Lancashire & Cumbria Innovation Alliance

Lancashire & Cumbria Innovation Alliance Test Bed: Final Evaluation Report for a Targeted Supported Self-Care Programme

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EXECUTIVE SUMMARY

Over a period of 30 months, the Lancashire and Cumbria Innovation Alliance Test Bed implemented and evaluated a combination of innovative technologies and practices aimed at supporting older people (aged 55+) with long-terms conditions (LTCs) to remain well in the community, avoiding unnecessary hospital admissions. The combinatorial health technologies were designed to better enable older people with LTCs to self-care at home and to improve patient activation. The LTCs included COPD, heart failure, asthma, diabetes and dementia - conditions that present a major challenge for the Northwest. Patients with LTCs were recruited to one of three cohorts depending on their level of risk of hospital admission (Cohort 1 being the highest risk category); individuals with mild to moderate dementia were recruited to Cohort 4. The combination of technologies each patient received was dependent on their level of risk and their primary LTC.

The Test Bed evaluation focused on two key outcomes: i) the extent to which supported self-care health technology might improve patient outcomes and the patient experience for frail older people living with long-term conditions; and ii) the potential cost effectiveness of the intervention and how this might be scaled up to provide better value for both patients and taxpayers. The evaluation adopted a two-phase approach: Phase 1 included a bespoke patient survey and a matched control analysis (3:1); Phase 2 adopted a qualitative approach including observational interviews with patients and carers; and weekly diaries, action learning meetings, and focus groups with members of staff and other key stakeholders. The evaluation was underpinned by a Logic Model to aid spread and adoption.

Key Messages

- The data showed that the use of Test bed technology made little difference to hospital service usage;

- The costs of the Test Bed intervention exceeded cost savings in secondary care for both Cohorts 1 and 2 although this was considerably lower for Cohort 2. If cost is the key measure, Test Bed technologies may be more effective for patients with slightly lower levels of risk (10-24%) although different models of purchasing health technologies should be explored;

- Overall our data show a strong level of engagement and benefit for self-management of care and patient activation amongst patients and carers using the Test Bed technology;

- Our data suggest an unexpected benefit of the Test Bed technology as a method of early detection for previously undiagnosed health problems with good potential for cost savings downstream;

- Whilst protected time is needed for staff to deliver combinatorial health technologies successfully, the Test Bed enabled staff to have more contact and connections with their patients. Many staff also welcomed the added diversity the programme brought to their role.

- Decisions about which combinatorial technologies to give to a patient should begin with the individual's healthcare needs, and not what technologies are available.

Patients and clinicians need to work together to understand what technologies will work for whom.
- Patients want technologies that can be tailored to individual needs or personalised to their own lifestyles.

Patient Profile

- The majority of Test Bed participants were retired white, males (61%) which may reflect the prevalence of LTCs which were the focus of the Test Bed intervention. Most patients lived with a spouse/partner or relative and most already had access to the internet.
- The average age of patients participating in the Test Bed was 71.6 years, indicating that older patients are willing to engage with health technology.
- The percentage of patients in Cohort 1 who stated that they were confident or somewhat confident in the use of technology increased over the course of the Test Bed programme from 51% to 67%. This was reinforced by findings from the Phase 2 data.

Phase 1

Health and Wellbeing

- Patient activation for those with the lowest level of activation improved during the period of the intervention across all cohorts.
- On average, participants exhibited slightly better health-related quality of life and wellbeing at the end of the Test Bed. While there was no statistically significant change in overall health and wellbeing, improvements were evident in the dimensions of: usual activity; and pain and discomfort.
- Among Cohort 1 participants, age was negatively correlated with three of the EQ-5D-5L dimensions: self-care, pain/discomfort, and anxiety/depression. This may reflect participants' ability to adapt to impairments over time and that the combinatorial technology may play a role in assisting patients to adapt. With no control comparison we are unable to definitively attribute improvements to the use of the technology.

Service Usage

Based on the matched control data:

- The Test Bed had a very small effect (approximately zero) on the number of A&E visits per patient in both Cohorts 1 and 2.
- There was a reduction in outpatient appointments per patient of 0.26 in Cohort 1 and 0.27 in Cohort 2.
- Test Bed patients revealed higher average levels of secondary care service usage than those in the control group.
- The pre-post comparison among the Test Bed and control patients for the number of A&E visits per patient; and the probability of being admitted as an inpatient show little difference between the two groups.
- The pre-post comparison of outpatient appointments within Test Bed and control group revealed a reduction of 0.15 appointments per patient among the Test Bed participants compared to an increase of 0.11 appointments per patient among the Control patients.

- For patients participating in the Test Bed, the data show a reduction in the probability of inpatient admission of 2% in Cohort 1 and 2.6% in Cohort 2.

Based on the survey data:

- Overall, there was little difference in the mean use of hospital services in the Test Bed population. There was a slight increase in the use of day hospital services and a decrease in the use of outpatient appointments.
- In primary care, community health and emergency services there was a slight increase in the mean use of services when comparing results at baseline (1.08) and end point 24 (1.3).
- Overall, the percentage of patients using at least one primary care service showed little change over the period of the Test Bed. There was a 10% reduction in usage among Cohort 1 participants but a 12% increase among patients in Cohort 2.
- Community health services were rarely used by Test Bed participants and showed no meaningful change over the 24 weeks of the intervention. Similar patterns were observable in the use of other community-based services such as telecare, dentist or optician.
- The decrease observed in the use of services provided by social worker or care managers was more than compensated for by the increase observed in the use of private home help/cleaner.
- Due to the relatively short time span of the Test Bed, the evaluation was only able to pick up on increases in service utilisation arising from identifying previously unknown conditions. It is unable to assess any potential longer-term reductions in in-patient care arising from early identification of these conditions versus the delivery of lower cost treatment within community settings.

Average Cost and Comparison with Control Group

- The average cost for hospital services increased from £332 at baseline to £433 at 24 weeks. The increase was mainly driven by the changes observed in day hospital services.
- Primary care, community health or emergency services show a modest increase over the 24 weeks, from £113 to £128. The changes observed in social care services are negligible.
- Community mental health services and other community based services show small reductions over the 24 weeks.
- During the 24 weeks of the intervention, the average monthly cost of medication for patients was £228, but patients in cohort 1 spent more than patients in cohort 2 at £285 and £152 respectively for the same period.
- The average cost of the technology made available to participants in cohort 1 was £1,486 and £335 for patients in cohort 2.
- The average cost per patient increased from £1,711 at baseline to £1,822 at week 24.
- As would be expected, overall costs for patients in cohort 1 were more expensive than for patients in cohort 2. However, while there were no meaningful changes in the costs of patients in cohort 1 (from £2,426 to £2,437), the average cost of a patient in cohort 2 increased from £832 to £981.
- Average costs of patients in cohort 1 were around 2.5 times higher than those found for patients in cohort 2 over the 24 weeks.

- Compared to the matched control, patients in Cohort 1 showed cost savings in all three measures of secondary care. In A&E visits there was a saving of approximately £3 per patient, in outpatient appointments the saving was approximately £35 per patient and approximately £78 for hospital admissions. Total cost savings for this cohort were approximately £116 per patient.
- Compared to the matched control, patients in Cohort 2 showed cost savings in two of the three measures of secondary care. Hospital admission cost savings were approximately £101 per patient; and outpatient appointments cost savings were approximately £37 per patient. A&E visit costs increased by approximately £5 per patient.
- Overall, the total cost saving for Cohort 2 was approximately £133 per patient.
- For those patients completing the 6 month intervention in Cohort 1, the cost of the Test Bed intervention exceeded by £1,370 (per patient) the cost savings achieved by the reduction in secondary care use.
- For those patients completing the 6 month intervention in Cohort 2, the cost of the Test Bed intervention exceeded the cost savings by approximately £175 per patient.
- The Test Bed reduced secondary care use among Cohort 1 at a higher cost than among Cohort 2 patients. This is unsurprising given the higher costs of technology used in Cohort 1.
- The overall finding that the cost of the Test Bed exceeds cost savings due to reductions in secondary care use should not be considered in isolation. First, it is important to acknowledge both the strengths and limitations of the Phase 1 evaluation approach. Second, the time-frame of the Test Bed may have been too short to accurately measure changes in secondary care use.

Phase 2

Patients

- Overall, patients' experiences of using the Test Bed technologies were positive. However, many needed the support of a family member or friend when using the technology.
- The majority of patients across all cohorts were confident in using the technologies after an initial induction period and this confidence increased over time.
- Experiences of training and initial support differed significantly across cohorts dependent on the technology a patient received. Good training, induction and ongoing support is essential for the successful implementation of Test Bed technologies.
- Individualisation of the technology was particularly important for Cohort 4 to ensure that individuals were not given information about dementia they did not want or expect at that point in time.
- Patients felt input from a healthcare professional would help them tailor the technologies to their own healthcare needs, so gaining more from it.
- While the data reveal reductions in healthcare system utilisation, examples of increased utilisation of healthcare services and medication also exist, due to identification of previously undiagnosed conditions, increased patient engagement, or the need for alternative or additional medication. Such short-term increases in service use are likely to be offset by longer-term cost-savings, but this was not verifiable within the time-span of the Test Bed programme.

- Phase 2 data suggest patients in Cohort 1 gained the largest increase in confidence relating to their health. This is largely attributable to an increase in patient/carer reassurance as a result of being monitored through the technology.
- While patients and family carers valued the monitoring of their data by healthcare staff, they also took an active role in this monitoring.
- Patients need clear information about how their data is being used. Concerns were expressed about where their data was being held, who had access to it, and the purposes for which it was being used.
- For the small number of Cohort 1 patients who did not report any benefits from taking part in the Test Bed, this was because the technology did not address what the patient viewed as their primary health condition.
- Most patients in Cohort 1 increased their knowledge and skills about their health condition as a result of taking part in the Test Bed programme.
- While changes in daily activities can be an indicator of changes in quality of life, this may not be an appropriate indicator for those in the highest risk group, many of whom are housebound. As a result, the Phase 2 data did not reveal any positive influence on daily activities for many Test Bed patients in Cohort 1.
- Most patients interviewed in Cohort 2 experienced an increase in confidence in relation to their health as a result of taking part in the Test Bed. This was linked to an increase in knowledge and skills, resulting in people being better able to self-manage their health.
- The majority of Phase 2 patients in Cohort 2 had COPD. Most found participation in the Test Bed programme helped them to learn about their condition and how to better manage it.
- Participation in the Test Bed programme had a positive influence on daily activities for some participants, with the biggest impact occurring in Cohort 2.
- In Cohort 3, there was very little evidence of increased confidence relating to health. Patients in this cohort differed from the other cohorts in that they were younger, many still being in paid employment and did not consider themselves to have a long-term condition. The lack of increase in confidence was a result of these patients being confident in managing their health at the outset.

Carers

- There is limited evidence of an increase in health-related confidence or knowledge and skills related to dementia as a result of participation in Cohort 4. Where evidence did exist, this related to the family carer rather than the patient, and was a direct result of knowing the patient was being monitored.
- The Test Bed technology was often the responsibility of the family carer, with many patients saying they could not have participated in the programme without the support of a family member of carer.
- The evaluation highlighted the importance of ensuring family carers are closely involved in decision-making regarding the implementation of combinatorial health technologies to support patients with dementia, as well as other long-term conditions.
- There is evidence of significant carer burden across all cohorts. There is also a sense of major transitions and changes for family carers and patients related to Cohort 4. The family carer is key to negotiating these ongoing changes. Technologies need to address the needs of the family carer.

Staff

- The Test Bed enabled members of staff to have more contact and connections with their patients, with many welcoming the added diversity the programme brought to their role.
- Time was a key challenge for successful delivery, with the Test Bed resulting in additional workload for those operating on the front line. Protected time is required for successful delivery of a programme such as this, particularly in the implementation stage and especially for patients with dementia.
- A small number of patients and carers required significant reassurance and support in using the technologies. In these cases, service utilisation increased during the Test Bed programme.
- Many people engaged with, and received, better healthcare as a result of Test Bed participation. The short-term increases in service utilisation were viewed by staff as a positive outcome as patients were receiving better and more appropriate care.
- Though the Phase 1 data showed little change over the duration of the Test Bed, staff maintained that improved healthcare, arising from the Test Bed programme, would result in a reduction of emergency care and hospital admissions in the long term.
- Staff across the Test Bed highlighted the importance of being part of a willing and engaged team when embarking on such a programme. Good communication and working relationships are key to successful implementation.
- Where staff felt ownership of the programme and were involved in decision-making, there was greater buy-in and support for the Test Bed. Conversely, where staff were not involved in decision-making, or ownership was not encouraged, staff felt disengaged from the process.
- Issues arose throughout the Test Bed as a result of clinical teams not being involved in decisions and programme design from an early stage. This included members of staff being expected to refer their patients into the Test Bed while not knowing what the technology entailed, and technology content contradicting advice given to patients by healthcare teams.
- It is important that staff receive appropriate and regular training and support if they are to understand the technologies, how they can be tailored to the individual, and their value to their patients.
- Continuity in the staff responsible for identifying and managing patients using healthcare technologies is important to its successful implementation.

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1. CONTEXT

Over a period of 30 months, the Lancashire and Cumbria Innovation Alliance (LCIA) Test Bed implemented and evaluated a combination of innovative technologies and practices aimed at supporting older people (aged 55+) with long-terms conditions to remain well in the community, avoiding unnecessary hospital admissions. The combinatorial health technologies were also designed to better enable older people with long-term conditions (LTCs) to self-care at home and improve patient activation. The LTCs included COPD, heart failure, asthma, diabetes and dementia - conditions that present a major challenge for the Northwest. Across the Test Bed, patients with LTCs were recruited to one of three cohorts depending on their level of risk of hospital admission; individuals with mild to moderate dementia were recruited to the fourth cohort. The combination of technologies each patient received was dependent on their level of risk and their primary LTC.

The LCIA Test Bed was delivered through two neighbouring Vanguard sites – the Fylde Coast Local Health Economy and Morecambe Bay Health Community (Better Care Together). Located in Lancashire and South Cumbria.

Both our Vanguards were focused on population-based new models of care that were central to delivering the vision of the NHS Five Year Forward View: integrated primary and acute care systems (PACSs) and multispecialty community providers (MCPs) whose focus was on integration. The MCP model was designed to dissolve the historical divide between health and social care. It involves redesigning care around the health of the population, irrespective of existing institutional arrangements. Blackpool Fylde and Wyre (Your care, Our priority) was a MCP Vanguard.

Better Care Together was a PACS Vanguard. PACS were based on GP registered lists with the aim of improving the physical, mental and social health and wellbeing of the local population and reducing inequalities. PACS were designed to bring together health and care providers with shared goals and incentives, so they could focus on what is best for the local population. Critically, the general practice was at its core. The current fragmented and complex contracting, funding and governance systems within the NHS, and between NHS and social care, were seen to frustrate a focus on population health. The vision was, that by joining up services in through PACS, better decision-making and more sustainable use of resources would be facilitated, enabling a greater focus on prevention and integrated community-based care, and less reliance on hospital care.

Both Vanguard sites presented significant challenges for delivering healthcare for a number of reasons:

Firstly, life expectancy in Lancashire is 18 months shorter than in the rest of the country and the prevalence of heart failure, asthma and depression are all higher than average. Lancashire has 20% more people with three or more Long Term Conditions (LTCs) than the national average (Bradshaw, 2017).

Secondly, Lancashire and South Cumbria encompasses a significant rural population, presenting a major challenge to those providing care, with long distances between hospitals and patients in rural and remote areas expected to undertake significant travel to attend

appointments. For example, the population of the Morecambe Bay Vanguard site is dispersed across an area of over 1,000 square miles. Delivering the LCIA Test Bed programme across the two Vanguard areas was thus viewed as having the potential to provide a 'real-world' test site for the use of technology to provide services remotely.

Thirdly, the population of older people is increasing. Compared to the average across England, Lancashire has a higher proportion of people in all age bands over 50 years of age. In the Fylde Coast, those aged over 65 are projected to increase to between 31-35% by 2028 and increasing numbers of these people experience multiple and complex long-term conditions (ONS, 2016).

Fourthly, continuing to care for our communities using current modes of practice is financially unsustainable. Forecasts for the 5 year period from 2016-2021 showed that commissioner deficits could reach as high as £15m. The acute provider deficit over this period was expected to grow to £56m and local authorities within the footprint anticipated spending cuts of 10%. In 2015, Healthier Lancashire's "Alignment of Plans" framework estimated a £180m deficit across all Lancashire commissioners, providers and social care.

To address these issues, the Fylde Coast Vanguard implemented an integrated health, community and social care 'Extensive Care Service' across Lancashire, to support those patients over 60 years of age, with 2 or more long-term conditions and a high risk of non-elective admission. Similarly, the Morecambe Bay Vanguard was in the process of implementing a programme which would include an 'out of hospital model', involving networks of multidisciplinary integrated core teams based in the community to provide care focused on frail older people and those with long-term conditions. Both Vanguards included projects focused on promoting 'self-care' and the home rather than the surgery as the site of care, aiming to implement a range of self-care interventions to support patients and their carers in managing their health and care.

Given the region's dispersed population, innovative and cost-effective solutions are urgently required. The Test Bed was thus seen to offer a valuable and timely opportunity for local organisations working within the footprint of the two Vanguard sites to work together to address these challenges by supporting people to better manage their own care at home. The physical proximity of the Vanguard sites and their aligned focus on the provision of care for older people with LTCs through community-based approaches (albeit using different models of delivery), offered an ideal site within which the LCIA Test Bed could build on an existing system to implement the programme. By building on this infrastructure, the Test Bed was seen to offer strong potential for achieving substantial impact in an area of need and enabling wider adoption of proven technology.

Lancashire and Cumbria Innovation Alliance – the partnership

The LCIA was formed out of an already-established NHS / University partnership - the Lancaster Health Hub. Through the Health Hub, Lancaster University worked with its 10 local NHS partner organisations to respond to this call by providing the drive, impetus and leadership for designing the Test Bed project and for developing the proposal. This included input from the University's Centre for Ageing Research, which housed academic expertise for

a robust and independent evaluation of the Test Bed. It also involved close working with the Innovation Agency (the North West Coast Academic Health Science Network). The NHS component of the LCIA focused on the two Lancashire NHS Vanguards, which were the sites for recruitment and data collection, as well as the Lancashire Care NHS Foundation Trust, which hosted the LCIA.

The LCIA partnership also included a range of technology innovators, who were selected through a matching process that took place prior to the submission of the bid. The aim was to introduce bespoke combinatorial technological solutions to support the new models of care that were being implemented across the LCIA footprint. An iterative approach was used, involving a series of meetings with different large businesses in the Digital sector and senior representatives from the NHS Vanguards and Lancaster University. The need was defined according to which technology offer would best support the Vanguards' proposed new models of care. At the first "match making" event the NHS partners pitched this need to technology providers who were potentially interested, to enable conversations to be opened up with those businesses whose solutions could potentially fit the need. A set of scoring criteria for assessing the technologies objectively and transparently was drawn up, and each potential technology partner was assessed through meetings at which the scoring criteria were applied. Philips Health Systems was selected as the LCIA lead innovation partner at this point.

A second "match making" event enabled us to refine our proposal. The identified lead technology partner, Philips, was also able to help identify other potential collaborators. Some SMEs stepped back at this point for various reasons (i.e. some were unable to see a way forward without resource, others did not wish to work with other SME partners etc.). The final partnership included the following industry partners, SMEs, social enterprises and voluntary organisations, who brought their expertise and technology to help develop and introduce this technology-enabled, supported self-care programme:

- Philips Health Systems
- Speakset
- Cambridge Cognition
- Simple Telehealth
- Intelesant
- Good Things Foundation
- House of Memories

As the bid documents were developed, the combinatorial aspects were developed into a compelling narrative underpinned by strong and committed senior leadership from the NHS, a robust, high-quality evaluation proposal, and assured by the involvement of Philips Health Systems.

Once the bid was awarded, a range of systems and processes for project development, implementation and governance were established specifically for this purpose. None of these were previously in place. This also required considerable work to configure new roles, appoint staff, prepare and submit proposals for ethical approval, and develop plans and systems for recruitment of participants and data collection.

The Technologies

What follows in this section is an outline of the technologies used and the Cohorts within which they were applied.

Innovator: Philips	**Technology:** Motiva	**LCIA Test Bed Cohort(s):** 1 and 4

Overview:

Using Motiva, patients were able to take their own vital signs using wireless (Bluetooth) enabled weighing scales and blood pressure cuffs. Where appropriate, these were supplemented by manually entered readings from pulse oximeters and tympanic thermometers. These readings were collected through a tablet or television set top box and forwarded immediately to the clinical team looking after that patient. The Motiva Clinical system used risk profiling algorithms to prioritise patients whose vital signs indicated that an intervention was required.

The clinical team were also able to schedule messages (hints & tips or reminders), educational video content (how to take your blood pressure, eating well) and surveys (traffic light, validated measures) for the patients to complete.

For Cohort 1, Motiva was used to variously measure one or more of weight, blood pressure, pulse and SPO2 depending on the patient's long-term condition.

For Cohort 4, Motiva was used mainly for messaging, video and surveys. Vital signs could be monitored if the patient was being titrated onto a drug regime.

Notes:

Patients did not need broadband in their home (though Motiva can use domestic wireless if it exists) but a good mobile signal was required.

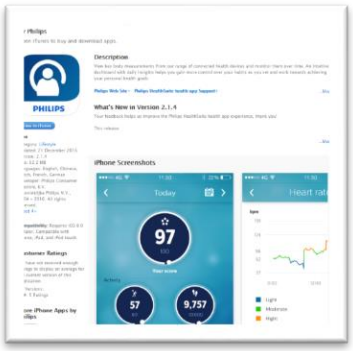
Images:

Innovator: Philips	**Technology:** Health Watch	**LCIA Test Bed Cohort(s):** 2 and 4

Overview:
This was a health watch (as opposed to a sports watch) with very accurate sensors. It does not feature GPS. It is best paired with a smartphone running the Philips Health Suite App.
For Cohort 2, the watch was used to measure activity of patients with COPD
For Cohort 4, the watch could be used to record sleep patterns, nutrition and hydration.

Notes:
Patients needed a smartphone (Apple or Android) to use the health watch. No patient in Cohort 4 received the Health Watch.

Images:

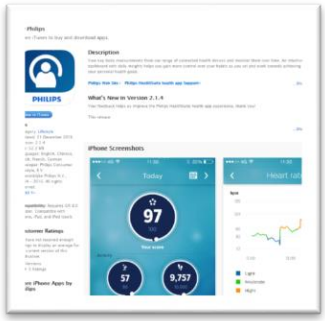


Innovator: Philips	**Technology:** Personal Blood Pressure Cuff	**LCIA Test Bed Cohort(s):** 2

Overview:
The blood pressure cuff worked in conjunction with the Philips Health Suite App to allow a patient to record their own blood pressure. It was not monitored remotely by a clinical team. The aim was for the cuff to encourage behavioural change and as an educational tool.

Notes:
Patients did need a smartphone (Apple or Android) to use this technology.

Images:



Innovator: Speakset	**Technology:** Domestic video calling	**LCIA Test Bed Cohort(s):** 1 and 4

Overview:

Speakset provided a set top box that converted any domestic television into a video calling system. It uses the SCART socket on the back of the television to connect the set top box and utilises a simple to use remote control. The use of SCART meant that any call would automatically cut across the programme being watched; hence the patient did not have to do anything other than accept the call using the remote control. The patient was also make their own calls from the television.

Whilst many video calling solutions are available, this one was chosen because it uses existing televisions (which nowadays are excellent quality, good size and have excellent sound).

Notes:

Patients needed broadband in their home for this to operate. Speakset was initially trialled but there were problems with NHS firewalls, hence the technology was not deployed more widely on the Test Bed. These issues have since been resolved.

Images:

Innovator: Intelesant	**Technology:** COPD monitoring App (How are you Today?)	**LCIA Test Bed Cohort(s):** 2

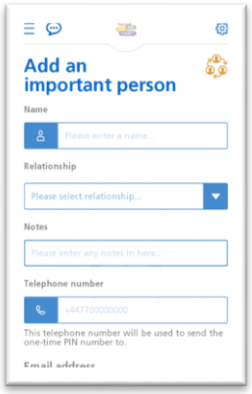
Overview:

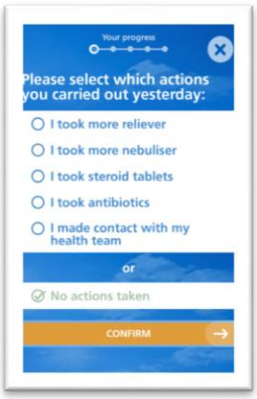
This app was co-developed with Lancashire Care NHS Foundation Trust's respiratory team. It asked the same 5 questions each day and recommended a strategy for the day depending on replies. Patients were able to invite others to share their plan, and could securely message between the patient, their connected people, and the clinical team. The app enabled quick and easy checks whilst incorporating the individual's action plan in response to changes in symptoms.

Notes:

Patients need a smartphone (Apple or Android) for this to operate.

Images:





Innovator: uMotif	**Technology:** General symptom capture	**LCIA Test Bed Cohort(s):** 3

Overview:

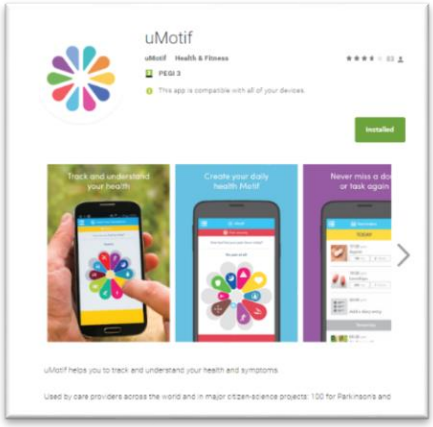
uMotif was used to capture patient data through an intuitive graphical user interface. It helped patients track and understand their health and symptoms. Up to 10 aspects can be captured (e.g. 'how much coffee have I drunk', 'how much energy I have') as well as providing:

- Health report – compile your own health report, to help improve how the individual and his/her clinicians care for them
- Wearable devices – connect to the individual's own wearable devices including Fitbit, Withings and Jawbone
- Medication reminders – enables patient to enter his/her own medications and set reminders so doses were not missed
- Task lists – keeps track of the patients regular tasks and sends reminders
- Daily diary – enables patient to keep a note of how they have been doing and enables the creation of a photo diary

Notes:

Patients need a smartphone (Apple or Android) to use this technology.

Images:



Innovator: Cambridge Cognition	**Technology:** Cognitive Testing	**LCIA Test Bed Cohort(s):** 1, 2, 3.

Overview:

CANTAB Mobile is an assessment tool designed for healthcare professionals to identify the earliest signs of clinically significant memory impairment which may be indicative of Alzheimer's disease. The assessment comprised three tests: the Paired Associates Learning (PAL) test to assess episodic memory; the Geriatric Depression Scale (GDS) to identify signs of depression and an Activities of Daily Living questionnaire (ADL) to assess functionality in daily life. Both the PAL and GDS tests were for completion by all patients; the ADL survey was only for completion by patients whose memory performance was below the expected range. Using the normative data built in to the software, the patient's performance would automatically be compared to others of the same age, gender and level of education. Standardised scoring was designed to ensure consistent interpretation of the results. Reports are available to view immediately and are easy to interpret by the healthcare practitioner. The aim was to help clinical teams to understand how best to work with their patients.

Notes:

Patients were to complete this test with a clinician. They would not need any devices to do so. The clinical teams trialled CanTab but there were appropriateness concerns and as a consequence it was not used within the Test Bed. These concerns have now been resolved through new versions of the software and a 'train the trainer' identified for any future use.

Images:

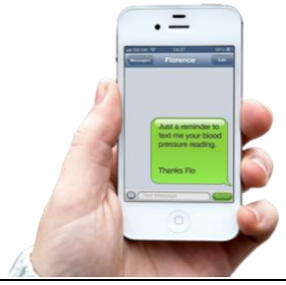
Innovator: Florence/NHS Simple	**Technology:** SMS based reminders and vital sign tracking	**LCIA Test Bed Cohort(s):** 1, 2, 4

Overview:

Florence text messaging service was designed to improve patients' engagement, involvement and adherence to shared clinical management plans. The service is not specific to any condition and is suitable for conditions ranging from mental health, COPD, diabetes to Parkinson's and medication adherence. It was designed to increase compliance and adherence to shared clinical management plans above the level achievable under normal care, with the aim of educating patients to manage their own condition and to participate in their own care. The system was designed to help patients in a closed loop environment, promoting self-reliance and independence, but it also works equally effectively where readings/responses are shared with clinicians in the traditional manor (with notifications of alerts where appropriate).

