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Wessex Academic Health Science Network

Wessex NHS Insights Prioritisation Programme (NIPP)

Evaluation of the use, applicability and acceptability of digital remote monitoring for people living with frailty in the community, to inform development of frailty virtual wards

Full report

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1 Background

NHS England funded Applied Research Collaborations (ARCs) and Academic Health Science Networks (AHSNs) to work together on NHS Insights Prioritisation Programme (NIPP) projects. These projects aimed to accelerate the evaluation of innovation that supports post-pandemic ways of working and delivers benefits to patients. The purpose of NIPP was to assist implementation of innovation whilst addressing health inequalities. The Wessex project focused on digital remote monitoring among older people with frailty and was developed to align with the priorities of the two local Integrated Care Systems (ICSs). Developing care pathways for older people with frailty is a high priority for both Dorset and Hampshire and Isle of Wight (HIOW) ICSs. This is because the population aged 65 years and older is higher than the national average, with some local authority areas having a significantly older population (Office for National Statistics, 2021). Clinical frailty is defined by the British Geriatrics Society (2014) as a distinctive health state related to the ageing process in which multiple body systems gradually lose their in-built reserves. The population living with clinical frailty are at high risk of hospital admission and extended hospital stays, with hospital admission often leading to adverse effects on their level of functioning (Ellis, Marshall and Ritchie, 2014; Keeble *et al.*, 2019).

The NHS Long-Term Plan (NHS England, 2019) promotes digitally enabled care, and the pace of implementation was escalated by the pandemic. Enabling care at home where possible is a high national priority to increase operational resilience (NHS England, 2022a). Virtual wards support patients who would otherwise be in hospital to receive the acute care they need at home. These developed rapidly through the pandemic to support Covid-19 patients (NHS England, 2022b). Digital remote monitoring means patients are monitored by professionals remotely via a digital platform and is a key component of a virtual ward. Individuals may measure vital signs and enter their data into an app or website, or use wearable devices providing continuous monitoring of vital signs (NHS England, 2021b). Virtual wards can also include in-person care. The model that blends in-person care with remote monitoring, referred to as Hospital at Home, is being promoted to support people with frailty who are acutely unwell (NHS England, 2021a). Research has shown that Hospital at Home type services based primarily on in-person care can provide an alternative to hospital admission for medically unwell older people (Singh *et al.*, 2022). However, the evidence to support use of digital remote monitoring is not specific to older people, and rarely considers frailty.

A significant proportion of published research on digital remote monitoring relates to patients with long term conditions such as heart failure. Two systematic reviews suggested digital remote monitoring of vital signs reduces heart failure-related hospital admission and all-cause mortality, when compared to usual care (Inglis *et al.*, 2011; Kitsiou *et al.*, 2021). However, the sample population of the reviewed studies in both these systematic reviews had a mean age of 67 across the studies. This limits the transferability of the findings to a population of older people with frailty. The prevalence of frailty increases with age, rising to between 25 and 50% of those aged over 85 years (Clegg *et al.*, 2013). Indeed, a trial involving 339 older people with heart failure (229 intervention and 110 usual care), with a mean age of 80, found digital remote monitoring had no impact on 12-month all-cause mortality or heart failure-related admissions (Olivari *et al.*, 2018). However, they did find that digital remote monitoring significantly increased quality of life compared to those receiving usual care.

Digital exclusion is when individuals are excluded from use of digital technology due to barriers such as poor accessibility, connectivity or digital skills (NHS Digital, 2019). It is known to disproportionately impact

older people and increases with age (Good Things Foundation, 2022). Yet, a review of systematic reviews investigating the impact of digital technologies on older adults' access to health and social care services found that there is a lack of evidence on the impact of these technologies on equitable access (Kunonga *et al.*, 2021). This gap in evidence on the impact of using digital remote monitoring services on access to health and social care highlights the importance of increasing understanding of both the positive and negative consequences on access. There is a need to identify those who might benefit and those who are vulnerable to exclusion.

Most of published research is about the impact of digital remote monitoring on clinical outcomes, rather than user experience. A scoping review of digital health approaches used by older people with frailty reviewed 105 articles investigating a range of technologies including remote monitoring. However, despite studies claiming to be for people with frailty, the authors found that 39% of studies did not report frailty assessment (Linn *et al.*, 2021). Only a quarter were clearly focused on populations of older people with frailty or pre-frailty only. In addition, user experience was only assessed in 23% of studies. This highlights a gap in evidence on the experience and acceptability of digital health approaches by older people with frailty. Support for digital health technologies for older people with frailty may also be provided by informal caregivers, but there has been limited focus on this in previous studies. Liu *et al.* (2021) investigated patient factors impacting different modes of virtual care provision in a geriatric clinic. They found that frailty and absence of a caregiver was associated with lower rates of videoconference assessment, although the reasons for this were not explored. As caregiver burden is prevalent among informal caregivers of people with frailty (Ringer *et al.*, 2017), the impact of digital remote monitoring on informal caregivers requires further investigation.

As well as digital remote monitoring of physiological signs and symptoms, there is a growing literature on use of Artificial Intelligence (AI)-powered technologies. These have been deployed to recognise routines of daily living and reduce risks associated with living independently for people with frailty and dementia (Fowler-Davis et al., 2020). There is some evidence to suggest this approach has potential to support early detection of physical decline (Pol et al. 2013, Wilmink et al.2020). However, factors including ease of use, size, invasiveness, and aesthetics may influence acceptability of these technologies amongst older people (Stavropoulos et al., 2020). This can be influenced by the older persons' cultural background, alignment with values and expectations (Berridge, Chan and Choi 2019).

Overall, the extant literature suggests that digital remote monitoring could have benefits for older people with frailty but is less clear about how acceptable such approaches are. A lack of acceptability could impact uptake and potentially lead to health inequalities for people with frailty. Addressing potential health inequalities has been identified by a local branch of Age UK as an area of concern and is a core component of NIPP. There is a need for a greater understanding of the views and experiences of older people, informal caregivers and professionals within social care and frailty virtual wards to inform decisions about wider implementation of digital remote monitoring. The NIPP project sought to generate insights into whether digital approaches provide an acceptable alternative to non-digital care provision within health and social care. These insights are required to support the provision of care that meets the needs of older people with frailty and does not create health inequalities.

2 Aims and Objectives

The overall objectives of the NIPP project were:

- To understand the advantages and disadvantages of digital remote monitoring for older people with frailty, in terms of uptake, ease of use and acceptability.
- To provide evidence to inform development of services for older people with frailty.
- To develop guidance to support implementation of digital remote monitoring in frailty virtual wards.
- To produce a web-based Implementation Toolkit for use by researchers and practitioners.

The project was made up of four work packages: 1) Listening activities; 2) A research study of use and acceptability of digital remote monitoring for older people with frailty; 3) An evaluation of digitally enabled care in a frailty virtual ward; and 4) Development and piloting of an Implementation Toolkit. The toolkit work package is reported separately.

2.1 *Aim of Listening Activities*

The aim of this work package was to understand the views of older people within the local community on the benefits, barriers, and burdens of digital remote monitoring. It sought to gain insight from a wider population than just those who have used or have experience of digital remote monitoring.

2.2 *Aim of the Research Study*

The aim of this work package was to explore use and acceptability of two approaches to digital remote monitoring (monitoring of signs and symptoms, and monitoring using AI-powered environmental sensor technology) among older people with frailty in their own home.

The research sought to answer the following questions:

- What is the uptake and use of these two digital approaches by older people with frailty?
- How is use of these two digital approaches experienced by older people with frailty, informal caregivers and frontline community health and social care staff involved in delivering care to this population?

2.3 *Aim of the Frailty Virtual Wards Evaluation*

In August 2022, two NHS organisations launched separate frailty virtual wards. The focus of the evaluation was on the use, decision-making and impact of digital remote monitoring within frailty virtual wards in the hope to gain insight on the experiences, uptake and acceptability.

The evaluation aimed to:

- Provide evidence on the impact of technology-enabled virtual wards within a frail cohort on patients and staff.
- Provide learning on the benefits and challenges of technology-enabled virtual wards within a frail cohort.
- Understand the workforce costs of technology-enabled virtual wards compared to virtual wards without technology.

In addition, HIOW ICS wanted to understand:

- The use and uptake of digital remote monitoring within two NHS trusts
- The pathway and referral into the technology-enabled frailty virtual ward.

3 Methods

3.1 *Listening Activities*

The listening activities were an informal, non-rigorous, but convenient approach to collating experiences from older people who had not necessarily used or experienced digital remote monitoring. The listening activities were organised to garner and collate views from a diverse range of community groups primarily serving older people. The sessions were conducted in small to medium sized groups (dependent on the membership of the community group) to enable maximum discussion about digital remote monitoring. This allowed exploration of not only what people thought but why they thought that way. It was considered a suitable approach to garner opinions within a short timeframe.

A two-pronged approach was applied to recruitment: 1) networking with pre-existing contacts and 2) building new connections and reaching out to groups not previously engaged. Due to this approach, the groups were purposively sampled. The groups involved were:

- a group for older people wanting to learn digital skills
- a carers' club
- an exercise class
- a lunch club
- a sheltered accommodation group
- a group serving those from a majority black ethnic minority population.

Each session focused on one of two types of digital remote monitoring: signs and symptoms monitoring or AI-facilitated environmental sensor monitoring.

Table 1: Details of listening activity groups

Listening Activity Community Groups	Type of technology	Number of participants	General demographics
Group supporting technology use	Signs and symptoms	3	Aged 65+, White British, 1 participant had a mild learning disability.
Steady and Strong exercise class	Signs and symptoms	5	Aged 65+, White British, all mobile with 1 participant using a walking stick for assistance.
Carers' group	Environmental sensors	9	Aged 65+, White British, all informal carers.
Older person's lunch club	Environmental sensors	14	Aged 65+, White British, 2 participants with mild dementia.
Community group	Signs and symptoms	15	Aged 55+, White British, Black, Black British, Caribbean or African, 1 stroke survivor, 3 partially deaf.
Supported housing residents' forum	Environmental sensors	12	Aged 60+, White British, 2 White non-British, 1 participant reported mental health issues.
Total number of participants		58	

At least two members of the project team attended each session, with one facilitating and one taking notes. The data was collected by using flipchart paper that was visible and verbally relayed to the group at the end of each session. Any misinterpretation could therefore be corrected. The notetaker collated some direct quotes but also summarised views from the group to try and gather as many reflections of their views as possible. Additionally, questionnaires were given out at the end of each session for individuals who had not had the opportunity to voice their opinion completely; pre-paid envelopes were provided. Due to the nature of the events and this approach, no identifiable data was collected therefore no consent forms were required.

