaviours to remain safe at home. Being proactive by pressing an OK button daily elicited a sense of control over engagement with the technology, helping to boost confidence and self-reliance in older adults. Missing the OK button may be associated with an increased risk of hospital use, presenting an opportunity for preventive strategies to minimise further loss and avoid hospital admissions. However, findings illustrated the importance of matching telecare devices (both reactive and proactive) to individual needs, preferences, and social and financial resources, to avoid

negative impacts on health, well-being, and independence. The feasibility trial found the proactive telecare system to be feasible and acceptable in the population of older adults, with older adults with chronic conditions, disabilities, or low social resources highlighted as key beneficiaries. Suggested changes were made regarding the recruitment and implementation strategy for a future evaluation study. Given the potential for proactive telecare use to support health, well-being, and independence, and it was acceptable in an older adult population, proactive telecare may provide a scalable intervention that could potentially reduce hospital admissions and associated costs. A future full scale randomised controlled trial is required to evaluate the effectiveness and cost effectiveness of this approach.

8. References

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9. Appendices

9.1. Appendix 1. Checklist for adherence to the consolidated criteria for reporting qualitative research (COREQ) (Chapter 3)

Topic and Item No.	Guide Questions/Description	Response
Domain 1: Research team and reflexivity		
Personal Characteristics		
	1. Interviewer/facilitator: Which author/s conducted the interviews?	Lauren Fothergill (LF)
	2. Credentials: What were the researcher's credentials? E.g. PhD, MD	LF: MPH
	3. Occupation: What was their occupation at the time of the study?	LF: Research Assistant/ PhD student
	4. Gender: Was the researcher male or female?	Female
	5. Experience and training: What experience or training did the researcher have?	LF: Mixed-methods researcher, experienced interviewer, GCP trained.
Relationship with participants		
	6. Relationship established: Was a relationship established prior to study commencement?	Researcher met the participants during recruitment
	7. Participant knowledge of the interviewer: What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	Participants knew that LF was a researcher. They knew that the researcher was affiliated to the participating university.
	8. Interviewer characteristics: What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	Participants knew that the researcher was interested in their perspectives of the utility of using proactive telecare and to what extent it could support independence.
Domain 2: Study design		
Theoretical framework		
	9. Methodological orientation and Theory: What methodological	Thematic analysis

	orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	
Participant selection		
	10. Sampling: How were participants selected? e.g. purposive, convenience, consecutive, snowball	Purposive (e.g. for older adults – they were using proactive telecare, family members – they had a relative using proactive telecare, staff – they were involved in delivering proactive telecare, older adults not currently using telecare – recruited from local older adult social groups).
	11. Method of approach: How were participants approached? e.g. face-to-face, telephone, mail, email	Participants were approached and recruited via telephone.
	12. Sample size : How many participants were in the study?	30 semi-structured interviews were conducted across various participant groups; (20 older adults, 4 family members and 6 staff members).
	13. Non-participation: How many people refused to participate or dropped out? Reasons?	Three people showed interest in the study but were not able to attend due to other commitments.
Setting		
	14. Setting of data collection: Where was the data collected? e.g. home, clinic, workplace	Data were collected over the phone.
	15. Presence of non-participants; Was anyone else present besides the participants and researchers?	No.
	16. Description of sample: What are the important characteristics of the sample? e.g. demographic data, date	Older adults: age, gender, level of care, level of mobility, living arrangements, ethnicity, previous occupation. Staff: organisation, age, gender.

		Family member: age, gender, age of family member using proactive telecare.
Data collection		
	17. Interview guide: Were questions, prompts, guides provided by the authors? Was it pilot tested?	No
	18. Repeat interviews: Were repeat interviews carried out? If yes, how many?	No
	19. Audio/visual recording; Did the research use audio or visual recording to collect the data?	Interviews were audio-recorded using a recording device.
	20. Field notes: Were field notes made during and/or after the interview or focus group?	Yes.
	21. Duration: What was the duration of the interviews or focus group?	Approx. 44 minutes (range from 25-80 minutes).
	22. Data saturation: Was data saturation discussed?	Yes.
	23. Transcripts returned: Were transcripts returned to participants for comment and/or correction?	No
Domain 3: analysis and findings		
Data analysis		
	24. Number of data coders: How many data coders coded the data?	One researcher was involved in coding; however, the themes were discussed between three researchers until themes were finalised.
	25. Description of the coding tree: Did authors provide a description of the coding tree?	No; however initial coding was informed by the interview guide, and coding was continuously refined.
	26. Derivation of themes: Were themes identified in advance or derived from the data?	Themes were derived from the data.
	27. Software: What software, if applicable, was used to manage the data?	NVivo 12

	28. Participant checking: Did participants provide feedback on the findings?	No
Reporting		
	29. Quotations presented: Were participant quotations presented to illustrate the themes / findings? Was each quotation identified? e.g. participant number	Yes
	30. Data and findings consistent: Was there consistency between the data presented and the findings?	Yes
	31. Clarity of major themes: Were major themes clearly presented in the findings?	Yes
	32. Clarity of minor themes: Is there a description of diverse cases or discussion of minor themes?	Yes

9.2. Appendix 2. Ethical approval letter (Chapter 3)

Applicant: Lauren Fothergill
Supervisor: Professor Carol Holland and Professor Niall Hayes
Department: DHR FHMREC
Reference: FHMREC 11 June 2021

Re: Exploring older adults, family members, and staff views on a digital tool - 'OKEachDay', to support independent living and wellbeing

Dear Lauren,

Thank you for submitting your research ethics application for the above project for review by the Faculty of Health and Medicine Research Ethics Committee (FHMREC).

The application was recommended for approval by FHMREC, and on behalf of the Chair of the Committee, I can confirm that approval has been granted for this research project.

As principal investigator your responsibilities include:

- ensuring that (where applicable) all the necessary legal and regulatory requirements in order to conduct the research are met, and the necessary licenses and approvals have been obtained;
- reporting any ethics-related issues that occur during the course of the research or arising from the research to the Research Ethics Officer at the email address below (e.g. unforeseen ethical issues, complaints about the conduct of the research, adverse reactions such as extreme distress);
- submitting details of proposed substantive amendments to the protocol to the

Please contact me if you have any queries or require further information. Email: fhmresearchsupport@lancaster.ac.uk

Yours sincerely,

Research Ethics Officer,
Secretary to FHMREC.

9.3. Appendix 3. Study invitation (Chapter 3)

**Exploring the views of older adults and organisations on the
'OKEachDay' tool to support independent living and well-being**



**Would you like to take part in a research study to explore people's views
on using digital technology to support independent living and wellbeing?**

We are looking for people aged 65 and over

The study will involve either an in-person or telephone interview with a researcher to share your views on using digital technology to support independent living.

If you wish to take part or find out more information, please complete the researcher by email by email or phone:

Researchers name: Lauren Fothergill

9.4. Appendix 4. Participant Information Sheet (Chapter 3)

Participant Information Sheet

Exploring the views of older adults and organisations on an 'OKEachDay' tool to support independent living and wellbeing

For further information about how Lancaster University processes personal data for research purposes and your data rights please visit our webpage:

www.lancaster.ac.uk/research/data-protection

My name is Lauren Fothergill and I am conducting this research as a postgraduate student in the faculty of Health and Medicine at Lancaster University.

What is the study about?

Retaining independence in older people has many benefits, including improving physical and mental health, boosting confidence and self-esteem, and improving overall quality of life. There are many ways to promote independence, and one potential way is using technology. 'Ok each day' is a digital tool that provides daily contact services to older adults. The purpose of this study is to capture views and experiences from older adults and organisations on what they believe the potential benefits and challenges are in using OK each day to support independent living and wellbeing.

Why have I been approached?

You have been approached because the study requires information from people who either currently use OK each day or potentially may use it and are over 65, or you are a nominated contact for someone who already uses OK each day, or you work at a social housing provider which currently provides OK each day to its residents, or you are an OKEachDay staff member.

Do I have to take part?

No. It's completely up to you to decide whether or not you take part. We will describe the study and go through this information sheet with you to answer any questions you may have. If you agree to participate, we will ask you to sign a consent form and will give you a copy to keep. However, you would still be free to withdraw from the study at any time, without giving a reason and without any negative consequences, by advising the researchers of this decision. This would not affect your legal rights.