Notes: As a text-based service, this will work on any mobile phone - smart or non-smart.

Images:



Innovator: House of Memories	**Technology:** Reminiscence Therapy	**LCIA Test Bed Cohort(s):** 4

Overview: The House of Memories App allowed people living with dementia and their carers/families to explore objects from the past and share memories together. Though it can be used by anyone, it was designed for, and with, people living with dementia and their carers.

The app allows people to browse through objects from across the decades, brought to life with multimedia, to reminisce about a range of everyday objects, from school life to sport. People are able to create their own memory tree, memory box or memory timeline. It is possible to create personal profiles for different people, so that they can save their favourite objects and look at them again.

Notes: Patients need a smartphone (Apple or Android) to use this technology. It was not possible to download House of Memories onto the Philips tablet. As a result, patients from Cohort 4 were encouraged to access it online. House of Memories came late to the LCIA Test Bed; hence its application was limited.

Images:

Innovator: Good Things Foundation	**Technology:** Digital Inclusion	**LCIA Test Bed Cohort(s):** All
Overview: The Good Things Foundation is the UK's leading digital inclusion organisation, managing a network of 5,000 local places - the Online Centres Network - which provides people with the digital skills they need. Since 2013, the Good Things Foundation has been running the Widening Digital Participation programme, funded by NHS England, and has trained over 130,000 people to improve their digital health skills. They also run the Learn My Way learning platform (www.learnmyway.com), which hosts over 30 free courses to help people to improve their digital skills, including courses on how to use NHS Choices, and how to access GP services online. **Notes:** Good Things do not provide 'at home' one-to-one training for patients, or training on the specific technologies being used, hence referrals were limited.		
Images:   		

Table 1.1 below summarises the combination of technologies provided by the innovator partners as used by cohort. In addition, patients in Cohorts 1 and 2 received a range of the following technologies dependent on their specific long-term condition: digital scales, pulse oximeter, blood pressure monitor, tympanic ear thermometer, health watch and/or basic cell phone.

Table 1.1. Combinatorial Technologies by Cohort

Innovator partners	Product name	Product type	Target group	Cohort 1	Cohort 2	Cohort 3	Cohort 4
1. Philips Health Systems	• Motiva patient tablets • Motiva clinical user interface • TV set-top boxes • Motiva call scripts, reviews and reporting tools • Health Watch	• Device • Software • Device • Service • Device	Chronic disease management	Yes Yes Yes Yes	Yes		Yes Yes Yes Yes
2. Umotif	• Patient mobile app • Clinical engagement tool	• App • Software	LTCs – vital signs capture			Yes	
3. NHS Simple	Flo – messaging system	Software			Yes		
4. Intelesant	COPD management appl	App	LTCs – functional ability		Yes		
5. *Speakset	Webcam and set-top box	Software	N/A – Community care; video consultation	Yes			Yes
6. *Cambridge Cognition	Mobile Cantab	App (cognition assessment)	Dementia (early onset)				Yes
7. Good Things Foundation	Digital adoption support	Service	N/A – Digital inclusion	Yes	Yes	Yes	Yes
8. *House of Memories	Reminiscence Therapy	App	Dementia				Yes

*Installation of these technologies was limited or laid down for this Test Bed.

3. AIMS AND OBJECTIVES OF THE LCIA TEST BED EVALUATION

Aims:

The Test Bed evaluation aimed to focus on two key outcomes:

Firstly, the extent to which supported self-care telehealth technology might improve patient outcomes and the patient experience for frail older people living with long-term conditions in Lancashire and Cumbria.

Secondly, the potential cost effectiveness of the intervention and how this might be scaled up to provide better value for both patients and taxpayers.

Objectives:

Key objectives of the evaluation were to:

a) Identify benefits to patients and patient outcomes to include: increased sense of empowerment and improved quality of life: increased service satisfaction; enhanced knowledge, skills and confidence; enhanced patient activation;

b) Undertake an economic evaluation (for Cohorts 1 and 2) of costs and cost reductions associated with the intervention in comparison to existing services and shifts in resource consumption (reducing avoidable healthcare utilisation e.g. medication, GP and other health professional visits, home visits, length and number of in-patient admissions and community service use);

c) Identify the strengths and weaknesses of the intervention and how these may be built on or addressed;

d) Assess how the intervention may improve on existing services, make best use of voluntary and community services and increase patients' ability to self-care;

e) Assess the impact of the intervention on the workforce in terms of communication between care teams, productivity, capacity and co-ordination of care, work satisfaction.

f) Identify how the intervention might be constructed as a model that could be scaled up to provide better value to patients and taxpayers.

2. EVALUATION DESIGN AND METHODOLOGY

Ethics and Ethics Approvals

The evaluation was designed in two inter-linked phases to capture different information designed to address the objectives identified above. Phase 1 consisted of a longitudinal survey undertaken at three time points and control data (3:1) drawn from the Clinical Commissioning Support Unit (CSU) (further details below). The survey was designed to gather information which would allow us to assess any change in cost and service usage arising as result of the intervention as well as impact of the intervention on patient outcomes. In discussion with the Health Research Authority (HRA) and in agreement with the NHS Research and Development managers of those NHS trusts involved in the programme, Phase 1 was deemed to be service evaluation and as such did not require NHS ethical approval. In keeping with the ethical requirements of Lancaster University however, we submitted and received ethics approval from Lancaster University's Faculty of Health and Medicine Research Ethics Committee for Phase 1 of the evaluation (Reference: FHMREC16025).

Phase 2 of the evaluation adopted a qualitative design and focused on understanding the impact and experiences of patients using the technologies, and the impact on working practices amongst members of staff involved in the delivery of the technologies. Phase 2 was deemed by the HRA to be gathering new data and was thus defined as research requiring HRA approvals (IRAS Project ID: 208395). Phase 2 of the evaluation was also adopted onto the National Institute for Health Research portfolio.[1]

Evaluation Design

The two phases of the evaluation design adopted different methods, sampling and recruitment strategies. Each had its own participant information sheets, consent forms and, where applicable, schedules (e.g. for the interviews and focus groups) (see Appendices). A separate flyer was designed for patients with dementia, providing information about the study in an informative and accessible manner, drawing on images and large font (see Appendices). In all instances, it was made clear to patients that they could be supported by a carer or other family member if they wished.

All materials developed for the evaluation and submitted to ethical review were shared and informed through discussion with: patient by experience groups (including those with dementia); a clinical reference group; and an evaluation advisory board. Feedback and comment from these three groups was taken into account in finalising the documents submitted for ethics approval.

Further details regarding participation and informed consent to Phase 2 are detailed below in the Phase 2 methodology section.

[1] NIHR Portfolio reference number is the same as the IRAS number (IRAS Project ID 208395)

Participation and informed consent

Patient participation in Phase 2 of the evaluation was optional and participants were asked to indicate if they were willing to take part in Phase 2 in the Phase 1 consent form. Those subsequently selected to participate in Phase 2 were consented at the time of their first interview. To ensure informed consent and that each participant understood what they were consenting to, the researcher discussed each aspect of the form with each participant before it was signed. Ethical approval was received from the HRA for an alternative consent form with a large font size, and for which clauses on the consent from could be cut into strips, with one clause per strip of paper (see Appendices) This enabled the researcher to go through each clause with the participant, focusing on one clause at a time. Once the participant understood the clause, they were asked to initial it. This option made the information in the consent form more manageable for some patients. Prior to ethical approval, this was discussed and approved by the Lancaster patient by experience group (linked to the NHS). This approach was particularly useful for those patients with poor cognitive ability. Consenting a person to Cohort 4 (the dementia cohort), was undertaken with the patient in the presence of a family member, friend or carer.

Anonymity and data

All qualitative data was audio recorded using an encrypting digital voice recorder. In the process of transcription, names of participants were anonymized and any identifying features removed or coded. These points were included in the consent forms and discussed with each participant before the interview/action research meeting/focus group/deliberative panel. All audio files were deleted from the recorder once data analysis was complete.

Appendix 23 contains information regarding participant payment, data storage, participant benefit, potential risk to participants, withdrawal and researcher risk.

Test Bed Survey

Self-reported data was collected from the Test Bed participants through a survey undertaken at three time points across the 6 months during which they received the intervention: baseline, week 12 and week 24. More detail on the survey is provided below.

Clinical teams from the Vanguard sites, the Evaluation Advisory Group and a ‘patient by experience group’ gave feedback on the survey to the Evaluation Team to help fine-tune the survey and ensure clarity in the questions asked.

In general, we received positive comments from participants on the survey. Most participants and the clinical teams noted that the language was user-friendly, though some participants were unclear about one or two questions. The clinical teams, with the support of the Evaluation Team were able to clarify any issues with the survey when needed.

Methodology: Phase 1

Recruitment

Patients aged 55 years and over who had a long-term condition, including COPD, dementia, diabetes and heart failure, were recruited into one of four cohorts dependent on their level of risk of hospital admission. Table 2.1 sets out the recruitment criteria.[2]

Table 2.1. Recruitment criteria for the four LCIA Test Bed Cohorts

Cohort	Age	Risk of hospital admission	Long-term conditions
Cohort 1	Aged 55 years or over	>25%	COPD, Heart Failure (HF)
Cohort 2		10%< risk <25%	
Cohort 3		<10%	Diabetes, Asthma, CHD, Hypertension
Cohort 4		N/A	Early stage dementia (ACE-III assessment tool)

Patients were recruited to the Test Bed by the clinical teams and all patients consenting to take part in the programme and receiving the technology were required to participate in Phase 1 - the Service Evaluation. The Midlands and Lancashire Clinical Commissioning Support Unit (CSU) shared data on long-term conditions and risk of hospital admission with the clinical teams to aid identification of potential Test Bed participants. The risk of admission was calculated using the Combined Predictive Model.[3]

Using information on the percentage of frail and older patients and the number of patients estimated to be appropriate for the service in both the Fylde Coast and Better Care Together Vanguard Sites, it was originally envisaged that a total of 1,600 patients would be recruited. Cohorts 1-3 each had a target of 500 patients with Cohort 4 (early stage dementia) having a smaller target of 100 patients. Details of actual recruitment to Phase 1 of the evaluation and recruitment trajectories are discussed in the findings section.

The process of consent and overseeing completion of the Phase 1 surveys was conducted by the clinical teams to ensure patient confidentiality; the Evaluation Team did not have access to any identifiable patient data in Phase 1.

Sources of Data

The dataset used for the evaluation of the Test Bed was created by linking and pseudonymising data from the intervention and control group as explained below.

[2] Varey et al. 2018. Available at: http://bmjopen.bmj.com/content/8/2/e017268.full?ijkey=bV4BAyJkDLLBABt&keytype=ref Accessed on: 1 March, 2018.

[3] This Model allows segmentation of the population into relative risk segments and facilitates matching the intensity of outreach and intervention with the risk of unwarranted secondary care utilisation. For further reference see Wennberg et al. Combined Predictive Model: Final report and technical documentation. London, UK: The King's Fund 2006.

Intervention group

Phase 1 of the evaluation consisted of survey data collected from all Test Bed participants and data provided by the CSU for the matched control.

Participants recruited to the Test Bed were asked to complete 3 surveys each in total: at baseline, week 12 and week 24, with a 4-week recall period. The survey included sociodemographic data; validated instruments for use with older people to assess health related quality of life (HRQoL), health and wellbeing; and use of health care services (hospital, primary care and social care services, and medication).[4]

For the Test Bed group, the CSU provided one dataset with patient-level administrative hospital data for the Fylde Coast and Better Care Together Vanguard Sites. Data included age, gender, risk score, and long-term conditions based on primary care data.

Patients included in the analysis

The following Test Bed patients were included in Phase 1 of this Evaluation:

- Patients satisfying the recruitment criteria in terms of age (55 years and over), risk of hospital admission and long-term conditions;
- Participants who completed the 24-week Test Bed programme. We excluded individuals who withdrew part-way through the programme;
- Participants for whom the CSU is allowed to extract data from primary care systems;[5]
- Participants for whom the CSU has risk stratification data.[6]

For various reasons (including withdrawal, surveys lost or not completed at the appropriate time point) we did not have complete survey data for all patients. Following discussion, the Evaluation Team took the decision to include only those patients who had completed surveys at all three time points. We acknowledge that differences between completers and non-completers may have implications for the final results, but we cannot assess exactly how this might bias the results. More on the implications of this decision will be included in the discussion section.

Comparator group

The control group was a retrospective sample of patients receiving treatment as usual. It comprised people aged 55 and over, with a primary or secondary diagnosis of COPD or heart failure, and with predicted risk of admission probability of 10% or greater. These patients received standard care in the same Vanguard sites twelve months prior to the start of the

[4] To ensure survey data consistency, the survey information was centralised using the software Qualtrics.

5 Also known as individuals that are not under 'type 1 objector'. Patients under 'type 1 objector' are patients for whom the CSU is not allowed to extract data from primary care systems.

[6] This included patients that were not deceased by the date of data extraction (23 April 2018). Deceased patients' information is removed from the risk stratification processing and the CSU does not keep records of their primary care data. Therefore, there is no information to link to.

Ten Test Bed participants who completed the 24 week intervention have deceased before 23 April. Of them, 5 participants completed the survey at all 3-time points. The CSU shared risk stratification data as of 30 November 2017, so we were able to use this information for the 5 participants in this condition.

Test Bed programme. Data included identified patients with a hospital discharge date between 1 July 2015 and 30 June 2016.

For the control group, the CSU provided one dataset with patient-level administrative hospital data for the Fylde Coast (including Blackpool and Fylde and Wyre Clinical Commissioning Group) and Better Care Together (Morecambe Bay)[7]. Control data included age, gender, risk score, and long-term conditions based on primary care data, and hospital service use (A&E visits, hospital inpatient admissions, and outpatient visits).[8]

Final extraction of all CSU datasets was conducted on 23 April 2018.

Data Governance

All patients were recruited by the clinical teams and each was allocated a unique 'Test Bed Code' by the Test Bed management team. This code was shared with both the CSU and the Evaluation Team. The NHS number (and any other patient identifiers) of Test Bed participants was held only by the Test Bed management team, clinical teams and the CSU.

The Test Bed management team shared the 'Test Bed Code' and the NHS number with the CSU via the Data Services for Commissioners Regional Office (DSCRO) so the latter could extract the control sample ensuring that no controls were drawn from the Test Bed intervention group. This process ensured only CSU and DSCRO authorised staff within the Data Warehouse department were able to manipulate patient identifiable data.

The Evaluation team were not able to identify the NHS number of patients or any sensitive information about participants (e.g. name, address, phone number, NHS number). Hence, there was no risk of breaking pseudonymisation either in the Test Bed or control groups.

Survey Data Collection

Survey data was collected between 18th October 2016 and 27th April 2018. A total of 460 participants were considered to be 'active'[9] in Phase 1 of the evaluation. From them, the Evaluation Team received 394 baseline surveys, 368 mid-point (12-week) surveys and 373 end-point (24-week) surveys. These figures varied significantly between the two Vanguards sites and across the cohorts.

In total, 317 Test Bed participants completed both the 24-week intervention and all three time-point surveys. This means that at least one survey was missing for 143 of the participants, who either did not complete a baseline and / or a mid-point survey. Two participants were excluded from the analysis for the following reasons: one participant was under the age of 55 years at the time of consent, and the CSU did not have the risk

[7] Lancashire North CCG merged with the South Cumbria element of Cumbria CCG on 1st April to become Morecambe Bay CCG.

[8] The CSU shared a patient-level and hospital admission-level dataset which was linked using a variable 'Digest', which is the non-reversible encrypted, pseudo NHS number field. The control data came from the 'Aristotle' system with two month delayed information. The CSU data has not been subject to rigorous data cleaning and validation.

[9] Patients who completed the 24-week programme by the end of April 2018 and were therefore considered active in the Phase 1 Evaluation.

stratification information for another participant. This gave a total of 315 Test Bed participants with complete datasets across the cohorts and both Vanguards sites.

Participants recruited to Cohorts 1, 2 or 3 were offered the option of completing either a paper-based or an online survey. Following consultation with clinicians, Cohort 4 participants (early stage dementia) were only offered the paper-based survey. Where participants indicated a preference for the paper-based version of the survey, this was administered by the clinical teams and then forwarded to the Evaluation Team. Whilst the evaluation team did not interact directly with participants regarding survey completion, an evaluation team member was available to provide support to participants and clinical staff if required.

Details of the number of surveys collected from active participants, the type of survey (paper-based or online) and the number of missing questionnaires are presented in Table 2.2. Further detail of surveys received and missing surveys per Cohort is included in Appendix 1.

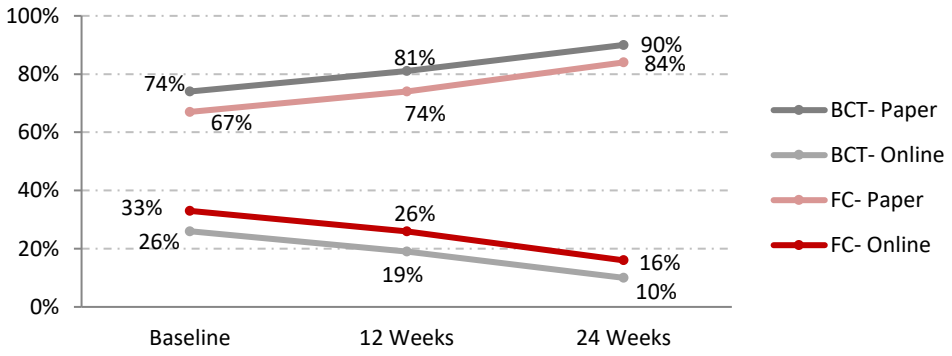
Table 2.2. Survey data collection: October 2016 to April 2018

Cohort	Baseline surveys		12-week surveys		24-week surveys		Total All surveys completed		
	Better Care Together	**Fylde Coast**	**Better Care Together**	**Fylde Coast**	**Better Care Together**	**Fylde Coast**	**Better Care Together**	**Fylde Coast**	**Total**
1	163	34	155	35	158	36	137	32	**169***
	142 Paper, 21 Online	13 Paper, 21 Online	131 Paper, 24 Online	18 Paper, 17 Online	141 Paper, 17 Online	24 Paper, 12 Online			
	18 Missing	*3 Missing*	*26 Missing*	*2 Missing*	*23 Missing*	*1 Missing*			
2	118	48	103	46	116	41	87	39	**126**
	71 Paper, 47 Online	45 Paper, 3 Online	80 Paper, 23 Online	44 Paper, 2 Online	105 Paper, 11 Online	41 Paper			
	30 Missing	*5 Missing*	*45 Missing*	*7 Missing*	*32 Missing*	*12 Missing*			
3	11	5	10	4	5	2	5	2	**7**
	4 Paper, 7 Online	5 Online	6 Paper, 4 Online	1 Paper, 3 Online	5 Paper	1 Paper, 1 Online			
	4 Missing	*6 Missing*	*5 Missing*	*7 Missing*	*10 Missing*	*9 Missing*			
4	15		15		15		15		**15**
	15 Paper		15 Paper		15 Paper				
	0 Missing		*0 Missing*		*0 Missing*				
TOTAL	**394**		**368**		**373**		**229**	**88**	**317**
	290 Paper, 104 Online		**295 Paper, 73 Online**		**332 Paper, 41 Online**				
	66 Missing		***92 Missing***		***87 Missing***				

*Two participants were excluded from the analysis: one participant was younger than 55 years at the time of consent, and the CSU does not have the risk stratification information of another participant.

A higher percentage of participants recruited from both Vanguards preferred to complete paper-based rather than online surveys. The percentage of mid-point online surveys decreased with time. Figure 2.1 shows that the percentage of patients completing online surveys in Better Care Together went from 26% at baseline to 19% at 12-weeks and 10% at 24-weeks. A similar trajectory holds in the Fylde Coast, going from 33% at baseline dropping to 26% at 12-weeks and 16% at 24-weeks. These figures may be a reflection of both patients' preferences and operational feasibility during the data collection process.

Figure 2.1. Paper-based and online surveys per Vanguard Site



To prevent inconsistency, incompleteness or missing data, we undertook a data quality assurance process, working closely with the clinical teams to minimise the risk of receiving inconsistent or incomplete questionnaires. However, it is important to note that the Test Bed population comprised frail older people with long-term conditions. As with all surveys, some participants preferred not to respond to certain survey questions, provided inconsistent information, or did not complete all three surveys.

Healthcare Resource: Use and Cost

We estimated the costs of resource use (hospital services, primary care, social care, community mental health and other community-based services), technology and medication intake. All costs were assigned as nominal prices as of 2017. No discounting (0%) was taken into consideration for the time horizon of this evaluation[10] and we did not adjust for inflation.

Data sources, unit costs, assumptions and data processing details are provided below.[11]

Healthcare resource use

Healthcare resource use was costed using published national reference costs. We obtained unit costs from two sources: the PSSRU Unit Costs of Health and Social Care (2017); NHS

[10] It is common practice not to apply discount rates for economic evaluation with short (e.g. less than one year) time horizons (Husereau et al. 2013).

[11] It is important to note that the cost and use of healthcare resources, cost of technology and medication use in this evaluation are estimates based on a number of assumptions. The cost estimates provide an indication of the potential cost of using the TB toolkit and are not absolute figures.

reference costs 2016/17. Unit costs are shown in Table 2.3 and further details on the assumptions are provided in Appendix 2. We report average costs in each of the services.

Table 2.3. Costs of Healthcare Resources: Unit costs

Service	Unit Cost (£)	Unit of measure
Hospital Services		
Accident and Emergency	**259**	Visit
General Hospital Inpatient Admission	**3,903**	Stay
Community Hospital Inpatient Admission	**3,903**	
Day Hospital [a]	**727**	Visit
Outpatients Visits to Clinical Based at Hospital Site	**137**	Appointment
Primary Care, Community Health Services		
General Practitioner (GP)	**183**	Working hour
Paramedic (Ambulance Service)	**36**	
Community Matron	**53**	
Community/District Nurse	**53**	
Practice Nurse	**36**	
Specialist Nurse	**62**	
Social Care Services		
Social Worker or Care Manager	**59**	Working hour
Home Care/Home Help Worker	**21**	
Private home help/cleaner*	**12.5**	
Community Mental Health Services		
Psychiatrist / Psycho-geriatrician	**108**	Working hour
Community psychiatric nurse / Community mental health nurse	**62**	
Other mental health professional	**44**	
Other Community-Based Services		
Telecare	**36**	Working hour
Dentist/ Oral Hygienist	**101**	
Optician	**45**	

[a] Day hospital refers to a medical treatment that has to be administered at the hospital but does not require overnight stay.
Source: Unit Costs of Health and Social Care 2017; NHS reference costs 2016/17. * Online quote for Lancaster

Technology costs

The costs of the intervention include technology costs plus the costs of programme delivery by clinical staff and are estimates based on different sources and assumptions. In order to respect the Non-Disclosure Agreement of the technology innovators, we drew on public information.

To cost the license of software (in lieu of the costs of the Motiva software), we considered software that is licensed to users and for which a regular payment is due.[12] We assume that a licence fee includes contingency costs (e.g. battery replacement, power lead, and technical support). Regarding equipment, we considered the prices of technologies that had similar characteristics to the Test Bed toolkit and which are available in the market (e.g. tablets, weighting scales, blood pressure meters, thermometer, mobile apps which require licenses). We assumed that people keep their equipment, there were no data storage fees, and that the clinical equipment did not have a long-term value.[13] Costs shown do not include deinstallation and refurbishment (data cleaning) rates. Due to the lack of availability of data on the actual technology devices, we did not consider economies or diseconomies of scale in the acquisition of equipment. We did not include staff costs of the Test Bed programme administration as in wider rollout this would become part of everyday practice that would not require specific Test Bed administration.[14]

We report the unit cost per patient in each cohort considering the care pathways including different combinations of technology:

- Cohort 1. Three care pathways in both Vanguards: Motiva for patients with COPD; Motiva for patients with heart failure; and CANTAB Mobile for all Cohort 1 patients (with COPD or heart failure);
- Cohort 2. Two different care pathways in each Vanguard. For cohort 2 patients in the Fylde Coast the care pathway included a combination of Flo, Intelesant and the Health Watch. In Better Care Together, the care pathway included a combination of Flo and Intelesant.

We made assumptions to calculate staff costs using the clinical teams' experience in the Test Bed to calculate healthcare staff-time needed to operate the Test Bed programme. We know from the focus groups and action learning meetings that staff in different salary bands in each Vanguard were involved in conducting the readings, interpreting the information from the technology and alerting patients using the toolkit. We report technology and healthcare staff-time average unit costs per Cohort and care pathway. We also show the total cost per Vanguard using the average unit costs.

Table 2.4 presents the unit costs for costing technology and we provide further details on the assumptions in Appendix 3.

[12] As for Motiva, the platform provides a service where patients are given access to web based contents relevant for the management of their disease. Patients are also given the option to report some health measurements on a regular basis. Information reported by patients is stored and alerts are issued to physicians/nurses/carers if measurements are out of line. This is the type of service that is licensed to users. Given these general features, we have assumed the price of the statistical package SPSS. See for reference: https://www.ibm.com/uk-en/marketplace/spss-statistics/purchase#product-header-top Accessed on 28 February 2018.

[13] The cost of technology used over a period of time was not amortised over the technology's useful life.

[14] The cost-effective analysis was done from a UK National Health Service perspective. Therefore, the potential financial impact on patients and their families and caregivers (e.g. travel costs, family caregiver time) was also not included.

Table 2.4. Costs of Test Bed technology and healthcare staff needed per Cohort: Unit costs

Technology Cost

Care Pathway [a]	License/Equipment	Unit Cost (£)
Technology: Motiva toolkit (Cohort 1)		
Cohort 1 (all participants HF or COPD)	License Fee	**949.56**
	Installation	**135.00**
	Tablet	**79.99**
HF	Wireless weighing scale	**80.00**
	Blood pressure meter	**86.80**
	Tympanic Ear Thermometer	**16.79**
COPD	Pulse oximeter (SPO2 monitor)	**35.99**
	Tympanic Ear Thermometer	**16.79**
Technology: Intelesant (Cohort 2)		
Cohort 2 Intelesant	License App	**9.53**
Technology: Florence/NHS Simple toolkit (Cohort 2)		
Cohort 2 Flo	License fee	**109.11**
	Message fee	**12.00**
	Tympanic ear Thermometer	**16.79**
	Pulse Oximeter (SPO2 Monitor)	**35.99**
	Blood Pressure Monitor	**86.80**
	Phone (basic cell phone)	**10.00**
Technology: Philips Health Watch (Cohort 2)		
Cohort 2 Health Watch	Philips Health Watch	**157.99**
Technology: CANTAB Mobile (Cohort 1 & 2)		
Cohort 1 and 2	Access to the tool	**0.85**

Notes: [a] While Speakset was originally envisaged as part of the combinatorial technologies on offer, in practice this was not used by Test Bed participants.

Healthcare Staff Cost

Care Pathway	Staff	Unit Cost[a] (£)
Fylde Coast: **Motiva Cohort 1 (all participants HF or COPD)**	Staff (2 nurse practitioners band 8 and 1 GP Consultant) Reading, interpreting (excluding alerts)	**152.86**
	Staff (2 nurse practitioners band 8 and 1 GP Consultant) Only alerts to patients	**38.21**
Better Care Together: **Motiva Cohort 1 (all participants HF or COPD)**	Staff (2 nurse practitioners band 8 and 1 GP Consultant) Reading, interpreting (excluding alerts)	**185.61**
	Staff (2 nurse practitioners band 8 and 1 GP Consultant) Only alerts to patients	**46.40**
Fylde Coast: **Flo, Intelesant, Health Watch Cohort 2**	Staff (GP consultant) Reading, interpreting (excluding alerts)	**9.92**
	Staff (GP consultant) Only alerts to patients	**0.00**
Better Care Together: **Flo and Intelesant Cohort 2**	Staff (GP consultant) Reading, interpreting (excluding alerts)	**163.72**
	Staff (GP consultant) Only alerts to patients	**27.29**

Note:
The unit cost is calculated using the cost per working hour, the number of hours and days the staff is involved in the Test Bed to estimate the total cost of a week. Then this is scaled to a year and divided by the number of cohort members recruited in each Vanguard Site. The unit of measure of the unit cost is staff time per patient.

We report the average unit costs per cohort by showing the average costs of technology and healthcare staff by Cohort and Vanguard.

For the cost-effectiveness analysis we added the unit cost per patient per cohort at the end, as we know that these costs only apply to patients in the intervention group.