In total 58 individuals aged 55+ from six community groups engaged in the listening activities between April and September 2022 (Table 1).

3.2 *Research Study*

The study used both quantitative and qualitative methods. Analysis of quantitative data assessed uptake and adherence of digital remote monitoring. Qualitative data was collected on acceptability and usability of digital remote monitoring. We planned to collect data from three organisations providing digital remote monitoring services in Wessex acting as participant identification centres. This included one social care organisation piloting AI-facilitated sensor monitoring and two NHS organisations. One NHS organisation was providing signs and symptoms monitoring and the other providing both types of monitoring. However, neither of the NHS sites were able to provide any quantitative data or to circulate interview invitation letters to their digital remote monitoring service users. This was due to significant delays (more than six months) in research governance approval processes at one NHS trust and challenges due to frontline service pressures. We were therefore only able to collect data from the social care organisation's technology enabled care service and those using this service.

Retrospective quantitative data was collected for all individuals referred to the service between 01 April 2021 and 30 September 2022. The fields of the data set are outlined in Table 2. The service was piloting two types of AI-facilitated sensor monitoring. The data was collated by the team providing the service and anonymised, and was therefore anonymous to the research team. Category of frailty (robust, mild, moderate or severe) was estimated by the service by matching details of each individual's health conditions, functional deficits and care needs held in the organisation's records with the deficits that inform calculation of the electronic frailty index (Health Improvement Scotland, 2021).

Qualitative data was collected using semi-structured interviews. All users of the pilot services aged 65 years and older, living with frailty (mild, moderate or severe) and living in their own home were invited to participate. The exception was those who were known to have a level of cognitive impairment such that they would not have had capacity to consent to the study. All caregivers of users aged 65 and over living in their own home with frailty, except paid caregivers, were also invited to participate. This included informal caregivers of those users ineligible to participate themselves due their level of cognitive impairment. Invitations were sent by the service on behalf of the research team. For each digital approach, the planned sample was 4 to 8 older people, 4 to 8 informal caregivers, 2 to 4 domiciliary care workers and 2 to 4 community nursing staff, with a combined sample of 30 to 45 participants. Unfortunately, due to data collection from only one of three organisations, the number recruited was just three (Table 3). It was not possible to collect data from frontline community nurses and domiciliary care workers as initially planned due a lack of involvement of community nurses or domiciliary carers from a domiciliary care organisation in the care of the one older person recruited.

Table 2 - Data fields included in data sets

Data field	Data type
Accepted service	Yes / No
Gender	Male / Female
Age range at time of referral to the service	65-69; 70-74; 75-79; 80-84; 85-89; 90+
Ethnicity	White British/ White Other / Black / Asian / Mixed / Other
Index of Multiple Deprivation (IMD) decile (determined by post code or LSOA at source)	1 - 10
Either electronic Frailty Index or Clinical Frailty Score, or Frailty Category at time of referral to the service	Fit / Mild / Moderate / Severe. (Where a score is provided this will be converted to a category by the research team)
Whether the individual lives alone	Yes / No
Whether the individual has dementia / cognitive impairment	Yes / No
Relationship of main caregiver	Spouse / Sibling / Child / Neighbour or Friend / Other
Gender of main caregiver (unless paid caregiver)	Male / Female
Main caregiver lives with older person	Yes / No
Service start date	Date
Service end date	Date
Planned service end date	Date
Reason for any early discontinuation	Text description of reason
Frailty score/category at time of early discontinuation	Fit / Mild / Moderate / Severe (Where a score is provided this will be converted to a category by the research team.)
Adherence to data submission plan (where applicable)	Text description of adherence
Reason for declining the service (where recorded)	Text description of reason

Table 3: Numbers invited to participate and recruited to the study

	Invited to participate	Recruited to the study
Older people with frailty using the service	15	1
Informal caregivers	14	2

Two interviews were completed face-to-face and one by telephone and they were all audio-recorded. All participants provided written consent prior to their interview. The interviews explored their experience of digital remote monitoring including acceptability, benefits and burdens of the AI-facilitated sensor pilots. The recordings were transcribed verbatim. Characteristics of the participants were also collected to inform comparisons with other participants. However, due to the poor response rate, this comparison was not

possible. However, Table 4 provides some characteristics of the sample, although this has been limited to maintain anonymity of the participants.

Table 4: Characteristics of sample

	User age	Caregiver age	Ethnicity	User lives alone?	Relationship of caregiver
Older person	85+	Data not collected	White British	Yes	N/A
Informal caregivers	85+	45 - 64	White British	Yes	Child

3.3 *Evaluation*

The evaluation was anticipated to be a mixed method evaluation to understand the uptake and cost of digital remote monitoring on frailty virtual wards and the experiences of staff working on frailty virtual wards. In the early stages, we expected engagement from five frailty virtual wards across HIOW ICS. However, due to multiple factors, we only received data from two frailty virtual wards. It was planned to assess the use and uptake of digital remote monitoring by patients referred into frailty virtual ward by collating demographic characteristics and to indirectly understand cost effectiveness by gathering workforce time activities on frailty virtual wards from two NHS organisations. However, unfortunately, due to system pressures and delays with governance, no quantitative data was received and only the following will be summarised:

- The impact of digital remote monitoring in frailty virtual wards including the number and rate of referrals, the patients utilising digital remote monitoring, weekly bed capacity and length of stay.
- The uptake and use of digital remote monitoring including anonymised demographic metrics such as age, ethnicity, gender, frailty score, health conditions, living status and indices of multiple deprivation (IMD).
- The time the workforce spends on frailty virtual wards with and without digital remote monitoring to begin to understand the cost effectiveness of digital remote monitoring.

The qualitative component comprised of staff interviews and two rapid insight events. Interviews were completed to understand the rollout of the frailty virtual wards. We were interested to understand the decision-making and processes of referring patients on and off the wards. We were also interested in the impact on staff workload and workflow to grasp a global understanding on their experiences. The other qualitative data came from two rapid insight events to understand the attitudes towards digital innovation and what is important to drive change. Rapid insight events are online events that can be held with a variety of stakeholders to generate insight into a specific topic of interest followed by rapid analysis and dissemination (Chandler, Darnton and Sibley, 2023). The events were held at two different time points, October 2022 and January 2023, and invited operational and strategic staff working on frailty virtual wards to identify any changes in attitudes. Again, alongside the interviews, recruitment for the rapid insight events were supported by project and clinical leads on frailty virtual wards with the addition of strategic leads locally and regionally.

To encourage participation, the rapid insight events were promoted on social media and through HIOW virtual ward steering groups. Both events were completed online via Microsoft Teams and were recorded and transcribed. A total of 12 participants attended the two events, six in the October 2022 event, six in the January 2023 event.

Staff were convenience sampled based on prior agreed criteria for individuals who work on frailty virtual wards in any capacity (and across NHS Agenda for Change job bandings). Project and clinical leads within the trusts supported recruitment to identify key informants for the interviews that represent multidisciplinary care within frailty virtual wards. We planned to interview 10 individuals with different roles and job bandings (consultants, advanced practitioners, health care assistants, physiotherapists) to establish a holistic perspective of the wards. Nevertheless, recruitment was challenging due to frontline work pressures, which led to a poor response rate. Only three interviews completed with a Medical Consultant and Band 7 and Band 8a nurses. The interviews were semi-structured interviews to guide conversation and were all completed online via Microsoft Teams between January and February 2023. The interviews ranged from 40 minutes to 80 minutes and were all recorded with a Dictaphone for later transcription and analysis.

3.4 *Analysis*

3.4.1 Quantitative Analysis

Statistical analysis was used to describe the characteristics of the population aged 65 years and older with frailty who used the AI-facilitated environmental sensor monitoring service (research study). Data on those referred to the service, those who declined or who withdrew from the service was also analysed. It was not possible to complete any comparative analysis due to the small size of the data set.

3.4.2 Qualitative Analysis

All qualitative data was analysed using a thematic analysis. Thematic analysis is a descriptive approach to qualitative data analysis (Howitt, 2019). The first five listening activities were analysed in September 2022, to generate initial insights. The analysis was undertaken by four of the project team who coded the data in pairs, which were then discussed to generate themes. Rapid high-level thematic analysis forms part of the AHSN Rapid Insight event methodology, generating mind maps within a week of each event (Chandler, Darnton and Sibley, 2023).

Due to the paucity of data collected across the entire project, data from the three work packages were analysed together. It became apparent that cross-cutting themes existed. The approach to thematic analysis described by Braun and Clark (2022) was used and analysis was organised and managed using Microsoft Excel. Two researchers familiarised themselves with the data and individually coded the data corpus. This included the data from the six listening activities, the six qualitative interviews and the two rapid insight events. The codes generated were then discussed and brought together into categories, with the data for each category collated in Microsoft Excel. The categories were then jointly discussed and explored to generate themes, which were checked against both the coded extracts and the data corpus. Each researcher completed the writing to describe two of the themes which they then discussed and refined together.

4 Findings

4.1 *Quantitative Findings from the Research Study*

The following analysis is based on one data set and includes all people referred to the social care service providing AI-facilitated sensor monitoring between August 2021 and September 2022, totalling 40 individuals. Due to the small size of this sample, findings cannot be generalised.

Uptake of the pilot services was lower than anticipated, with less than 40% of anticipated total numbers referred to service. Of those referred to the service, 20% (n=8) did not progress to use it. Seven people declined the service and one person died in hospital before the service could start (age 85+, moderate frailty). 82.5% (n=33) were accepted into the service including the individual who died before starting the service could start. The breakdown by age and frailty category of the total number referred to the service, giving the numbers who declined the service, used the service, and used the service but discontinued early is provided in Table 5.