What will I be asked to do if I take part?

If you decide you would like to take part, you would be asked to participate in an interview at a convenient date, time, and venue for you. The interview will be carried

out on the telephone/Microsoft Teams/zoom, or in person. A researcher will contact you to go over the information sheet and explain the procedures. You will be asked to give your written consent to participate before the interview. Interviews will be approximately 30 minutes. The interview will be audio-recorded and transcribed by a researcher. The recorder will be encrypted, and the transcripts will be stored on an encrypted password protected storage drive. Any written notes will be scanned in and stored in the encrypted storage device.

At the end of the interview, you will be asked if you could pass on the researcher's contact details to other potential participants, to help invite more people to the study. We will talk you through the study procedures upon arrival to the research activity and give you chance to ask any questions.

Will my data be identifiable?

The data collected for this study will be stored securely in a University approved secure cloud storage and only the researchers conducting this study will have access to this data.

- Audio recordings will be destroyed and/or deleted once the project has been submitted for publication/examined
- The files on the computer will be encrypted (that is no-one other than the researcher will be able to access them) and the computer itself password protected.
- At the end of the study, transcripts will be stored on the University's cloud storage system for ten years. At the end of this period, they will be destroyed.
- The typed version of your interview will be made anonymous by removing any identifying information including your name. Anonymised direct quotations from your interview may be used in the reports or publications from the study, so your name will not be attached to them. All reasonable steps will be taken to protect the anonymity of the participants involved in this project.
- All your personal data will be confidential and will be kept separately from your interview responses.

There are some limits to confidentiality: if what is said in the interview makes me think that you, or someone else, is at significant risk of harm, I will have to break confidentiality and notify appropriate persons.

What will happen to the results?

The results will be summarised and reported in a thesis and may be submitted for publication in an academic or professional journal. You will not be personally identified if the results are published.

Are there any risks?

There are no risks anticipated with participating in this study. However, if you experience any distress following participation you are encouraged to inform the researcher and contact the resources provided at the end of this sheet.

Are there any benefits to taking part?

Although you may find participating interesting, there are no direct benefits in taking part.

Who has reviewed the project?

This study has been reviewed and approved by the Faculty of Health and Medicine Research Ethics Committee at Lancaster University.

Where can I obtain further information about the study if I need it?

If you have any questions about the study, please contact the main researcher:

Lauren Fothergill, PhD Student

Or other members of the research team:

Professor Carol Holland, Professor in Ageing

Professor Niall Hayes, Professor of Information and Organisation, Department of Organisation, Work and Technology

Thank you for taking the time to read this information sheet.

Resources in the event of distress

Should you feel distressed either as a result of taking part, or in the future, the following resources may be of assistance: <https://www.mind.org.uk/information-support/guides-to-support-and-services/crisis-services/helplines-listening-services/>

9.5. Appendix 5. Consent form (Chapter 3)

Exploring the views of older adults and organisations on an 'OKEachDay' device to support independent living and wellbeing.

We are asking if you would like to take part in research which aims to capture views of 'OK each day' to support independent living. OK each day is a digital tool that helps confirm safety and wellbeing. You don't have to be using 'OK each day' to take part in the study. We are interested in hearing your views on the tool and what the potential benefits and challenges are in using it.

Before you consent to participate in this study, we ask that you read the participant information sheet and this form, if you agree with each statement below, please initial the boxes and sign and date this consent form. If you have any questions before signing, please speak to the principal investigator, Lauren Fothergill.

1. I confirm that I have read the information sheet and fully understand what is expected of me within this study
2. I confirm that I have had the opportunity to ask any questions and to have them answered.
3. I understand that my interview will be audio (video) recorded and then made into an anonymised written transcript.
4. I understand that audio (video) recordings will be kept until the research project has been examined.
5. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my medical care or legal rights being affected.
6. I understand that once my data have been anonymised and incorporated into themes it might not be possible for it to be withdrawn, though every attempt will be made to extract my data, up to the point of publication. If I am involved in focus groups and then withdraw, I understand that it may not be possible to withdraw my data. I understand that after the interview has taken place, I have 14 days to notify the researcher if I want to withdraw my data from the study.
7. I understand that the information from my interview will be pooled with other participants' responses, anonymised and may be published; all reasonable steps will be taken to protect the anonymity of the participants involved in this project.
8. I consent to information and quotations from my interview being used in reports, conferences and training events.
9. I understand that the researcher will discuss data with their supervisor as needed.

9.6. Appendix 6. Interview guides (Chapter 3)

Questions for proactive telecare users

Experience and perception of being independent

Firstly, I'd like to talk to you about your experience and views on living independently at home.

What does living independently mean to you?

- How would you describe your level of independence?

Do you think there are any benefits to living independently? If so, what are they?

- Do you think there are any health benefits to living independently? Mental health, physical health, quality of life?

Do you think there are any negatives to living independently? If so. What are they?

- Any negative health impacts to living independently? Mental health/loneliness, physical health, quality of life.

Experience and views on using proactive telecare

Next, I'd like to talk to you about your experience and views on using proactive telecare

When did you get proactive telecare? Why did you get it?

How long did it take to adapt to using OK each day? How do you feel about using it?

- Did it take long to figure out how it worked? Did you need help to understand how to use it?

Why do you continue to use proactive telecare?

What do you like about proactive telecare?

- What benefits do you think there are to using it? Health benefits?

What don't you like about proactive telecare?

- Do you think there are negatives to using it? If so, what are they? Can you see any unintended consequences to using proactive telecare? Negative health impacts?

Have you noticed any changes in life since using proactive telecare?

Who do you think could benefit/or not benefit from using this (people with mild dementia, people living on their own, vulnerable people)?

Demographic questions

Lastly, I have some demographic questions for you. Can you please tell me:

How old are you?

How would you describe your gender?

- Male
- Female
- Other (please specify)
- Prefer not to say

How would you describe your ethnic background?

- White
- Mixed/multiple ethnic group
- Asian/Asian British

- Black/African/Caribbean/black British
- Other
- Prefer not to say

How would you describe your current/previous employment status?

- In full-time paid work
- In part-time paid work
- In full-time education
- In part-time education
- Full-time carer/homemaker
- On leave/out of work due to illness or disability
- Retired
- Other, please specify
- Prefer not to say

What are your current living arrangements?

- Live alone
- Live with partner/spouse/children
- Live with other adults
- Other, please specify

In general, would you say that your level of mobility is

- Partially affected/limited
- No issues

Do you have any formal/informal care?

Questions for family members of proactive telecare users

Experience and perception of independence for their family member

Firstly, I'd like to talk to you about your experience and views on your relations independence at home.

What does living independently mean to you and your family?

- How would you describe your family members/friends level of independence?

Do you think there are any benefits to living independently? If so, what are they?

- Do you think there are any health benefits to living independently? Mental health, physical health, quality of life?

Do you think there are any negatives to living independently? If so. What are they?

- Any negative health impacts to living independently? Mental health/loneliness, physical health, quality of life.

Views on their relation using proactive telecare

Next, I'd like to talk to you about your experience and views of your relation using proactive telecare

When did your family member/friend get proactive telecare? Why did they get it?

How long did it take for them adapt to using proactive telecare? How do you feel about the tool?

- Did it take long to figure out how it worked? Did they need help to understand how to use it?

Why does your family/friend you use proactive telecare? How does it affect you? (Safety, wellbeing, peace of mind?)

What do you like about proactive telecare? What benefits do you think there are to using it? health benefits, well-being?

What don't you like about proactive telecare? Do you think there are negatives to using it? If so, what are they? Can you see any unintended consequences to using proactive telecare? Negative health impacts?

Have you noticed any changes in life since your relation started using proactive telecare?

Who do you think could benefit from using proactive telecare (people with mild dementia, people living on their own, vulnerable people?)

Demographic questions

Lastly, I have some demographic questions for you. Can you please tell me:

How old are you?

How would you describe your gender?

- Male
- Female
- Other (please specify)
- Prefer not to say

Questions for proactive telecare staff

Demographic questions

I have some demographic questions for you. Can you please tell me:

What organisation do you work for and what is your role?