Medication

We followed a micro-costing approach to achieve reliable cost estimates.[15] We obtained medication unit costs from two commonly-used resources. Firstly, we used the Drug Tariff

[15] This represents a challenge. Data on medication requires care and time to collect, and careful documentation should be done on how to collate unit costs and process data, including addressing the potentially multiple missing-data scenarios that could exist across the relevant variables (see Patel et al, 2017).

that lists the price that the NHS reimburses pharmacies for drugs, dressings and devices.[16] Secondly, we used the MIMS online database of prescription drugs. This provides prices of new branded drugs that are not included in the Drug Tariff.[17] We applied costs of generic preparations over branded versions to ensure cost estimations were conservative.

The costs of medication intake in this evaluation are estimates based on a number of assumptions.[18] Unit costs tables are not presented here but are available upon request from the Evaluation Team.

The protocol for handling partially missing or incomplete medication and the approach to estimating daily costs of prescribed medications is included in Appendix 4.

Annual average cost:

The average cost per day per medication was calculated considering the medications reported at all three time points per type of medication (LT, MT or ST) and the average number of patients taking each type of medication.

We report the average cost of medications per participant over a 24-week period and the annual average cost per type of medication in each cohort, this is generated by multiplying the annual cost per day by the proportion of patients taking medications.

Statistical Analysis

In the following subsections we set out the methodology used for the quantitative analysis. This includes information related to Cohorts 1, 2 and 4. Recruitment to Cohort 3 proved challenging as it involved those aged over 55 years with a long-term condition but with a low risk of hospital admission (< 10%). As a result, few of these patients were readily identifiable to GPs and were difficult to identify through more general recruitment processes. To understand this situation, we draw on the example of Better Care Together:

[16] The Drug Tariff is issued on a monthly basis. This is good for generic drugs and drugs that are used often. Amendments to the Drug Tariff. November 2017. Available at: https://www.nhsbsa.nhs.uk/pharmacies-gp-practices-and-appliance-contractors/drug-tariff/drug-tariff-updates. Accessed on 10 November, 2017.

[17] Available at: https://www.mims.co.uk/ Accessed on 10 November, 2017 and 3 January, 2018.

[18] Assumptions have been agreed in consultation with a lead GP working within TB.

Strategies and Challenges for Recruitment to Cohort 3

To recruit to Cohort 3, staff in GP practices searched their patient database using the necessary cohort criteria and producing a list of NHS numbers. A clerk then logged on to the EMIS system and entered each nine-digit NHS number to retrieve individual patient details. At this point the clerk checked each patient record for a mobile phone number or email address, indicating that the patient may have a Smartphone or Tablet and so suitable to participate. Patients were then contacted by the clerk to explain that their GP surgery was part of the Test Bed and that the doctor thought that they may benefit from taking part. If the patient was willing to take part, they were offered an appointment to attend a meeting at the surgery. Despite these efforts, recruitment to Cohort 3 was unsuccessful. Many patients did not have a mobile phone number and/or email address on file, limiting the number of patients that could be contacted.

Phase 2 interviews conducted with Cohort 3 patients also suggested that other factors may include: not being invited to take part by a healthcare practitioner known to the patient; that people in this cohort do not consider themselves to be unwell or to have a long-term condition; and that the technology being offered did not have an element of interaction or monitoring with healthcare staff.

Following discussion with NHSE, the LCIA took the decision to stop recruitment of Cohort 3 at an early stage. Whilst a small number of patients had been recruited to this cohort, and remained on the Test Bed, figures were too low to allow for any meaningful statistical analysis, hence these patients are not included in Phase 1 of the evaluation.

Health Related Quality of Life and Wellbeing of Test Bed participants

Changes in health and wellbeing were measured through validated instruments to assess health related-quality of life (HRQoL) and wellbeing of Test Bed participants and also through the more in-depth qualitative data discussed in other sections in this report.

For all cohorts, the following validated instruments were used: EQ-5D-5L; Patient Activation Measure (PAM13); Warwick-Edinburgh Mental Wellbeing Scale (WEMWBs); and the De Jong Gierveld Loneliness Scale.[19]

First, we report the number of participants to be included in the statistical analysis of the validated instruments used to assess HRQoL. We present the mean values per instrument at baseline, 12 and 24 weeks. We also show the sample size, maximum and minimum values per instrument and time point. Finally, we report these descriptive statistics per Vanguard site.

[19] Only patients judged by a clinician to have an acceptable level of cognitive function to give informed consent are invited to take part in the Test Bed. Therefore, the self-reported measures are valid for all the participants and proxy reporting is not included.

EQ-5D-5L

The EQ-5D is perhaps the most well-known and widely used generic preference-based measure of HRQoL for economic evaluation of health care technologies. It comprises five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression.[20] Each dimension requires the participant to complete one of five potential responses (scored 1 to 5) with a sliding scale for health on the day of survey completion (scored 1-100, with 1 = poorest health). To compute the index scores, we used the tariffs published for the English population (Devlin et al., 2018).

We report the EQ-5D-5L health profiles at all three time points and 95% confidence intervals per cohort. We used a correlation matrix to explore the correlation between the EQ-5D dimensions with sociodemographic variables.

PAM-13

Individuals' activation[21] was measured using the PAM-13 instrument, which provides two core metrics: the PAM score and the PAM level. The activation score is based on a 0-100 point scale (100 being the 'highest' activation score), with most individuals having activation scores between 30 and 90. The activation score is used to categorise individuals into one of four progressively higher levels of activation, level 1 being the lowest and level 4 the highest.[22]

The developers of PAM13 (Insignia Health®) require all PAMs data be sent to them for processing and calculation of the mean PAM score per level of activation. Hence the Evaluation Team did not compute these results directly. The percentage of the population who improved, declined, or did not change was calculated in comparison to other levels of activation due to Test Bed participation. We show the changes from baseline to 24 weeks for the overall Test Bed population and for Cohorts 1, 2, and 4.

WEMWBS

The Warwick-Edinburgh Mental Well-being Scale (WEMWBS)© is a useful tool for monitoring mental wellbeing. This instrument enables investigation of the determinants of mental wellbeing. It comprises 14 positively worded statements with five response categories from 'none of the time' to 'all of the time' with a two-week recall period. This tool provides a single score ranging from 14-70, with 14 being the 'lowest' wellbeing score and 70 the highest.[23]

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[20] Further details on Eq-5D-5L can be accessed at: https://euroqol.org/ Accessed on: 10 July 2016.

[21] Activated individuals are defined as those who have the knowledge, skills and confidence to self-manage their health. These three domains create an underlying human behavioural construct that allows individuals to be effective and efficient at self-managing their health or appropriately accessing care (Insignia Health. Patient Activation Measure (PAM) Practice Manual).

[22] Level 1 is defined as the 'Disengaged and overwhelmed' level; level 2 the 'Becoming aware, but still struggling'; level 3 the 'Taking action'; and level 4 'Maintaining behaviours and pushing forward' stage. For further reference see: ©2017 Insignia Health. Patient Activation Measure® (PAM®) Practice Manual. All rights reserved. ©2017 Insignia Health. Patient Activation Measure® (PAM®) Administration System. All rights reserved.

[23] See for reference: The Warwick Medical School available at:

The Evaluation Team calculated the WEMWBS scale using the information from the official user guide.[24] We show the mean index values of the score at all three time points and 95% confidence intervals per cohort.

De Jong Gierveld Scale

Perceived loneliness by Test Bed participants was measured using the De Jong Gierveld Loneliness Scale[25], a commonly used scale translated and validated in several European countries. The Jong Gierveld is a 11-item scale with three response categories, summed to provide a single score ranging from 0-11 (11 being the highest score or highest level of loneliness).

We estimated the De Jong Gierveld Loneliness score using the information from the Manual of the Loneliness Scale. We report the mean index values of the score at all three time points and 95% confidence intervals per cohort.

Healthcare Resource: Use and Cost

We provide a summary of the average service use reported by Test Bed participants and the average cost at each time point by cohort including the following services: hospital (A&E admissions, inpatient admissions, and outpatient attendance); primary care; social care; community mental health; and other community-based services (e.g. dentist, optician).[26]

Regarding the cost of technology, we report on the average cost per patient on technology and healthcare staff per Cohort using information from both Vanguard Sites

Regarding medication, we report on the number of medications taken by Test Bed participants by type of treatment (long, medium or short-term medications). We also report the average annual cost per patient.

Cost Analysis

In the following subsections we describe the methodology for the cost analysis including Cohorts 1 and 2.

Selecting the matched controls

We selected a control group, consisting of three controls per Test Bed participant, matched for gender, age, long-term condition, and predicted probability (risk) of hospital inpatient

https://warwick.ac.uk/fac/med/research/platform/wemwbs/ Accessed on: 15 August, 2016.

[24] User guide available at: https://warwick.ac.uk/fac/med/research/platform/wemwbs/researchers/userguide/wemwbs_user_guide_jp_02.02.16.pdf Accessed on: 15 August, 2016.

[25] Jong-Gierveld, J. D. (1999). Manual of the loneliness scale. Available at: https://research.vu.nl/ws/portalfiles/portal/1092113 Accessed on: 15 August, 2016.

[26] All costs refer to the use of healthcare resources reported by patients from October 2016 to April 2018.

admission. We performed the matching using a Mahalanobis distance algorithm without replacement of the selected controls. The main aim of the matching was to minimise any potential confounding effects of the matching variables and hence obtain a control group with similar characteristics to the Test Bed participants.

Outcome measures: secondary care utilisation

Our measures of secondary care use included A&E visits, outpatient appointments and inpatient admissions. In terms of inpatient admissions, we report the number of Test Bed participants admitted to hospital at baseline, 12 weeks, and 24 weeks.[27] For the purpose of this evaluation, we consider that a Test Bed participant has been admitted to hospital if they have reported a general hospital or community hospital inpatient admission. This includes elective admissions and pre-arranged hospital admissions.[28] Additionally we report A&E visits and outpatient appointments at each time point. When comparing the Test Bed participant figures with the controls at the three time points, we scaled the Test Bed results by a factor of four to make the data comparable for a one-year period. This is because we had data over one year for the controls. Hence, we compared the scaled baseline period for the Test Bed participants to the first 4-month period for the controls; the scaled 12 week survey results to the second 4 month period for controls; and the scaled 24 week survey results to the third 4 month period for controls.

We report the proportion of patients admitted to hospital for the control group over 12 months - additionally splitting this into three periods of four months to match the phasing of the three surveys. We also report this split by cohort. Finally, we also report accident and emergency use and outpatient appointments for the controls.

To compare the difference between the Test Bed participants and the control group we estimated the change in service use over the respective data collection periods. We then compared these changes between the two cohorts using a *z*-test for a difference in proportions.

A simple comparison of service use before and after the Test Bed intervention would not have included a control group as a baseline.

No contamination between the control group and Test Bed participants occurred because the Test Bed participants were excluded from the control sample. Additionally, the combination of technologies provided by the LCIA Test Bed was not available to the controls.

[27] We did not consider it necessary to adjust for seasonality because Test Bed participants were recruited from October 2016 to October 2017. As such we recruited participants at different times of the year hence any differences arising due to seasonality should average out across the participants.

[28] Elective inpatient admission data exclude emergency admissions or the transfer from a Hospital Bed in another Health Care Provider. Definition available at: https://www.datadictionary.nhs.uk/data_dictionary/nhs_business_definitions/e/elective_admission_de.asp?shownav=1 [Accessed on 1 July 2016].

The control data comes from the year prior to the implementation of the Test Bed programme. Therefore, we have data for the controls over a calendar year. Participants were active on the Test Bed over an 18 month period because they were recruited in waves throughout the Test Bed programme. Whilst recognising that seasonal variations in hospital admissions occur, it is our view that the results, for both controls and Test Bed participants, were not affected by such variations as data collection occurred over more than one calendar year (see Figure 4.1 for Test Bed recruitment trajectories).

For both controls and Test Bed participants we report within group differences in hospital admissions between the three respective time points for each group. We then report a difference in difference analysis between control and participant groups over 12 months. We also report this analysis for cohorts 1 and 2.

Statistical analysis was carried out using the statistical software Stata (version 14).

Methodology: Phase 2

Phase 2 of the evaluation was designed to complement Phase 1 and gain a more in-depth understanding of the impact of the intervention on patients, carers and the patient experience, as well as an understanding of the impact of the Test Bed on staff and staff working practices.

The following methods were used in Phase 2 of the evaluation:

- Observational interviews
- Staff diaries and action learning meetings
- Focus groups
- Deliberative panels
- Ranking activity
- Lessons learned activity
- Logic model and implementation process model

For ease of reference, a summary of the Phase 2 evaluation methods and participants is set out in Table 2.5 below.

Table 2.5. Summary of evaluation methods used in Phase 2 and participants

Phase 2 Methods	Phase 2 Participants			
	Patients (with carers as appropriate)	Staff delivering service	Other key stakeholders (technology innovators, voluntary sector, etc.)	Managers/ administrators
Observational interviews	Y	N/A	N/A	N/A
Staff diaries	N/A	Y	N/A	N/A
Action learning meetings	N/A	Y	Y	Y
Focus groups	N/A	Y	N	N
Deliberative panels	Y	Y	Y	Y
Ranking activity	Y	Y	Y	Y
Lessons learned activity	N/A	Y	Y	Y
Logic model	Y	Y	Y	Y

Patient observational interviews

Two sequential observational interviews were undertaken with each patient selected to take part in Phase 2 in their own home over the six-month period of the intervention: a) in the first month of participating in the programme; and b) during the final month (month six). The home-based setting was important as it facilitated a better understanding of participants' health status, health knowledge and activation prior to their participation in the programme, how they engaged with the service and used the technology within their own homes at the outset, and whether this changed over time. This approach was specifically designed to gain a more in-depth understanding of: how participants engage with and experience the technology and the Fylde Coast Vanguard / Better Care Together services; how this may influence patient activation and self-management of care; any barriers to improving self-care; whether the programme can increase their sense of empowerment and independence; service satisfaction; and overall quality of life. For interview protocols, see the Appendices.

Patients indicated their willingness to consider participating in Phase 2 of the evaluation through ticking a box on the Phase 1 consent form. More patients indicated a willingness to participate in Phase 2 than were required allowing us to select patients through a process of theoretical sampling. In particular we were concerned to sample as evenly as possible across all 4 cohorts, to consider gender, age (ensuring a spread of ages from younger old to oldest old), LTC and the combinatorial technologies being used. Where possible we also considered lone dwelling v living with a partner/family member.

Staff diaries and action learning meetings

All key stakeholders and service providers involved in the delivery of the service were invited to complete brief weekly diaries and participate in regular 'action learning' meetings, informed by the diary data, as part of a rapid cycle review process. Weekly diaries were completed by 21 members of staff involved in the Test Bed and the five action learning meetings were attended by 23 people in total. In the action learning meetings, members of the evaluation team met regularly with key stakeholders involved in the implementation and delivery of the service to reflect on shared learning, agreed action and the impacts of change. This included technology innovators, members of staff from the Test Bed hubs, voluntary sector providers and others.

Action learning meetings took place at three-monthly intervals and involved a cycle of discussion, shared learning and reflection, and agreed action to be taken forward regarding the operation, delivery and effectiveness of the service. Agreed action from these meetings built on this cycle of learning and assessment of the service throughout the Test Bed period. To facilitate discussion at these meetings, key stakeholders were asked to complete weekly diaries documenting their experiences of the service, including what works well and less well, and any observations of patients' responses to the service (time spent/support need/technical difficulties) (see Appendices). Diaries were brief and simple to complete and were designed to feed into the action learning meetings and to fine-tune themes for the focus groups and deliberative panels. Diaries were submitted electronically with participants being encouraged to keep a personal copy as an 'aide memoire' to reflect on prior to each action learning meeting.

Focus groups

Toward the end of the evaluation we held three focus groups with key members of staff involved in the delivery of the service, and a further four interviews with staff unable to attend the focus groups (N=16 participants in total). Our objective here was to recruit not only those directly involved in delivering the service to older participants but also those organising and managing it. Recruitment to the focus groups was split evenly across the two sites. The aim was to gain an in-depth understanding of how Fylde Coast Vanguard/Better Care Together services with the technology impacted on working practices. The focus groups also explored the extent to which the programme increased: communication between the care teams; productivity; capacity and co-ordination of care; and overall work satisfaction. For the focus group protocols, please see Appendices.

Deliberative discussions

In the final three months of the evaluation, we held two deliberative discussion groups (one per Vanguard site) with 27 key stakeholders, including: older participants; members of the Vanguard care teams; key stakeholders from clinical and community settings, and social care; innovators; and senior managers and commissioners from the Test Bed sites.

Deliberative discussion groups are designed to validate and fine-tune outcomes by producing an informed and collective view resulting from deliberation. They offer a bottom-up approach that can shift evaluation findings into outcomes related to policy, practice and guidance for

employers. To achieve this, draft findings emerging from the data analyses were presented with the aim of drawing on the various expertise of the participants.

In this evaluation, deliberative discussions helped to identify and validate those key components of the programme that would comprise a new model of care that may be scaled up for wider roll-out; and helped to finalise the evaluation recommendations. Finally, the discussion groups helped us to fine-tune the Logic Model through a process of 'backward mapping' (see below).

For a plan of the deliberative panels, see Appendix 25.

Ranking activity

At the end of each of the two deliberative discussion groups, participants were asked: 'What do you think are the most important things to come out of the LCIA Test Bed?' In small groups, participants identified their top three issues and shared these with the whole group.

Following the two deliberative discussion groups, key issues identified by participants were pooled together to form statements that represented feedback received from all the deliberative discussions. A brief survey was constructed using the survey software Qualtrics, containing two key themes: the first theme covered statements relating to patients and family carers; the second theme covered statements relating to members of staff.

The survey was then forwarded by email to all those who attended the deliberative panels (a paper version was produced and posted to one participant who had no email access). For each of the two themes, participants were asked to rank the statements in order of importance. The results of this ranking activity are discussed later in the report. See Appendix 26 for a full version of the ranking activity survey.

Lessons learned activity

In the early stages of the LCIA Test Bed, a 'lessons learned' activity was undertaken by members of the evaluation team to identify learning that might prove useful for similar complex multi-organisational programmes. Four focus groups and five individual interviews were undertaken with members of the LCIA Test Bed from the clinical operations groups (n=11), the technology innovators (n=4), the evaluation team (n=2) and the project management board (n=5). Data were transcribed and thematically analysed, with the results from this exercise also informing the development of the logic model, see Appendix 27.

Logic model

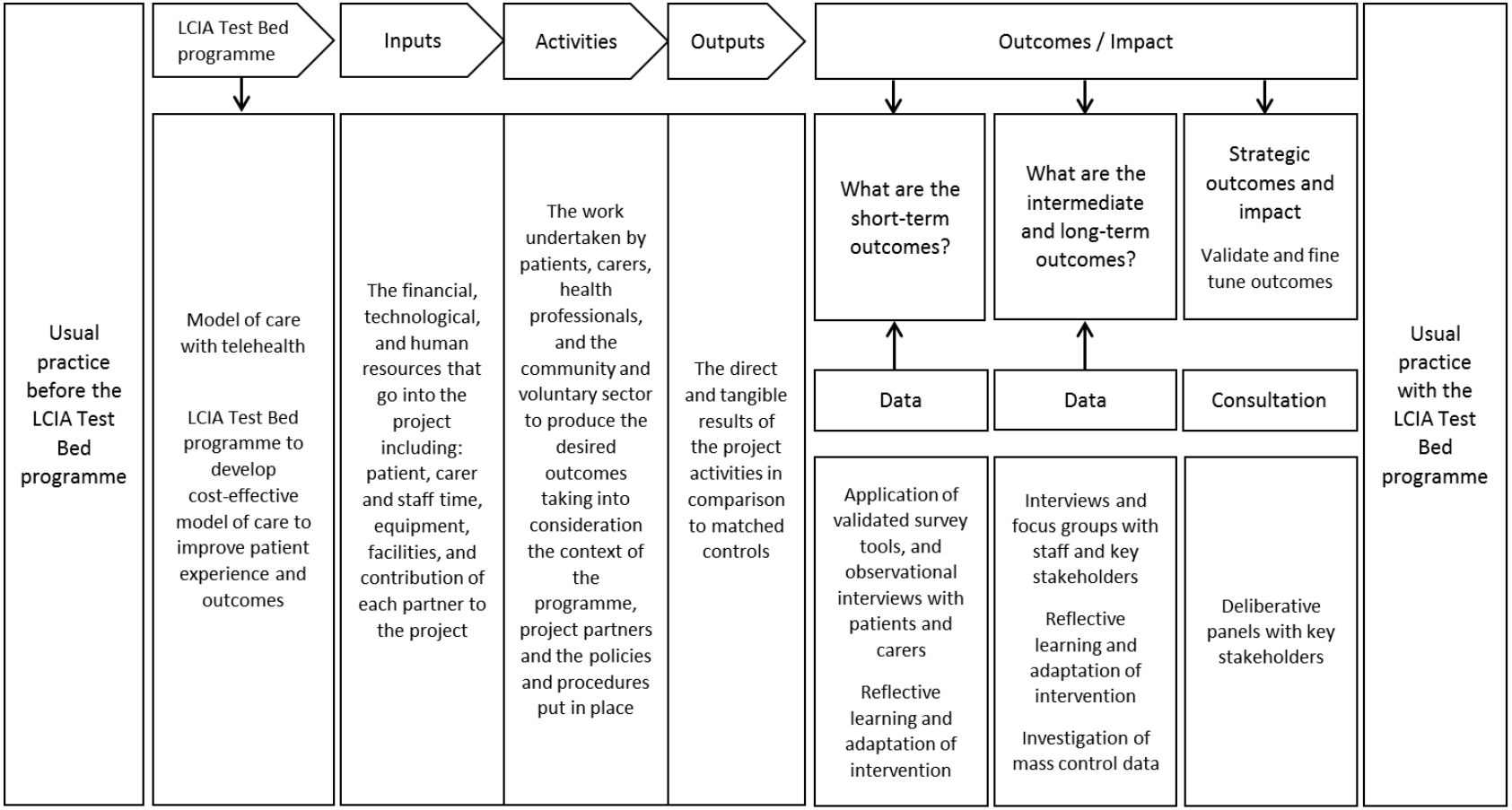
The evaluation is located within a logic model framework designed to develop understanding of the impact of the Test Bed programme. It also enables an understanding of the processes, management and participation required for wider rollout of a service of this kind using combinatorial technologies.

In developing the logic model, the following key elements were addressed:

- Activities – the focus of the logic model is the New Models of Care with Technology programme. The programme of work is considered in its context, including the partners of the project, and the policies and procedures that are in place.
- Inputs – the financial, human, organisational, and material resources of the project. This includes a range of stakeholders, including: older patients and carers; Fylde Coast Vanguard and Better Care Together teams; clinicians; GPs; community nurses; other health professionals; and innovator, voluntary and community sector input.
- Outcomes – the desired and actual results of the project and a logic model that will support roll out and scalability.

The initial version of the logic model is presented below in Figure 2.2.

Figure 2.2. Initial version of LCIA Test Bed evaluation logic model



The logic model is a process model – one that has been fine-tuned iteratively over the course of the Test Bed programme. The model has been informed by a number of data sources including the weekly diaries, the action learning meetings and the lessons learned activity.

In addition to these data sources, 12 interviews were conducted with 10 key stakeholders involved in the management and delivery of the Test Bed including clinical leads, general practitioners, nurses, project managers, team co-ordinators, and project evaluators.

These data aided understanding of the key resources and activities required to successfully roll out the Test Bed, and this information was used to populate the draft logic model. Several iterations of the model took place as new data was collected, and as the logical relationship between the different components (resources, activities, aims and outcomes) became clearer. During a biannual evaluation advisory board meeting, members provided feedback about the logic model which in turn led to further revisions.

The final version of the logic model that is presented later in this report was finalised through a process of 'backward mapping' during the final deliberative discussion group meetings. At each of these events, participants were presented with the full draft version of the logic model and invited to offer comments and suggestions, both in group discussion and through written annotations. In this way, the final logic model was developed by drawing on informed and collective views resulting from ongoing iteration and deliberation involving all key stakeholders involved in the development and implementation of the LCIA Test Bed.

Qualitative data analysis

All qualitative data was analysed thematically with the aid of Atlas.ti qualitative software. Identification of emerging themes and initial coding was undertaken by the field researcher then shared and agreed during evaluation team data analysis workshops. This allowed for the verification of the coding framework and enabled the evaluation team to develop an analysis of the situation. The coding framework was also shared with the Evaluation advisory board. The major codes emerging from the data were presented to the deliberative panels for fine-tuning and final verification.

3. FINDINGS

The findings are discussed in two main sections reflecting the analyses of Phase 1 and Phase 2 respectively. Phase1 findings are presented in three main subsections; recruitment, descriptive statistics (including resource use of Test Bed participants), and cost-effectiveness analysis. Our analysis relates to the Test Bed population overall and to individual cohorts.

The Phase 2 findings focus on the experiences of patients and carers of engaging with the Test Bed programme, its impact on their lives and their sense of subjective health and wellbeing. It also addresses the impact of the Test Bed on the working lives of staff involved in the programme. This is followed by the discussion of the final Logic Model.

Findings: Phase 1

Recruitment

Recruitment of participants started on October 2016 and finished on October 2017. Recruitment targets were based on a completion rate of 70-80% of the original target of 1,600 patients. However, significant delays occurred with the recruitment process.[29] To address the challenges for recruitment resulting from these delays, revised recruitment trajectories were agreed by the Board and a three-month extension was also granted by NHS England in June 2017. Recruitment to Cohort 3 proved problematic for this age/risk group and recruitment to this Cohort ceased following discussion and agreement with NHS England.[30]

Table 3.1. Revised Trajectories as of June 2017

September 17	Cohort 1	Cohort 2	Cohort 3	Cohort 4	Totals
Fylde Coast	150	140	250	22	562
BCT	250	250	250	23	773
Total	400	390	500	45	1335
Target	500	500	500	100	1600
%	80%	78%	100%	45%	83%

Despite the extension, final recruitment to the Test Bed was significantly below the original and revised targets. A total of 740 participants consented to take part in the Test Bed with 460 completing the 24-week programme by the end of April 2018 and as such, considered active in Phase 1 of the Evaluation. The number of participants recruited and active is presented in Table 3.2.

[29] Delays in recruitment were due to a number of factors including: longer than anticipated time to advertise and appoint the right staff to run the overall programme and to implement the Test Bed within the Vanguard sites; resistance from some clinicians who felt excluded from the original bid due to tight timescales leading to lack of 'buy-in' to the programme; significant delays in final sign off of the Collaboration Agreement; the need to write then amend technology protocols in line with clinical requirements.

[30] This group consisted of those aged 55+ with a long-term condition but a lower than 10% risk of admission. As these individuals were effectively already living well with their condition they had limited contact with health services making it challenging for GPs and other health services to readily identify them.

Final recruitment reached 46% (740/1,600) of the original target, though dropout, attrition and incomplete data resulted in the Test Bed having only 460 active participants in Phase 1 of the Evaluation. These figures are shown in column D in Table 3.2. In Cohort 1, active participants across both Vanguard sites reached 44% (218/500); in Cohort 2 recruitment reached 40% (201/500); Cohorts 3 and 4 reached only 5% and 15%, of the initial target respectively.

Prior to Cohort 3 being laid down, a small number of patients had been recruited. In discussion with the clinical teams, it was agreed to continue these patients on the Test Bed. Whilst numbers were too small for statistical analysis, these were followed up qualitatively in Phase 2 of the evaluation.