Table 5: Breakdown of numbers referred, declining, using and discontinuing by age and frailty category

Age band & frailty category	Number referred	Number who declined	Number who used service	Number who used but discontinued early
Age <75, mild frailty	3	2	1	1*
Age <75, moderate frailty	1	0	1	1
Age <75, severe frailty	2	0	2	0
Age 75-84, mild frailty	5	1	4	2
Age 75-84, moderate frailty	8	0	8	1
Age 75-84, severe frailty	3	1	2	1
Age 85+, mild frailty	8	0	8	3
Age 85+, moderate frailty	7**	2	4	1
Age 85+, severe frailty	3	1	2	2
Total	**40**	**7**	**32**	**12**

* Frailty category was mild on referral but moderate at time service discontinued.
** One accepted the service but died before starting to use the service.

The reasons provided for decline of the service are detailed in Table 6 and indicate some mistrust of digital monitoring technology. Of the seven individuals who declined the service 56% (n=4) were female. Breakdown of age and frailty category is provided in Table 7 and IMD decile based on home address in Figure 1.

Table 6: Reasons provided for declining the monitoring service

No. of individuals	Reason	Explanation
1	Did not want to be monitored	Declined equipment during installation
1	Did not want to be monitored	Suspicious of device 'watching' them
1	Not fit for purpose	Wife felt there was too much equipment and would not meet needs
1	Moved to residential care	-
3	No reason given	-

Table 7: Breakdown of those who were referred to but who declined the service by age and frailty category

Age band & frailty category	Number of individuals	Percentage of total declining
Age <75, mild frailty	2	28.6%
Age <75, moderate frailty	0	0.0%
Age <75, severe frailty	0	0.0%
Age 75-84, mild frailty	1	14.3%
Age 75-84, moderate frailty	0	0.0%
Age 75-84, severe frailty	1	14.3%
Age 85+, mild frailty	0	0.0%
Age 85+, moderate frailty	2	28.6%
Age 85+, severe frailty	1	14.3%
Total	**7**	**100%**

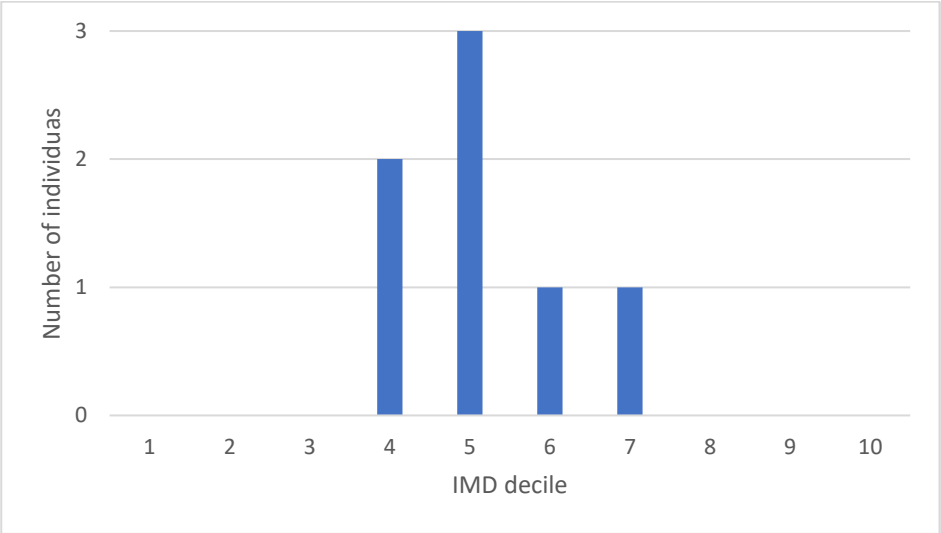

Figure 1: IMD decile for individuals declining the service

Table 8: Breakdown of those who used the service by age and frailty category

Age band & frailty category	Number of individuals	Percentage of total declining
Age <75, mild frailty	1	3.1%
Age <75, moderate frailty	1	3.1%
Age <75, severe frailty	2	6.3%
Age 75-84, mild frailty	4	12.5%
Age 75-84, moderate frailty	8	25.0%
Age 75-84, severe frailty	2	6.3%
Age 85+, mild frailty	8	25.0%
Age 85+, moderate frailty	4	12.5%
Age 85+, severe frailty	2	6.3%
Total	**32**	**100%**

59.4% (n=19) of those who used the service were female. A breakdown of age and frailty category is provided in Table 8 and IMD deciles provided in Figure 2. 75% (n=24) had cognitive impairment or dementia. All except one lived alone, with this individual living with their spouse who was also their main caregiver. 68.8% (n=22) had a family member as their main caregiver (19=child; 2=sibling; 1=spouse), indicating a certain level of family support, whilst for 10 people their main caregiver was a paid caregiver. Most familial care givers were female (63.6%).

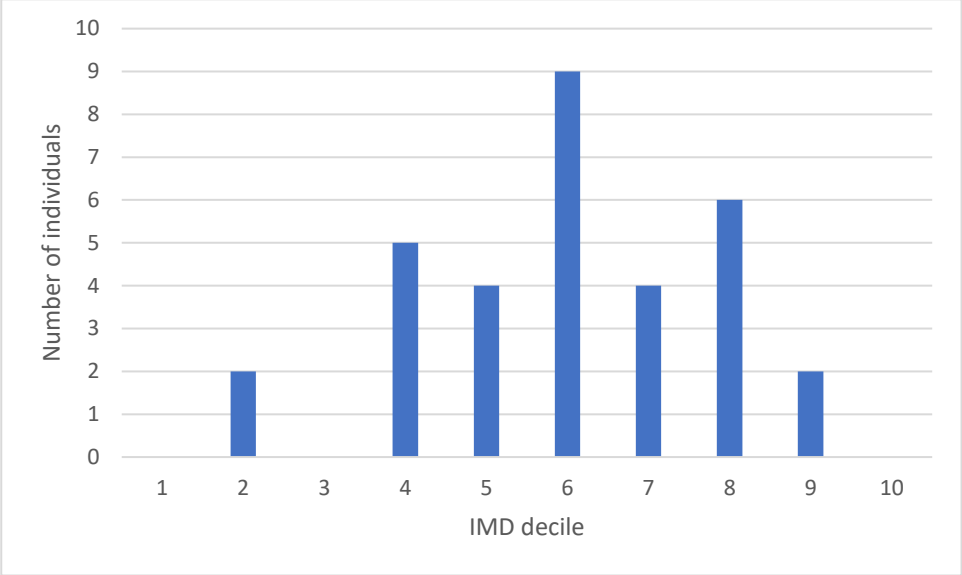

Figure 2: IMD decile for individuals using the service

Table 9: Breakdown of those who discontinued the service early by age and frailty category

Age band & frailty category	Number of individuals	Percentage of total declining
Age <75, mild frailty	1*	8.3%
Age <75, moderate frailty	1	8.3%
Age <75, severe frailty	0	0.0%
Age 75-84, mild frailty	2	16.7%
Age 75-84, moderate frailty	1	8.3%
Age 75-84, severe frailty	1	8.3%
Age 85+, mild frailty	3	25.0%
Age 85+, moderate frailty	1	8.3%
Age 85+, severe frailty	2	16.7%
Total	**12**	**100%**

* Frailty category was mild on referral but moderate at time service discontinued.

37.5% (n=12) of those who used the service discontinued it early, in an average of 83.9 days. Five individuals died and three individuals went into long-term residential care. The reasons the others discontinued the service were:

- Unable to establish internet connection or phone signal during installation.
- Did not like the equipment, kept switching it off, removed the system and declined to be monitored.

- Got distressed by equipment talking to her and condition had improved so no longer required.
- Kept disconnecting the device so unable to provide accurate data (device inappropriate).

75% (n=9) of those who discontinued the service early were female. Table 9 provides a breakdown of their age and frailty category. For all except one there was no change in their frailty category between being referred to the service and the time they discontinued. The individual for whom there was a change in status, this was a change from mild to moderate frailty. IMD deciles for those who discontinued early is provided in Figure 3.

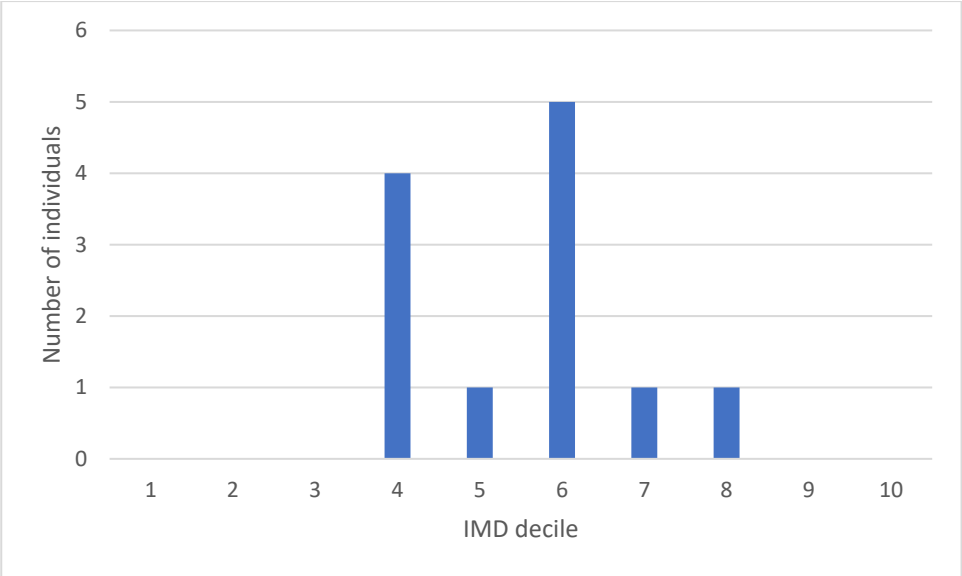

Figure 3: IMD decile for individuals who discontinued the service early.

4.2 *Qualitative Findings*

4.2.1 Rapid Insight Mind Maps

The Rapid Insight events collated high level insight on the opinions of operational and strategic staff and their views on the benefits and barriers of frailty virtual wards, who benefits from the launch of virtual wards, why staff would use digital remote monitoring and what technology staff would not use with a frail population (Figure 4, Figure 5, Figure 6, Figure 7, Figure 8 and Figure 9). Due to low attendance and different individuals attending both sessions, impactful comparisons could not be produced. However, reflections can be made:

- Perceived benefits from the two time points demonstrate how virtual wards evolve at pace as training of staff, its use of technology and working safely outside of a hospital was highlighted in the first session. Whereas the second session identified the use of technology and tools for patients and staff communication and management within virtual wards. Within the three months, there was a transition from enablers of training with the technology to using the technology and assisting their work.
- There was no change to barriers between the two time points, all attendees stated a lack of resource with staff, time, and suitable technology available. Sharing data between services and across organisations remained an issue with interoperability.
- Many parts of the health and social care system were thought to benefit from frailty virtual wards, these are shown in Figure 5.