How old are you?

How would you describe your gender?

- Male
- Female
- Other (please specify)
- Prefer not to say

Experience and perception of independence for older adults

Firstly, I'd like to talk to you about your views on older adults independence in the home environment

What does living independently mean to you and the organisation?

Do you think there are any benefits to living independently? If so, what are they?

- Do you think there are any health benefits to living independently? Mental health, physical health, quality of life?

Do you think there are any negatives to living independently? If so. What are they?

- Any negative health impacts to living independently? Mental health/Loneliness, physical health, quality of life.

Views on proactive telecare

Next, I'd like to talk to you about your experience and views of delivering proactive telecare

Describe your experience of using proactive telecare in your role /tell me about your role in delivering proactive telecare.

(housing association staff) Why do you think [organisation name] use proactive telecare?

What do you like about proactive telecare? What benefits do you think there are to using it for older people?

- Health benefits to residents/organisational benefits

What don't you like about proactive telecare? Do you think there are negatives to using it for older people? If so, what are they?

- Negative health impacts to residents/organisational impacts?

(housing association staff) Have you noticed any changes in resident's lives since using proactive telecare? Any changes in the organisation?

Who do you think could benefit from using proactive telecare (people with mild dementia, people living on their own, vulnerable people)?

Questions for older adults who currently do not use proactive telecare

Experience and perception of being independent

Firstly, I'd like to talk to you about your experience and views on living independently at home.

What does living independently mean to you?

- How would you describe your level of independence?

Do you think there are any benefits to living independently? If so, what are they?

- Do you think there are any health benefits to living independently? Mental health, physical health, quality of life?

Do you think there are any negatives to living independently? If so. What are they?

- Any negative health impacts to living independently? Mental health/Loneliness, physical health, quality of life.

Views on using proactive telecare

Next, I'd like to talk to you about your views on proactive telecare service

Would you use it? And why? How would you feel about using it? Could you see yourself using it daily?

Who do you think could benefit from using this proactive telecare service (people with mild dementia, people living on their own, vulnerable people)?

What do you like about this proactive telecare service? Do you think there could be benefits to using it? If so, what are they?

- Health benefits?

What don't you like about this proactive telecare? Do you think there could be negatives to using it? If so, what are they? Can you see any unintended consequences to using proactive telecare service?

- Negative health impacts?

You can choose how often you press the button, once a day, twice a day, what do you think of this?

- You could have a phone call everyday instead of pressing the button, what do you think of this?/who do you think this might benefit? Having someone to check in has been viewed as an opportunity to have a chat if you want, is this something you can see yourself doing? If so, why?
- The system can also send reminders if you want, so say for doctor appointments, picking up prescription, would you find this useful or not? Who could this be useful for?

Demographic questions

Lastly, I have some demographic questions for you. Can you please tell me:

How old are you?

How would you describe your gender?

- Male
- Female
- Other (please specify)
- Prefer not to say

How would you describe your ethnic background?

- White
- Mixed/multiple ethnic group
- Asian/Asian British
- Black/African/Caribbean/black British
- Other
- Prefer not to say

How would you describe your current/previous employment status?

- In full-time paid work
- In part-time paid work
- In full-time education
- In part-time education
- Full-time carer/homemaker
- On leave/out of work due to illness or disability
- Retired
- Other, please specify
- Prefer not to say

What are your current living arrangements?

- Live alone
- Live with partner/spouse/children
- Live with other adults
- Other, please specify

In general, would you say that your level of mobility is

- Partially affected/limited
- No issues

Do you have any formal/informal care?

9.7. Appendix 7. Search terms (Chapter 4)

Database	Search terms
Medline	<p>telecare OR telehealth OR assistive living technology OR wear* device* OR smart home technology</p> <p>psychological well-being OR well-being OR psychological wellbeing OR wellness OR quality of life OR anxiety OR depression OR mental health OR control OR self-regulation OR loneliness OR stress OR emotional OR autonomy OR positive mood OR wellness</p> <p>independent living OR community-dwelling older adults OR older adults OR elder* OR seniors OR frail elder*</p> <p>NOT</p> <p>Dementia</p> <p>Child*</p> <p>Care homes</p>
PsycINFO	<p>telecare OR telehealth OR assistive living technology OR wear* device* OR OR smart home technology</p> <p>psychological well-being OR mental health OR control OR anxiety OR depress* OR agency OR self-regulation OR emotional control OR quality of life OR loneliness OR stress OR emotional OR autonomy OR positive mood</p> <p>independent living OR community-dwelling older adults OR elderly OR seniors OR older adults</p> <p>AND NOT dementia AND cancer</p> <p>Children</p> <p>Care homes</p>
Academic search ultimate	<p>telecare OR telehealth OR assistive living technology OR wear* device* OR smart home technology</p> <p>psychological well-being OR well-being OR anxiety OR depression OR mental health OR control OR agency OR resilience OR self-regulation OR loneliness OR stress OR emotional OR autonomy OR positive mood</p> <p>older adults OR independent living</p>
Web of Science	<p>telecare OR telehealth OR assistive living technology OR wear* device* OR OR smart home technology</p> <p>Older adults OR independent living OR elder</p>

	Psychological OR wellbeing OR anxiety OR control OR agency OR self-regulation OR mental health OR quality of life OR depression OR resilience
CINAHL	<p>telecare OR telehealth OR assistive living technology OR assistive technology OR wear* device* OR smart home tech*</p> <p>psychological well-being OR well-being OR wellbeing OR psychological wellbeing OR wellness OR quality of life OR anxiety OR depress* OR mental health OR control OR self-regulation OR loneliness OR stress OR emotional OR autonomy OR positive mood OR wellness OR psychological resilience OR psychological frailty</p> <p>independent living OR community-dwelling older adult* OR older adult* OR elder* OR senior* OR frail elder*</p>

9.8. Appendix 8. Study characteristics (Chapter 4)

R&R refers to relevance and rigour and the level of usefulness (either labelled as moderate or high).

Author and year	Study methodology	Study focus	Study setting and sample	Country	Intervention	R&R
Lynch et al. 2022	Qualitative interviews and ethnographic methods	Aimed to explore how reassurance emerges through human-technology interactions?	Older adult users of pendant alarms. Age not specified. N=19	United Kingdom	Pendant alarm	High usefulness
De San Miguel and Lewin 2008	Retrospective quantitative survey with free text comments.	Aimed to determine if people used their alarms, and to explore how this type of technology impacts on older individuals lives and why.	Older adults who had used pendant alarms for 6 months or longer. N=1476	Australia	Pendant alarm	Moderate usefulness
Berridge 2017	Qualitative semi-structured interviews	Aimed to explore how older people adopt, refuse, discontinue and adapt to using passive monitoring systems.	Long term telecare users (6 years). Older adults aged 65 and over. N= 15.	United States of America	Five sensors installed in specific predefined locations within apartments. Telecare service provided through a call centre.	High usefulness
Chaudhuri et al. 2017	Qualitative focus groups	Aimed to explore the experiences and perceptions of older people on fall	Older adults aged 60 and over, living in independent and assisted living communities. Explained a	United States of America	Fall detector device – call button and ambient sensors to detect a fall.	High usefulness

		detection technologies and their willingness to use such devices.	theoretical telecare device and asked opinions on it. N=27.			
Johnston et al. 2010	Qualitative semi-structured interviews	Aimed to explore the experiences of older people who had fallen recently and their thoughts on pendant alarms.	Older adults aged 65 years and older who had sustained a fall in the previous six months. N=31. 20 participants currently used pendant alarms.	Australia	Pendant alarm	High usefulness
Brownsell and Hawley 2004	Quantitative Pre and post intervention study with control group. Qualitative interviews afterwards.	Aimed to explore the impact of telecare on reducing the fear of falling.	Older adults currently using automatic fall detectors aged over 75 years or those aged 60–74 years who had experienced a fall in the previous six months. Monitored over 17 weeks. Assigned to a control group (n = 21) or intervention group (n = 34). N=55.	United Kingdom	Automatic fall detector	Moderate usefulness
Hirani et al. 2014	Randomised control trial	Aimed to explore the impact of telecare on quality of life, anxiety, and depression.	Participants over 18 years old. 77.4% were aged over 65 and over. Randomised to received telecare or not. Trial length was 12 months. N=1189.	United Kingdom	Across all sites participants received a Tunstall Lifeline Connect or Connect+ base unit and pendant/bracelet alarm.	Moderate usefulness
Elers et al. 2018	Qualitative semi-	Aimed to explore the experiences of	Older adults aged 74-92 years. Participants were	New Zealand	Home monitoring technology.	High usefulness