Table 3.2. Recruitment to Test Bed by Vanguard and Cohort: October 2016 to April 2018

Cohort	A. No. recruited participants			B. No. active participants (participants in Phase 1 Evaluation)			C. Initial Recruitment Target	D. Active participants over recruitment target B / C (%)
	BCT [a]	FC [b]	Total	BCT [a]	FC [b]	Total	Total	%
1	223	149	**372**	181	37	**218**	**500**	**44**
2	202	93	**295**	148	53	**201**	**500**	**40**
3	17	29	**46**	15	11	**26**	**500**	**5**
4 [c]	27		**27**	15		**15**	**100**	**15**
TOTAL	**740**			**460**			**1,600**	**29**

Notes:

[a] BCT= Better Care Together Vanguard Site

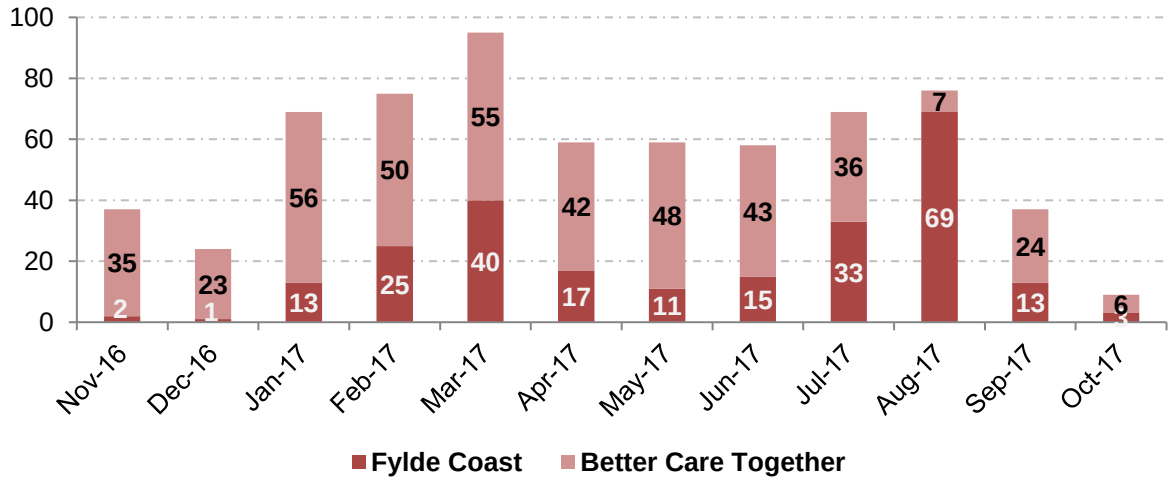
[b] FC=Fylde Coast Vanguard Site

[c] Participants for Cohort 4 are being recruited through the Memory Assessment Service (MAS) in Fylde & Wyre and Better Care Together.

Recruitment process

Figure 3.1 below shows the overall trajectory of recruitment of participants for Cohorts 1 and 2 and the trajectories by Vanguard site from October 2016 to October 2017. Figures vary between the two Vanguards. Recruitment rates in Fylde Coast reveal an irregular pattern, throughout the recruitment period. The maximum number of participants recruited was reached in August 2017. It is likely that these recruitment patterns in Fylde Coast were the result of various factors, but mainly by staff absences and changes in staff working on the Test Bed. The Fylde Coast appears to have made a concerted effort to increase recruitment in the final months of the programme.

Figure 3.1. Recruitment trajectories of participants in Cohorts 1 and 2 across Vanguard Sites: October 2016 to October 2017



Note: Recruited Test Bed participants to Cohort 1 and 2= 667; Fylde Coast (FC)= 242; Better Care Together (BCT)= 425.The figure shows recruited participants and not active participants recruited.

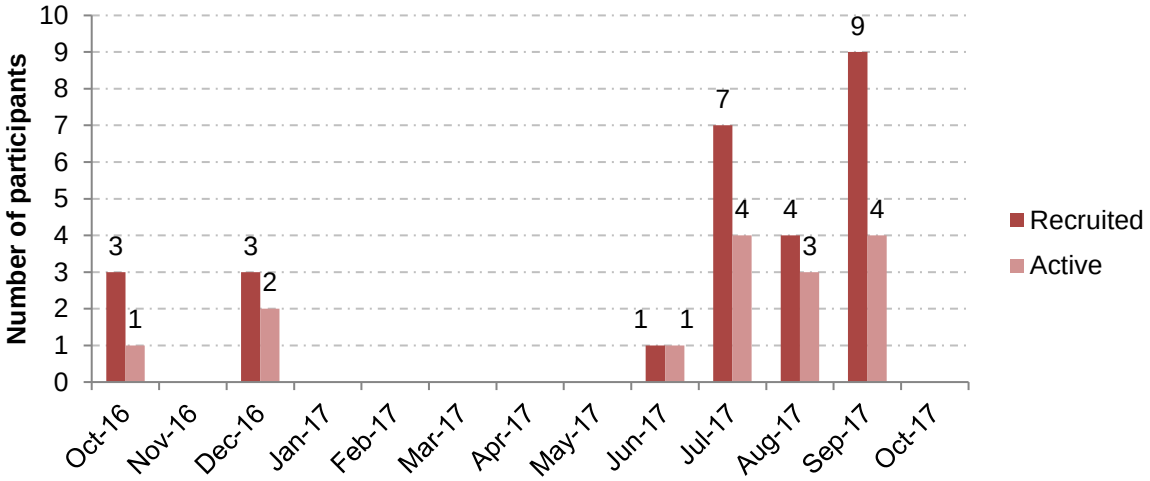
In Better Care Together, recruitment rates reveal a steadier pattern of recruitment across the programme, enrolling between 35 and 50 participants per month between January and July 2017. This suggests a more persistent engagement with the intervention but may also be linked to the different delivery model used in Better Care Together to implement the Test Bed. Further reflections on these differences in recruitment are included in the discussion section of the report.

Recruitment to Cohort 4

A total of 27 participants consented to take part in Cohort 4 of the Test Bed with 15 participants remaining active on the programme. The initial recruitment target was 100 participants, hence the recruitment rate reach 15% of the original target (15/100).

Figure 3.2 shows the trajectory of overall recruitment to this cohort. No participants were recruited on November 2016 and from January to June 2017.

Figure 3.2. Recruited and active participants for Cohort 4: October 2016 to October 2017



Attrition

Attrition during the Test Bed was high. A total of 280 patients initially recruited to the programme withdrew due to a range of factors (see Table 4.8). The main reasons given for withdrawal being: an inability to get on with the technology (N=83, 30%), discharge from the Extensive Care Service[31] among participants in Fylde Coast (N=47, 17%), or a decline in health (N=46, 16%). Thirty-eight patients declined to give a reason for withdrawal (14%). A total of 23 patients became deceased during the 24 week programme.

High attrition rates also reflect the general health and frailty of the Test Bed population, raising diverse challenges related to the study of the effect of interventions on high-risk population.

In the Fylde Coast 152 patients recruited to Cohort 1 and 2 withdrew from the programme compared to 96 patients that did not complete the 24-week Test Bed programme in Better Care Together. It is also worth noting that the number of participants withdrawing from the Test Bed in the Fylde Coast due to an inability to get on with technology (46) was double that of Better Care Together (24). We are unable to say definitively why this difference occurred but again it may be linked to the different model of implementation used within the two Vanguard sites. Attrition due to declining health across Vanguard sites is similar in absolute terms. Drawing on our qualitative data, we explore in more detail reasons why some patients did not get on with the technology in Phase 2 of the evaluation.

Given the lower than anticipated recruitment figures (particularly in the Fylde Coast) and attrition rates across both Vanguards, final results in Cohorts 1 and 2 are heavily skewed toward Better Care Together. In other sections in this report, we explain further the limitations of the recruitment numbers and the implications for the evaluation.

[31] Due to delays in deployment of the technologies due to the writing and rewriting of new technology protocols, a good number of patients originally consented to the Test Bed within the Fylde Coast Vanguard had completed their 6 months on the Extensive Care service before the revised protocols were ready. Clinicians felt unable to retain these patients on Extensive Care for a further six months to facilitate the Test Bed, hence these 47 patients were withdrawn from the programme. See also for reference. NHS Blackpool Clinical Commissioning Group (2017) 'Extensive Care'. Available at: http://blackpoolccg.nhs.uk/local-services/new-models-of-care/extensive-care/ [Accessed on 20 November 2017].

Table 3.3. Attrition: Drop-out and Non-Active Test Bed Participants, April 2018

Reason	Fylde Coast Cohort			Better Care Together Cohort				Total
	C1	C2	C3	C1	C2	C3	C4	
Not contactable / unreachable		2	7	2	20			31
Move of residence		1						1
Did not get on with technology	19	27	7	10	14	1	5	83
Decline of health	16	2	2	13	7	1	5	46
Consent/questionnaire to long/upsetting				2	3			5
Other or rather not say	18		2	10	8			38
Deceased	12	2		5	2		2	23
Discharged from Extensive Care	47							47
Removed from study by clinical team		6						6
Total	**112**	**40**	**18**	**42**	**54**	**2**	**12**	**280**

Descriptive statistics

A total of 308 Test Bed participants (293 in Cohorts 1 and 2, and 15 patients in Cohort 4) were included in the statistical analysis in Phase 1 of the evaluation as illustrated in Table 3.4.

Table 3.4. Test Bed participants included in the statistical analysis of the validated instruments to assess Health Related Quality of Life and wellbeing

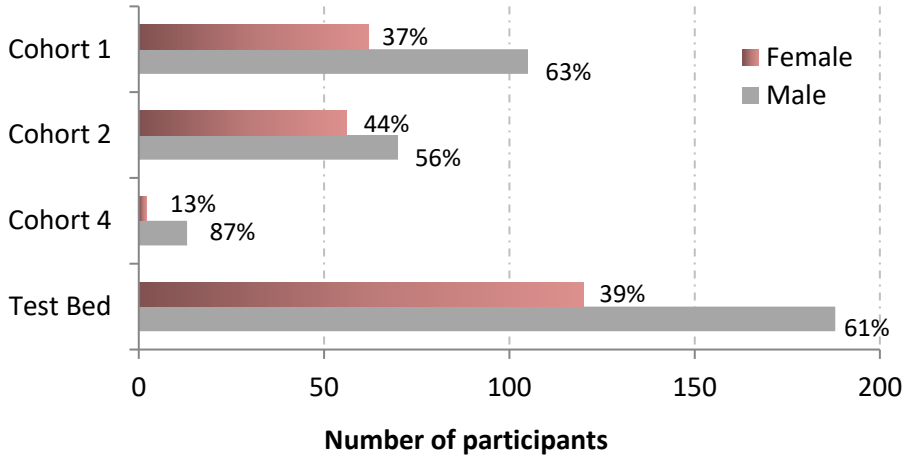
Vanguard Site	Cohort		Total	Cohort 4*
	1	2		
Fylde Coast	31	39	**70**	**15**
Better Care Together	136	87	**223**	
Total	**167**	**126**	**293**	**15**

*Participants for Cohort 4 are being recruited through the Memory Assessment Service (MAS) in the Fylde Coast and Better Care Together Vanguard Sites. For illustration purposes Cohort 4 is shown in a separate column.

Socio-demographic characteristics of Test Bed participants

Table 3.5 below illustrates the socio-demographic characteristics of Test Bed participants. Of the 308 Test Bed participants included in Phase 1 of the Evaluation, 120 were female (39%), and 188 (61%) were male. In each cohort there was a higher proportion of men (Figure 3.3). Appendix 5 illustrates the education level and employment condition of Test Bed patients.

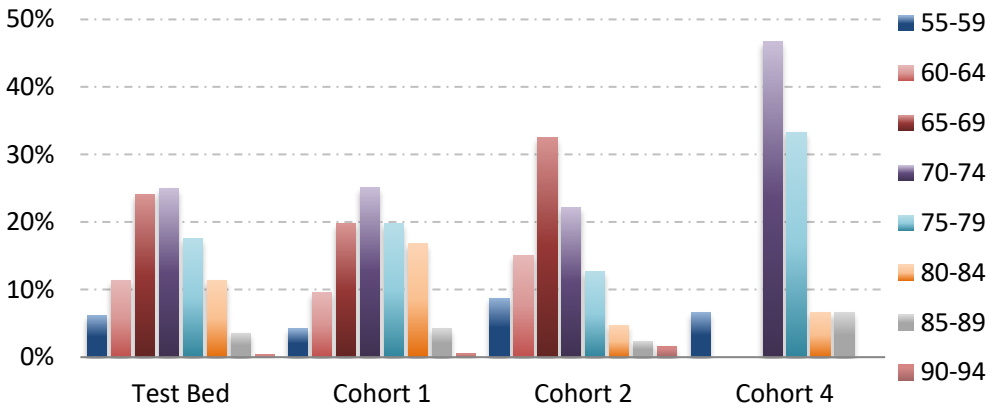
Figure 3.3. Number and Percentage of Participants by Gender and Cohort



Source: Test Bed, Information from 14 October 2016 to 27 April 2018.

Figure 3.4. Percentage of Participants by Age Group and Cohort shows the age distribution of participants by cohort. The mean age of participants was 71.6 years. On average, participants in Cohort 1 were 72.8 years of age. The average age in Cohort 2 was 69.6 years, and in Cohort 4 the average age was 75 years - and hence they were the oldest group in the Test Bed.

Figure 3.4. Percentage of Participants by Age Group and Cohort



Source: Test Bed, Information from 14 October 2016 to 27 April 2018.

There was little ethnic diversity within the Test Bed population (see Table 3.5). This reflects the ethnic make-up of the population of the two Vanguard sites. Aggregate data for the footprint of these two Vanguard areas, drawn from the 2011 Census, shows that 99% of people aged 55 years or above defined their ethnicity as White;[32] 98% of Test Bed participants also described themselves as White. Most of the participants were married or living in civil partnerships (58%) although nearly 32% of participants lived alone.[33] These figures were very

[32] According to 2011 Census aggregate data, in Blackpool and Lancaster area, 99% of people aged 55 years or above defined their ethnicity as White. Source: Office for National Statistics; National Records of Scotland; Northern Ireland Statistics and Research Agency (2016): 2011 Census aggregate data. UK Data Service (Edition: June 2016). DOI: http://dx.doi.org/10.5257/census/aggregate-2011-1

[33] As the aim of the Test bed was to support older people with LTCs to better self-care at home, no Test Bed participants were recruited from nursing or residential care settings.

similar across both Cohorts 1 and 2. For example, in Cohort 1, 32% of patients lived alone and in Cohort 2 34% lived alone. The proportion of patients with early-mid stage dementia in Cohort 4 was considerably lower at only 7%.

In terms of educational status, the majority of Cohort 1 patients had completed secondary school (57%) with 40% of them completing college or university level education. In Cohort 2, 62% and 34% respectively completed these education levels. On average, men in Cohort 1 were better educated than women, but this pattern was reversed in Cohort 2 where women were more educated than men (see Figure A in Appendix 5).

As expected, given the target age group for this Test Bed, around 84% of all Test Bed participants were retired (Figure B in Appendix 5). Around 86% of Cohort 1 participants were retired compared to 80% in Cohort 2 and 93% in Cohort 4.

Around 80% of the Test Bed population overall already had access to the internet at recruitment, this figure was similar across patients in both Cohorts 1 and 2.

Appendix 6 details the background characteristics of the participants at baseline in each Vanguard site.

Table 3.5. Background characteristics of the Test Bed population at baseline

		Cohort 1 (n=167) ***N (%)***	**Cohort 2 (n=126)** ***N (%)***	**Cohort 4 (n=15)** ***N (%)***	**Test Bed population (n=308)** ***N (%)***
Gender					
Male		105 (62.9)	70 (55.6)	13 (86.7)	188 (61.1)
Female		62 (37.1)	56 (44.4)	2 (13.3)	120 (38.9)
Age					
[55,59]		7 (4.2)	11 (8.7)	1 (6.7)	19 (6.2)
[60,64]		16 (9.6)	19 (15.1)	-	35 (11.4)
[65,69]		33 (19.8)	41 (32.5)	-	74 (24.0)
[70,74]		42 (25.1)	28 (22.2)	7 (46.7)	77 (25.0)
[75,79]		33 (19.8)	16 (12.7)	5 (33.3)	54 (17.5)
[80,84]		28 (16.8)	6 (4.8)	1 (6.7)	35 (11.4)
[85,89]		7 (4.2)	3 (2.4)	1 (6.7)	11 (3.6)
[90,94]		1 (0.6)	2 (1.6)	-	3 (0.9)
Average		72.78	69.59	75	71.59
Ethnicity					
White		165 (98.8)	123 (97.6)	15 (100)	303 (98.4)
Mixed		-	1 (0.8)	-	1 (0.3)
Other		1 (0.6)	-	-	1 (0.3)
Prefer not to say		1 (0.6)	2 (1.6)	-	3 (0.9)
Marital Status					
Single		12 (7.2)	10 (7.9)	1 (6.7)	23 (7.5)
Married		92 (55.1)	70 (55.6)	13 (86.7)	175 (56.8)
Civil Partnership		2 (1.2)	1 (0.8)	-	3 (0.9)
Separated		-	2 (1.6)	-	2 (0.6)
Divorced		26 (15.6)	16 (12.7)	-	42 (13.6)
Widowed		35 (21)	24 (19)	1 (6.7)	60 (19.5)
Prefer not to say		-	3 (2.38)	-	3 (0.9)
Living arrangements		102 (61.1)	76 (60.3)	14 (93.3)	192 (62.3)

		Cohort 1 (n=167) *N (%)*	Cohort 2 (n=126) *N (%)*	Cohort 4 (n=15) *N (%)*	Test Bed population (n=308) *N (%)*
Spouse/partner					
	Living alone	53 (31.7)	43 (34.1)	1 (6.7)	97 (31.5)
	Parent(s)	1 (0.6)	-	-	1 (0.3)
	Children	18 (10.8)	3 (2.4)	-	21 (6.8)
	Friend(s)	-	-	-	-
	Other	9 (5.4)	5 (3.9)	-	14 (4.5)
	Spouse and children	13 (7.8)	1 (0.8)	-	14 (4.5)
Education					
None		1 (0.6)	3 (2.4)	-	4 (1.3)
	Primary school	2 (1.2)	-	-	2 (0.6)
	Secondary school	95 (56.9)	78 (61.9)	8 (53.3)	181 (58.8)
	College	44 (26.3)	32 (25.4)	5 (33.3)	81 (26.3)
	University	23 (13.8)	11 (8.7)	2 (13.3)	36 (11.7)
	Prefer not to say	2 (0.6)	2 (0.6)	-	4 (1.3)
Employment	Employed full time	2 (1.2)	5 (4)	-	7 (2.3)
	Employed part time	9 (5.4)	8 (6.3)	-	17 (5.5)
	Unable to work due to caring responsibilities	-	1 (0.8)	-	1 (0.3)
	Unable to work due to ill health	9 (5.4)	9 (7.1)	1 (6.7)	19 (6.2)
	Unemployed	1 (0.6)	-	-	1 (0.3)
	Retired	144 (86.2)	101 (80.2)	14 (93.3)	259 (84.1)
	Voluntary	2 (1.2)	1 (0.8)	-	3 (0.9)
	Prefer not to say	-	1 (0.8)	-	1 (0.3)
Access to the internet	No	31 (18.6)	22 (17.5)	1 (6.7)	54 (17.5)
	Yes	133 (79.6)	100 (79.4)	13 (86.7)	246 (79.9)
	Intermittent or poor quality	2 (1.2)	3 (2.4)	1 (6.7)	6 (1.9)
	Prefer not to say	1 (0.6)	1 (0.8)	-	2 (0.6)

Notes:

[a] Living arrangements categories are not mutually exclusive.

[b] Percentages may not add up to 100% due to rounding.

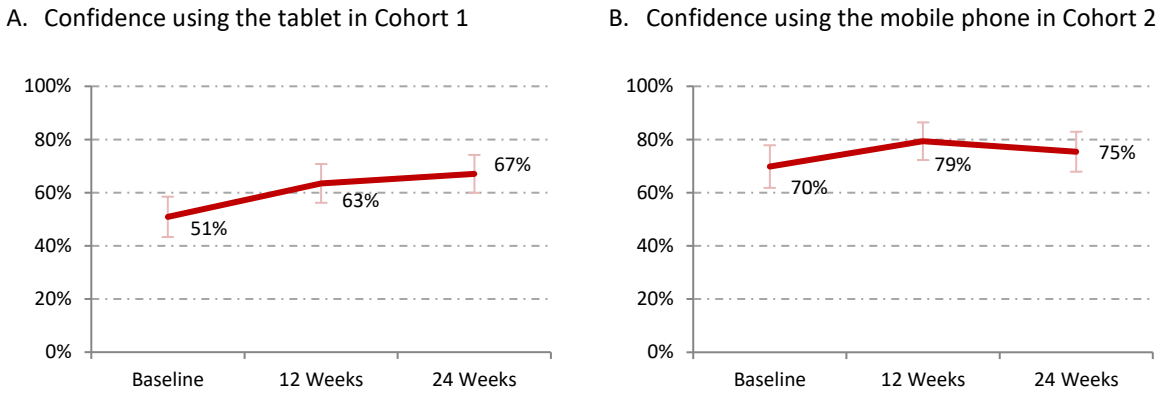
Confidence with technology

Data from the Phase 1 survey reveal that Test Bed participant confidence with the use of technology varied across devices, cohorts and across the timespan of the intervention. Patients were given access to different combinations of technology depending on the cohort and Vanguard that they were assigned to and their specific LTC.

Among the 308 participants included in this analysis, the tablet and Motiva platform were the main technology in the care pathway for Cohort 1 patients; Flo (the text messaging service for patients using a mobile phone) was the main technology given to Cohort 2 participants in Better Care Together, whilst the health watch the main technology given to Cohort 2 patients in the Fylde Coast. Hence Cohort 2 patients received different care pathways and combinations of technology across the two Vanguard Sites. Further information about the care pathways is included in the section of the technology costs in this report.

Figure 3.5 illustrates that when comparing baseline to week 24, there was a statistically significant increase in the proportion of Cohort 1 participants who felt more confident using tablets (Part A). Among Cohort 2 participants, there was a slight increase in confidence with the use of mobile phones; however, this change was not statistically significant (Part B).

Figure 3.5. Participants indicating they felt confident or somewhat confident with the use of technology at baseline, 12 weeks and 24 weeks (%).



Notes: Percentages were calculated per device. For instance: 42% of participants felt confident using a mobile phone, 29% felt somewhat confident, 22% did not feel confident, and 7% did not respond to this question.
Non-response rate in the level of confidence on technology at baseline ranges from 6% to 11%. At 12-weeks, non-response rate goes from 13% to 23% and at 24-weeksranges from 10% to 16%.
Vertical bars represent 95% Confidence Intervals.

As numbers in Cohorts 4 were low, analysis of confidence with technology is not included in this report. Appendix 7 presents the percentage of participants self-defining as confident or somewhat confident with other types of technology including smartphone and computer per Cohort.

Health related quality of life and wellbeing of Test Bed participants

Analyses of the Phase 1 data from the 308 participants who completed the Test Bed programme show little change in overall health and wellbeing. However, the data reveal that patient activation for those with the lowest level of activation did improve during the period of the intervention across all cohorts.

Table 3.6 presents a summary of the mean values of the validated instruments in all Cohorts, with the following sections presenting a more detailed analysis of the figures shown. Information on the sample size used to calculate the mean of each validated instrument and the average values per Vanguard site are presented in Appendix 8 and Appendix 9.

Table 3.6. Mean Values of Validated Instrument to Assess Health Related Quality of Life and Wellbeing of Participants at Baseline, 12 weeks and 24 Weeks Intervention

Instrument	Cohort 1 (N=167)			Cohort 2 (N=126)			Cohort 4 (N=15)			Test Bed population (N=308)		
	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks
EQ-5D-5L	0.67	0.69	0.67	0.74	0.73	0.74	0.74	0.75	0.74	0.70	0.70	0.70
PAM13	60.26	59.60	61.68	61.37	61.88	61.13	48.25	47.29	47.09	60.13	59.93	60.75
WEMWBS	51.42	50.94	50.96	50.75	50.41	50.66	46.07	47.20	46.25	50.85	50.52	50.58
De Jong Gierveld	4.04	4.21	4.13	3.99	3.97	4.31	3.64	3.57	3.71	4.00	4.08	4.18

Notes:

[a] Decimal figures are rounded to the nearest hundredth.

[b] EQ-5D-5L, PAM13 and WEMWBS scores, the higher the value the better quality of life. In the DeJong Gierveld score, the lower the value the better (less loneliness).

[d] The EQ-5D-5L index values have been calculated considering data at all time points on 288 participants. The PAMs scores were estimated using data on 308 patients. The WEMWBS was calculated considering data on 280 participants and the De Jong Gierveld Scale on 273 participants. Exclusion of participants is due to non-response and methodological considerations per instrument.

Source: Test Bed, Information from 14 October 2016 to 27 April 2018.

EQ-5D-5L

Health profiles

Varying proportions of participants reported having health related quality of life related issues for each of the five EQ-5D-5L dimensions across cohorts at all three time points. In the overall Test Bed population the mean value of all dimensions (apart from self-care) decreased slightly. [34] However, the overall data mask differences between Cohorts 1 and 2, with a slight improvement in mobility (from 2.68 at baseline to 2.65 at 24 weeks), usual-activity (from 2.62 at baseline to 2.54 at 24 weeks), pain/discomfort (from 2.44 at baseline to 2.25 at 24 weeks) and anxiety (from 1.66 at baseline to 1.64 at 24 weeks) among Cohort 1 patients. In Cohort 2, there was a slight increase in mobility (from 2.22 at baseline to 2.20 at 24 weeks) and anxiety (from 1.62 at baseline to 1.59 at 24 weeks). Figure 3.6 illustrates the mean value of each of the EQ-5D-5L dimensions over the course of the intervention.

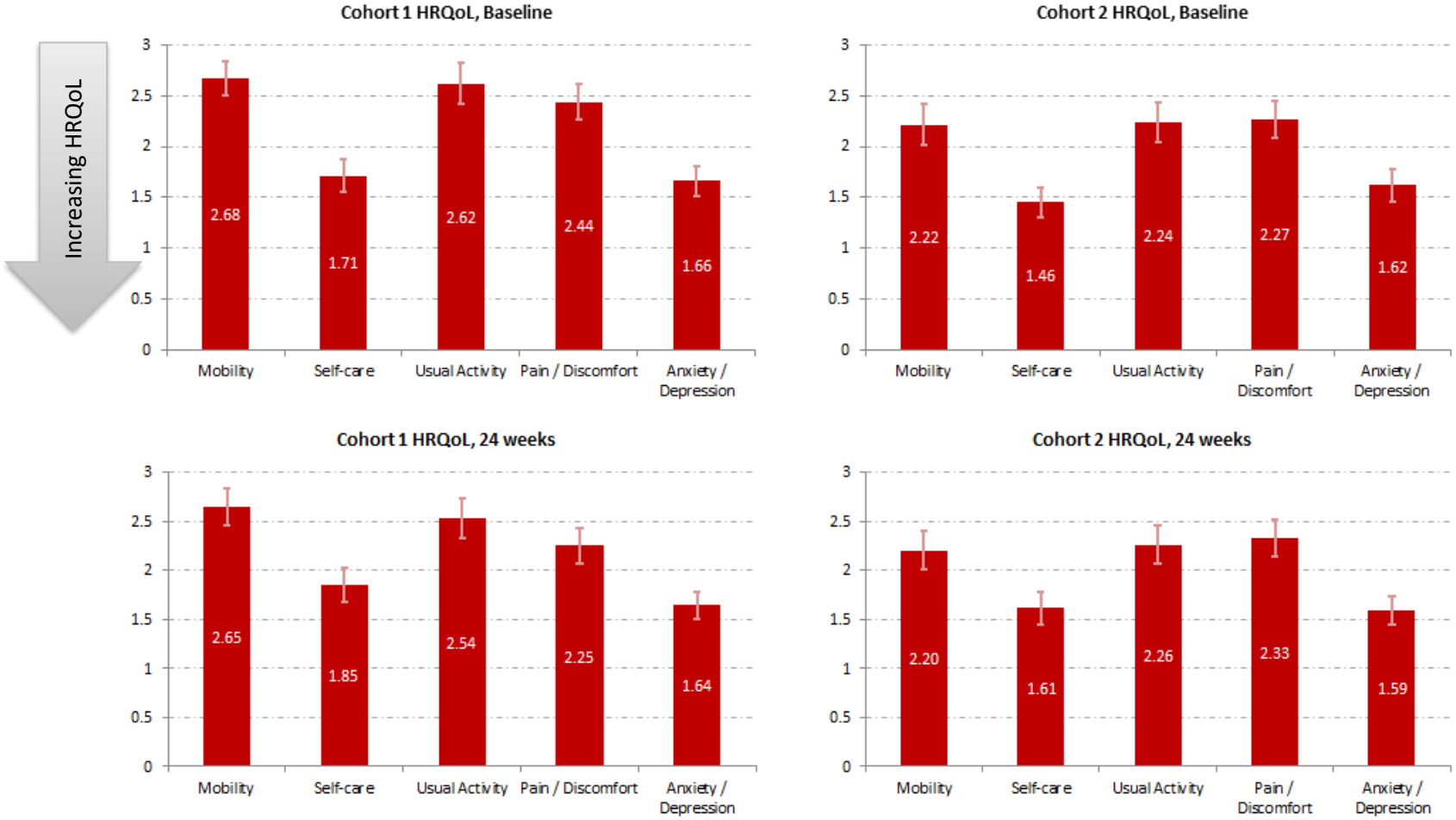
Using a correlation matrix of pairwise correlations between EQ-5D-5L dimensions and socio-demographic variables, the data shows that for Cohort 1 patients, being a woman is positively correlated with problems in a number of dimensions including: mobility, self-care, pain/discomfort, and anxiety/depression (statistically significant at the 5% level). However, we found no statistically significant correlation between being a woman and any dimensions in Cohort 2 (see Appendix 10 and Appendix 11).