- When asked why they would consider using digital remote monitoring for this population, a variety of responses were given. Overarching themes included the patient experience and providing them with the best care and reassurance in the comfort of their own home. From the staff perspective digital remote monitoring would allow for better workforce utilisation to support cross system working and increase service capacity. Lastly, they would use digital remote monitoring if suitable technology were available, and family were able to support.
- There were a number of changes or changes staff would like to see in the communication pathways and digital remote monitoring. The mind map demonstrates this in Figure 8; however, it was reiterated with previous questions that a clearer understanding of the suitability of digital remote monitoring for people living with frailty is required.
- To understand the suitability and needs to successfully implement digital remote monitoring for this population, we asked what patients they would not consider using technology with. Alongside cognitive and physical impairments, mental health challenges were stated and patients with a limited support network.

Overall, significant differences were not found between the two Rapid Insight events, which may be a result of only a three-month gap. However, digital remote monitoring on frailty virtual wards is still in its infancy so it may be too early to detect any changes.

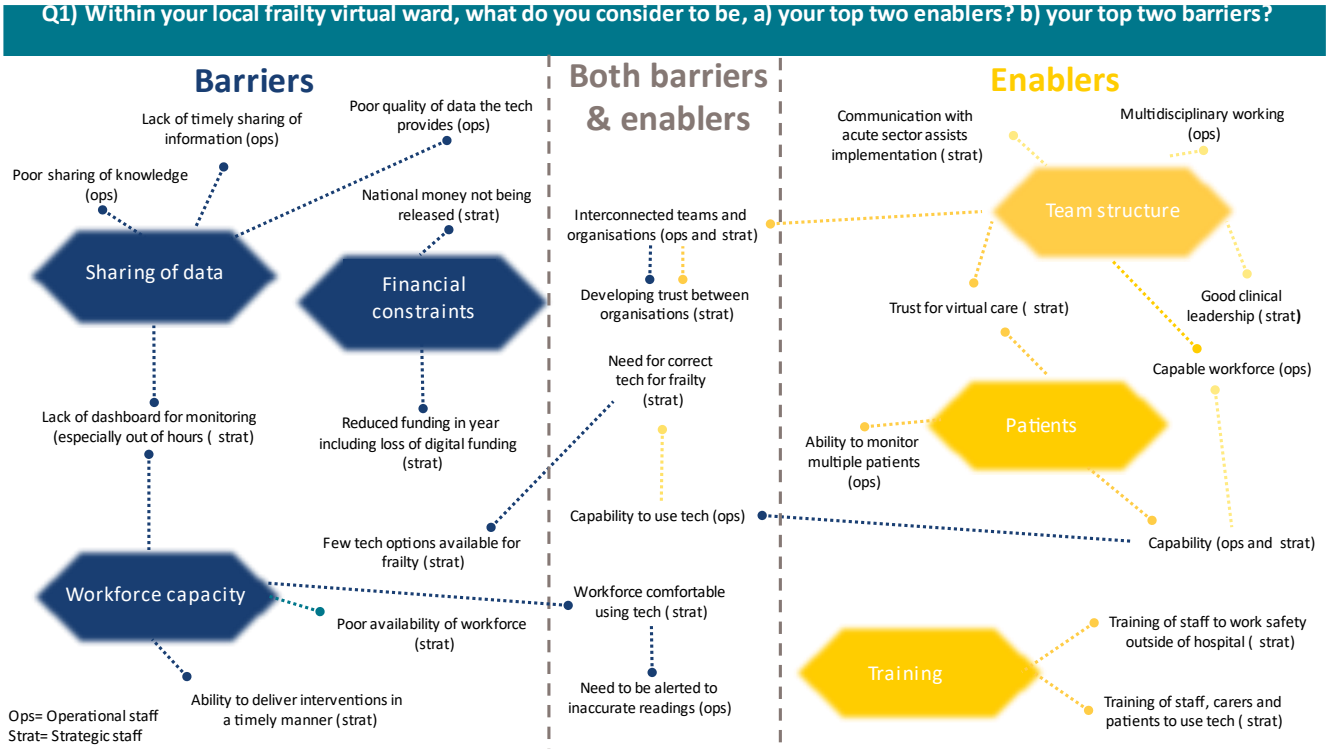

Figure 4: Rapid Insight event part 1 Mind Map Question 1. Ops=Operational staff, Strats=Strategic staff.

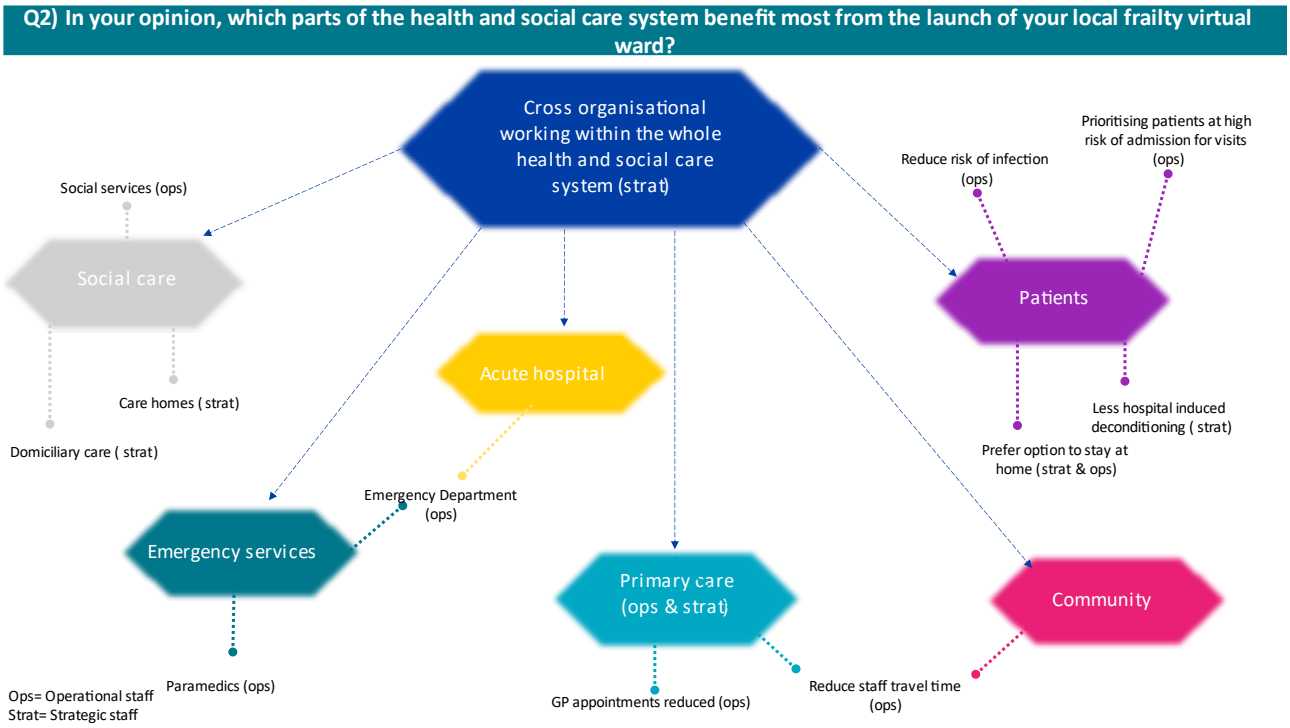

Figure 5: Rapid Insight event part 1 Mind Maps Question 2. Ops=Operational staff, Strats=Strategic staff.

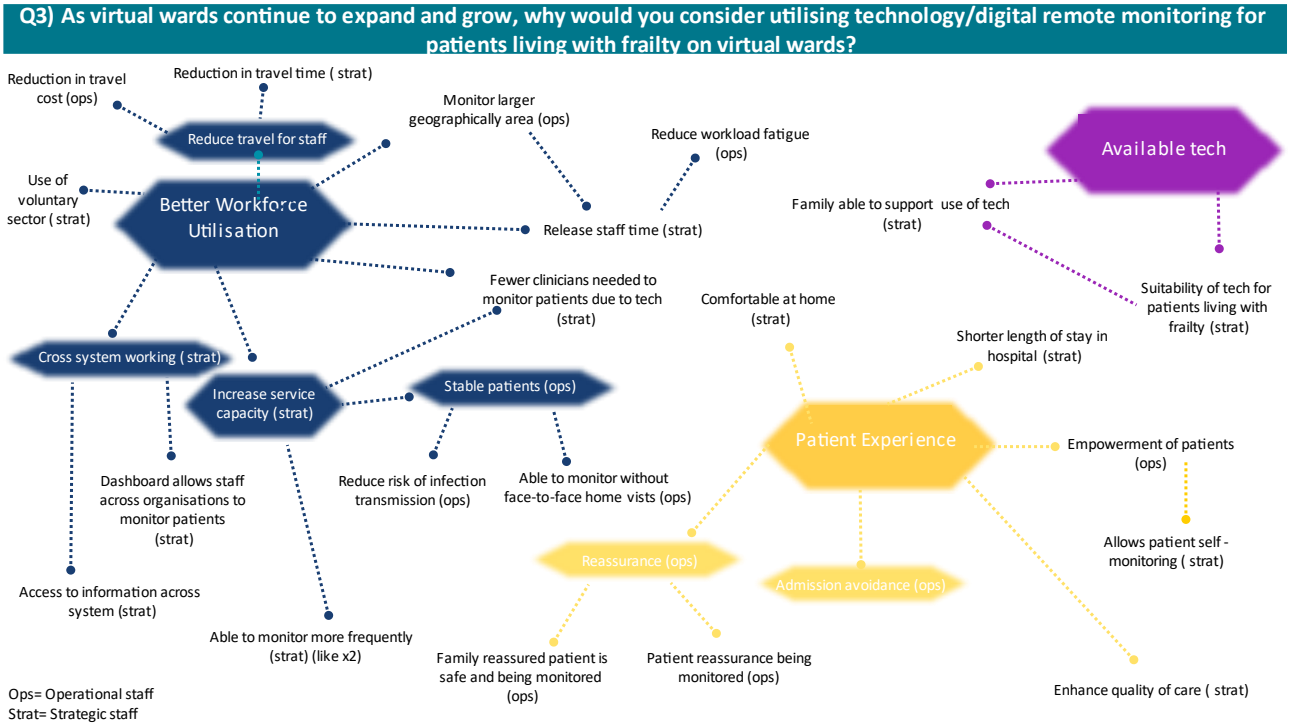

Figure 6: Rapid Insight event part 1 Mind Map Question 3. Ops=Operational staff, Strats=Strategic staff.