	structured interviews	telecare use in older adults	asked about their needs and how telecare could fulfil their needs. N=10.			
Hamblin 2016	Qualitative, multi-method, longitudinal research study - ethnographic observations, qualitative interviews and photography and diaries.	Aimed to understand factors which influence telecare acceptance and usage.	Older adults aged 65 and over. Participants were new telecare users, or had been telecare users for 12 months. N=60.	United Kingdom	Pendant alarm	Moderate usefulness
Greenhalgh et al. 2013	Ethnographic methods.	Aimed to develop a theoretical model of assistive technology use	Older adults aged 60 and over. N=40. Participants were visited at home and asked about their use (or non-use) of technologies.	United Kingdom	Assistive living technology – including telecare in the form of pendant alarms	High usefulness
Brownsell et al. 2008	Quantitative controlled trial	Aimed to quantify the impact of telecare on users, specifically to understand the impact on people's health and wellbeing	Older adults aged over 70. 24 participants were in the intervention group, with a control group of 28 people. N=52. 12 month monitoring period.	United Kingdom	Flood detectors and temperature Detectors, fall detectors and automatic light switch, movement detectors.	Moderate usefulness
Bowes and McColgan 2012	Qualitative semi-structured interviews	Aimed to understand how far telecare can support older	Older adults aged 60 years and older receiving telecare services at home and in housing with care. N= 76.	United Kingdom	Home alert system linked to a telephone, with two passive detectors, which can	High usefulness

		people's goals of independence, participation, and identity.	Study conducted over 3 years.		detect movement, flood detectors, heat sensor and smoke detector.	
Wild et al. 2008	Qualitative focus groups	Aimed to identify monitoring needs and expectations of community-residing elderly and their family members.	Older adults aged 65 years and older. Participants were asked about their opinions on a potential home monitoring sensor. N= 23.	United States of America	In-home monitoring – ambient sensor	Moderate usefulness
Watson et al. 2021	Qualitative semi-structured interviews	Examined the impact on service users of rapid response services in social housing.	Participants included older adult service users and vulnerable service users. Age not specified. N=10	United Kingdom	24/7 emergency response service combined with a telecare service	Medium usefulness
Karlsen et al. 2017	Qualitative systematic review	Aims to review qualitative evidence of community-dwelling older adults' experience with the use of telecare in home care services.	This review considered studies that examined older adults' experiences with the use of active and passive technology devices.	Norway	Personal alarms and sensor technology	High usefulness
Percival and Hanson 2016	Qualitative focus groups	Aimed to explore priorities of older people regarding possible uses of telecare services.	Carried out focus groups with 10 older people. Age not specified. Participants were presented with specially designed case	United Kingdom	Flood detector, fall detector, bed sensor	Moderate usefulness

			scenarios related to telecare devices. N=10			
Pol et al. 2016	Qualitative semi-structured interviews	Aimed to determine the perspectives of older people regarding the use of sensor monitoring in their daily lives.	Older adults aged over 68 who had a sensor monitoring system installed in their home for 1 and a half years. N=11	Netherlands	Sensor monitoring system – ambient sensors	High usefulness
Nyman and Victor 2014	Quantitative cross-sectional survey	Aimed to investigate telecare use in older adults.	Users of personal call alarms among community-dwelling adults aged 65 and over. N=3,091	United Kingdom	Pendant alarm	High usefulness
Leikas and Kulju 2018	Qualitative focus group	Aimed to understand ethical issues related to monitoring technology.	Older adults aged 70 years and above, using ambient sensors for study purposes. N=8.	Finland	Movement sensors (ambient)	High usefulness
Karlsen et al. 2019	Qualitative semi-interviews	Aimed to understand use of telecare for older adults and their family caregivers.	Older adults aged 60 years and above and a received telecare service within the last 0–3 months. N=18.	Norway	Telecare – first to third generation.	High usefulness
Hamblin et al. 2017	Ethnography – interviews and field data (mixed method)	Aimed to understand factors which affect the optimal use and implementation of telecare.	Older adults aged 65 and above who had been assessed as at risk of falls. N=60.	United Kingdom	Telecare – first to third generation.	High usefulness

Berridge et al. 2019	Qualitative semi-interviews	Aimed to examine the experiences and insights of low-income, immigrant senior residents that offered a sensor-based passive monitoring system.	Older adults using a sensor-based passive monitoring system. Age not specified. N=20.	United States of America	Sensor-based passive monitoring system.	High usefulness
Aceros et al. 2015	Ethnographic methods – interviews, focus groups (quali mixed method)	Aimed to explore what was meant by ‘good aging’ and how it is constituted in telecare practices.	Older adults who currently used a telecare service consisted of a personal alarm system. Age not specified. N=10.	Spain	Pendant alarm	Moderate usefulness
Pech et al. 2021	Literature review	Aimed to review telecare devices to support older people.	Review of literature exploring telecare use in older adults, age not specified.	France	Telecare – first to third generation.	Low usefulness
De San Miguel et al. 2017	Cohort study	Aimed to assess effectiveness of telecare in providing assistance in an emergency and other health and well-being outcomes.	Older adults aged 65 years or older who either used telecare or had expressed an interest in using it. N=295. Community-dwelling.	Australia	Pendant alarms	Moderate usefulness

Camp et al. 2022	Semi-structured interviews	Aimed to understand older adults' opinions on the kind of telecare they would be willing to use within their own homes.	Older adults split into two groups: younger group (aged 55-69 years) and an older group (≥ 70 years). N=32. Community-dwelling.	United Kingdom	Ambient sensors	Moderate usefulness
López & Domènech 2008	Ethnographic qualitative interviews	Aimed to understand how autonomy is embodied through the use of a telecare device.	Data extracted from 12-month ethnographic research study in a Catalan Telecare Service. Age not specified. Community-dwelling.	Spain	Telecare package – red button/pendant	Moderate usefulness
Peng et al. 2023	Structured questionnaire survey	Aimed to investigate the factors associated with the telecare acceptance for older adults in Hong Kong.	Older adults aged 60 and above. N=110. Community-dwelling.	Hong Kong	Telecare – sensor technology	Moderate usefulness
Reyes et al. 2023	Semi-structured interviews	Aimed to understand the types of technologies that older adults use to support their health and motivations behind use.	Older adults aged 65 years and above. And used a device for their health care. N=22. Community-dwelling.	Australia	Telecare – sensor technology	Moderate usefulness

Felber et al.2023	Systematic review	Aimed to investigate how ethical questions are discussed in the field of Smart home health technologies in caregiving for older persons.	Older adults aged 65 years and above and caregivers. Community-dwelling.	Switzerland	Telecare – sensor technology	Moderate usefulness
Fawcett and Karastoya nova 2023	Semi-structured interviews	To analyse how Covid-19 affected older people in three areas of Scotland	Older adults in receipt of telecare services. Mean age was 74. N=29. Community-dwelling.	United Kingdom	Telecare – pendant alarms	High usefulness