Regarding the relationship between age and quality of life dimensions, among Cohort 1 participants, age was negatively correlated with three of the EQ-5D-5L dimensions: self-care, pain/discomfort, and anxiety/depression (statistically significant at the 5% level).[35] This means that older people reported having fewer problems in these particular dimensions, which potentially reflects participants' ability to adapt to impairments over time.

[34] The higher the mean in each dimension of the Eq-5D-5L, the more significant or higher the problem related to that dimension.

[35] Correlation matrix coefficients significant at the 5% level.

Figure 3.6. Health related quality of life per dimension by cohort at baseline, 12 weeks, and 24 weeks of intervention: mean values

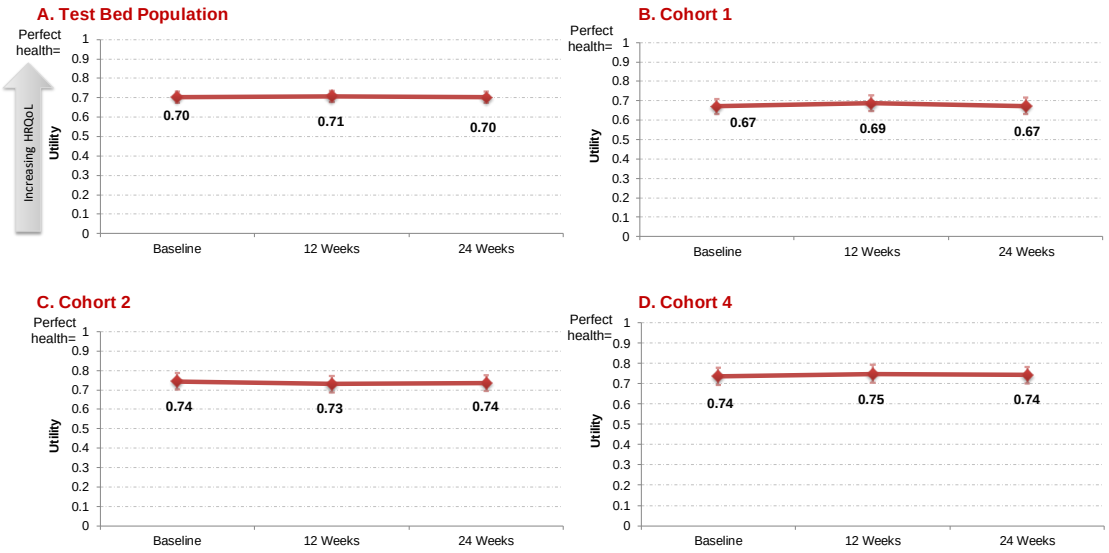


Notes: [a] EQ-5D-5L level values: No problems (1); Slight problems (2); Moderate problems (3); Severe problems (5); Extreme problems (5). EQ-5D-5L statement levels range from 1 to 5 (1 means no problem and 5 means unable). Therefore, the higher the mean in each dimension more significant is the problem.
[b] The maximum sample size for the Test Bed population is 288; 157 for Cohort 1; and, 116 for Cohort 2. Sample size at each time point is shown in Appendix 8.
[c] Vertical bars represent 95% confidence intervals. [d] Information per Cohort at 12 weeks is not shown.

EQ-5D-5L Index

The EQ-5D-5L index values were calculated to assess HRQoL at baseline, week 12, and week 24. Figure 3.7 illustrates the mean EQ-5D-5L index values and 95% confidence intervals for each of the Cohorts and the overall Test Bed population.

Figure 3.7. EQ-5D-5L Index Values at baseline, 12 weeks, and 24 weeks of intervention: mean values



Notes:

[a] Decimal figures are rounded to the nearest hundredth.

[b] Vertical bars represent 95% Confidence Intervals. The mean EQ-5D-5L index values have been calculated considering data on 288 participants. Non-response from participants has been excluded.

[c] The EQ-5D-5L Value Set for England was used to obtain the EQ-5D-5L index values.

Source: Devlin, N., Shah, K., Feng, Y., Mulhern, B., & van Hout, B. (2017). Valuing health-related quality of life: an EQ-5D-5L value set for England. Health Economics. In England, problems with pain/discomfort and anxiety/depression were the most important factor in overall quality of life.

[d] The higher the EQ-5D-5L index values the better in terms of health-related quality of life level of patients.

Test Bed, Information from 14 October 2016 to 27 April 2018.

The mean EQ-5D-5L index value in the population at baseline is 0.70 and varies slightly from the estimated mean of the index score for England of 0.662.[36] This would suggest that, overall, participants within the Test Bed have slightly better health-related quality of life than the overall English population. However, this figure needs to be treated with caution as the Test Bed population does not have the same make-up as England as a whole.

[36] Mulhern et al. (2017) have recently estimated the mean of the index score in England is 0.662. See for reference: Mulhern, B.; Feng, Y.; Sha, K.; van Hout, B; Janssen, B., Herdman, M.; Devlin, N. Comparing the UK EQ-5D-3L and the English EQ-5D-5L Value Sets. March 2017. Office of Health Economics. Research Paper 17/02. Please note that this mean of the index score has been estimated using the EQ-5D-5L Value Set for England in Devlin, et al (2017) Valuing Health-Related Quality of Life: An EQ-5D-5L Value Set for England. Office of Health Economics. Research Paper 16/01.

Recently, Devlin et al (2017) published an updated EQ-5D-5L Value Set for England, so the mean of the index score might be slightly different.

Part A in Figure 5.6 shows the mean EQ-5D-5L index values of the Test Bed population. At all time points this value was around 0.70. The data did not show any change that was statistically significant (either in the overall Test Bed population or by cohort).[37] Parts B to D in Figure 5.6 reveal that there was no statistically significant change across Cohorts 1, 2, and 4 participants. As expected, Cohort 2 patients were seen to have better health-related quality of life (i.e. having a higher EQ-5D-5L index score) than those in Cohort 1. Patients in Cohort 4 showed similar results to those in Cohort 2.

In summary, analysis of the EQ-5D-5L data revealed that, on average, there was no statistically significant change in the health status of patients participating in the Test Bed programme.[38]

PAM-13

Table 3.7 illustrates the numbers of Test Bed patients sitting within each initial PAM level and the mean PAM score for the Test Bed population at baseline and week 24, together with levels of change to the mean PAM scores, by number and percentage change.

The developers of the PAM measure, Insignia Health®, note that emphasis should be placed upon monitoring the impact on patients in activation level 1 (defined as the 'Disengaged and overwhelmed') and 2 (defined as the 'Becoming aware, but still struggling'). These are the two lowest levels of activation, where gains are greatest and most important.

The average PAM score at baseline of the Test Bed participants was 60.13. In Cohort 1, the average PAM score was 60.26 and in Cohort 2 it was 61.37. This means that those in Cohort 2 had a higher level of activation at baseline than those in Cohort 1. Approximately half of the Test Bed population - a total of 48.4%: comprising 16.9% of patients in level 1 (categorised at 'disengaged and overwhelmed') and 31.5% in level 2 (categorised at 'becoming aware, but still struggling') reported to be in the two lowest levels of activation at baseline.[39] However, the overall data mask differences between Cohorts 1 and Cohort 2. Around 51% of Cohort 1 participants were in the two lowest levels of activation, compared to 43% of Cohort 2 participants who were in the lowest levels of activation. This is unsurprising given the difference in risk levels between two groups.

Following the approach to assessing the correlation of the Test Bed programme with patient activation set out by Insignia Health®, we calculated the score change within each activation level from baseline to end point. To calculate the change, we followed patients within each of the four levels of activation and compared the mean point change of PAM score from baseline to 24 weeks. As illustrated in Table 3.7, the mean PAM score of the overall Test Bed

[37] There is no evidence against the null hypothesis that there is 'no difference' between the mean EQ-5D-5L index values at baseline, at week 12 and at week 24. This means the change is not statistically significant, as can be appreciated by the fact that there is an overlap of the 95% confidence intervals across time periods (shown in 4.8).

[38] Appendix 8. Sample size, maximum and minimum values per Validated Instrument to Assess Health Related Quality of Life and Wellbeing of Participants at Baseline, 12 weeks and 24 Weeks Intervention shows that these same conclusions hold when using EQ-5D-3L index values.

[39] Level 1 is defined as the 'Disengaged and overwhelmed' level; level 2 the 'Becoming aware, but still struggling'; level 3 the 'Taking action'; and level 4 'Maintaining behaviours and pushing forward' stage. For further reference see: ©2017 Insignia Health. Patient Activation Measure® (PAM®) Practice Manual. All rights reserved. ©2017 Insignia Health. Patient Activation Measure® (PAM®) Administration System. All rights reserved.

population at baseline from 52 patients at level of activation 1 was 43.64 changing to 48.35 at end point. Hence, the mean point change from baseline to 24 weeks was 4.71.

Of those 52 patients in level of activation 1, the mean PAM score improved for 34 of these patients (65%); declined for 14 patients (27%) and remained unchanged for the remaining 4 patients. Parts A-D present the changes per level of activation in each of the cohorts.

Comparing activation levels 1 and 2 of the overall Test Bed population from baseline to end point, the mean PAM score increased 4.71 (from 43.64 to 48.35) and 7.09 (from 51.22 to 58.31) points, respectively. This suggests an improvement in activation amongst those with the lowest levels of activation, especially those patients in Cohorts 1 and 2, who at the start of the Test Bed were in activation level 2 (from 51.40 to 58.45 points; and from 50.88 to 57.92 points respectively). An improvement in activation of those who were in the lowest activation levels at baseline in Cohort 4 was also visible; especially among participants initially in activation level 2 (from 51 to 63.10 points).

PAM level of activation 4 should be viewed separately, as these are patients who already had a high level of activation at baseline and as a consequence there is likely to be little or no change in their PAM score. Indeed, these patients can often fall back a few points, but nevertheless, remain in the highest activation level.[40]

[40] ©2017 Insignia Health. Patient Activation Measure® (PAM®) Administration System. All rights reserved.

Table 3.7. PAM score change over 24 weeks of Test Bed by Cohort (from baseline to 24 weeks) in Test Bed population and Cohort 1, 2 and 4

A. Test Bed Population

Test Bed Population (N=308)

Initial PAM level of the group	Level 1	Level 2	Level 3	Level 4
N	52	97	87	62
Mean PAM score at baseline	43.64*	51.22†	62.83	83.66

Test Bed Population: Change from Baseline to 24 weeks

Initial PAM level of the group	Originally Level 1	Originally Level 2	Originally Level 3	Originally Level 4
N	52	97	97	62
Mean PAM score at 24 weeks	48.35*	58.31†	63.37	70.85
Mean Point Change from Baseline	**4.71**	**7.09**	**0.53**	**-12.81**
No. of participants score declined (%)	14 (26.9)	30 (30.9)	43 (42.2)	49 (79.0)
No. of participants score unchanged (%)	4 (7.7)	16 (16.5)	8 (7.8)	5 (7.8)
No. of participants score improved (%)	34 (65.4)	51 (52.6)	51 (50.0)	8 (12.5)

* Mean difference between 24 weeks and baseline: 4.71 (95% CI 1.92, 7.5), P=0.001.

† Mean difference between 24 weeks and baseline: 7.09 (95% CI 4.17, 10.01), P<0.001.

B. Cohort 1

Baseline Cohort 1 (n=167)

Initial PAM level of the group	Level 1	Level 2	Level 3	Level 4
N	22	63	50	32
Mean PAM score at baseline	44.92	51.40	63.28	83.52

Cohort 1: Change from Baseline to 24 weeks

Initial PAM level of the group	Originally Level 1	Originally Level 2	Originally Level 3	Originally Level 4
N	22	63	50	32
Mean PAM score at 24 weeks	48.05	58.45	66.68	69.62
Mean Point Change from Baseline	**3.13**	**7.05**	**3.40**	**-13.90**
No. of participants score declined (%)	7 (31.8)	24 (38.1)	16 (32.0)	25 (78.1)
No. of participants score unchanged (%)	3 (13.6)	6 (9.5)	6 (12.0)	3 (9.4)
No. of participants score improved (%)	12 (54.5)	33 (52.4)	28 (56.0)	4 (12.5)

C. Cohort 2

Baseline Cohort 2 (n=126)

Initial PAM level of the group	Level 1	Level 2	Level 3	Level 4
N	21	33	43	29
Mean PAM score at baseline	44.55	50.88	62.30	84.12

Cohort 2: Change from Baseline to 24 weeks

Initial PAM level of the group	Originally Level 1	Originally Level 2	Originally Level 3	Originally Level 4
N	21	33	43	29
Mean PAM score at 24 weeks	50.85	57.92	60.69	72.90
Mean Point Change from Baseline	**6.30**	**7.03**	**-1.61**	**-11.22**
No. of participants score declined (%)	3 (14.3)	6 (18.2)	23 (53.5)	23 (79.3)
No. of participants score unchanged (%)	0 (0.0)	10 (30.3)	2 (4.7)	2 (6.9)
No. of participants score improved (%)	18 (85.7)	17 (51.5)	18 (41.9)	4 (13.8)

D. Cohort 4

Baseline Cohort 4 (n=15)

Initial PAM level of the group	Level 1	Level 2	Level 3	Level 4
N	9	1	4	1
Mean PAM score at baseline	38.42	51.00	62.98	75.00

Cohort 4: Change from Baseline to 24 weeks

Initial PAM level of the group	Originally Level 1	Originally Level 2	Originally Level 3	Originally Level 4
N	9	1	4	1
Mean PAM score at 24 weeks	43.28	63.10	50.70	51.00
Mean Point Change from Baseline	**4.86**	**12.10**	**-12.28**	**-24.00**
No. of participants score declined (%)	4 (44.4)	0 (0.0)	4 (100.0)	1 (100.0)
No. of participants score unchanged (%)	1 (11.1)	0 (0.0)	0 (0.0)	0 (0.0)
No. of participants score improved (%)	4 (44.4)	1 (100.0)	0 (0.0)	0 (0.0)

Notes: PAM Scores were calculated by Insignia Health considering data on 308 participants.
Source: Test Bed, Information from 14 October 2016 to 27 April 2018.

WEMWBS

Figure 3.8 presents the WEMWBS mean score for the Test Bed population and cohorts at all time points with 95% confidence intervals.[41] Part A shows a mean score of the Test bed

[41] WEMWBS Population Norms in Health Survey for English data 2011 show that the mean of WEMWBS Score is 51.6071, with a standard error of 0.10391 and standard deviation of 8.70601. See for reference:

population at baseline of 50.85, 50.52 at mid-point and 50.58 at end point. This suggests that the wellbeing score of Test Bed participants was 'average' (with the average score being between 41 and 59).[42]

The mean scores demonstrate a very small decrease (from 50.85 to 50.58) in the mental wellbeing of Test Bed participants but the change is not statistically significant (either within the overall Test Bed population or within each of the cohorts).[43] This means that levels of wellbeing do not appear to have changed across the period of the intervention either across or within the cohort groups. With no control comparison for the WEMWEBs scores we are unable to definitively attribute changes in wellbeing (even if very small) to the use of the technology.

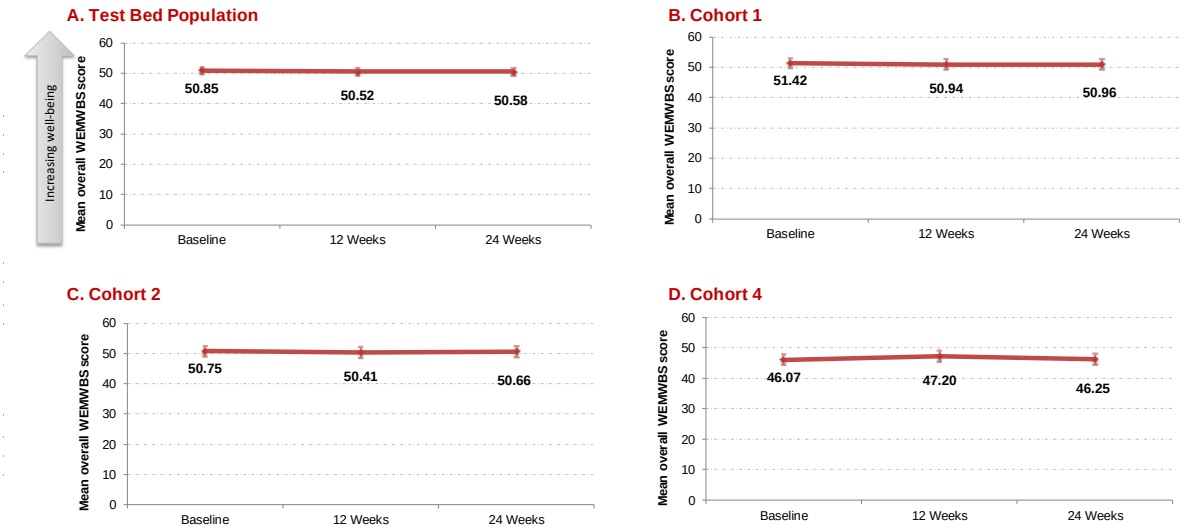
WEMWBS score for all Cohorts at all time points is within the 40-59 points range. The following five evidence-based steps are suggested to improve Test Bed patient's wellbeing: get active; connect with others; keep learning; be aware of yourself and the world; and give to others.

https://www2.warwick.ac.uk/fac/med/research/platform/wemwbs/researchers/interpretations/wemwbs_population_norms_in_health_survey_for_england_data_2011.pdf

[42] Wellbeing self-assessment. Available at: https://www.nhs.uk/Tools/Documents/Wellbeing%20self-assessment.htm [Accessed on 10 June, 2017]

[43] There is no evidence against the null hypothesis that there is 'no difference' between the mean WEMWBS score values at the three time points. This means the change is not statistically significant, as can be appreciated by the fact that there is an overlap of the 95% confidence intervals across time periods (shown in Figure 4.9).
To estimate the statistically significance in the change of the WEMWBS score, the Wilcoxon signed-rank test is performed as suggested by the WEMWBS User Guide available at:
https://www2.warwick.ac.uk/fac/med/research/platform/wemwbs/researchers/userguide/ [Accessed on 10 June, 2017].
In addition to the user guides provided, we used an Excel Template containing sample data available to download. This is a version of one originally produced by Lambeth local authority and adapted by Cheshire and Merseyside Public Health and Warwick Medical School.

Figure 3.8. WEMWBS Score Values at baseline, 12 weeks and 24 weeks intervention: mean values



Notes:

[a] Decimal figures are rounded to the nearest hundredth.

[b] Vertical bars represent 95% Confidence Intervals.

[c] The mean WEMWBS scores have been calculated considering data on 280 participants. If 4 or more of the 14 items were not responded, the WEMWBS cannot be calculated. Non-response has been excluded.

[d] The higher the WEMWBS score the better in terms of the wellbeing of patients.

Source: Test Bed, Information from 14 October 2016 to 27 April 2018.

De Jong Gierveld Scale

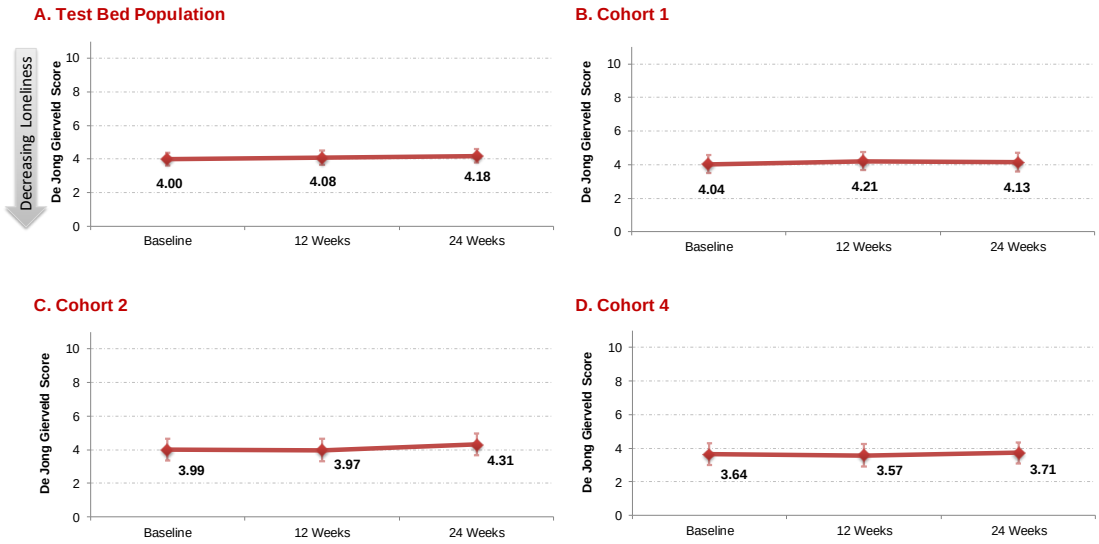
Figure 3.9 illustrates mean loneliness score values and 95% confidence intervals by Cohort and for the total population. Part A shows the mean loneliness scores of the Test Bed population. This score value is 4 at baseline, 4.08 in week 12, and 4.18 in week 24,[44] suggesting that participants report being 'moderately lonely' according to this particular scale.

The De Jong Gierveld score ranges from 0-11 (11 being the highest score or highest level of loneliness). Hence, the data illustrate that loneliness figures for the Test Bed population increased slightly during the intervention but that the change is not statistically significant (for either the overall Test Bed population or by cohort).[45] Parts B and D in Figure 3.9, illustrate similar results with regard to the change in mean index values across all cohorts. Hence, levels of loneliness do not appear to have changed across the period of the intervention either within or across cohorts.

[44] When the De Jong Gierveld Score takes a value within the range [3-8] means the population/participants is 'moderately lonely'.

[45] There is no evidence against the null hypothesis that there is 'no difference' between the mean of De Jong Gierveld Loneliness Score values at the three time points. This means the change is not statistically significant, as can be appreciated by the fact that there is an overlap of the 95% confidence intervals across time periods (shown in Figure 3.9). We used a two-sample test of binomial proportion to assess the differences of the mean.

Figure 3.9 De Jong Gierveld Loneliness Score Values at baseline, 12 weeks and 24 weeks intervention: mean values



Notes:

[a] Decimal figures are rounded to the nearest hundredth.

[b] Vertical bars represent 95% Confidence Intervals.

[c] The mean scores of the De Jong Gierveld Loneliness Scale have been calculated considering data on 273 participants. If 2 or more of the 11 items were not responded, the Loneliness Scale cannot be calculated.

[d] The higher the De Jong Gierveld Loneliness score the worse in terms of loneliness.

Source: Test Bed, Information from 14 October 2016 to 27 April 2018.

Correlations of socio-demographic characteristics and HRQoL and wellbeing

We used a correlation matrix of pairwise correlations to explore the relationship between the validated instruments to assess the health-related quality of life (HRQoL) and wellbeing of and the socio-demographic characteristics of Test Bed participants (see Appendix 12). Being a man is positively associated with higher EQ-5D-5L scores (better health) at all time points (statistically significant at the 5% level). The existing evidence base does suggest that women tend to report lower HRQoL scores than men.[46] This is interesting given more men than women have been recruited to Cohorts 1 and 2.

Greater age was positively correlated with higher levels of wellbeing and lower levels of loneliness (statistically significant at the 5% level). This finding is somewhat surprising given the evidence suggests loneliness can increase in later life as older people lose their friendship networks (due to increased morbidity and mortality) and can experience lower levels of wellbeing as people experience more age-related health issues and co-morbidities. Education showed no statistically significant correlation with health, activation, wellbeing or loneliness (with the exception of loneliness at baseline). As expected, a higher EQ-5D-5L score is associated with higher activation, higher wellbeing, and lower levels of loneliness at all time

[46] See for instance Cherepanov, et al (2010) D., Palta, M., Fryback, D. G., & Robert, S. A. (2010). Gender differences in health-related quality-of-life are partly explained by sociodemographic and socioeconomic variation between adult men and women in the US: evidence from four US nationally representative data sets. *Quality of Life Research*, *19*(8), 1115–1124. http://doi.org/10.1007/s11136-010-9673-x

points. Moreover, EQ-5D-5L, activation, wellbeing and loneliness scores at mid-point and end-point were positively correlated with scores at baseline (statistically significant at the 5% level). This means that the higher the scores at baseline, the higher the scores at mid and end point.

HealthCare Resource: Use and Cost

Healthcare Resource

A total of 293 Test Bed participants in Cohorts 1 and 2 were included in the statistical analysis of the use of resources and cost-effectiveness analysis in the Test Bed Phase 1 Evaluation.

Table 3.8 presents a summary of the average use of hospital services, primary care, community health or emergency services, social care, community mental health, community-based and day activity services at each time point for the Test Bed population and each cohort.

On average at baseline, there were 0.82 contacts with hospital services per participant. At mid-point, the mean use of hospital services was 0.87 contacts and at end-point it was 0.82 contacts.

Overall, there was little difference in the mean use of hospital services amongst the Test Bed population. There was a slight increase in the use of day hospital services and a decrease in the use of outpatient appointments.

The mean use of secondary care services among Cohort 1 participants was 0.96 contacts per participant at baseline, 1.14 at mid-point and 0.97 at end-point, showing that the highest number of contacts occurred mid-way through the intervention. In Cohort 2, the mean use was 0.63 at baseline, 0.50 at mid-point, and 0.61 at end-point, illustrating a slight decrease from baseline to end-point. As expected, given their higher level of risk of admissions, Cohort 1 showed a higher mean use of hospital services than Cohort 2 at all-time points.

The mean use of primary care services of Test Bed participants was 1.08 contacts per patient at baseline, 1.28 in mid-point and 1.30 at end-point, suggesting an increase in the mean use of primary care services of around 0.22 at the end of the Test Bed programme. The average use of primary care services among Cohort 1 went from 1.45 at baseline to 1.52 at end-point. Whereas among Cohort 2, the average use of primary care services went from 0.58 at baseline to 1.01 at end-point.

Regarding social services, the decrease observed in the use of services provided by social workers or care managers (from mean use of 0.09 at baseline to 0.02 at end-point) was more than compensated for by the increase observed in the use of private home help/cleaner (from 0.48 at baseline to 0.82 at end-point).

The mean use of primary and social care services for participants in the Fylde Coast appear to have a higher mean use than that of Better Care Together, especially among Cohort 1 patients at mid and end-point. Appendix 13 includes detailed information on the average use of services in the Fylde Coast; the mean use of participants in Better Care Together is shown in Appendix 14).

Community health services were very rarely used by the Test Bed participants and showed no meaningful change over the period of the intervention. Similar patterns can be observed in the use of other community-based services such as telecare, dentist or optician (see Appendix 15).

The results presented above are based on the analysis of the self-reported survey data of Test Bed participants. In the following sections we compare the mean use of secondary care services (A&E visits, inpatient admission, outpatient appointments) between the Test Bed participants and the control group to infer the intervention or Test Bed effect on secondary case use.

Table 3.8. Mean Use of Health and Social Care Services at baseline, 12 weeks and 24 weeks intervention

Hospital services	Mean use of service- Test Bed population			Mean use - Cohort 1			Mean use - Cohort 2		
	Baseline	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**
Accident & Emergency	0.06	0.06	0.07	0.09	0.10	0.10	0.02	0.01	0.03
General hospital inpatient admission	0.04	0.05	0.04	0.06	0.08	0.05	0.02	0.02	0.02
Community hospital inpatient admission	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.01
Day hospital	0.13‡	0.15	0.22‡	0.16	0.21	0.20	0.10	0.06	0.25
Outpatient visits to clinic based at hospital site	0.48§	0.52	0.44§	0.58	0.65	0.56	0.35	0.35	0.29
Other	0.09	0.09	0.03	0.07	0.11	0.05	0.13	0.06	0.02
Mean use of hospital services	**0.82***	**0.87**	**0.82***	**0.96**	**1.14**	**0.97**	**0.63**	**0.50**	**0.61**
Patients who have used at least one of hospital services	114	119	111	80	80	72	34	39	39
%	*39%†*	*41%*	*38%†*	*48%*	*48%*	*43%*	*27%*	*31%*	*31%*
N	*293*	*293*	*293*	*167*	*167*	*167*	*126*	*126*	126

* P> 0.99 for difference between 24 weeks and baseline.