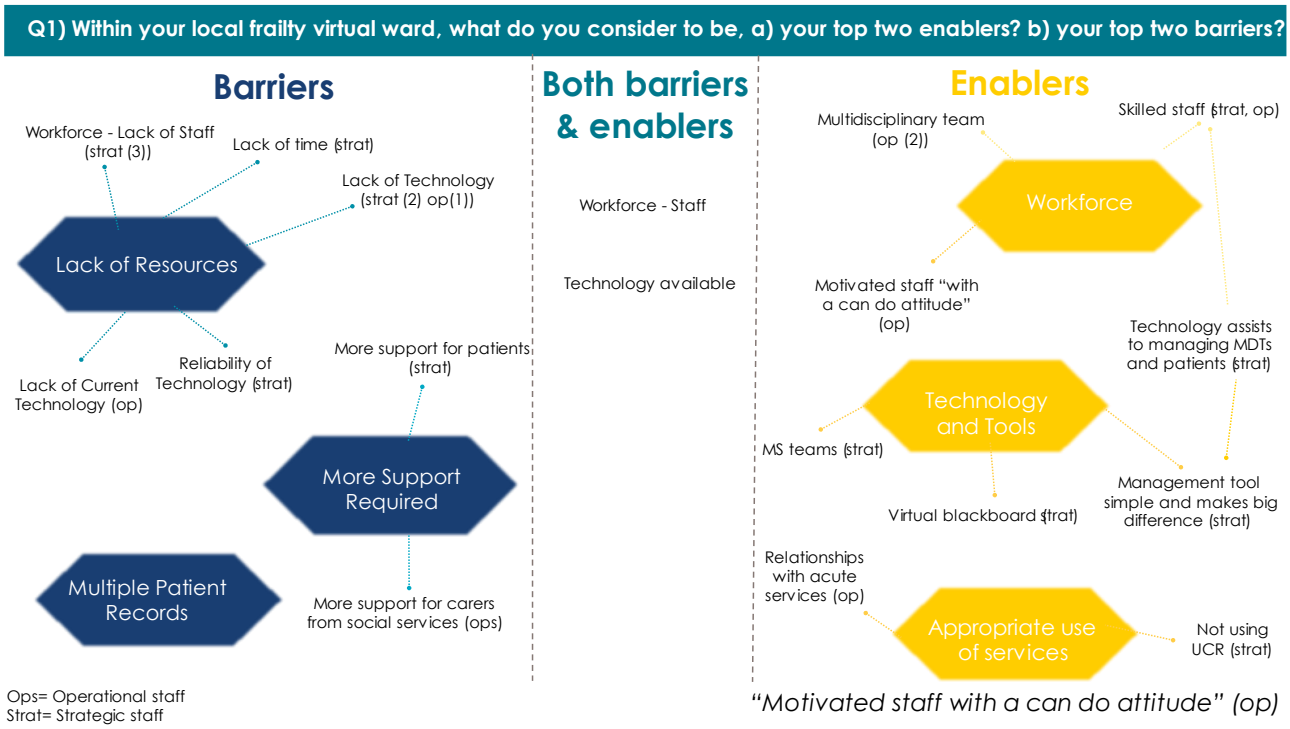

Figure 7: Rapid Insight event part 2 Mind Maps Question 1. Ops=Operational staff, Strats=Strategic staff.

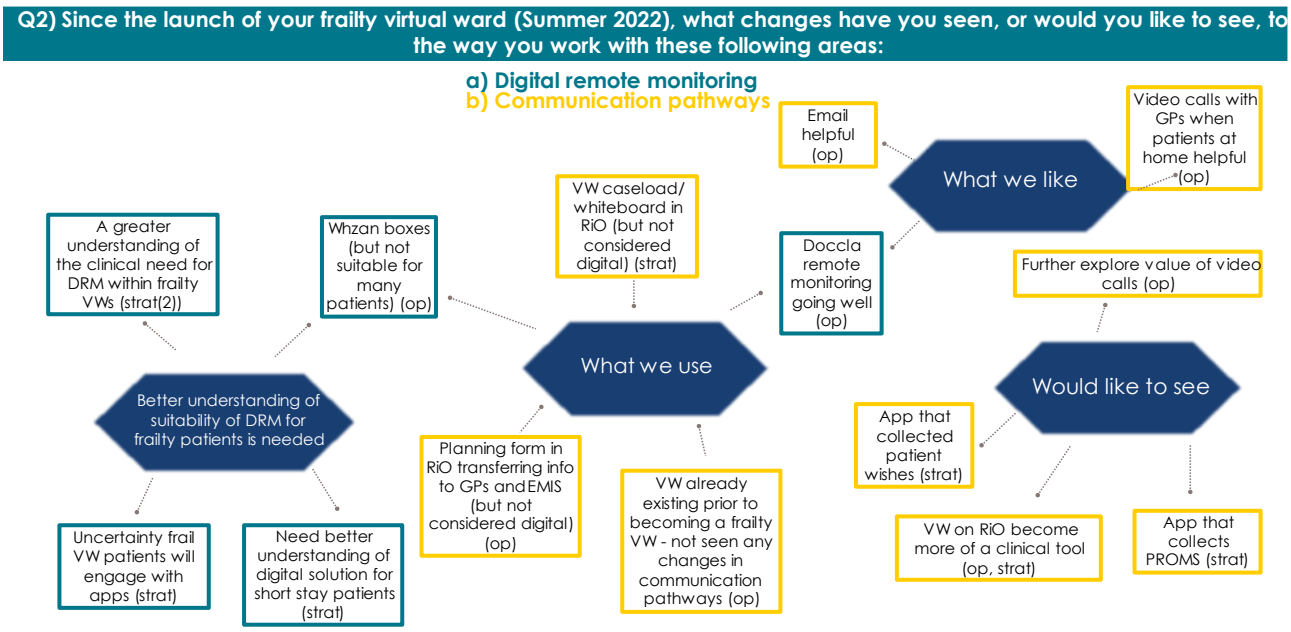

Figure 8: Rapid Insight event part 2 Mind Map Question 2. Ops=Operational staff, Strats=Strategic staff, VW= Virtual ward.

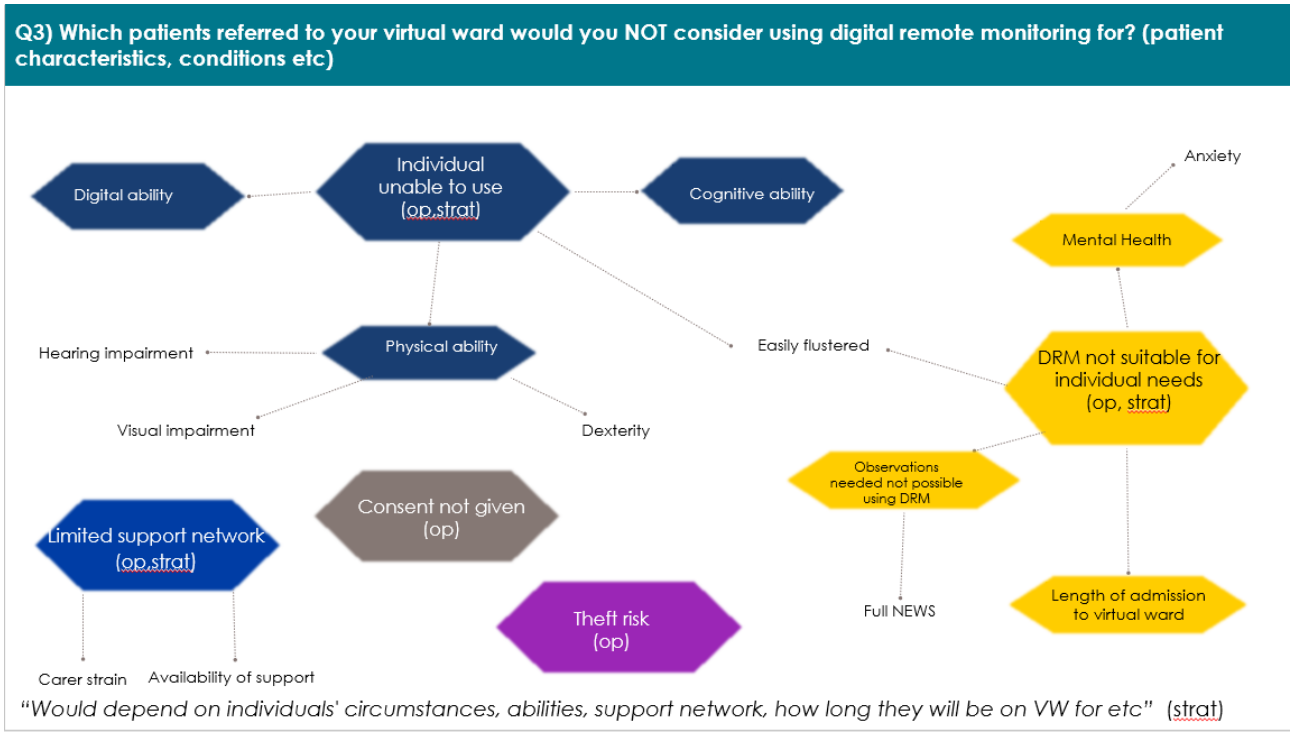

Figure 9: Rapid Insight event part 2 Mind Map Question 3. Ops=Operational staff, Strats=Strategic staff, VW=Virtual ward, DRM=Digital remote monitoring.

4.2.2 Findings from Overall Thematic Analysis

Four themes were developed through the analyses. Three related to digital remote monitoring: putting digital remote monitoring into practice; need for an individualised balance of technology facilitated care and direct provision of care; and reassurance – both provided and needed. The fourth theme, Frailty Virtual Ward in practice, related to frailty virtual ward operations beyond use of digital remote monitoring. Use of digital remote monitoring within the virtual wards was still in its infancy, so much of the data collected as part of the evaluation interviews related to virtual wards more generally and this is outlined within this theme.