9.9. Appendix 9. Data extracts and notes from CMO development and refinement (Chapter 4).

CMO	Source	Data extract	Notes
CMO1: Providing a connection to help	Watson et al., 2021, page 900.	" <i>The first time [I fell] I was laid for hours before I managed to get to a phone to call help. I ended up at hospital and staying for 3 days. That's why I signed up for rapid response. The last time was very different: I pressed the button and they were here in minutes, lifted me up and went on their way. Brilliant.</i> " (SU09).	(pendant alarm) (housing association context) - rapid response to an emergency - Rapid response team providing care faster than NHS - fast response is crucial to peace of mind.
CMO2: Ensuring privacy	Wild et al., 2008 , page 193.	"None of us want to give up control but being monitored I think would be very reassuring." Woman B.	If monitoring technology is viewed as facilitating safety, users may accept foregoing privacy.
CMO3: Detecting subtle changes in health	Pol et al., 2016, page 488.	Mr. A expressed: " <i>Look there are my sensors, they are my watchdogs, and they look after me.</i> " The sensors were able to capture things that the participants did not notice. Mr. A expressed this as follows: " <i>if there should be a slow change in my daily pattern, I certainly wouldn't report it. I wouldn't notice.</i> "	Monitoring helps to detect early indicators of health deterioration. Works towards staying at home – longer goal. Preventive tool.
CMO4: Meeting future needs	Hamblin et al., 2016, page 8.	Future needs had an inverse effect on obtrusiveness for some participants: rather than rejecting telecare because it may not meet future requirements, some had it installed to meet needs they were anticipating.	Some people were proactive rather than reactive. Preparedness is important to some. May not be relevant for all, for some perceived need is required. May be linked to

			stigma around technologies.
CMO5: Assessing needs	Lynch et al., 2022, page 6.	Gordon, an older man with multiple chronic health conditions, talked about the issuing of his community alarm device as indicative of the council's consistent failure to meet his needs: Gordon: <i>"The council have always let me down in not getting the help that's needed [...] What annoys me most of all, they put stuff on that I'm not really interested in, and they talk a lot of rubbish, a lot of them."</i>	When technology does not match needs, frustration and feeling of being let down. Ignoring contexts results in user not attaching meaning to technology (pendant alarm).
CMO6: Choice in telecare	Hamblin et al., 2016, page 8.	<i>"I'm now beginning to understand, as age is catching up with me, that I am being forced – notice my word here – I am being forced in little ways to become dependent on somebody else. I'm being checked up on... it's an interesting aspect but not one that I necessarily like. I've been too independent for too many years ... it's nice to know that they are there in the background but, how can I put this, I don't want to become dependent" (Mr Eaves, 70s).</i>	Some feel forced to use telecare. Viewed as a lesser of two evils, struggle between wanting to stay at home and wanting to remain independent (telecare may impede independence if it's not seen as a true 'choice').
CMO7: Choice in how telecare is used	Percival and Hanson., 2016, pages 894-895.	Positive implications of telecare for individual choice and self-determination were also raised. Participants thought that ICT may provide an older, virtually housebound person such as Mr Agnew (case scenario two) with more choice in respect of the ways in which he interacts, to be 'in control of his own world and his own contact'. Behind many of the comments raised in the context of choice was that it is closely aligned with older people's sense of self-determination in	People having a choice in <i>how</i> telecare is used will enable better matching to individual needs. Gives a sense of empowerment through facilitating autonomy.

		running their own lives.	
CMO8: Providing social connections	Percival and Hanson., 2016, page 900.	an alarm call centre manager, spoke of the frequency with which service users press their alarm button, purely to hear a human voice and have 'a chat'. The manager, frustrated that he only has resources to deal with life and limb emergencies, is now of the opinion that 'emotional support' maybe a 'legitimate' use of the alarm service, which needs to be costed so that the potential for having necessary staff available is examined.	Shows individuals with limited social resources (contexts) seeing telecare as a route to social connection.
CMO9: Understanding telecare	Lynch et al., 2022, page 114553.	Harry did not understand the workings of the community alarm or why, when he pressed its button, someone would try to talk to him through the white box by his television. Rather than offering Harry a connection, the technology offered a hermeneutic relation which made no sense, provoking anxiety rather than reassurance. <i>"Harry: Making me wonder if they're trying to get in touch for any reason. I: And do they try and call you through that [community alarm box]? Harry: I'm not sure."</i>	Understanding telecare important in reducing anxiety towards telecare, and important in providing reassurance.
CMO10: Customising telecare	Karlsen et al., 2019, page 1307.	<i>"When memory gets worse it is ok to receive reminders, because then you remember it, and then you can do it."</i> (Gabriel). However, for one participant who did not need a voice reminder, this was experienced as stigmatising.	Creativity and customisation - allowing for tech to fit into everyday life - gives control.
CMO11: Familiar design	Peng et al., 2023, page 1067.	older people seem more likely to accept the relatively traditional healthcare product (i.e., blood pressure meter) which they are more acquainted when	If older adults feel apprehensive towards technology (context), or where

		<p>compared to the new emerging ones (e.g., smartwatch, GPS tracker, smart elderly home). The older population are generally considered resistant to change. They may lack the basic knowledge on new technologies, and thus are unwilling to use such technologies.</p>	<p>they lack knowledge on how to use the technology, telecare with a familiar design may make it easier for people to use, and reduce technological anxiety.</p>
<p>CMO12: User expectations</p>	<p>Hamblin et al., 2016, page 6.</p>	<p>a few in the study made negative comments about response arrangements when alerts were triggered, as they felt the responders took too long to reach them when they had activated their devices in emergencies; as a result, in two cases participants chose alternative providers. Inaccurate measurement with some devices could be off-putting (with bed sensors and, in particular, fall detectors cited as either too sensitive or not sensitive enough to record a 'soft fall') and led to their removal.</p>	<p>When technology fails to meet goals and expectations, it will lead to a person stopping use.</p>

9.10. Appendix 10. Ethical approval letter (Chapter 5)

Applicant: Lauren Fothergill
Supervisor: Professor Carol Holland

Title: A proactive monitoring technology for detecting health and well-being deterioration in older adults at home

Dear Lauren,

Thank you for submitting your research ethics application for the above project for review by the Faculty of Health and Medicine Research Ethics Committee (FHMREC).

The application was recommended for approval by FHMREC, and on behalf of the Chair of the Committee, I can confirm that approval has been granted for this research project.

As principal investigator your responsibilities include:

- ensuring that (where applicable) all the necessary legal and regulatory requirements in order to conduct the research are met, and the necessary licenses and approvals have been obtained;
- reporting any ethics-related issues that occur during the course of the research or arising from the research to the Research Ethics Officer at the email address below (e.g. unforeseen ethical issues, complaints about the conduct of the research, adverse reactions such as extreme distress);
- submitting details of proposed substantive amendments to the protocol to the

Yours sincerely,

Chair of the Faculty of Health and Medicine Research Ethics Committee

9.11. Appendix 11. Study poster (Chapter 6).

Removed for publication of thesis

9.12. Appendix 12. Ethical approval letter (Chapter 6).

Applicant: Lauren Fothergill
Supervisor: Professor Carol Holland

Title: The OKEachDay feasibility trial: A mixed method study

Dear Lauren,

Thank you for submitting your research ethics application for the above project for review by the Faculty of Health and Medicine Research Ethics Committee (FHMREC).

The application was recommended for approval by FHMREC, and on behalf of the Chair of the Committee, I can confirm that approval has been granted for this research project.

As principal investigator your responsibilities include:

- ensuring that (where applicable) all the necessary legal and regulatory requirements in order to conduct the research are met, and the necessary licenses and approvals have been obtained;
- reporting any ethics-related issues that occur during the course of the research or arising from the research to the Research Ethics Officer at the email address below (e.g. unforeseen ethical issues, complaints about the conduct of the research, adverse reactions such as extreme distress);
- submitting details of proposed substantive amendments to the protocol to the

Yours sincerely,

Chair of the Faculty of Health and Medicine Research Ethics Committee

9.13. Appendix 13. Participant Information Sheet (Chapter 6).

Participant Information Sheet

Using technology to support independence at home

For further information about how Lancaster University processes personal data for research purposes and your data rights please visit our webpage: www.lancaster.ac.uk/research/data-protection

My name is Lauren Fothergill and I am conducting this research as a PhD student on the Health Research doctoral programme at Lancaster University, Lancaster, United Kingdom.

We would like to invite you to take part in our research study. Before you decide, we would like you to understand why the research is being done and what it would involve for you. The PhD researcher, Lauren, will go through the information sheet with you and answer any questions you have.

What is the study about?

Retaining independence in older people has many benefits, including improving physical and mental health, boosting confidence and self-esteem, and improving overall quality of life. There are many ways to promote independence, and one potential way is using technology.