† P=0.80 for difference between 24 weeks and baseline.

‡ P=0.005 for difference between 24 weeks and baseline.

§ P=0.36 for difference between 24 weeks and baseline.

Primary Care, Community Health or Emergency Services	Mean use of service- Test Bed population			Mean use - Cohort 1			Mean use - Cohort 2		
	Baseline	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**
GP	0.45	0.55	0.48	0.59	0.61	0.44	0.25	0.46	0.54
Paramedic (Ambulance service)	0.04	0.03	0.06	0.05	0.06	0.06	0.02	0.00	0.06
Community matron	0.05	0.03	0.02	0.04	0.02	0.02	0.06	0.05	0.02
Community/District nurse	0.21	0.27	0.29	0.37	0.46	0.47	0.00	0.01	0.06
Practice nurse	0.21	0.27	0.23	0.27	0.37	0.31	0.13	0.13	0.13
Specialist nurse	0.13	0.13	0.21	0.13	0.19	0.22	0.12	0.06	0.21
Mean use of primary care services	**1.08**‖	**1.28**	**1.30**‖	**1.45**	**1.71**	**1.52**	**0.58***	**0.71**	**1.01***
Patients who have used at least one of primary care services	129	135	127	94	92	77	35	43	50
%	*44%¶*	*46%*	*43%¶*	*56%*	*55%*	*46%*	*28%*	*34%*	*40%*
N	*293*	*293*	*293*	*167*	*167*	*167*	*126*	*126*	*126*

‖ P<0.001 for difference between 24 weeks and baseline.
¶ P=0.87 for difference between 24 weeks and baseline.
* P<0.001 for difference between 24 weeks and baseline.

Social Care Services	Mean use of service- Test Bed population			Mean use - Cohort 1			Mean use - Cohort 2		
	Baseline	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**
Social worker or Care manager	0.09	0.03	0.02	0.14	0.05	0.03	0.02	0.00	0.00
Home care/home help worker	0.70	0.62	0.66	0.95	0.91	0.98	0.37	0.25	0.25
Private home help/cleaner	0.48	0.54	0.82	0.57	0.62	0.96	0.37	0.44	0.27
Mean use of social care services	**1.28**	**1.19**	**1.50**	**1.66**	**1.58**	**1.97**	**0.76**	**0.68**	**0.88**
Patients who have used at least one of social care services	47	44	49	33	27	32	14	17	17
%	*16%*	*15%*	*17%*	*20%*	*16%*	*19%*	*11%*	*13%*	*13%*
N	*293*	*293*	*293*	*167*	*167*	*167*	*126*	*126*	126

Community Mental Health Services	Mean use of service- Test Bed population			Mean use - Cohort 1			Mean use - Cohort 2		
	Baseline	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**
Psychiatrist / psycho-geriatrician	0.02	0.00	0.01	0.00	0.01	0.01	0.04	0.00	0.00
Community psychiatric nurse / Community mental health nurse	0.02	0.01	0.02	0.04	0.02	0.04	0.00	0.00	0.01
Other mental health professional	0.03	0.06	0.04	0.01	0.05	0.02	0.06	0.06	0.06
Mean use of community mental health services	**0.06**	**0.07**	**0.07**	**0.04**	**0.08**	**0.07**	**0.10**	**0.06**	**0.07**
Patients who have used at least one of the community mental health services	6	7	8	2	5	5	4	2	3
%	*2%*	*2%*	*3%*	*1%*	*3%*	*3%*	*3%*	*2%*	*2%*
N	*293*	*293*	*293*	*167*	*167*	*167*	*126*	*126*	126

Other community-based services	Mean use of service- Test Bed population			Mean use - Cohort 1			Mean use - Cohort 2		
	Baseline	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**
Telecare	0.01	0.09	0.01	0.01	0.07	0.01	0.00	0.10	0.00
Dentist, oral hygienist	0.12	0.14	0.09	0.09	0.13	0.09	0.16	0.15	0.10
Optician	0.08	0.06	0.05	0.09	0.06	0.05	0.06	0.07	0.04
Mean use of other community-based services	**0.20**	**0.29**	**0.15**	**0.19**	**0.26**	**0.16**	**0.21**	**0.33**	**0.13**
Patients who have used at least one of the other community-based services	37	49	27	21	30	17	16	19	10
%	*13%*	*17%*	*9%*	*13%*	*18%*	*10%*	*13%*	*15%*	*8%*
N	*293*	*293*	*293*	*167*	*167*	*167*	*126*	*126*	126

Day activity services	Mean use of service- Test Bed population			Mean use - Cohort 1			Mean use - Cohort 2		
	Baseline	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**
Day care – local authority social services department	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Day care – voluntary organisation	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.00	0.02
Day care – NHS (community-based)	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00
Lunch club	0.01	0.01	0.00	0.01	0.01	0.01	0.02	0.01	0.00
Social club	0.02	0.06	0.03	0.02	0.07	0.04	0.03	0.06	0.02
Exercise class	0.22	0.19	0.19	0.10	0.02	0.04	0.37	0.42	0.38
Other services	0.17	0.12	0.09	0.10	0.04	0.11	0.27	0.23	0.07
Mean use of day activity services	**0.43**	**0.40**	**0.33**	**0.23**	**0.15**	**0.20**	**0.70**	**0.73**	**0.49**
Patients who have used at least one of the day activity services	48	51	41	14	14	16	34	37	25
%	*16%*	*17%*	*14%*	*8%*	*8%*	*10%*	*27%*	*29%*	*20%*
N	*293*	*293*	*293*	*167*	*167*	*167*	*126*	*126*	126

Cost of healthcare resources

Before comparing Test Bed participants with the controls, Table 3.9 presents the average cost of health and social care services at baseline, mid and end-point 12 for the Test Bed population and for each cohort. At baseline, the average cost of using hospital services is around £331.93. At mid-point, the cost is £390.98 and at end-point it rises to £433.50. This increase in the average cost of hospital services was mainly driven by changes observed in day hospital services.

The trajectories of the cost of hospital services followed a different pattern across Cohorts. The highest cost among Cohort 1 patients came in the middle period but the highest cost among Cohort 2 came at mid-point in the programme. As expected, Cohort 1 revealed a higher mean use of hospital services and a higher cost than Cohort 2.

Primary care, community health and emergency services showed a modest increase over the 24 weeks of the intervention, from £113 to £128. However, the overall data masks differences between Cohort 1 and 2, with a modest increase over the 24 weeks in Cohort 1 but doubling the mean use, and therefore the cost, among Cohort 2.

Changes observed in social care services are negligible in both the overall Test Bed population and in Cohort 1. Community mental health services and other community-based services showed small reductions over the 24 weeks.

Using the information on the mean use of services and on the mean average costs of health and social care services, Table 3.9 presents a summary of the average costs.

For all services, at all time points, the majority of the patients were recruited to the Better Care Together Vanguard, consequently, the *overall cost* is higher than that of the Fylde Coast Vanguard.

Table 3.9. Average Cost of Health and Social Care Services at baseline, mid-point and end-point of the 24 week intervention

Hospital services	Test Bed population			Cohort 1			Cohort 2		
	Baseline Cost (£)	**12 weeks Cost (£)**	**24 weeks Cost (£)**	**Baseline Cost (£)**	**12 weeks Cost (£)**	**24 weeks Cost (£)**	**Baseline Cost (£)**	**12 weeks Cost (£)**	**24 weeks Cost (£)**
Accident & Emergency	15.54	15.54	18.13	23.31	25.9	25.9	5.18	2.59	7.77
General hospital inpatient admission	156.12	195.15	156.12	234.18	312.24	195.15	78.06	78.06	78.06
Community hospital inpatient admission	0	0	39.03	0	0	39.03	39.03	0	39.03
Day hospital	94.51	109.05	159.94	116.32	152.67	145.4	72.7	43.62	181.75
Outpatient visits to clinic based at hospital site	65.76	71.24	60.28	79.46	89.05	76.72	47.95	47.95	39.73
Other	-	-	-	-	-	-			
Average cost	**331.93**	**390.98**	**433.5**	**453.27**	**579.86**	**482.2**	**242.92**	**172.22**	**346.34**

Primary Care, Community Health or Emergency Services	Test Bed population			Cohort 1			Cohort 2		
	Baseline Cost (£)	**12 weeks Cost (£)**	**24 weeks Cost (£)**	**Baseline Cost (£)**	**12 weeks Cost (£)**	**24 weeks Cost (£)**	**Baseline Cost (£)**	**12 weeks Cost (£)**	**24 weeks Cost (£)**
GP	82.35	100.65	87.84	107.97	111.63	80.52	45.75	84.18	98.82
Paramedic (Ambulance service)	1.44	1.08	2.16	1.8	2.16	2.16	0.72	0	2.16
Community matron	2.65	1.59	1.06	2.12	1.06	1.06	3.18	2.65	1.06
Community/District nurse	11.13	14.31	15.37	19.61	24.38	24.91	0	0.53	3.18
Practice nurse	7.56	9.72	8.28	9.72	13.32	11.16	4.68	4.68	4.68
Specialist nurse	8.06	8.06	13.02	8.06	11.78	13.64	7.44	3.72	13.02
Average cost	**113.19**	**135.41**	**127.73**	**149.28**	**164.33**	**133.45**	**61.77**	**95.76**	**122.92**

Social Care Services	Test Bed population			Cohort 1			Cohort 2		
	Baseline Cost (£)	**12 weeks Cost (£)**	**24 weeks Cost (£)**	**Baseline Cost (£)**	**12 weeks Cost (£)**	**24 weeks Cost (£)**	**Baseline Cost (£)**	**12 weeks Cost (£)**	**24 weeks Cost (£)**
Social worker or Care manager	5.31	1.77	1.18	8.26	2.95	1.77	1.18	0	0
Home care/home help worker	14.7	13.02	13.86	19.95	19.11	20.58	7.77	5.25	5.25
Private home help/cleaner	6.00	6.75	10.25	7.125	7.75	12	4.625	5.5	3.375
Average cost	**26.01**	**21.54**	**25.29**	**35.34**	**29.81**	**34.35**	**13.58**	**10.75**	**8.63**

Community Mental Health Services	Test Bed population			Cohort 1			Cohort 2		
	Baseline Cost (£)	**12 weeks Cost (£)**	**24 weeks Cost (£)**	**Baseline Cost (£)**	**12 weeks Cost (£)**	**24 weeks Cost (£)**	**Baseline Cost (£)**	**12 weeks Cost (£)**	**24 weeks Cost (£)**
Psychiatrist / psycho-geriatrician	2.16	0	1.08	0	1.08	1.08	4.32	0	0
Community psychiatric nurse / Community mental health nurse	1.24	0.62	1.24	2.48	1.24	2.48	0	0	0.62
Other mental health professional	1.32	2.64	1.76	0.44	2.2	0.88	2.64	2.64	2.64
Average cost	**4.72**	**3.26**	**4.08**	**2.92**	**4.52**	**4.44**	**6.96**	**2.64**	**3.26**

Other community-based services	Test Bed population			Cohort 1			Cohort 2		
	Baseline Cost (£)	**12 weeks Cost (£)**	**24 weeks Cost (£)**	**Baseline Cost (£)**	**12 weeks Cost (£)**	**24 weeks Cost (£)**	**Baseline Cost (£)**	**12 weeks Cost (£)**	**24 weeks Cost (£)**
Telecare	0.36	3.24	0.36	0.36	2.52	0.36	0	3.6	0
Dentist, oral hygienist	12.12	14.14	9.09	9.09	13.13	9.09	16.16	15.15	10.1
Optician	3.6	2.7	2.25	4.05	2.7	2.25	2.7	3.15	1.8
Average cost	**16.08**	**20.08**	**11.7**	**13.5**	**18.35**	**11.7**	**18.86**	**21.9**	**11.9**

Technology

Table 3.10 summarises the average cost of the technology per patient for Cohorts 1 and 2 taking into account the different combinations of technologies, different care pathways and healthcare staff needed. These are classified into a single scenario. Part A shows the average cost of technology per patient in Cohort 1 and Part B presents the average cost of technology per patient in Cohort 2. The cost of the technology used for Cohort 1, which includes the cost of health care staff required to deliver the programme, is around 4.5 times higher than for Cohort 2.

We have varied the assumptions to calculate the licence fee per patient in the technology used by cohort 1 and 2. We costed the license fee per patient using the number of patients that received the technology in each care pathway (scenario 1).

Regarding the average cost per patient, the costs of the care pathways for Cohort 1 patients were approximately £1,486 in both scenarios considering different assumptions. This figure includes the unit cost of the technology (around £1,260) and the cost of healthcare staff-time (around £220). However, the costs of technology per patient in Cohort 2 differ across scenarios. In scenario 1, the cost per patient was £335, including £200 for technology devices and around £135 for healthcare staff-time.

The last five columns of Table 3.10 show the cost per Vanguard using the average cost per patient and the number of patients per Vanguard within each care pathway. Under the scenario we present, costs per patient the cost of the technology and healthcare staff-time of providing the service to the 31 patients in Cohort 1 in Fylde Coast is approximately £46,500 (approx., £1500 per patient). In Better Care Together, the cost of providing the technology to 136 patients is around £200,000 (approx. £1470 per patient). Hence despite differences in the models of delivery used in each Vanguard, there is little difference in the cost per patient. The cost of the technology and healthcare staff-time is calculated using the number of patients as specified in the table.

Under scenario 1, the cost of the technology and healthcare staff-time for providing the service to the 39 patients in Fylde Coast is approximately £11,300 (approx. £290 per patient). In Better Care Together, the cost of providing the technology to 87 patients is around £31,000 (approx. £356 per patient).

Table 3.10. Technology: Unit Costs of technology and Costs per Cohort and Vanguard

Scenario 1. Cohort 1

Care pathway [a]	Cost per Patient (£)	Fylde Coast N	Fylde Coast Cost (£)	Better Care Together N	Better Care Together Cost (£)	Total Cost (£)
Technology						
Motiva-COPD	1,217.33	17	20,694.61	94	114,429.02	135,123.63
Motiva-Heart Failure (HF)	1,348.14	14	18,873.96	42	56,621.88	75,495.84
CANTAB Mobile [b]	0.85	31	26.35	136	115.60	141.95
Average	**1,262.04**		**39,594.92**		**171,166.50**	**210,761.42**
Healthcare Staff [c]						
Motiva- COPD or HF	224.42	31	6,956.94	136	30,520.78	37,477.73
Average Unit Cost	**1,486.46**		**46,551.86**		**201,687.28**	**248,239.15**

Notes: [a] A total of 45 patients in Cohort 1 had both COPD and HF. For the purposes of the Test Bed they could only chose one care pathway on Motiva (i.e. COPD or HF). We assumed that 50% of those patients used COPD care pathway and 50% used HF care pathway. [b] The cost of licence per patient using CANTAB Mobile is calculated over 293 active participants in Cohorts 1 and 2 (250/293=0.85). [c] Average healthcare staff time unit cost per patient is estimated over 149 participants recruited in the Fylde Coast and 223 patients recruited in Better Care Together.

Scenario 1. Cohort 2

Care pathway [a]	Cost per Patient (£)	Fylde Coast N	Fylde Coast Cost (£)	Better Care Together N	Better Care Together Cost (£)	Total Cost (£)
Technology						
Flo [b]	270.69	4	1,082.76	70	18,948.30	20,031.06
Intelesant [c]	9.53	4	38.12	17	162.01	200.13
Health Watch	157.99	31	4,897.69	0	0.00	4,897.69
CANTAB Mobile [d]	0.85	39	33.15	87	73.95	107.10
Average	**200.29**		**6,051.72**		**19,184.26**	**25,235.98**
Healthcare Staff						
Flo, Intelesant, Health Watch [e] or Flo and Intelesant [f]	134.96	39	5,263.43	87	11,741.50	17,004.93
Average Unit Cost	**335.25**		**11,315.15**		**30,925.76**	**42,240.91**

Notes: [a] Speakset was not included as this technology was not used by TB participants. [b] The cost of licence per patient using Flo is estimated over 74 active patients using this technology across both Vanguards (8,000/74=109.11). [c] The cost of licence per patient using Intelesant is calculated over 21 active patients using this technology across both Vanguards (200/21=9.53). [d] The cost of licence per patient using CANTAB Mobile is calculated over 293 active participants in Cohorts 1 and 2 (250/293=0.85). [e] Care pathway for Cohort 2 participants in Fylde Coast (mixture of the health watch: 80%, Intelesant: 10% and Flo: 10%). Percentages assumed based on discussion with clinical teams. Average healthcare staff time unit cost per patient is estimated over 93 participants recruited in the Fylde Coast. [f] Care pathway for Cohort 2 participants in Better Care Together (Flo: 80% and Intelesant: 20%). Percentages assumed based on discussion with clinical teams. Average healthcare staff time unit cost per patient is estimated over 202 participants recruited in Better Care Together.

We acknowledge that our cost-estimations of the technologies used are conservative (although in some cases our assumptions may have had the effect of under-estimating costs and in some other cases the effect of over-estimating costs). It is also worth noting that as this was a Test Bed, all technology costs were based on a new purchase model; alternative models (such as leasing arrangements) may be less costly, but due to technology innovator confidentiality agreements we were unable to access this information.

Medication

Usage of high numbers of medications was reported in the surveys by Test Bed participants. Not unexpectedly, given the health conditions and age group of participants in this Test Bed, 65% of medications reported were long-term medications that patients take continuously. Around 30% of reported medications were medium-term medications.

Table 3.11 summarises the average cost of medication per patient in Cohorts 1 and 2 including long, medium and short-term medications. During the 24 weeks of the intervention on average patients had a cost of £1,367 in medication. Part A shows the average cost per patient in Cohort 1 and Part B presents the average cost per patient in Cohort 2. On average, a patient in Cohort 1 cost around £1,710 over the 24-week period of the intervention (£3,421 in medication a year or £285 per month), whilst a patient in Cohort 2 cost on average £913 over the same period (£1,826 in medication a year or £152 per month). Among both Cohorts, the largest proportion of cost was due to long-term medications.

Table 3.11. Medication use: Average Unit Costs per Cohort

A. Cohort 1 (N=167)

Type of treatment	A. Average cost per day (£)	B. Average patients	C. Total cost per day (£)[a]	D. Annual Cost (£)	E. Proportion of Test Bed E= B / 167	F. Average annual cost per patient (£) F= D * E
Long Term [b]	0.40	3.53	329.09	120,116.95	0.021	2,536.87
Medium Term [c]	2.89	2.45	668.05	60,124.31	0.015	882.18
Short Term [d]	0.41	1.60	18.05	252.67	0.010	2.42
Total						**3,421.48**

Notes:

[a] The total cost per day is estimated by summing the cost per day of all medications within a medication type. The cost per day per medications is calculated by multiplying the average cost per day per patient by the average patients taking each medication.

[b] 339 Long Term medications reported by Test Bed participants in Cohort 1.

[c] 151 Medium Term medications reported by Test Bed participants in Cohort 1.

[d] 31 Short Term medications reported by Test Bed participants in Cohort 1.

B. Cohort 2 (N=126)

Type of treatment	A. Average cost per day (£)	B. Average patients	C. Total cost per day (£)[a]	D. Annual Cost (£)	E. Proportion of Test Bed E= B / 126	F. Average cost per patient (£) F= D * E
Long Term [b]	0.47	2.89	203.78	74,381.50	0.023	1,706.50
Medium Term [c]	0.35	2.30	72.11	6,489.65	0.018	118.43
Short Term [d]	0.32	1.55	9.47	132.59	0.012	1.63
Total						**1,826.56**

Notes:

[a] The total cost per day is estimated by summing the cost per day of all medications within a medication type. The cost per day per medications is calculated by multiplying the average cost per day per patient by the average patients taking each medication.

[b] 238 Long Term medications reported by Test Bed participants in Cohort 2.

[c] 98 Medium Term medications reported by Test Bed participants in Cohort 2.

[d] 23 Short Term medications reported by Test Bed participants in Cohort 2.

Total Average Cost per Participant

Table 3.12 provides a summary of the average cost per patient using health and social care services at all three time points of the intervention. The average cost per patient increased from £1,711 at baseline to £1,822 at week 24.

As would be expected, overall costs for patients in cohort 1 were more expensive than for patients in Cohort 2. However, while there were no meaningful changes in the costs of

patients in Cohort 1 (from £2,426 to £2,437), the average cost of a patient in Cohort 2 increased from £832 to £981.

Average costs of patients in Cohort 1 were around 2.5 times higher than those found for patients in cohort 2 over the 24 weeks.

To give a sense of scale using a total of 293 Test Bed participants, we calculated a weighted total cost based on the population by multiplying the total average cost per participant by the number of participants.

The weighted total cost ranges from around £501,000 to £534,000 considering a population of 293 patients.

Similarly, we calculated a weighted total cost based on the number of patients in each cohort should the combinatorial technologies in each cohort be replicated. Considering a total of 167 patients in cohort 1, the weighted total cost ranges from approximately £405,122 to £407,000. Considering a population of 126 patients in cohort 2, the weighted total cost is around £105,000 to £124,000.

Table 3.12. Total average cost per participant and per cohort

Health and Social Care Service	Test Bed population			Cohort 1			Cohort 2		
	Baseline	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**
Hospital services	331.93	390.98	433.50	453.27	579.86	482.20	242.92	172.22	346.34
Primary Care, Community Health or Emergency Services	113.19	135.41	127.73	149.28	164.33	133.45	61.77	95.76	122.92
Social Care Services	26.01	21.54	25.29	35.34	29.81	34.35	13.58	10.75	8.63
Community Mental Health Services	4.72	3.26	4.08	2.92	4.52	4.44	6.96	2.64	3.26
Other community-based services	16.08	20.08	11.70	13.50	18.35	11.70	18.86	21.90	11.90
Mean cost of health care services	**491.93**	**571.27**	**602.30**	**654.31**	**796.87**	**666.14**	**344.09**	**303.27**	**493.05**
Technology	991.40	991.40	991.40	1,486.46	1,486.46	1,486.46	335.25	335.25	335.25
Medicines	227.97	227.97	227.97	285.12	285.12	285.12	152.21	152.21	152.21
Total average cost per patient	**1,711.30**	**1,790.64**	**1,821.67**	**2,425.89**	**2,568.45**	**2,437.72**	**831.55**	**790.73**	**980.51**
N	*293*	*293*	*293*	*167*	*167*	*167*	*126*	*126*	*126*

Cost Analysis

Matching of Test Bed participants to controls

Table 3.13 shows the descriptive statistics for the participant and control groups for the matching variables. The distribution of the covariates used in the matching are almost identical in the two groups. The average age is 71 years in both groups, the percentage of females is 59.7%, the distribution of long term conditions is very similar (approximately 65% COPD, 20% heart failure, 80% both COPD and heart failure), and the average risk of hospital admission was 30% in both groups.

Table 3.13. Baseline characteristics of participants and matched control group

	Matched Controls	**Test Bed participants Cohort 1 & 2**
Number of patients	879	293
Matching covariates		
Age (average)	71.42	71.41
Female	59.73%	59.73%
Long-term conditions		
COPD	64.51%	68.26%
Heart Failure (HF)	22.98%	20.14%
COPD or HF	81.23%	81.23%
Risk of hospital admission	30.50 (20.85)	30.10 (21.35)

Note: Numbers presented are either mean (standard deviation) or percentage.

Secondary care use

Table 3.14 shows secondary care use of Cohorts 1 and 2 in the Test Bed as well as secondary care use of the matched controls. Our measures of secondary care use included A&E visits, outpatient appointments and inpatient admissions.

For Test Bed patients these measures refer to three periods covering four weeks each: the first period was at baseline, the second at mid-point and the third at end point. For control patients the measures refer to three periods covering four months each: the first being from 1st July 2015 to 31st October 2015; the second from 1st November 2015 to 29th February 2016; the third from 1st March 2016 to 31st July 2016.

To allow a comparison of secondary care use between the Test Bed and controls, we scaled the measures for Test Bed patients by multiplying them by a factor of four. In this way, we compared secondary care use by Test Bed patients over a one-year period to secondary care use by control patients also over a one-year period.[47] For the Test Bed participants, columns

[47] The change is over a one year period because we assumed that the first four months of the year is the 'beginning of the year' and the third four months is the 'end of the year'. Therefore, the change over one year is given by the change from the beginning to the end of the year.

A, D and G show the raw data and columns B, E and H show the scaled data. For the control patients, columns B, E and H show the raw data.

For Test Bed participants the raw data for A&E visits was the total number of visits reported by participants whilst for the control patient the raw data for A&E visits was the total number of visits recorded in the CSU dataset. Since we matched three controls to each Test Bed participant, the total numbers in the Test Bed and control patients are not comparable. Therefore, we calculated the number of A&E visits per patient, shown in Column C. Similarly, the raw data for outpatient appointments was the total number of outpatient appointments, hence we calculated the number of outpatient appointments per patient, shown in Column F.

For inpatient admissions, the raw data was the number of patients admitted to hospital in each of the three time periods. Again, to allow comparisons, we calculated the proportion of patients admitted, shown in Column I. These numbers can be interpreted as the probability of being admitted as an inpatient over a period of four months.[48]

Overall, Table 3.14 reveals that the Test Bed participants had much higher secondary care use than the control patients. For instance, over the first four-month period, Test Bed participants had 0.25 A&E visits per patient, compared to 0.29 at the third of our four-month periods. For the controls, the average was much lower being 0.07 A&E visits per patient in the first four months, and 0.11 visits per patient in the third of the four-month periods. One reason for this may be the different sources of data, i.e. that data on secondary care use by Test Bed participants came from self-reported surveys whilst for the control patients the data came from administrative records.

Table 3.14 shows that amongst both the Test Bed participants and the control patients, the number of A&E visits was larger in the last 3 month period than in the first. The probability of being admitted to hospital, on the other hand, was smaller in the last period compared to the first. For outpatient appointments, the trend differed between Test Bed participants and control patients: for Test Bed participants the number of appointments was smaller in the last period compared to the first period, while for control patients the number was larger in the last period.

Estimating the impact of the Test Bed using simple pre-post differences in secondary care use in the Test Bed participants would be misleading because differences in care use could have been driven by general trends unrelated to the Test Bed. By comparing the pre-post difference in the Test Bed participants to the pre-post differences in the control patients, we obtain an approximation of the Test Bed intervention effect. Thus, in Table 3.15 we used the data presented in Table 3.14 to estimate the intervention effect using the difference-in-difference in estimator. The first and second row show the pre-post comparison of A&E visits, outpatient appointments and inpatient admissions of the Test Bed participants and the control patients over one year respectively. The last row shows the intervention effect

[48] Ideally, we would have measured the number of inpatient admissions rather than the number of patients being admitted as an inpatient. However, for the Test Bed participants we could not use administrative data on secondary care use but had to rely on survey data, which does not include information on the frequency of hospital admissions.

calculated as the pre-post difference in the Test Bed participants minus the pre-post difference in the control patients.

There was an increase of A&E visits per patient in both the Test Bed participants and the control group. The last row shows the difference in difference estimate for this outcome was approximately zero at 0.001 (95% CI -0.075, 0.077) over one year.

For outpatient appointments, the Test Bed participants showed a decrease of 0.15 appointments per patient, whereas the controls showed an increase of 0.11 appointments per patient over the one-year period. Therefore, the difference-in-difference estimate showed a beneficial effect of the Test Bed, with 0.26 fewer outpatient appointments per patient (95% CI -0.59, 0.06). However, this effect was not statistically significant at a 5% level of significance.

Regarding the probability of being admitted to hospital, Test Bed participants showed a decrease of 2.7% compared to a decrease of 0.5% in controls. Therefore, the difference-in-difference analysis showed a benefit of the Test Bed of 2.3% (95% CI -0.09, 0.04) over one year. Again, this effect was not statistically significant.

Figure 3.10 illustrates the results from Table 3.15. Broadly, the same trends are evident across the three outcome measures within both Cohorts 1 and 2 and for the overall results. The largest impact was on outpatient appointments. Here the data reveal that the average number of outpatient appointments in the control group increased over the study period, (especially among control patients matched to participants in Cohort 1), whereas the average appointments per patient reduced overall and for both in both Cohorts 1 and 2 (especially among Cohort 1 participants). The difference-in-difference estimate was very similar in both cohorts at approximately 0.26 fewer outpatient appointments per patient over one year.