4.2.2.1 Putting digital remote monitoring into practice

Practical considerations of the technology and the user should be considered. Firstly, the findings indicated that the physical positioning of the technology matters, consideration to make the sensor and its placement obvious for users is important (AI-facilitated sensor). For example, mounting it on the wall or labelling it would allow the user and carer to acknowledge its presence and know it is there. Users and carers described the sensor to be unnoticeable and unobtrusive, they wanted to know the user is being monitored, however, there was a tendency to forget about it completely. Additionally, there was a need to make the physical design of the sensor simple to show aspects of the sensor are functioning (i.e., indicate the technology is on and monitoring the user). Without this, there was uncertainty on when it is monitoring or whether it is monitoring at all. Interestingly, from the community groups, older people who have not used any digital remote monitoring worried the technology would be intrusive and "*Big Brother-ish*". There was a big concern about privacy and wanting to understand where and who their data is shared with. More information on privacy and data sharing was expressed and is needed to reassure individuals using it and individuals who are considering using it.

Within this theme, other practicalities described were the user's ability to use the technology. Physical and cognitive impairments such as dexterity and cognitive decline were highlighted to be addressed and should not be dismissed, especially with technology monitoring vital signs that involves engagement from users and carers.

> "I think it might be a bit more challenging in the frail elderly, firstly some of them got cognitive issues and wouldn't know what the hell they're doing with it. I think it would distress them more than anything…" (Staff 3)

One carer indicated there is a tendency to make assumptions about older people and the generalisation of not able to manage digital remote monitoring, needing support of a carer, and therefore, assuming technology is not suitable for an older population. The carer described this underestimation as "disempowering" and believes it undervalues applicability for older people, as many patients and older people are willing and able to use technology.

> "There seems to be this thought that either older people don't need to know, aren't capable of knowing, or somehow those around them will find out for them which, I think, is a rather disempowering of older people as well." (Carer 2)

On the other hand, the interviews highlighted that applicability of the different aspects of digital remote monitoring can be overestimated. Frailty and providing care for people living with frailty is complex. Professionals emphasized that all aspects of an individual's use, including physical and cognitive impairments need to be considered as technology may not be adaptable to meeting multiple needs. For example, a user may have multiple needs with dexterity issues but also cognitive decline that would need to be addressed. Professionals working on frailty virtual wards understand the importance of the correct clinical management plan for each patient, including if digital remote monitoring was suitable and the type of digital remote monitoring needed. In addition to the complexity of frailty, the health and social care system was suggested as complex. Accessing services providing digital remote monitoring was suggested to be difficult and can often be dependent on social determinants, especially for individuals in a rural location or a self-funder. One user gained access to digital remote monitoring pilot only because they were approached by their neighbour who works within social care and was aware of the pilot.

> "…he might benefit from this, that and the other" but there's never been a proper assessment and actually, because he's self-funding very little guidance about how you contact anybody…" (Carer 2)

The cost of the technology was mentioned by a carer and by every listening activities group. The cost plays a factor for users and carers. It was mentioned that if "it's free, that is great" (Carer 1). However, if it is going to cost, this needs to be factored in with their health and social care costs.

To summarise, there is a need to understand the practicalities of the technology and the design itself. All physical and cognitive impairments and the ability of the user should be considered. The assessment of the patient with frailty, their needs, and the appropriateness of digital remote monitoring is important to consider. This ultimately impacts the implementation and rollout of digital remote monitoring within this population.

4.2.2.2 Need for an individualised balance of technology-facilitated care and direct provision of care

The findings show that digital remote monitoring should and could help to support independence and care at home rather than in hospital. Maintaining independence was important to older people. Digital remote monitoring was seen to offer potential to assist this, particularly for those living on their own.

> "Anything that enabled me to live here and be relatively independent" (Service user 1)

It was suggested that it could help people feel more secure at home (Listening Activity 4) and might help people stay in their home for longer (Listening Activity 3). However, that monitoring might interfere with getting out and about was also raised as a concern (Listening Activity Questionnaire), although going out had not caused a problem for the service user interviewed.

Virtual ward staff also considered caring for older people at home, rather than in hospital, as important. Admission avoidance was identified as a main goal of virtual wards from both the Rapid Insight events and the staff interviews. An example was given of a patient with complex respiratory disease and high anxiety levels who had been discharged from hospital only because monitoring was available.

> "… that's what's really important. That's the ability to keep them at home." (Staff 1)

However, the findings show that digital remote monitoring needs to be provided alongside both face-to-face care and direct care provided in other ways, such as by telephone or a video link. Providing direct care was valued highly by those participating in the listening activities, the research participants and the virtual ward staff. Face-to-face care, in particular, was considered the 'gold standard' (Listening Activity 1), with visits remaining a significant component of virtual ward care. In relation to taking clinical observations, it was suggested that having a professional take the readings reassured individuals that it was done properly (Listening Activity 1).

> "You know, you can't beat a human." (Carer 1)

Direct interaction, where the older person could directly communicate with a staff member, provided more reassurance to family carers than digital monitoring alone. It ensured that the most appropriate response to any concerns was triggered. Virtual ward staff also suggested that direct interaction could enhance care.

> "I think, the greatest reassurance for me was the, the <name of analogue> gadget that he had because I knew that it would communicate with him." (Carer 2)
>
> Video calls with GPs when patients at home helpful (Rapid Insight event 2, operational staff)

Concern was expressed that digital remote monitoring might reduce direct contact at a time when an older person's health had deteriorated. It was thought this could potentially lead to deterioration in mental health and exacerbate loneliness.

> These sensors would make people feel more alone and lonely. They could lead to a higher incidence of poor mental health through lack of human contact with carers. (Listening Activity 6)

A balance between digital remote monitoring, face-to-face care and direct interaction by phone or online needs to be tailored to each individual. This should be informed both by their specific needs and their preferences. Concern was expressed that it might get imposed on people as there is not enough care available.

> "I had an email this morning that said this is making this lady really anxious and she doesn't want it. Actually, our first priority has to be the person. Adding to her anxieties is not a good way of supporting." (Staff 1)

> It feels like the health and care system is trying to impose tech as there is not enough care. (Listening Activity 6)

The balance of care types should also be informed by the needs of informal carers. Monitoring of signs and symptoms at home could put additional burden on carers.

> The sudden increase in digital remote monitoring has made unpaid carers more vulnerable as there is more pressure. (Listening Activity 3)

A virtual ward staff member suggested that this tailored approach would evolve as the virtual wards evolve and become more established.

> "I think we will get better at targeting and using that remote monitoring for a niche rather than whole kit caboodle (sic)." (Staff 1)

4.2.2.3 Reassurance – both provided and needed

Digital remote monitoring was viewed by virtual ward staff, research participants and listening activity participants as potentially helpful to older people. It could provide reassurance that health and wellbeing is being monitored. For those who were either using a monitoring service themselves or whose family member was using it, there was a consensus that they would try anything that might help support them to remain safe in their own home. It could also reassure individuals requiring additional information to assure themselves that their health had not deteriorated.

> "Trying anything was worthwhile as far as I was concerned because it gave me more reassurance." (Carer 2)

> More peace of mind and independence, frequent monitoring of health (Listening Activity 6)

However, for many listening activity participants, who had not previously used digital remote monitoring, it was apparent that any technology, in particular for monitoring signs and symptoms, was frightening. They expressed concern about using the equipment correctly and worried they might provide incorrect readings to staff.

Digital remote monitoring was also considered helpful for informal carers. It could provide peace of mind for family and carers who might worry about an older person when they were at home alone.

> Family reassured patient is safe and being monitored (Rapid Insight event 1, operational staff)

> "You know, once mum's carer's been in at whatever time, it's--- it's always in the morning, she's got all the rest of the…the day and the evening." (Carer 1)

Older people were willing to try anything that might relieve the burden on their family. However, concerns were also expressed that the signs and symptoms monitoring, in particular, could add pressure and expectation on them.

> 'My daughter would love it as she could check that I am still alive [laughed]' (Listening Activity 4)

> Unpaired carers knowledge of conditions and medical understanding is overestimated. (Listening Activity 3)

However, in practice, for digital remote monitoring to reassure users of the service and their carers, some understanding of the technology and how it works is required. Simple and jargon-free instructions should be provided, repeated as required and available in different takeaway formats. These should start with basic, sometimes assumed, knowledge to reduce worry about using the equipment. Older people and their carers also need to know what to expect and how the technology service operated. This included needing contact with the service provider to reassure and check everything is as it should be.

> "… that could have been half-a-dozen bullet points quite frankly: 'the monitor does this', 'this is what we're checking', 'these are the circumstances under which a call will be initiated' and that would have been very simple and very straightforward." (Carer 2)
>
> Needs lots of interface to reassure/check things are okay and check they are using the equipment and tech correctly. (Listening Activity 1)

With one type of sensor technology, there were specific concerns raised about its placement. As it was not labelled, it was thought it could get moved or covered up by someone who did not know what it was. Another worry was the lack of visible indication that it is working.

> "It hasn't got a flashing light or anything so, you don't know if it's working or not or… there's no way of kind of getting feedback from it." (Carer 1)

Older people and carers wish to know that someone is actually monitoring their data, who is monitoring and when. They also wanted to understand how alerts were triggered and what informed the interpretation of the data. This felt a bit remote to carers of people using the service. They wanted to understand the data collected from the technology and how this was being interpreted. However, although older people may wish to understand clinical readings this should not be an expectation (Listening Activity 1).

> Need to know existing/what is normal for you and consider existing conditions (Listening Activity 5)
>
> "…you know, it would be really interesting to kind of like see: 'this is the data that we pick up' or: 'these are… these are your mum's normal patterns, do you agree?'. Like a read-out or a graph or some kind of way of me going: "Oh, yeah". So, a bit more involvement because it feels a bit remote. Yeah, somebody somewhere is monitoring something, but I've got no part in being able to say: 'yes' / 'no'." (Carer 2)

Older people thought it would take time for them to trust technology (Listening Activity 5). Trusting digital remote monitoring was however impacted by a perceived lack of reliability and false alarms. This led to a loss of confidence particularly if the alerts triggered were not fully understood. Older people, carers and staff need to be reassured that anything untoward would be detected.