OKEachDay is a service that encourages people to confirm they are safe by pressing an 'OK' button each day. The user presses the OKEachDay button at 'at a time chosen by the user, one or more times a day e.g. after they get up and before going to bed. If they do not – one of the OKEachDay team members will call the user to ask how they are. If after several attempts the OKEachDay team can't get hold of them, they will then notify friends, family, or neighbours the user has nominated. In some cases, OKEachDay staff members will inform the emergency services if they think it's necessary.

OKEachDay may help older people stay independent at home. It gives the user control to confirm they are safe at a time that suits them. It also gives the opportunity to speak to a member of the OKEachDay team if they would like a general chat. Technology that can help people stay independent for longer may improve overall health and well-being.

To understand how OKEachDay could help support independent living in older adults, we aim to give this technology to a group of people as a trial, to see if it is acceptable and useful.

The findings will help us to further develop technologies like this to support independence in older people living at home. This is a feasibility study (a practice-run before doing a large-scale study). It will help us find out more about the following:

- We would like to know how helpful and acceptable this technology is for older people living at home, and how easy it is to use.

- We would like to know how people find participating in this type of trial, and whether they are willing to be randomly allocated into two groups, either group 1 who will receive OKEachDay straight away, or group two who will receive OKEachDay at a later stage.
- Whether people taking part can complete the questionnaires we plan to use without difficulty.
- We would like to know how well OKEachDay works for people living at home independently.

We can then make changes before we do a larger study. We need to ensure that research meets people's needs and are asking your help to do this. If you are interested in taking part, please read the rest of this information sheet.

Why have I been approached?

You have been approached because the study requires information from people who are 65 years or older who live in their own home/community-based dwelling.

Do I have to take part?

No. It's completely up to you to decide whether or not you take part. We will describe the study and go through this information sheet with you to answer any questions you may have. If you agree to participate, we will ask you to sign a consent form and will give you a copy to keep. However, you would still be free to withdraw from the study at any time, without giving a reason and without any negative consequences, by advising the researchers of this decision. This would not affect your legal rights.

What will I be asked to do if I take part?

If you decide you would like to take part, you would be asked to give your written consent to take part in the study. The student researcher will ask you to complete an initial survey, which you can choose how to complete: you can either 1) have the survey sent to your home address and you can complete in your own time and send it back (Freepost), or 2) complete the survey with the researcher either in person or over the phone (this is up to you); you will be asked questions about yourself, your current health, your current care or plans for care, and about your current independence, mental health, and quality of life. It will take approximately 30-45 minutes to complete.

After the initial survey, you will be allocated (randomised) to have OKEachDay either straight away, or in 3 months time

. A researcher will then contact you to let you know which group you have been allocated to. This may take a couple of days.

You will receive either:

1. OKEachDay
2. OKEachDay in 3 months time.

There is a possibility that you may be disappointed by which group you have been allocated to, but each of the groups is equally important to the study and we hope whatever the outcome you will continue to take part. If you are allocated to group 2, you will still receive OKEachDay in 3 months time.

During the 8-week study

Group 1

If you are allocated to group 1, you will receive OKEachDay straight away to use for 8 weeks. The OKEachDay team will call you to ask which device you would like. You can either receive a telephone which plugs into your telephone socket, or a tablet device which plugs into a wall socket. If you request the telephone version, this also works as your own phone and you can use it to make and receive calls as normal. However, you can continue to use your own telephone as normal and plug in the OKEachDay telephone too, as all OKEachDay telephones have a double socket adapter. The OKEachDay phone works on your own telephone line and you will not need to change your phone number.

You will receive the device in the post, and then the OKEachDay team will phone you to explain how to set it up, which involves plugging it in and testing the touchscreen/phone to make sure it works. The telephone and tablet do not require broadband. Both options are pictured below:



Figure 1. Image of the OKEachDay devices; tablet device (on the left) and the telephone device (on the right).

The OKEachDay team will ask you to confirm who you would like to choose as your nominated contact. Choose someone who is likely to know where you are, or lives nearby, and will be able to come and visit you if we are unable to contact you. Most people nominate friends, family, or neighbours as their chosen contacts. The OKEachDay team will ask you to provide up to three nominated contacts. If you live in sheltered accommodation, your nominated contacts could be your housing officer.

The OKEachDay team will ask you to confirm a time each day that you would like to press the button, this can be between once or three times a day, it is up to you how often you would like to press it. An automated message is sent to the device 10 minutes before your agreed time to press the button as a prompt. If

you cannot press the button before this agreed time, the OKEachDay team will try to call you on all your phone numbers first. If the team cannot contact you, then they will notify your nominated contacts.

You can also set up reminders on the system, for important activities such as taking medication for example. This functionality can be set up by calling the OKEachDay contact centre and the reminder will be an audio call. This function is optional.

Please keep the box the equipment arrives in when you first get started. This will contain a freepost return address label. At the end of the 8 week period we will ask you to post the equipment back to the OKEachDay team.

Group 2

If you are allocated to group 2, you will receive OKEachDay 3 months after you consent to join the study.

Both groups will receive a courtesy call every 2 weeks from the student researcher to check in on how you are getting on in the study. For both groups, we would like to follow your progress and will ask you to complete a second survey after the 8-week study period. When these questionnaires are due the research assistant will contact you to confirm that you are happy to continue and either send the questionnaire to your home address for you to complete in your own time and send back to the researcher, or we can arrange a mutually convenient time to meet with you, at your home, or over the phone/online to complete the questionnaire.

Additionally, after we have conducted the second survey we may wish to interview you for around 30-45 minutes by the method of your choice (telephone, online or in your home). You do not have to agree to this interview to be able to take part in the study. If you are interested, the student researcher will contact you to organise a time convenient for you. This interview will be audio recorded and transcribed and the interview transcript will be anonymised. We will ask you about the support you have received from OKEachDay, the things you found useful or most helped/did not help and your experience of the research trial.

Will my data be identifiable?

The data collected for this study will be stored securely and only the researchers conducting this study will have access to this data

- Audio recordings will be destroyed and/or deleted once the project has been submitted for publication/examined
- Hard copies of questionnaires will be kept in a locked cabinet.
- The files on the computer will be encrypted (that is no-one other than the researcher will be able to access them) and the computer itself password protected.
- At the end of the study, hard copies of questionnaires will be kept securely in a locked cabinet for ten years. At the end of this period, they will be destroyed.

- The typed version of your interview will be made anonymous by removing any identifying information including your name. Anonymised direct quotations from your interview may be used in the reports or publications from the study, so your name will not be attached to them. All reasonable steps will be taken to protect the anonymity of the participants involved in this project.
- All your personal data will be confidential and will be kept separately from your interview responses.

There are some limits to confidentiality: if what is said in the interview makes me think that you, or someone else, is at significant risk of harm, I will have to break confidentiality and speak to a member of staff about this. If possible, I will tell you if I have to do this.

What will happen to the results?

The results will be summarised and reported in a thesis and may be submitted for publication in an academic or professional journal. You will not be personally identified if the results are published.

Are there any risks?

There are no risks anticipated with participating in this study. However, if you experience any distress following participation you are encouraged to inform the researcher and contact the resources provided at the end of this sheet.

Are there any benefits to taking part?

Although you may find participating interesting, there are no direct benefits in taking part. Participants who take part in the study will receive a £20 shopping voucher as a thank you for taking part.

The equipment is provided free of charge. If you make any calls to the OKEachDay team these are free as a freephone number is used. Pressing the OK button is also free. The touchscreen will use some electricity. Over an 8 week period this will be between 30p-80p.

Who has reviewed the project?

This study has been reviewed and approved by the Faculty of Health and Medicine Research Ethics Committee at Lancaster University.

Thank you for taking the time to read this information sheet.

Resources in the event of distress

Should you feel distressed either as a result of taking part, or in the future, the following resources may be of assistance: <https://www.mind.org.uk/information-support/guides-to-support-and-services/crisis-services/helplines-listening-services/>

9.14. Appendix 14. Consent form (Chapter 6).

Consent form - Using technology to support independence at home

We are asking if you would like to take part in research which aims to understand how OKEachDay could help support independent living in older adults. This study will allocate the OKEachday system to a group of people as a trial, to see if it is acceptable and useful to older adults.