Table 3.14. Secondary care use by Test Bed participants and Controls at three time points

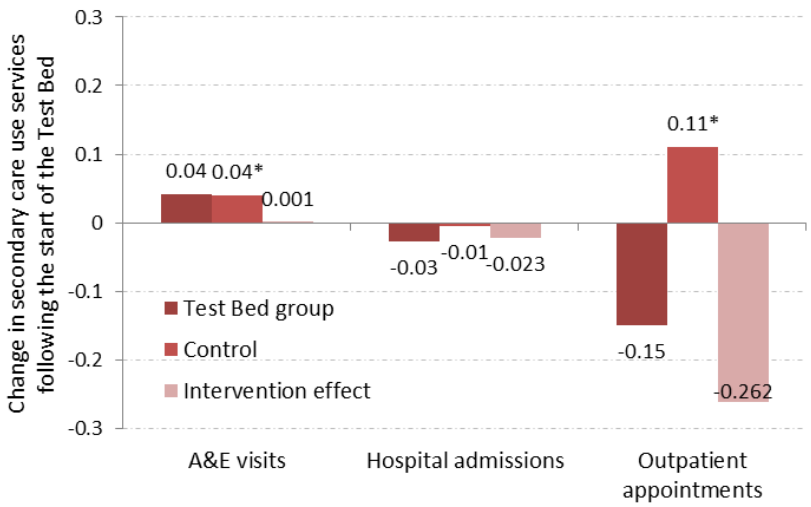
	A&E visits			Outpatient appointments			Inpatient admissions		
	A. Visits 1 month	**B. Visits 4 months**	**C= B / N No. Visits per patient**	**D. Apps 1 month**	**E. Apps 4 months**	**F= E / N No. Apps per patient**	**G. Patients admitted 1 month**	**H. Patients admitted 4 months**	**I= H / N Probability of being admitted**
Test Bed cases: Baseline (N=293)	**18**	**72**	**0.246**	**141**	**564**	**1.925**	**14**	**56**	**0.191**
Cohort 1 (N=167)	*15*	*60*	*0.359*	*97*	*388*	*2.323*	*10*	*40*	*0.240*
Cohort 2 (N=126)	*3*	*12*	*0.095*	*44*	*176*	*1.397*	*4*	*16*	*0.127*
Test Bed cases: 12 weeks (N=293)	**17**	**68**	**0.232**	**152**	**608**	**2.075**	**16**	**64**	**0.218**
Cohort 1 (N=167)	*16*	*64*	*0.383*	*108*	*432*	*2.587*	*14*	*56*	*0.335*
Cohort 2 (N=126)	*1*	*4*	*0.032*	*44*	*176*	*1.397*	*2*	*8*	*0.063*
Test Bed cases: 24 weeks (N=293)	**21**	**84**	**0.287**	**130**	**520**	**1.775**	**12**	**48**	**0.164**
Cohort 1 (N=167)	*17*	*68*	*0.407*	*94*	*376*	*2.251*	*9*	*36*	*0.216*
Cohort 2 (N=126)	*4*	*16*	*0.127*	*36*	*144*	*1.143*	*3*	*12*	*0.095*
Controls first 4 months (N=879)	**-**	**58**	**0.066**	**-**	**540**	**0.614**	**-**	**24**	**0.027**
Cohort 1 (N=501)	*-*	*28*	*0.056*	*-*	*342*	*0.683*	*-*	*16*	*0.032*
Cohort 2(N=378)	*-*	*30*	*0.079*	*-*	*198*	*0.524*	*-*	*8*	*0.021*
Controls second 4 months (N=879)	**-**	**92**	**0.105**	**-**	**576**	**0.655**	**-**	**25**	**0.028**
Cohort 1 (N=501)	*-*	*57*	*0.114*	*-*	*359*	*0.717*	*-*	*17*	*0.034*
Cohort 2(N=378)	*-*	*35*	*0.093*	*-*	*217*	*0.574*	*-*	*8*	*0.021*
Controls third 4 months (N=879)	**-**	**93**	**0.106**	**-**	**638**	**0.726**	**-**	**20**	**0.023**
Cohort 1 (N=501)	*-*	*58*	*0.116*	*-*	*434*	*0.866*	*-*	*14*	*0.028*
Cohort 2(N=378)	*-*	*35*	*0.093*	*-*	*204*	*0.540*	*-*	*6*	*0.016*

Table 3.15 Comparison of secondary care utilisation over one year: difference in difference analysis

	Difference in number of A&E visits per patient (95% confidence interval)			**Difference in number of outpatient appointments per patient (95% confidence interval)**			**Difference in the probability of inpatient admissions (95% confidence interval)**		
	Test Bed population	**Cohort 1**	**Cohort 2**	**Test Bed population**	**Cohort 1**	**Cohort 2**	**Test Bed population**	**Cohort 1**	**Cohort 2**
Test Bed participants									
Change over 1 year	0.041 *(-0.031, 0112)*	0.048 *(-0.056, 0.152)*	0.032 *(-0.046, 0.109)*	-0.150 *(-0.473, 0.173)*	-0.072 *(-0.496, 0.353)*	-0.254 *(-0.713, 0.205)*	-0.027 *(-0.089, 0.035)*	-0.024 *(-0.114,0.066)*	-0.032 *(-0.109, 0.046)*
Controls									
Change over 1 year	0.040 *(0.014, 0.066)*	0.060 *(0.025, 0.094)*	0.013 *(-0.027, 0.053)*	0.111 *(0.068, 0.155)*	0.184 *(0.133, 0.234)*	0.016 *(-0.055, 0.087)*	-0.005 *(-0.019, 0.010)*	-0.004 *(-0.025, 0.017)*	-0.005 *(-0.025, 0.014)*
Difference in difference - Intervention effect: Test Bed compared to Controls	**0.001** ***(-0.075, 0.077)***	**-0.012** ***(-0.122, 0.098)***	**0.019** ***(-0.069, 0.106)***	**-0.262** ***(-0.587,0.064)***	**-0.255** ***(-0.683, 0.172)***	**-0.270** ***(-0.734, 0.194)***	**-0.023** ***(-0.086, 0.041)***	**-0.020** ***(-0.112, 0.072)***	**-0.026** ***(-0.106, 0.053)***

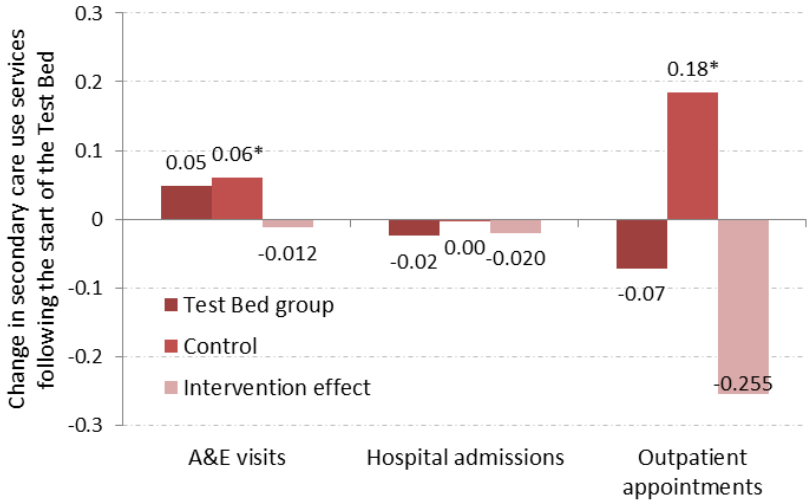
Figure 3.10. Changes in secondary care utilisation for the Test Bed, controls and intervention effect

A. Cohort 1 and 2

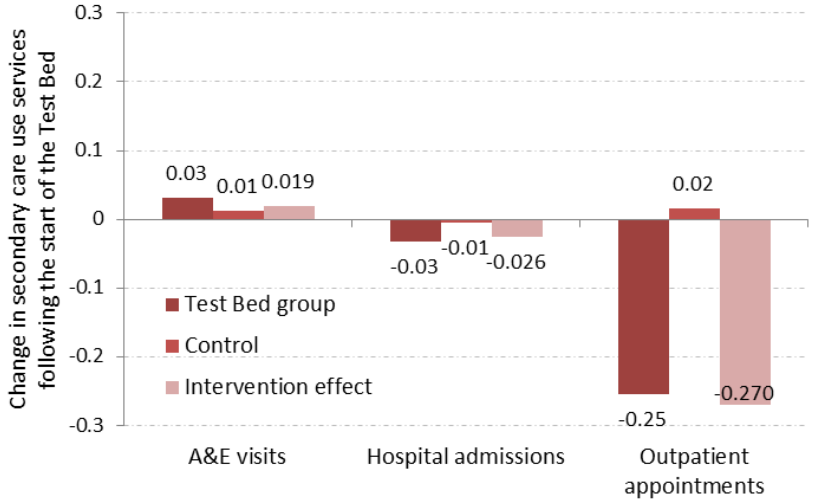


* denotes statistically significant at the 5% level.

B. Cohort 1



C. Cohort 2



Monetary value of the change in secondary care use

To understand how meaningful the Test Bed treatment effects were, we calculated the value of the Test Bed intervention by estimating the monetary value of the change in secondary care use shows the intervention effect, unit cost and the monetised intervention effect per patient for the overall Test Bed population and separately for Cohorts 1 and 2. We monetized secondary care use by multiplying the intervention effect by the unit cost per patient. The monetized intervention effect in the overall Test Bed population was -125.40. This negative value means that the Test Bed intervention resulted in cost savings of around £125 per patient.

In Cohort 1 there were cost savings in the three measures of secondary care. In A&E visits there was a saving of around £3 per patient, in outpatient appointments the saving per patient was approximately £35 and in hospital admissions of approximately £78. The total saving in this cohort was around £116 per patient.

In Cohort 2 there were cost savings in two of the three measures of secondary care. There were cost savings of approximately £101 per patient in hospital admissions and around £37 per patient in outpatient appointments. However, there was an increased cost in A&E visits of £5 per patient. Overall, in cohort 2 the total cost saving was approximately £133 per patient.

Table 3.16. Monetised Test Bed Intervention Effect Per Patient over one year

Secondary care use	Intervention effect	Unit Cost (£)	Monetised intervention effect (£)
Test Bed Population (N=293)			
A&E visits	0.001	259	0.26
Hospital admissions	-0.023	3,903	-89.77
Outpatient appointments	-0.262	137	-35.89
TOTAL			**-125.40**
Cohort 1 (N=167)			
A&E visits	-0.012	259	-3.11
Hospital admissions	-0.02	3,903	-78.06
Outpatient appointments	-0.255	137	-34.94
TOTAL			**-116.10**
Cohort 2 (N=126)			
A&E visits	0.019	259	4.92
Hospital admissions	-0.026	3,903	-101.48
Outpatient appointments	-0.27	137	-36.99
TOTAL			**-133.55**

We estimated the potential cost savings of the Test Bed by comparing the average cost savings in secondary care per cohort member with the cost of technology per cohort member.

Table 3.17 shows the cost per patient for the technology provided and the cost savings per patient in each cohort under our scenario of assumptions regarding the costs of technology. Details of this scenario was given previously in the cost of technology section.

Table 3.17. Unit cost per patient for technology and cost savings per patient over a one year period by cohort

Scenario 1.

Cohort	A. Unit cost per patient for technology (£)	B. Cost savings per patient (£)	C= A-B Cost of TB per patient (£)
Cohort 1	1,486.46	116.10	1,370.36
Cohort 2	335.25	133.55	201.70

Our finding that the cost of the Test Bed exceeds the cost savings due to reductions in secondary care use should not be considered in isolation. Firstly, we acknowledge that this approach has both strengths and limitations, which will be discussed in more detail in the discussion section below. Secondly, it is possible that the time frame of our study was too short to be able to accurately measure changes in secondary care use. Thirdly, our analysis does not account for health benefits that do not result in direct cost savings for the NHS. Linked to this, the analysis also does not account for indirect benefits from a societal perspective, such as improved quality of life for carers. Finally, the analysis is based on a new purchase model for the technologies, other options (such as leasing) may be more cost effective. The findings from the qualitative data in Phase 2 provide some insights into these benefits.

Findings: Phase 2

Phase 2 of the evaluation involved a range of participants. Patients and family carers took part in observational interviews to evaluate the effectiveness and experiences of participating in the Test Bed. Members of staff involved in the delivery of the programme across the two Vanguard sites completed weekly diaries and participated in focus groups to explore the impact of the Test Bed on daily working practices. In addition, key stakeholders, including technology innovators, were involved in regular action learning meetings and focus groups, with all learning captured in a logic model.

The Phase 2 findings section is structured as follows:

- Patients and Carers
- Staff
- Logic model
- Ranking activity

Patients and Carers

Patients taking part in Phase 2 of the Test Bed participated in observational interviews in their own homes within month one of using the programme and in the final month (Table 3.18 and Table 3.19).

As the qualitative element of the evaluation, the numbers of patients and carers participating in Phase 2 was relatively small. It is therefore important to acknowledge that this phase was focused on depth of understanding rather than generalisation of these data. However, it is worth highlighting that, of the total 315 patients who completed their participation in the Test Bed, 67 took part in the two-phased observational interviews in Phase 2 of the evaluation. As a result, the Phase 2 patient data represents 21% of all patient participants in the Test Bed. Our patient data is this highly representative of the whole sample.

Table 3.18. Phase 2 participants and interviews completed

Cohort	Risk of hospital admission (%)	Number of participants to complete Interview 1	Number of participants to complete Interview 2
1	>25	25	22
2	>10 and <25	20	18
3	<10	10	10
4	N/A	18	13
Carers	N/A	4	4
Total		77	67

As illustrated in Table 3.18, ten patients took part in the initial interview and withdrew from the Test Bed before the follow-up interview. These participants' data are included in the

analysis. However, where findings relate only to participants who completed the initial and follow-up interviews, this is made clear in the relevant sections.

Table 3.19. Phase 2 participant demographics

Cohort	Cohort 1		Cohort 2		Cohort 3		Cohort 4	Totals
Vanguard	BCT	FCV	BCT	FCV	BCT	FCV		
Gender	62% men (n=8) 38% women (n=5)	50% men (n=6) 50% women (n=6)	33% men (n=3) 67% women (n=6)	55% men (n=6) 45% women (n=5)	0% men (n=0) 100% women (n=5)	60% men (n=3) 40% women (n=2)	89% men (n=16) 11% women (n=2)	58% men (n=42) 43% women (n=31)
Mean average age	73.5 years	77 years	64.2 years	69.5 years	58.2 years	61.4 years	77.3 years	71.4 years
Ethnicity	100% White British							100% White British
LTC	62% COPD (n=8) 31% HF (n=4) 7% arthritis (n=1)	67% COPD (n=8) 33% HF (n=4)	89% COPD (n=8) 11% HF (n=1)	100% COPD (n=11)	Other (n=5)	Other (n=5)	100% Mild-moderate demented (n=18)	49% COPD (n=35) 25% Dementia (n=18) 12% HF (n=9) 13% other (n=10) 1% Arthritis (n=1)
Living arrangements	85% partner (n=11) 15% alone (n=2)	50% partner (n=6) 42% alone (n=5) 8% children (n=1)	56% partner (n=5) 44% alone (n=4)	64% partner (n=7) 36% alone (n=4)	60% partner (n=3) 40% alone (n=2)	100% partner (n=5)	89% partner (n=16) 11% alone (n=2)	73% partner (n=53) 26% alone (n=19) 1% children (n=1)
Index of multiple deprivation decile *	54% in 1-5 (n=7) 46% in 6-10 (n=6)	58% in 1-5 (n=7) 42% in 6-10 (n=5)	78% in 1-5 (n=7) 22% in 6-10 (n=2)	64% in 1-5 (n=7) 36% in 6-10 (n=4)	60% in 1-5 (n=3) 40% in 6-10 (n=2)	0% in 1-5 (n=0) 100% in 6-10 (n=5)	28% in 1-5 (n=5) 72% in 1-5 (n=13)	49% in 1-5 (n=36) 51% in 6-10 (n=37)
	Mean 5.77	Mean 4.75	Mean 4.0	Mean 4.09	Mean 5.2	Mean 7.0	Mean 6.17	Mean 5.27
Total participants	13	12	9	11	5	5	18	73

** Based on postcode; 1 is the lowest decile (indicating most deprived areas); 10 is the highest decile (indicating least deprived areas)*

Findings related to the patients and carers who participated in Phase 2 of the evaluation are discussed around the following themes:

- Engaging with the Test Bed technologies

- Healthcare services and relationships with healthcare professionals
- Impact on the care environment
- Patient activation
- Quality of life
- Carers

Engaging with the Test Bed Technologies

Patient experiences of using the Test Bed technologies

Prior to participation in the Test Bed programme, many patients were using a variety of digital technologies for health and other purposes, including computers, laptops, handheld tablets, websites, mobile phones, text messaging, apps and social media. Some, however, did not regularly use technologies. Of the total 73 patients who took part in Phase 2 of the evaluation, only 18% (n=13) suggested in interview 1 that they lacked confidence when using digital technologies. This is presented by Cohort and Vanguard in Table 3.20.

Table 3.20. Phase 2 participants' confidence with technologies in general at the outset of the Test Bed programme

Cohort 1		Cohort 2		Cohort 3		Cohort 4
BCT	FCV	BCT	FCV	BCT	FCV	
92% (n=12 out of 13)	75% (n=9 out of 12)	78% (n=7 out of 9)	64% (n=7 out of 11)	100% (n=5)	100% (n=5)	83%* (n=15 out of 18)
In total, 82% (n=60 out of 73) of Phase 2 participants were confident with technologies in general at the outset of the Test Bed programme ** The Cohort 4 figure refers to patients or family carers*						

Overall, people's initial experiences of using the Test Bed technologies were positive. Many participants however, did need the support of a family member or friend when using the technology for the first time. Following the initial induction period, the majority of participants in Cohorts 1 and 4 continued to use the Test Bed technologies with a family member, often their partner or spouse, for the duration of the intervention, with many explaining that it quickly became part of their daily routine.

> Family carer: *Once you get in a routine, it's a breeze really.*
>
> Patient: *Yeah. I have my inhalers after breakfast.*
>
> Family carer: *Yeah, we have breakfast…*
>
> Patient: *and then we do this [use the Test Bed technologies].*
>
> (A1-01 Interview 1)

Data suggest that in general, people found the Test Bed technologies easy to use. Those using a handheld tablet as part of the Motiva system (Cohorts 1 and 4) found this both easy to use and hold, whether or not they had previous experience of using a tablet. Furthermore, the

majority of participants across all cohorts found themselves to be confident using the technologies after an initial induction period.

Some Test Bed participants required formal support when issues arose with their equipment. The most common problem encountered by Cohort 1 and 4 participants related to error messages appearing on handheld tablets being used as part of the Motiva system.

Other problems experienced across the cohorts and technologies included inputting health data into text messages in the required format, converting weight from imperial to metric format, and getting locked out of apps. Participants were not generally perturbed by such hurdles, but problems arose when support channels were not clear to them or where they felt they were being a burden. Even when they had been provided with the details for a local contact, many patients did not want to be a burden by contacting someone:

> *Quite often I got messages that [the tablet] was no longer working, please contact the support line, you know. Well, I never did, I just sort of sent it back home and it carried on working again, you know [I needed help] just the once where I changed my broadband provider and it needed a new pin […] But all the time, I never had a number to ring […] It was a bit disappointing, that. I mean to get the new pin in I had to actually send [my local contact] an email. And then, you know, she… she contacted Red Alert and then… then the guy came and changed it. No, I've never had a number to contact, you know.*
>
> (B1-01 Interview 1)

Installation, training and initial support

Experiences of training and initial support differed across the cohorts depending on the equipment a patient received. Participants in Cohorts 1 and 4 received the Motiva technology and, as part of the programme, they were visited by a Red Alert colleague[49] who installed the equipment and provided initial training and support. There was much praise from patients and carers for the training and support provided by Red Alert colleagues. At these installation/training appointments, patients were provided with hand-written step-by-step notes to guide them through the use of the equipment (see Figure 3.11). These notes helped patient confidence in using the technologies, with many people referring to them for several days or weeks.

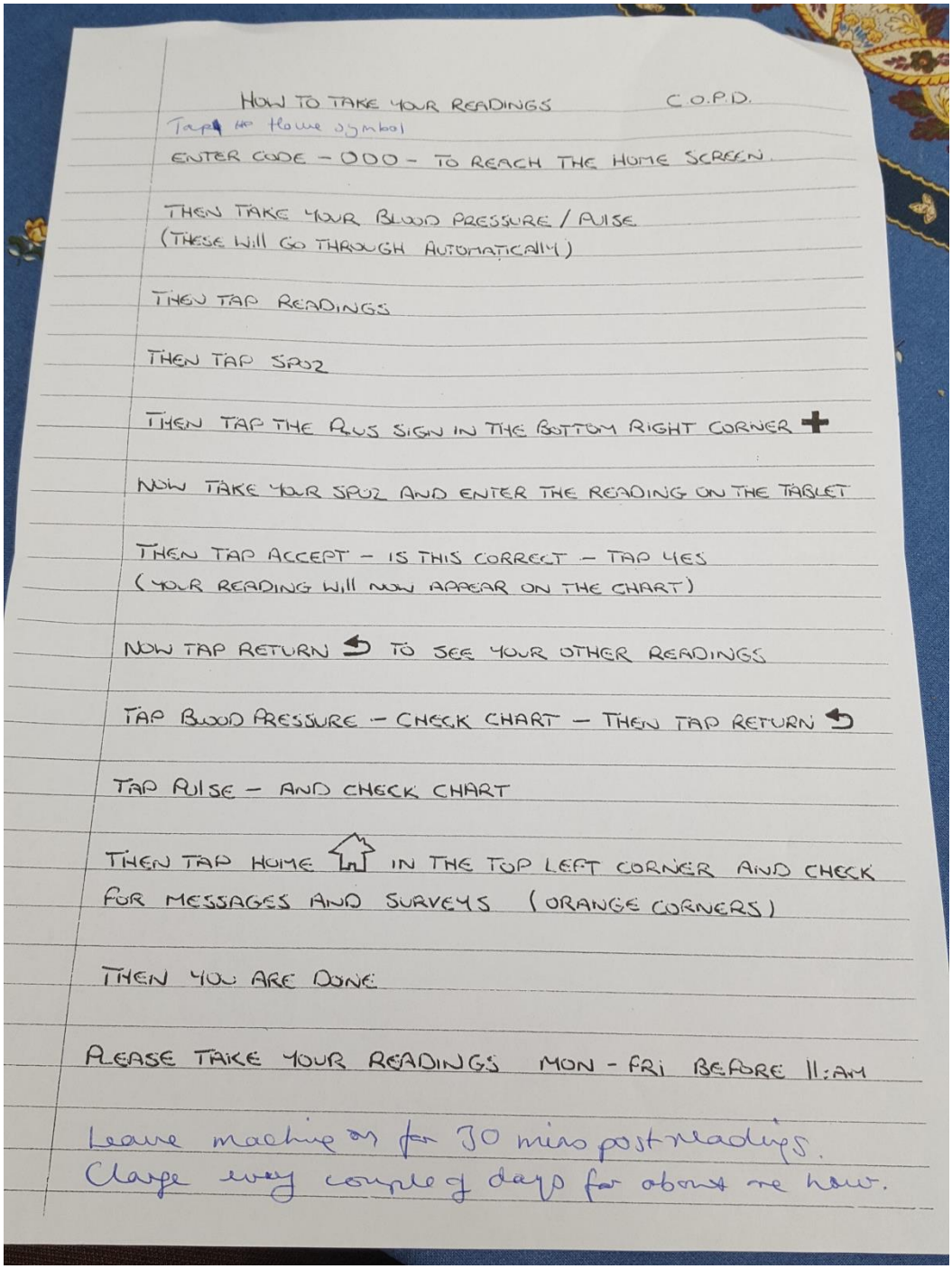
> *Well, [the Red Alert colleague] he'd done something which I thought was a good idea. You have the book… have you seen the booklet? It's quite a…quite a thick thing. And it doesn't run in logical order. But he gave me a crib list that he'd written out himself and it went through it as you do it, and that simplified it a lot, you know, you don't have to wade through the book and find the page […] it's so easy… he'd written a very simple instruction.*
>
> (B1-06 Interview 1)

In the case of all technologies, the majority of participants did not open or refer to the handbooks or instruction leaflets provided with the equipment. In some cases this was

[49] The company Red Alert provided installation, training and support to all patients receiving the Motiva technology

because materials were printed in small text which was inaccessible to the user; participants would have benefitted from large text versions. In the case of Cohorts 1 and 4, where participants used the Motiva system, the step-by-step notes provided by Red Alert proved to be very useful to patients and family carers.

Figure 3.11. Step-by-step notes provided by Red Alert to patients and family carers



B1-03 Interview 1

Cohort 2 and 3 participants received a range of other technologies including apps, watches and text messaging services. In many of these cases, participants felt unsupported in their

induction to the Test Bed programme. Some participants talked about the frustration of having to figure out the technology for themselves without training or support.

Participants suggested that initial one-to-one training by someone who, themselves, had received training on the technology would have been beneficial to them. In some cases, people attended an initial meeting to be signed up for the Test Bed, but it was sometimes clear that the person running the meeting did not know, themselves, how to use the technology, nor was it available for a demonstration. While patients received a detailed explanation about the Test Bed programme, some say they received little support regarding use of the technologies.

> Interviewer: *And how… how did you find it when she showed you it? Did you pick up straight away how to use it?*
>
> Patient: *Well, she didn't show me […] It was in the box with the instructions [and] the instructions weren't over-good. You've got to go through it and have a look for yourself really […] In the instructions it doesn't really tell you what to do […] It's trial and error.*
>
> (A2-01 Interview 1)

> *I think the thing... when it was originally mentioned at the Health Centre, I think basically the lady that introduced it was like a... well, she is a Nursing Auxiliary, and she's a very nice lady, but she herself said she hadn't had any training and she was hoping to have some training, but really she didn't know what it was about.*
>
> (A3-02 Interview 2)

Participants suggested that the availability of a live version of the technology at an initial meeting would have been very useful. They would also have appreciated support in the early stages of the Test Bed programme, including help to download an app or to make selections within the technologies which would be most appropriate for their healthcare needs.

In addition, some patients stressed the need for a more joined-up approach in the Test Bed, to ensure that everyone involved in their healthcare is on board and knows about the programme.

> Interviewer: *So what happened when you took [the app] with you to the doctor?*
>
> Patient: *He basically wasn't interested. It's only a trial […]*
>
> Interviewer: *And how did you feel about that?*
>
> Patient: *Well, I thought it was a waste of time having it, you know what I mean, afterwards.*
>
> Family carer: *But the doctor put you on this, didn't he? The surgery rung us up.*
>
> Patient: *It was the surgery that rung us up […] I showed him it, you know*

what I mean... I tapped into it [the app] and I showed him ... I don't think he had time or anything because you only... you know what I mean? He didn't have enough time to [look at it]. They [GPs] don't really push you but they definitely do look at the clock […] All the doctors have got to be on-side with it, you know what I mean, and if it takes five minutes to read the app, you know, to go through it […] They probably haven't told him properly what it's all about […] Maybe when they do the trials, they've got to tell all the doctors correctly.

(A3-01 Interview 2)

Patient acceptability of and trust in the technologies

Participants in Cohort 3 had high expectations of the technology. Referring back to Figure 3.5. Participants indicating they felt confident or somewhat confident with the use of technology at baseline, 12 weeks and 24 weeks (%)., 100% of participants in Cohort 3 (n=10) were confident with technologies in general at the start of the Test Bed programme, compared with 82% for the Phase 2 participants overall. In this cohort, patients were more likely to have experimented with other digital health technologies including apps and wearable devices. The technology provided to people in this cohort did not meet with their expectations.