> "I guess, my confidence in it has diminished because I'm thinking: 'actually, the only times I've heard about it are times when we can't really fathom why…why it's got different readings'" (Carer 1)

Another concern that could impact trust in digital remote monitoring was knowing that there were pathways in place to ensure an appropriate response if a problem was detected. This was a particular concern when the older person being monitored had functional impairments, such as hearing loss, making

direct contact with them by the service provider challenging. Calls to carers instead, when they did not live nearby, made making initial checks to identify the exact problem more difficult.

> "I can potentially see the benefits but only if we know what's being monitored, what triggers a response and what they're going to do if the person they're trying to make contact with has limited hearing capacity or limited mobility." (Carer 2)

4.2.2.4 Frailty Virtual Ward in Practice

4.2.2.4.1 Frailty virtual ward entity

From the virtual ward interviews, both frailty virtual wards were mentioned to have been set up within another team (Urgent Community Response) and as a result, are not completely separate from other services. This allows for a flexible set up within the frailty virtual ward for an adaptable service to provide support for patients and other services. However, they did not stand as their own '*entity*' predominantly due to limited resources and time.

> "It is complex. It's not a dedicated resource. The only dedicated resource is probably myself and the urgent community response leads that manage the virtual beds." (Staff 1)

Staff interviewed stated they see the significance to undertake an assessment for a patient if it's needed, irrespective of distinct criteria and suitability to the service. This gives capacity to assess the patient and to refer if necessary. The findings suggested other services are using the frailty virtual ward service, which demonstrates its need, but also highlights it is being used to bridge the gap between services and provide support to services that are at capacity and overstretched.

> "…Because you've got social care services, so they're struggling, which is impacting on our service greatly. You've got social services that can't provide emergency care. You've got emergency social care teams that can't provide care because they're already totally chock-a-block, and also blocking patients from coming out of hospital. We've got palliative patients who need to be picked up quickly, who can't be picked up quickly, so then we step in…" (Staff 2)

The ability to receive and give support to services is only doable due to the close link with other services and the local context. The physical location of different services and their base significantly helps with support and referrals as communication is considerably easier.

> "…I think the physical location of it is actually quite important." (Staff 3)
>
> "…everything to easily get all in one floor…" (Staff 3)

Overall, frailty virtual wards are needed, especially to support other services and provide a link to other services for patients if required. However, the service is yet to find its own 'entity' due to no dedicated resources and the rapid demand for frailty virtual wards.

4.2.2.4.2 Frailty virtual ward operations and management

Operating a frailty virtual ward requires multiple resources. One significant factor discussed is the ability to access data across systems to manage patients in a timely manner. One staff member mentioned having access to primary and secondary care systems, which is a phenomenal advantage to managing a patient, especially if the patient is acutely unwell (which most are in the service). Understanding the GP activity of a patient and their systems can help with the clinical management plan for a patient. Patients on a frailty virtual ward get reviewed daily and this is planned against the reviews from the previous day to closely

monitor the patient. As mentioned in theme one (Section 4.2.2.1), staff stress the importance of an updated clinical management plan that is constantly reviewed by senior members of staff. Input from patients themselves and other teams that could be involved in the care (reablement, rehabilitation, and urgent community response) are also valued. This itself is very time intensive, especially for senior members of staff. A lot of time can be spent doing background research on a patient and then reviewing them daily. However, this is an important step as part of the clinical management plan.

> "Getting the clinical management plans right, because if you get the management plans right the team can work the plan. It's complex. By the time I've done the research and seen the person and written a plan, then it's taking me a lot… It's a lot of people I need to see…" (Staff 1)

Another key component to a frailty virtual ward is informed, skilled and adaptable members of staff. A multidisciplinary team is needed to run a frailty virtual ward including medical input from a geriatrician. The staff working on a frailty virtual ward are skilled and need to be valued, especially in a workforce crisis and the difficulties with recruiting specific skillsets. Staff shortages remain a big factor with a current gap in certain job roles that are crucial to running a frailty virtual ward.

> "We've tried to recruit but, obviously, everyone's trying to recruit. We've got adverts out again to try and grow our own from within our own services, looking at our own professionals, but the people just aren't coming forward." (Staff 1)

The current workload remains high for all members of staff. Amongst other aspects, digital support with clinical monitoring would help with this. The potential of digital remote monitoring would help support the current workload for members of staff but also the ability to monitor more frequently without necessarily monitoring patients face-to-face.

Although difficult and complex, staff working on a frailty virtual ward need better accessibility to information across systems to provide more efficient care to patients.

4.2.2.4.3 An evolving and developing frailty virtual ward

In terms of growth, the frailty virtual ward service is still in its infancy, and this was mentioned by all staff members interviewed. The frailty virtual ward space is continuously developing and growing, and what resources are available are used smartly. Nevertheless, as the service evolves, the workload increases and demands more staff resource.

> "Our caseload is getting bigger and bigger and as the service is evolving…" (Staff 2)

It is the only emergency crisis team that responds within two hours and therefore operates differently from other services; however, more staff are needed within this service to provide an efficient and developing frailty virtual ward. As established above, frailty virtual wards care for acutely unwell patients in the community. Being at home reduces transmission of infection as the community is typically better at holding risk. For a frail population, this option provides a pathway to provide care without the consequences of infection in a hospital setting.

> "I think it's possible. I think community is much better at holding risk. Secondary care tends to be risk averse. Things that perhaps in a community setting I would go, 'That's okay, let's just keep an eye on it, let's see what it does.' If a paramedic goes out, they'll be in hospital and then they'll be in hospital for three weeks." (Staff 1)

Still, for frailty virtual wards to continue to develop, a greater understanding of them is needed. A clearer understanding of the service, how it operates and what is expected would bring clarity to patients and carers. Although patients are reviewed daily, this is sometimes virtually, which may be unclear to patients whether they are being monitored or not.

> "I don't know how much patients understand the concept of virtual ward, and I don't know if they understand that they're always reviewed every day…" (Staff 2)

Virtual wards are still a new concept to patients and with the complexity of the health and social care system, this may be confusing for some, especially if being cared for by other services and seeing other healthcare professionals whilst on the virtual wards.

4.3 *Intersection of Qualitative and Quantitative Findings*

On the account of the limited quantitative data received and analysed for the overall project, a thorough analysis and comparisons between the qualitative and quantitative findings cannot be produced. Nevertheless, from the small dataset received as part of the research study, some reflections can be made.

There is a consensus and commonality between the individuals who rejected the digital remote monitoring pilot and the users who accepted the service. Concerns were shared over the suitability of the technology and it not providing what was needed for individuals. Some individuals questioned the appropriateness of meeting user needs but also questioned the ability to use and if all physical and cognitive impairments would be met.

> "Wife felt there was too much equipment and wouldn't meet needs." (Declined individual, quantitative dataset)
>
> "I think the first principle is have people got the dexterity to be able to apply the devices?" (Staff, qualitative dataset)

Hesitation resonated between accepted and declined individuals for multiple reasons including data concerns and the awareness of being continuously monitored or the concern about how the technology works and is used. This demonstrates the uncertainty and mistrust of digital remote monitoring, not only with the device itself but the wider understanding of how it is used within their care.

5 Challenges

As with any evaluation and research project, the project was faced with multiple challenges. Firstly, the timeframe was a significant challenge predominantly due to setting up with multiple work packages, beginning from scratch with the project, but also developing new partnerships with local health and social care organisations. One example of this was the evaluation project, prior to initiating the work package, there were challenges in finding an appropriate partner organisation that fitted the criteria of the evaluation but also suited a partner organisation and their needs. The reality of the implementation of the digital remote monitoring services and their progression was not expected at the time of the funding application of NIPP. This caused a delay in what was already a tight timeline.

For the research study, time had to be factored in for research ethics approvals and approvals for capacity and capability from research and development (R&D) departments. In this instance, there was a significant delay of more than six months for one of the partner organisation's R&D department leading to the end of the partnership. Due to delays in progressing to data collection, the research study only received data from

one organisation instead of three. Other approvals including data sharing agreements were notably delayed for the evaluation that impacted the time available to process and data collect. The health and social care system is a continuous changing landscape, some of these changes impacted the project approval processes illustrating a mismatch between the process and the flexibility required for the project.

In terms of recruitment, there was a time delay between funding being released and recruitment of one member of the project team, ultimately causing a period of adjustment and time to establish roles and responsibilities. Alongside tight timelines for recruitment within the team, there were significant recruitment challenges for the research and evaluation projects. Overall, we struggled to recruit all anticipated participants including community nurses, domiciliary care workers, virtual ward staff, individuals using digital remote monitoring, and informal carers for the interviews. This caused the final number of interviews to be a lot lower than anticipated.

Providing rapid evidence to support and align with health and social care deliverables was challenging. There was a mismatch between national and local systems around what was wanted from the project to what was possible. Initial key expectations and timelines of the project did not align with local systems and their services, such as the local frailty virtual ward launch delays and the evaluation timeline. The time available to engage, process, and support data collection within some of these local systems was severely limited because of extreme workload and workforce pressures.

Lastly and more generally, the difference between evaluation and research in terms of processes, generalisation and general understanding of the difference impacts a project. Research has the ability to be generalised and can generate knowledge more widely. However, most types of evaluation tend to focus on specific information to determine the effectiveness of a specific programme or model. This difference affects how the outputs are used and can be used from this project. There are numerous processes and approvals required for a research project that can be onerous and time intensive, more so compared to most types of evaluation. These processes and approvals affected the timing of the project and the overall objectives that were delivered.

To summarise, we experienced numerous challenges within the project to provide rapid evidence to support and align with health and social care deliverables, working with tight timelines, working with a changing landscape and the expectations to inform insight both locally and nationally from research and evaluation projects. Due to these challenges, data collection was limited and although the final outputs present insight on digital remote monitoring in older people with frailty, they are neither robust nor generalisable.

6 Discussion

This project set out to investigate use, applicability and acceptability of digital remote monitoring for people living with frailty in the community, in order to inform development of frailty virtual wards. However, due to the challenges outlined in Section 5, data collected was limited. Analysis of data from across work packages that collected data to answer different questions severely hampers the robustness of the project findings. However, cross-cutting themes were evident and the decision to combine the data ensured that participant data generated insights.