Before you consent to participate in this study, we ask that you read the participant information sheet and this form, if you agree with each statement below, please initial the boxes and sign and date this consent form. If you have any questions before signing, please speak to the principal investigator, Lauren Fothergill.

1. I confirm that I have read the information sheet and fully understand what is expected of me within this study.
2. I confirm that I have had the opportunity to ask any questions and to have them answered.
3. I understand that if I take part in an interview, that this interview will be audio (video) recorded and then made into an anonymised written transcript.
4. I understand that audio (video) recordings will be kept until the research project has been examined.
5. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my medical care or legal rights being affected.
6. I understand that once my data have been anonymised and incorporated into themes it might not be possible for it to be withdrawn, though every attempt will be made to extract my data, up to the point of publication.
7. I understand that the information from my questionnaire/interview will be pooled with other participants' responses, anonymised, and may be published; all reasonable steps will be taken to protect the anonymity of the participants involved in this project.
8. I consent to information and quotations from my questionnaire answers/interview being used in reports, conferences, and training events.
9. I consent to information from the OKEachDay system to be accessed by the researcher for purposes related to the research (time button was pressed, missed button presses/frequency of button misses, number of calls to me by the OKEachDay team and length of calls).
10. I consent to the phone calls to and from the OKEachDay team being recorded for research analysis purposes. Your own personal calls will **not** be recorded.
11. I understand that the researcher will discuss data with their supervisor as needed.
12. I understand that any information I give will remain confidential and anonymous unless it is thought that there is a risk of harm to myself or others, in which case the

9.15. Appendix 15. Quantitative survey (Chapter 6)

OKEachDay study - Using technology to support independence at home

Name:

We would like to ask some questions about your current feelings about your independence and your current health and well-being. This survey will take approximately 20-30 minutes to complete.

Firstly, we would like to know a bit about you so that we have an idea of the range of people who have taken part in this study. However, you are free not to answer any of the questions below if you'd prefer.

Demographic questions		
How old are you?		
		Tick in this box
How would you describe your gender?	Male	
	Female	
	Other	
	Prefer not to say	
How would you describe your ethnic background?	White	
	Asian/Asian British	
	Black, Black British, Caribbean or African	
	Mixed or multiple ethnic group	
	Other ethnic group	
	Prefer not to say	
How would you describe your current employment status?	In full-time paid work	
	In part-time paid work	
	Retired	
	On leave/out of work due to illness or disability	
	Other, please specify:	

	Prefer not to say	
What is your current or previous occupation if retired? Please be specific. For example if you are/were in retail, please indicate what you sell/sold.		
What is your marital status?	Married	
	Single	
	In a relationship	
	Divorced	
	Separated	
	Widowed	
	Prefer not to say	
What is your highest educational qualification?	No educational qualifications	
	O grades, O levels, GCE/GCSEs	
	Highers, advanced highers, A levels	
	Vocational qualification (e.g. SVQ, NVQ, SCOTVEC)	
	Degree (e.g., BA, BSc)	
	Masters degree (e.g. MSc, MBA)	
	PhD degree	
	Professional qualification (e.g. CAEW, CIIA)	
	Other, please specify:	
	Prefer not to say	
What are your current living arrangements?	Live alone	
	Live with partner/spouse/children	
	Live with other adults	

	Other, please specify:	
In general, would you say that your health is...	Excellent	
	Very good	
	Good	
	Fair	
	Poor	
<p>The next few questions will ask for your views about your health. Answer each question by choosing just <u>one</u> answer. If you are unsure how to answer a question, please give the best answer you can.</p> <p>The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?</p>		
Moderate activities such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	Yes, limited a lot	
	Yes, limited a little	
	No, not limited at all	
Climbing several flights of stairs	Yes, limited a lot	
	Yes, limited a little	
	No, not limited at all	
<p>During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your <u>physical health</u>?</p>		
Accomplished less than you would like	Yes	
	No	
Were limited in the kind of work or other activities	Yes	
	No	
<p>During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any <u>emotional</u> problems (such as feeling depressed or anxious)?</p>		
Accomplished less than you would like	Yes	

	No	
Did work or activities less carefully than usual	Yes	
	No	
During the past 4 weeks, how much did pain interfere with your normal work (including work outside the home and housework)?	Not at all	
	A little bit	
	Moderately	
	Quite a bit	
	Extremely	
<p>These questions are about how you have been feeling during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling.</p> <p>How much of the time during the past 4 weeks...</p>		
Have you felt calm and peaceful?	All of the time	
	Most of the time	
	A good bit of the time	
	Some of the time	
	A little of the time	
	None of the time	
Did you have a lot of energy?	All of the time	
	Most of the time	
	A good bit of the time	
	Some of the time	
	A little of the time	
	None of the time	
Have you felt down-hearted and blue?	All of the time	
	Most of the time	
	A good bit of the time	
	Some of the time	
	A little of the time	
	None of the time	

During the past 4 weeks , how much of the time has your <u>physical health</u> or <u>emotional problems</u> interfered with your social activities (like visiting friends, relatives, etc.)?	All of the time	
	Most of the time	
	Some of the time	
	A little of the time	
	None of the time	
Do you have any care in place? If no, do you have any plans to put care in place?		
Do you currently use telecare? I.e. pendant alarm?		
Have you used telecare in the past?		
Do you have any health conditions, if so, how many?		

Now we will go through some statements about your thoughts and feelings. Please tick the box to confirm which description best describes your experience of each over **the last 2 weeks**. Tick only one box for each statement.

	None of the time	Rarely	Some of the time	Often	All of the time
I've been feeling optimistic about the future					
I've been feeling useful					

I've been feeling relaxed					
I've been feeling interested in other people					
I've had energy to spare					
I've been dealing with problems well					
I've been thinking clearly					
I've been feeling good about myself					
I've been feeling close to other people					
I've been feeling confident					
I've been able to make up my own mind about things					
I've been feeling loved					
I've been interested in new things					
I've been feeling cheerful					

Now the next set of questions are about how you have been feeling **in the past week**. Tick the box beside the reply that is closest to how you have been feeling in the past week. Don't take too long over your replies: your immediate is best. Tick only one box in each section.

I feel tense or 'wound up':		I feel as if I am slowed down:	
Most of the time		Nearly all the time	
A lot of the time		Very often	
From time to time, occasionally		Sometimes	
Not at all		Not at all	
I still enjoy the things I used to enjoy:		I get a sort of frightened feeling like 'butterflies' in the stomach:	
Definitely as much		Not at all	
Not quite so much		Occasionally	
Only a little		Quite often	
Hardly at all		Very often	

I get a sort of frightened feeling as if something awful is about to happen:		I have lost interest in my appearance:	
Very definitely and quite badly		Definitely	
Yes, but not too badly		I don't take as much care as I should	
A little, but it doesn't worry me		I may not take quite as much care	
Not at all		I take just as much care as ever	
I can laugh and see the funny side of things:		I feel restless as I have to be on the move:	
As much as I always could		Very much indeed	
Not quite so much now		Quite a lot	
Definitely not so much now		Not very much	
Not at all		Not at all	
Worrying thoughts go through my mind:		I look forward with enjoyment to things:	
A great deal of the time		As much as I ever did	
A lot of the time		Rather less than I used to	
From time to time, but not too often		Definitely less than I used to	
Only occasionally		Hardly at all	
I feel cheerful:		I get sudden feelings of panic:	
Not at all		Very often indeed	
Not often		Quite often	
Sometimes		Not very often	
Most of the time		Not at all	
I can sit at ease and feel relaxed:		I can enjoy a good book or radio or TV program:	
Definitely		Often	
Usually		Sometimes	
Not often		Not often	
Not at all		Very seldom	

The next set of questions are about self-efficacy. Self-efficacy is a person's belief in their ability to succeed in a particular situation. Tick the box beside the reply that is closest to how you feel. Tick only one box for each statement. Think about yourself and your life in general when you answer the following questions:

	Not at all true	Hardly true	Moderately true	Exactly true
I can always manage to solve difficult problems if I try hard enough				
If someone opposes me, I can find the means and ways to get what I want				
It is easy for me to stick to my aims and accomplish my goals				
I am confident that I could deal efficiently with unexpected events				
Thanks to my resourcefulness, I know how to handle unforeseen situations				
I can solve most problems if I invest the necessary effort				
I can remain calm when facing difficulties because I can rely on my coping abilities				
When I am confronted with a problem, I can usually find several solutions				
If I am in trouble, I can usually think of a solution				
I can usually handle whatever comes my way				

The next few questions are about feelings of loneliness. Indicate how often each of the statements below is descriptive of you. Tick only one box for each statement.

	I often feel this way	I sometimes feel this way	I rarely feel this way	I never feel this way
I am unhappy doing so many things alone				
I have nobody to talk to				
I cannot tolerate being so alone				
I lack companionship				
I feel as if nobody really understands me				
I find myself waiting for people to call or write				
There is no one I can turn to				
I am no longer close to anyone				
My interests and ideas are not shared by those around me				
I feel left out				
I feel completely alone				
I am unable to reach out and communicate with those around me				
My social relationships are superficial				
I feel starved for company				
No one really knows me well				
I feel isolated from others				
I am unhappy being so withdrawn				
It is difficult for me to make friends				
I feel shut out and excluded by others				
People are around me but not with me				

We would like to ask some questions about how concerned you are about the possibility of having a fall. On a scale from 1 to 10, with 1 being very confident and 10 being not confident at all, how confident are you that you do the following activities without falling? Put a tick in the box that indicates how confident you are. Tick only one box for each statement.

	Very confident			Fairly confident				Not confident at all		
	1	2	3	4	5	6	7	8	9	10
Take a bath or shower										
Reach into cabinets or closets										
Walk around the house										
Prepare meals not requiring carrying heavy or hot objects										
Get in and out of bed										
Answer the door or telephone										
Get in and out of a chair										
Getting dressed and undressed										
Personal grooming (i.e. washing your face)										
Getting on and off of the toilet										

The final part of the survey is about quality of life. Tick only one box for each statement.

Please indicate to what extent you experience the following:

My age prevents me from doing the things I would like to				
I feel that what happens to me is out of my control				
I feel free to plan for the future				
I feel left out of things				
I can do the things I want to do				
Family responsibilities prevent me from doing what I want to do				
I feel that I can please myself what I do				
My health stops me from doing things I want to				
Shortage of money stops me from doing the things I want to do				
I look forward to each day				
I feel that my life has meaning				
I enjoy the things that I do				
I enjoy being in the company of others				
On balance, I look back on my life with a sense of happiness				
I feel full of energy these days				
I choose to do things that I have never done before				
I am satisfied with the way my life has turned out				
I feel that life is full of opportunities				
I feel that the future looks good for me				

9.16. Appendix 16. TIDieR (Template for Intervention Description and Replication) Checklist (Chapter 6)



Template for Intervention Description and Replication

The TIDieR (Template for Intervention Description and Replication) Checklist*:

Information to include when describing an intervention and the location of the information

Item number	Item	Where located **	
		Primary paper (page or appendix number)	Other † (details)
	BRIEF NAME		
1.	Provide the name or a phrase that describes the intervention.	Page 139-140	_____
	WHY		
2.	Describe any rationale, theory, or goal of the elements essential to the intervention.	Page 136-138	_____
	WHAT		
3.	Materials: Describe any physical or informational materials used in the intervention, including those provided to participants or used in intervention delivery or in training of intervention providers. Provide information on where the materials can be accessed (e.g. online appendix, URL).	Pages 138-139	_____
4.	Procedures: Describe each of the procedures, activities, and/or processes used in the intervention, including any enabling or support activities.	Pages 138-140	_____
	WHO PROVIDED		
5.	For each category of intervention provider (e.g. psychologist, nursing assistant), describe their expertise, background and any specific training given.	Page 139-140	_____
	HOW		
6.	Describe the modes of delivery (e.g. face-to-face or by some other mechanism, such as internet or telephone) of the intervention and whether it was provided individually or in a group.	Pages 138-139	_____
	WHERE		

7.	Describe the type(s) of location(s) where the intervention occurred, including any necessary infrastructure or relevant features.	Pages 9	_____
WHEN and HOW MUCH			
8.	Describe the number of times the intervention was delivered and over what period of time including the number of sessions, their schedule, and their duration, intensity or dose.	Pages 8-10	_____
TAILORING			
9.	If the intervention was planned to be personalised, titrated or adapted, then describe what, why, when, and how.	Pages 8-10	_____
MODIFICATIONS			
10.*	If the intervention was modified during the course of the study, describe the changes (what, why, when, and how).	NA	_____
HOW WELL			
11.	Planned: If intervention adherence or fidelity was assessed, describe how and by whom, and if any strategies were used to maintain or improve fidelity, describe them.	Page 12	_____
12.*	Actual: If intervention adherence or fidelity was assessed, describe the extent to which the intervention was delivered as planned.	Page 31	_____

** **Authors** - use N/A if an item is not applicable for the intervention being described. **Reviewers** – use ‘?’ if information about the element is not reported/not sufficiently reported.

† If the information is not provided in the primary paper, give details of where this information is available. This may include locations such as a published protocol or other published papers (provide citation details) or a website (provide the URL).

‡ If completing the TIDieR checklist for a protocol, these items are not relevant to the protocol and cannot be described until the study is complete.

* We strongly recommend using this checklist in conjunction with the TIDieR guide (see *BMJ* 2014;348:g1687) which contains an explanation and elaboration for each item.

* The focus of TIDieR is on reporting details of the intervention elements (and where relevant, comparison elements) of a study. Other elements and methodological features of studies are covered by other reporting statements and checklists and have not been duplicated as part of the TIDieR checklist. When a **randomised trial** is being reported, the TIDieR checklist should be used in conjunction with the CONSORT statement (see www.consort-statement.org) as an extension of **Item 5 of the CONSORT 2010 Statement**. When a **clinical trial protocol** is being reported, the TIDieR checklist should be used in conjunction with the SPIRIT statement as an extension of **Item 11 of the SPIRIT 2013 Statement** (see www.spirit-statement.org). For alternate study designs, TIDieR can be used in conjunction with the appropriate checklist for that study design (see www.equator-network.org).

9.17. Appendix 17. Interview guide (Chapter 6).

Introduction

Confirm consent to participate (from consent form signed on recruitment)

In this interview I am interested in two key things:

- What it was like for you to take part in the research
- What it was like for you to use OKEachDay

Confirm consent to audio record and switch on recorder

Taking part in the research

- What interested you to take part in the study? What has it been like taking part in this research?
- How did you feel about being allocated into two groups? (randomised)
- Do you feel that all the information you were given at the beginning of the study was clear? Was it an appropriate time to discuss the study? Was there anything about the study that was unclear/you had concerns about?
- How did you find the courtesy call? Were they useful, or not? Would you have liked the researcher to check in more?
- How have you found completing the questionnaires with the researcher? How was the timing for this/method of collection?

Experiences of OKEachDay

- Which device did you have? Telephone or touchscreen?
- Thinking about your experience of using OKEachDay, what did you hope the device would do to help you live independently? Did using OKEachDay meet your expectations?
 - o Did you feel safer using the technology?
 - o Did you feel in control? Did you have autonomy?
 - o Did it fit with your daily life? Perception of self?
- How did you feel about using it? What did you like about OKEachDay/ what did you not like about it?
- Was it easy or hard to set up/use? How did you find integrating it into your routine? Did you experience any challenges in using it?
- What was it like engaging with the technology on a daily basis? What impact, if any did it have on supporting independent living?
- What was your experience of the telephone support? Did you forget to press? How was the support if you did forget? What impact, if any did it have on supporting independent living?
- Were your primary contacts contacted at any point? If so, how was this experience?

- Did you use the reminder functionality of OKEachDay? If so, how was this experience?
- During the trial, did you do anything differently in your life? In terms of living independently (exercise, socialising)
- Did you see any impacts from using OKEachDay? What was it about the device that helped/hindered these impacts?
- What do you think about the topics we asked about in the questionnaire (i.e. loneliness, anxiety, depression, quality of life, confidence, fear of falling)? Is there another impact that you think is important to people that we should be collecting information about in this research?

Ending

Was there anything else you would like to tell me?

Turn off recorder

Thank you