Uptake of digital remote monitoring was lower than anticipated at the outset of the project for both the AI-facilitated sensor service and within the virtual wards. The later than expected commencement of the virtual ward services at least partially explains the latter. Although the limited project findings suggest that digital remote monitoring can be helpful and acceptable to some older people, including those with frailty, there is a need to better understand why the uptake is low. Previous research found that there is the potential that negative and ageist attitudes of professionals towards use of digital technology by older people could influence whether such interventions are offered (Mannheim *et al.*, 2021). The finding of poor uptake therefore requires further investigation. Although there are criteria for referring an individual onto a virtual ward, there is a limited understanding for both the AI-facilitated sensor service and virtual wards as to how decisions are made to offer digital remote monitoring. Furthermore, it was unclear how someone living with frailty was offered referral into the AI-facilitated sensor service. This project was only able to collate data on those who declined the technology following referral to the AI-facilitated sensor service, not those who declined referral to the service. Understanding of the reasons for declining at point of offer could help with better targeting of technology.

As highlighted in the literature (Fried *et al.*, 2001; Boyle *et al.*, 2010; Kamil, Li and Lin, 2014), the qualitative findings also emphasise the cognitive, physical and sensory challenges faced by people living with frailty, such as hearing loss, manual dexterity and cognitive impairment. Age UK reports that digital design for older people is under-explored and a potential barrier to digital inclusion. There is a need to consider vision, hearing, cognitive challenges, interface preferences and so forth (Davidson, 2018). Our project findings indicate that these challenges may impact the usefulness of digital remote monitoring for those living with frailty. In particular, the prevalence of cognitive impairment in the cohort using the sensor technology service highlights the importance of understanding acceptability of such interventions amongst this population. This is especially highlighted because all of the 12 people using the service who discontinued early had cognitive impairment and the reasons for discontinuing the service included disconnecting, dislike of and being distressed by the technology. The findings also indicate there is a general mistrust of technology and that it can be perceived as frightening by older people. Further exploration as to the impact of sensory, motor and cognitive factors on use of technology is needed, particularly that which requires direct interaction between the older person with frailty and the technology.

Unfortunately, we were unable to investigate this as planned because of the engagement challenges we faced with services using signs and symptoms technology. However, the poor recruitment from those who were using the AI-sensor digital remote monitoring in this project raises questions about how best to seek the views of older people with frailty. This is especially the case for those with cognitive impairment, with many excluded from participation in the research due to levels of cognitive impairment that impacted their ability to provide consent. An integrative review, published after the start of this project, investigated best practice for recruiting older people with dementia into research, acknowledging that recruitment is difficult for this population (Davis and Bekker, 2022). They identified barriers and facilitators, with recruitment through organisations or services with established and trusted connections, incentives and use of multiple recruitment methods considered enablers.

Care at home is both a priority for the NHS (NHS England, 2022a) and also for older people. Those who took part in this project indicated they would prefer to stay at home if possible. The findings show that digital remote monitoring may support keeping people at home, but direct contact cannot be replaced completely. Direct communication, face-to-face or via either video or telephone, was preferred over remote care by older people and their carers who participated in our project. This reflects a broader

perception that face-to-face care is considered the gold standard by both patients and professionals (Thiyagarajan *et al.*, 2020; Mann, Turner and Salisbury, 2021). A flexible approach to offering digital intervention is needed to align remote support with personalised care (Mann, Turner and Salisbury, 2021). This was reflected in virtual ward staff talking about needing to tailor the digital offer to individual needs. Operationalising a targeted and personalised approach could also reduce the risk of widening health inequalities through the introduction of digital remote monitoring to people living with frailty. The findings touch on perspectives such as cost and mental health and loneliness as factors to take into consideration.

Another risk is that of increasing burden on informal caregivers, although unfortunately the sample size limited exploration of this in our project. However, our findings did raise the importance of informal caregivers to digital remote monitoring pathways. Both informal caregiver participants expressed a need to have knowledge and understanding of the system and how it worked in order to trust it and be reassured that it was going trigger an appropriate response. This suggests that implementation of digital remote monitoring services would benefit from co-design by patients and informal caregivers. This would reflect best practice older people's care which involves older people and their families in planning and coordinating care (Oliver, Foot and Humphries, 2014).

Since the Covid-19 pandemic, application of digital remote monitoring and virtual wards has rapidly evolved. However, this has not always happened as outlined in national guidance due to local system needs, approaches and set up (NHS England, 2023). It was highlighted in our findings and previous reports (Health Innovation Network, 2022) that virtual wards are set up slightly differently in different places. Virtual beds are closely aligned and interlinked with other services to prevent acute admission e.g., urgent community response, community frailty services. Agreeing with previous reports, communication and support between different services was generally reported to be good (Health Innovation Network, 2022). However, it was suggested that in order to continue the improvement and implementation of virtual wards and digital remote monitoring, access to data and interoperability between services and systems needs to be understood and developed.

Due to the ongoing challenges of suitability of digital remote monitoring for the frail population, currently frailty virtual wards continue to provide care mostly without digital remote monitoring. This highlights the need for ongoing process evaluation and suggests more evidence is required to understand this. One evaluation at Health Innovation Network (HIN) found high levels of acceptability and adherence with the technology, with 87% agreeing virtual ward technology was simple to use (Health Innovation Network, 2022). There were some mixed experiences that resemble our findings on needing more clarity around follow up action and contact with the virtual ward team. However, HIN evaluated mostly Covid-19, respiratory and cardiac virtual wards, not frailty virtual wards. As mentioned above, frailty virtual wards and digital remote monitoring is in its infancy and requires more evidence to support this provision of care.

Overall, despite the paucity of data this project has identified some of the benefits and barriers to digital remote monitoring. The findings provide some insights to inform practice. However, the project has primarily emphasised the significant evidence gap in understanding of the acceptability of digital remote monitoring to older people with frailty and the support needs of this population in relation to digital remote monitoring that persists. The project has also highlighted the challenges faced in obtaining the evidence, at the speed necessary to keep pace with digital innovation development, to underpin successful implementation to this cohort.

7 Implications

7.1 *Implications for Practice*

- Care pathways that include implementation of digital remote monitoring for people living with frailty should be co-designed with individuals living with frailty, their informal caregivers, professionals and public contributors, to ensure they are practical and do not create additional burden.
- Individuals living with frailty should have simple, clear and user-friendly instructions on how to use the technology and what it is used for. They should also have easy access to support and guidance. This could involve use of digital champions and third sector organisations that offer digital befriending to support implementation.
- To enable successful implementation of frailty virtual wards more broadly than just with use of digital remote monitoring, easier access to data from across organisations (e.g., acute, primary care, social care) is required to inform and support care provision.

7.2 *Implications for Policy*

- The national approach to frailty virtual wards recommends a hospital at home approach, which uses a hybrid model of face-to-face with technology enhanced care. The findings suggest this fits the needs of this population, with face-to-face care highly valued. Direct interaction via other means such as video or phone would also be considered alternatives to face-to-face care in some situations. A personalised approach is important, with the ability to adapt and tailor digital remote monitoring to individuals. However, further evidence is required to inform how this is best achieved.
- The findings highlight various challenges that could impact use of digital remote monitoring by those living with frailty. New technologies should be co-designed and piloted with individuals living with frailty. This could include early-stage testing with community groups, such as Age UK groups and dementia support groups, to understand the impact of physical and cognitive impairments.

7.3 *Implications for Research and Evaluation*

- Greater understanding of acceptability of digital remote monitoring for both older people with frailty and their informal caregivers, with a particular need to understand carer burden associated with this approach to care, remains a priority.
- The poor uptake of the digital remote monitoring service investigated in the research study highlights a need for understanding as to why referrals to digital remote monitoring services may be declined at the time they are offered (and before a referral is made) and how decisions are made by referring professionals about who is offered digital remote monitoring.
- For successful implementation of digital remote monitoring for frail, older people, further research is necessary to ensure policy and practice is underpinned by robust evidence specific to this population. This will require appropriate and flexible approaches, as the pace of digital innovation necessitates rapid evaluation. Straightforward approval and governance processes and dedicated resource within system partners, already working under pressure, are needed. Accessing the views of this population and their carers is critical but complex, as they face many challenges, and many have cognitive impairment. However, digital remote monitoring services must be co-produced with them.

8 Limitations

- A significant limitation for this project was the lack of data obtained. This resulted from issues with engagement of partner organisations and poor recruitment, something that is recognised as problematic for the population living with frailty (Provencher *et al.*, 2014).
    - Poor engagement with partner organisations was, in one case, due to delays with their R&D approval processes and in the other cases due to frontline work pressures.
    - Poor recruitment was exacerbated by having a significantly smaller than anticipated population to sample from, due to the numbers signing up to use the digital remote monitoring. An inability to extend the timeline of the project and a lack of agility within approval processes meant it was not possible to change the focus of the research study to investigate why older people were not taking up the offer of digital remote monitoring, although this became an important question to answer as the pilots progressed.
- Delay to frailty virtual ward setup. Although at the outset of the project it was expected that frailty virtual wards would be set up by March 2022, this timeline slipped. This meant that the wards were still in their infancy when the evaluation was being undertaken.

9 Conclusion

The project aimed to evaluate digital remote monitoring for individuals living with frailty within health and social care. There is limited evidence on uptake, use and acceptability of digital remote monitoring specific to this cohort. We explored the use and acceptability of two digital remote monitoring approaches amongst older people with frailty, informal caregivers and staff. One approach was the use of AI-facilitated environmental monitoring sensors, the other monitoring of signs and symptoms. We explored the benefits and challenges of using the latter approach within a frailty virtual ward. The findings show that digital remote monitoring needs to be tailored to each individual informed by their preferences. The practicalities and design of the technology, and the ability of the user needs to be considered and an appropriate balance with direct interaction (face-to-face, telephone or online) achieved. A perceived lack of reliability and false alarms impacts trust of digital remote monitoring. Knowledge and simple instructions would aid trust. The findings presented provide some insight into areas to be considered when implementing digital remote monitoring with those living with frailty but emphasise the complexities of its use by people with frailty. The poor uptake of digital remote monitoring highlights the need for further research and evaluation to ensure implementation of digital remote monitoring is underpinned by robust evidence, in particular to ensure that patients, carers and staff trust the technology. Digital remote monitoring could support independence and reduce hospital admissions. However, technologies need to be trialled with people with frailty and further research is necessary to ensure appropriate targeting. The challenges faced in delivering the project generated insight into the difficulties to be overcome to undertake evaluation of rapid changes to care provision and to gain access to the views of this population.

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