Patient: *Is [the app] of any use to me? Erm... could I do without it? Yes. And that's just because of my circumstances really. I've got a Fitbit which is a very able piece of kit and I use that all the time. This piece of software is different. I get confused as to how I should approach using it, if I'm honest […] this tries to do all things for all people.*

(B3-02 Interview 2)

It was a common theme across all cohorts that people were unclear what was happening with their data, exactly who had access to their data, and the purposes for which it was being used. This is illustrated for each individual cohort and technology in Table 4.28

Table 3.21. Phase 2 Participants unsure re who had access to their data

Cohort	Vanguard	Number of Phase 2 participants unsure what was happening with their data	Percentage by technology
1	BCT	31% (N=4 out of 13)	31% of participants receiving Motiva
	FCV	17% (N=2 out of 12)	17% of participants receiving Motiva
2	BCT	56% (N=5 out of 9)	75% of participants receiving Flo (N=3 out of 4) 40% of participants receiving Intelesant (N=2 out of 5)
	FCV	18% (N=2 out of 11)	33% of participants receiving Flo (N=1 out of 3) 12.5% of participants receiving watch (N=1 out of 8)
3	BCT	60% (N=3 out of 5)	60% of participants receiving Umotif app
	FCV	80% (N=4 out of 5)	80% of participants receiving Umotif app
4		44% (N=8 out of 18)	44% of participants receiving Motiva
Totals		**36% (N=26 out of 73)**	39% participants receiving Motiva 57% participants receiving Flo 40% participants receiving Intelesant app 12.5% participants receiving Philips health watch 70% participants receiving Umotif app

As illustrated in the above table, of the 73 patients who took part in Phase 2 of the evaluation, 36% raised the issue of uncertainty regarding where and who held their data in interview. The key comments received from patients focused on the following aspects:

- What happens to their data and who had access to it;
- Uncertainty about exactly who was monitoring their data;
- Questions about whether anyone is actually looking at their data;
- What the technology companies were doing with their data;
- Assuming that someone was looking at their data (when they were not);
- One patient thought a research centre had access to their data;
- Some patients believed that Lancaster University had access to all their data for the purpose of the evaluation.

See for example:

> Researcher note: *The carer thought Lancaster University, as part of the evaluation, were looking at the BP and survey data. We discussed this. It became clear she and her husband don't know who, if anyone, is looking at the data.*
>
> (C4-05 Interview 1)

Very few patients who received the health watch expressed any concern (12.5%; N=1), suggesting that some technologies are more trusted than others. It was also more an issue on Cohorts 3 and 4, being raised by 70% and 44% of patients interviewed respectively. This compares to 24% and 35% of patients interviewed in Cohorts 1 and 2 respectively.

While the data suggest some differences across different technologies, they do not suggest differences across the two Vanguard sites. This indicates that the uncertainty was unrelated to the model of care being implemented within the Vanguards. It is also possible that patients

may have received an explanation regarding their data but did not understand or retain the information. This was discussed in an action learning meeting where stakeholders felt that information-overload in the initial meeting may be an issue. At the initial meeting patients were not only signed up to the Test Bed programme, but were also required to complete consent forms, complete a baseline evaluation survey, as well as receiving the new technology.

In interview, many participants noted that they would like to be better informed about how their data was being used. Some patients and carers commented that, in the induction stage of the Test Bed, the focus had been on the programme itself, rather than broader issues of data security and management.

Individualisation of the technologies

The theme of individualisation of the technologies arose in many of the patient interviews. It was clear for example, that some patients would have liked the ability to personalise the technologies they were using, for example to state their likes and preferences, and to change the times they receive messages. Many participants would have liked input from a healthcare professional to help them to tailor the Test Bed technology to their own healthcare needs, and therefore get the most out of it.

> *I saw [a member of staff] and she more or less explained that it was a trial and that all the security side of things, you know, it wasn't being broadcast all over […] and she explained that side, but didn't go into the specifics, and nobody has been into the specifics...as to why I'm doing it and what... what I'm getting out of it.*
>
> (B2-08 Interview 2)

Others explained that they were already very knowledgeable about their own health conditions, having lived with and self-managed them for some time. In these cases, it was felt that the technologies could have been better tailored to the individual's needs.

> Patient: *It's like I said, ten o'clock in a morning… it's every morning they text me… I'm fine [at that time of day]. So, if they could do it at varied times maybe or send a text… I don't know how they could do it… to say, 'If you're breathing is bad within the next 24 hours, can you text me with your oxygen and…' Something like that, '…your temperature levels.'*
>
> Interviewer: *So that it's more tailored to you?*
>
> Patient: *Yeah, not make it at certain times of the day.*
>
> (B2-01 Interview 2)

Individualisation of the technology was particularly important for Cohort 4 to ensure that individuals were not given information about their health condition that they did not want or expect at that point in time. The majority of Cohort 4 participants had only recently received their dementia diagnosis, and many patients and family carers were still coming to terms with the information. So, for example, while some people found the videos in the Motiva system

to be useful and informative, others found them upsetting and even distressing, illustrating the complexities of providing digital technologies for this patient cohort:

> Family carer: *Something that does have to be mentioned is these little vignettes – the videos that they do. They're like little podcasts – they are absolutely first-class. I think that they are clear; the people who are speaking have been properly directed and it's just the length of them as well. They're only on for about three minutes, but whatever length it is, and I think: Blimey, we've… you know, really learnt a lot just in that few minutes*.
>
> (C4-04 Interview 1)

> Family carer: *We didn't look at the videos because we looked at them once, you know, there was some videos on it, and we looked at a few of them and then they were a bit depressing, weren't they? […] There's no point in depressing yourselves, you know, about it.*
>
> (C4-01 Interview 2)

Cohort 3 participants also wanted flexibility in the use of the technology and, unlike patients in Cohorts 1 and 2, did not necessarily want to use the equipment every day. For some in this cohort, it was too prescriptive to use the technology every day and patients did not understand that there was some flexibility in this, and that they did not have to complete all sections of the app every day of the week:

> Patient: *I think now really that, you know, you've said, if it's blood pressure you're focusing on, just use it for that.*
>
> Interviewer: *Yeah. Are you happier knowing that?*
>
> Patient: *Yes […] with the blood pressure, it would be so useful for me to do it every day [just for that]. And then, you know, sort of if time allows, I can fill in other bits and pieces of it.*
>
> (A3-02 Interview 2)

Healthcare services and relationships with healthcare professionals

Relationships and contact with healthcare professionals

Relationships and contact with healthcare professionals was a key theme within the Phase 2 data. For participants across all cohorts, access to healthcare along with continuity of care were of concern, with many discussing the difficulties they experienced in securing a GP appointment, particularly with a GP with whom they were familiar and had previously met with.

> Participant B1-07: *We… our normal GP that we saw for a long time is [name of GP]*
>
> Participant B1-08: *But we never see him because he only works two half-days a week and we can never get in. They just won't give you an appointment for him. The only way I can get an*

appointment with [him] is to ask for a telephone appointment with [him]. And then he rings me and he'll make me an appointment.

Participant B1-07: *Same for me.*

Participant B1-08: *And nobody on the desk will give me an appointment with him.*

Participant B1-07: *They won't… they won't…*

(B1-07 and B1-08 Interview 2)

Data suggest that the Test Bed programme reinforced to patients the importance of key healthcare staff in the management of their long-term conditions. Of the 21 people in Cohort 2, for example, 18 referred to the importance of key healthcare professionals in the management of their long-term condition. Key members of staff included community matrons, consultants, GPs, pulmonary rehabilitation teams and respiratory nurses. The key factor was that people felt they had a good relationship with these professionals and that there was some continuity of care.

Patient: *I mean they're all very good to me down [at the surgery] because they've known me... I mean I've been there for years, so they've all known me through whatever's gone on in life sort of thing – all the deaths and, you know, stuff that somebody else wouldn't necessarily know about, but they do.*

Interviewer: *Because you've had a tough time, haven't you? I know you've lost your partner and were you caring for your auntie?*

Patient: *Yeah.*

Interviewer: *Is that important to you that they know that about you?*

Patient: *Yeah, because... I mean it's nearly always the same GP who I get every time so he was the one who treated my mum, he treated my auntie as well, he looked after my dad and, you know, so he's been involved in everything really. So it's a case of, if I do phone up, he always tries to come. But I ask for him anyway, but he does normally try and come out anyway.*

Interviewer: *So you never wait for an appointment or anything like that?*

Patient: *No, not really... no […] I'm very lucky.*

(A2-04 Interview 2)

Relationships and trust between patients and healthcare professionals was a key theme within the Phase 2 data. For many participants in Better Care Together, it was their

relationship with a healthcare professional that informed their decision to take part in the Test Bed programme.

> *I was interested [in taking part in the Test Bed] because of the way it was described to me and really sold to me by [my GP]. He's my GP and, well, I just trust him and I feel he has helped me with my health for about 10 years. And, if he thought that I was a suitable candidate who would benefit, then I agreed.*
>
> (B1-03 Interview 1)

The theme of relationships and trust between patients and healthcare professionals in Cohort 3, however, differed to that of Cohorts 1 and 2. People in Cohort 3 were younger than in Cohorts 1 and 2, many were still in employment and did not consider themselves to have a long-term condition. People in Cohort 3 did not lack confidence regarding the self-management of their health in the way that some patients in Cohorts 1 and 2 appeared to. It was, however, apparent that, for some participants in Cohort 3, trust in the healthcare system and in healthcare staff was an issue. Some people in Cohort 3 referred to being 'passed around' different healthcare staff and feeling 'lost in the system' awaiting appointments, diagnoses, operations or treatments.

> Participant: *I have this chronic back problem, I'm on… I take morphine to stem the pain, I have 12 hour release. I have to have steroid injections: I can have up to two a year […] But then we moved up here and it all sort of changed […] I'd had three injections… three or four injections done […] I was in agony […] I got a letter off 'em and there's a 28-week waiting list […] what's gone on since, it's gone worse. I had to have my morphine upped by 50 percent […] when my painkillers wear off the pain's horrendous.*
>
> Interviewer: *And then is the depression then linked into that?*
>
> Participant: *That…I start getting…you know. I get up first thing in a morning I can hardly move and my whole body aches […] So I phoned the hospital up to see if there was anything that they could do. So I basically got… 'Well, you are on the list.' I said, 'Well, I know that,' I said, 'but can you help me?' 'Just a minute.' Right, they come back. 'You're now 270th on the list.' I went, 'You are kidding me.' 'Well, you was 480th when you first came to us.'*
>
> (A3-05 Interview 1)

There is a suggestion within the Cohort 3 data that dissatisfaction with their healthcare informed some people's decision to take part in the Test Bed programme. Furthermore, the data suggest that the Test Bed technology may, for some, go some way to redress the perceived imbalance created by negative experiences of healthcare services.

There are examples in the Phase 2 data of people using the Test Bed technology to improve their own healthcare experience. This included the gathering of 'proof or evidence' to share with a healthcare professional to inform decisions regarding diagnosis and treatment.

The arthritis I've had for years but the fibromyalgia is quite new, and finding somebody else who has it or, you know, trying to find out what it means, erm... when I saw the Rheumatology, he wasn't that helpful on it. I described my symptoms to him, he examined me and he said, 'Fibromyalgia... and this is the medication you need,' and that was it. [My GP] has seen me... and he has... when I went in with the medication I said, 'This is the dose that you gave me, it wasn't sufficient. There was a big dip in the middle where there was too wide a gap between the doses, so I've increased my medication to this,' and he goes, 'Yeah, that's fine.' […] That, as I understand, is the reasoning behind the [Test Bed] app, that you can go in and the GP can have that information and know how you've been.

(B3-04 Interview 1)

Healthcare system utilisation

A key objective of the Test Bed programme was to reduce healthcare system utilisation, and the Phase 2 data contains examples of where such a reduction was realised.

Patient: [The app is] *stopping me going to the doctor's.*

Interviewer: *Okay. Do you think you'd have had more appointments if you hadn't had the app?*

Patient: *I think I would have ended up going back to the doctor's because, like I say, I'd have left it too late again* [to take rescue medication for a chest infection]*. Whereas now, with this* [app], *it warned me that I really needed to start* [the medication]. *So for me it's a signal: just get your antibiotics started and your Prednisolone. And, like I said, I think that's… that's why my recovery wasn't as long, because I started in good time […] And it was all down to this* [app]. *Whereas I would have left it and left it and left it and I've ended up being nearly on my knees, going into the doctor's.*

Interviewer: *So you actually managed to manage your chest infection and get better without seeing a GP?*

Patient: *Yes.*

(B2-07 Interview 1)

There are, however, examples of Test Bed participation having the opposite effect, and increasing an individual's utilisation of healthcare services and medication. In these cases, participants were often diagnosed with a condition that had been previously undiagnosed. In some cases, this a direct result of patients engaging more with their healthcare as a result of their participation in the Test Bed. These increases in healthcare service utilisation were perceived by patients to be positive, as they felt more engaged in their healthcare, better supported in the management of their health, and in receipt of better healthcare than that received prior to their engagement with the Test Bed.

Impact on the care environment

Family carers played a key role in all patient cohorts except Cohort 3. Of the 73 patients who participated in the Phase 2 evaluation, 32 were accompanied in their interviews by a family carer who contributed to discussions. The majority of these family carers were spouses and partners (n=30; 94%). In only two cases was the family carer a daughter or son. In addition to the family carers being present for observational interviews, interview data revealed a broader network of support from family members who did not live with patients but who frequently visited and provided support with daily tasks. Other sources of support and help included neighbours, friends, family members living away, and support / social groups.

Of the 73 patients who took part in Phase 2, 26% lived alone (n=19), while 74% (n=54) lived with a spouse, partner, or adult child. In interview, participants referred to drawing on a range of other support, particularly in Cohort 1, including paying for help with garden maintenance, household chores, window cleaning, mobile hairdressers and odd-job services. Many Phase 2 participants were using or exploring the use of other technologies such as walking aids, wheelchairs, mobility scooters, panic alarms, air purifiers, key safes, grab rails and stair lifts. Patients and their family carers often discussed other changes they had recently made, or were preparing to make, to adapt to changing needs. Some examples include; moving house for reasons of layout or location (i.e. to be closer to healthcare services); ceasing to drive or selling cars/caravans; and altering gardens for ease of maintenance. A small number of participants discussed exploring day care and respite care to provide the family carer with a break from caring duties.

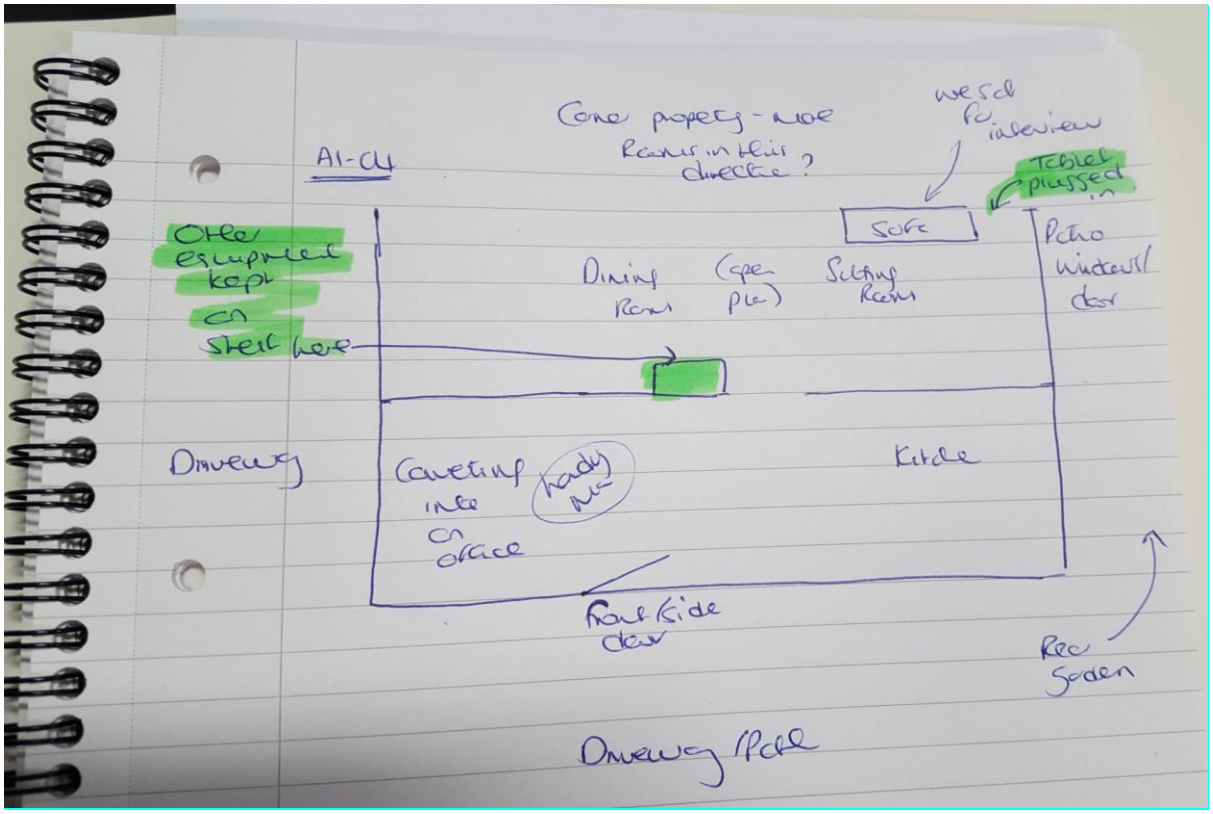
Participants across all cohorts expressed anticipation of changing needs, with many patients and carers exploring options available to them should they need support at some point in the future. Many Cohort 4 patients and family carers explained that, on receiving a dementia diagnosis, they were offered a lot of information, help and support. However, this was often at a time when they did not require it, and as months passed and needs changed, people often then did not know where to go and who to ask for help.

Participants' social networks differed across the patient cohorts. In general, Cohort 3 participants were active, with fairly large social networks, and often in paid employment. Of the ten patients in this cohort, two people lived alone. The majority of Cohort 4 patients were living with a spouse or partner, with only two participants living alone. Cohort 4 participants were often keeping socially active, sometimes following the advice of a clinician to ensure structure to each day, or as a strategy to alleviate cognitive decline. It was sometimes more difficult to keep active for patients in Cohorts 1 and 2 who were living with heart failure or COPD. For many of the participants with COPD, pulmonary rehabilitation classes were cited as an important social connection.

Along with receiving support themselves, many Phase 2 participants were an important source of help and support to other people in their social networks. This included driving neighbours to medical appointments and helping with shopping and DIY tasks. In one example, a husband and wife ran a social club for older adults, whilst in other examples, participants were the chair or treasurer of local groups.

Test Bed technologies differed across the patient cohorts, but all were discreet and in general did not have an adverse effect on the home environment. Cohort 1 and 4 patients using the Motiva system received the most equipment, which included a handheld tablet with a combination of pulse-oximeter, blood pressure meter, weighing scales, and thermometer. This equipment was generally kept in a convenient place for use each morning when participants would take and submit their readings. The only problem regarding the technology and layout of the home that arose in the Test Bed related to the handheld tablets. To address connection problems, patients were advised to keep their tablets permanently on charge. Patients interpreted this to mean the tablet could not be unplugged even when using. This then restricted patients' use of the tablet depending on socket location and availability in the home and the length of cable. It also led to concerns about running costs for some participants. This is illustrated in the following diagram of a patient's home (Figure 3.12):

Figure 3.12. Diagram of layout of participant home highlighting problem with sockets



Patient Activation and Quality of Life

In this section, patient activation and quality of life are discussed. We discuss each cohort separately to draw out the different findings within each of the cohorts.

Cohort 1

Overall, patients in Cohort 1 gained the largest increase in confidence, with 86% (n=19) of participants in this cohort feeling more confident about their health as a result of taking part in the Test Bed programme. The reason for this was largely attributable to an increase in reassurance experienced by patient and carer participation in the Test Bed. Of the 22 people

in Cohort 1 who took part in both observational interviews, 18 indicated an increase in reassurance about their health. The monitoring of patient data by healthcare staff in Cohort 1 was an important factor in this feeling of reassurance.

> *It's like having a doctor check you over every morning.*
>
> (A1-03 Interview 1)

> *Well, it's reassuring, isn't it? You know that somebody's watching it and if they spot something that you… if they saw something that wasn't right, they'd ring you […] especially when you've had… all my family – every one of 'em – have all had high blood pressure.*
>
> (B1-05 Interview 1)

However, while patients and family carers valued the monitoring of their data by healthcare staff, they themselves were also personally active in this monitoring. One participant explained how, living alone and suffering from heart failure, she felt panicky one night when she was in bed and so used the Test Bed technology to check her sats and reassure herself through self-monitoring (A1-03 Interview 2). In many cases, family carers were also using the equipment to monitor their loved ones' health:

> *Family carer: I watch him get weighed and […] I am always over his shoulder looking when he's using it.*
>
> (A1-05 Interview 1)

However, whilst the majority of patients felt a benefit from the technology, this was not always the case. Three patients in Cohort 1 - two from Better Care Together and one from Fylde Coast - said that they sometimes felt less reassured about their health as result of the Test Bed programme. In these cases, knowledge of their own health, for example seeing data about their pulse or blood pressure, appeared to exacerbate the health anxieties being experienced by these individuals.

Furthermore, a small number of people in Cohort 1 (n=3) did not report any benefits of taking part in the Test Bed. However, it is worth pointing out, that in each of these three cases, the patient's own primary health concern was not the condition being addressed by the Test Bed technology. One patient, for example, explained that his main health concern was the chronic pain he experienced, which he felt was not well managed, resulting in a lack of trust in healthcare staff and services. The Test Bed technology he was given, however, was focused on his COPD - which for him was far less of a problem:

> Participant B1-08: *I went to see about going on morphine because [my GP] had told me they'd put… if this Gabapentin didn't work, we'll try morphine, because I go to the pain clinic [in town] and that's a waste of time as well.*
>
> Participant B1-07: *You have injections in your spine, don't you?*
>
> Participant B1-08: *I have injections… yeah. And so that was the last resort, he'll put me on morphine… fine. Then when I went to the doctor's, it wasn't him, it was another doctor and he said*

to me, 'I don't believe in morphine so I'm not giving it you.' And I just said to him, 'Well, you're a waste of time talking to, aren't you? Come on, let's go.'

(B1-07 and B1-08 Interview 1)

A large number of patients in Cohort 1 increased their knowledge and skills about their health condition as a result of taking part in the Test Bed programme (68%; n=15). Of the 22 Cohort 1 patients who took part in the initial and follow up interviews, 64% had COPD (n=14); 32% had heart failure (n=7); and 4% had arthritis (n=1). The learning referred to by Cohort 1 participants as a result of participation in the Test Bed related to the following:

- Diet and exercise;
- New tips – such as the importance of drinking plenty of fluids;
- Learning to better manage their own LTC;
- Learning for carers – how to support someone with an LTC;
- Heart failure patients – learning to pace themselves and the activities they do;
- COPD patients – learning how to cope with COPD, and strategies to manage it

Participation in the Test Bed programme had a positive impact on daily activities for some participants, with a number of patients in Cohort 1 experiencing a positive effect on their daily activities as a result of participation in the Test Bed. For these patients, the increase in daily activities had a direct impact on their quality of life, as well as the quality of life of their family members.

'I mean I went into town on… yesterday we went into town. Now it was very cold, wind was blowing, and you felt cold and I had to sit down quite a few times, but I learnt that off one of the videos that was on the machine. If you feel out of breath, sit down. I mean I did get to the stage – I'll be honest with you – that I didn't feel like going into town, I didn't feel like going out of the house, but I said to my wife, 'Right, we're going in town, we're going to get some stuff today.'

(B1-02 Interview 1)

While changes in daily activities can be an indicator of changes in quality of life, this may not be an appropriate indicator for patients in Cohort 1, many of whom were very unwell and unable to leave their home. As a result, the Test Bed programme did not influence daily activities for many in this cohort. This is explained in the following interview with a patient living with COPD, diabetes and MS, and who is bed-bound:

Family carer: *It didn't [affect daily activities] in Mum's case, it didn't, because – I'm not being horrible – you don't do activities very much, do you?*

Patient: *No.*

Family carer: *You used to like get up and do baking etc., like do a bit and then come back, have a rest and go back. But your back's got worse and worse…*

Patient: *Yeah, it has.*

(A1-01 Interview 2)

Cohort 2

A significant number of patients in Cohort 2 (83%; n=15) experienced an increase in confidence in relation to their health as a result of taking part in the Test Bed programme. The reason for the increase in confidence in this cohort however, differed to that of Cohort 1. Whilst increased confidence in Cohort 1 was closely linked to reassurance and monitoring; in Cohort 2, it was linked to an increase in knowledge and skills, resulting in people feeling better able to self-manage their health. Phase 2 data indicated that the patients who learned the most were those in Cohort 2, with 94% (n=19) indicating in Interview 2 that they had increased their knowledge and skills about their health condition as a result of taking part in the Test Bed programme.

The majority of Phase 2 participants in Cohort 2 had COPD. For a significant number of people in this patient group, participation in the Test Bed programme helped them to learn about COPD and to understand how to better manage it. It is this increase in knowledge and skills which appears to be responsible for increased levels of confidence relating to health in Cohort 2 patients.

The increased knowledge and skills relating to COPD included the following:

- Understanding when and how to correctly use inhalers and other medication;
- Learning techniques and tips related to respiration wellbeing;
- Knowing how to identify the early signs of an exacerbation and avoid a crisis situation;
- Increased awareness of the patient's own general health and wellbeing;
- Understanding the importance of looking after oneself;
- Knowing what questions to ask healthcare professionals at routine check-ups;
- Becoming more motivated – for example to move more often and walk more steps;
- Making better use of learning in pulmonary rehabilitation classes (over 40% of Cohort 2 participants attended, with others being referred as a result of the Test Bed).

Participation in the Test Bed programme had a positive influence on daily activities for some participants, with the biggest impact taking place in Cohort 2. For this group of patients, 50% (n=9) experienced a positive effect on their daily activities as a result of participation in the Test Bed. For the following heart failure participant, the Test Bed programme helped him to lose weight which had a positive impact on his quality of life and helped to alleviate his depression symptoms:

Patient: *If [my GP] hadn't shown me that graph [of my Test Bed technology data], I'd have still been bloody fighting with myself what to do.*

Interviewer: *And you say 'fighting with yourself'… did it feel like a fight…*

Patient: *Yes.*

Interviewer: *The whole weight thing?*

Patient: *Yes. It's always a fight. I think that's two-thirds of my depression… fighting with myself […] I'm not the way I want to be, if you understand what I mean […] I've always been big and I know I can't do anything about that, but… er, more-so since I had the heart operation than owt else. They've given me a second chance. And they spent all that money on us, it's no good me being a fool and eating and eating and eating and sitting on my backside, like they say, not doing anything. They've worked hard to save me so I've got to put a bit in myself […]*

Interviewer: *Have you noticed a difference with how you feel [since losing weight]?*

Patient: *Mm… mm.*

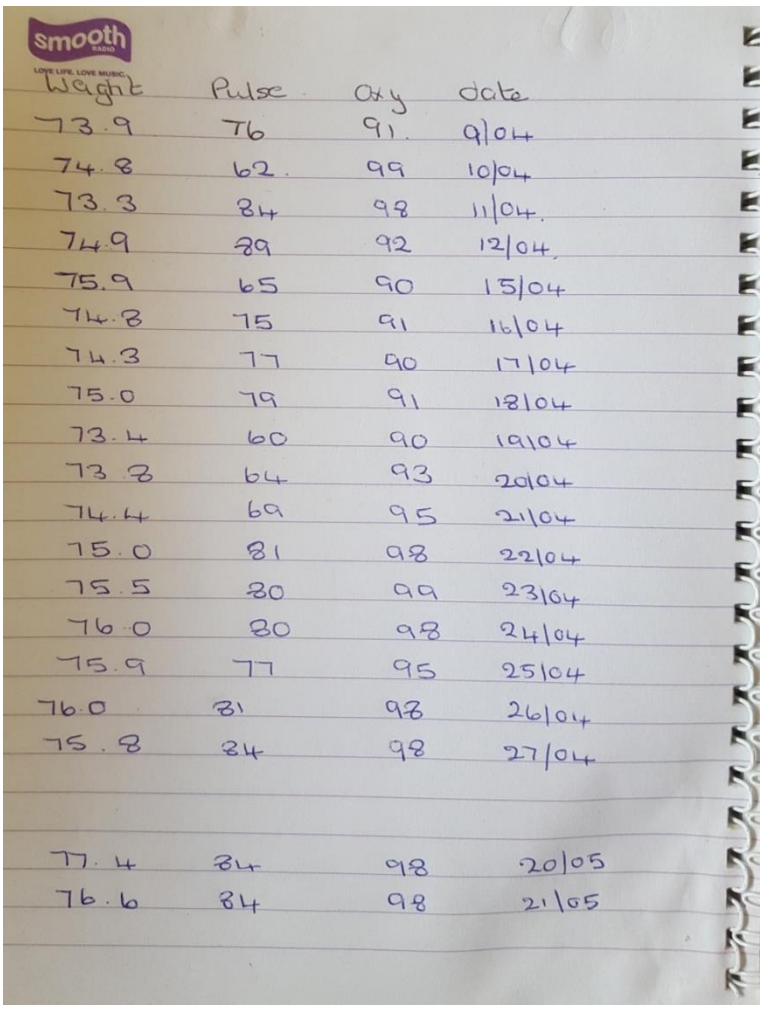
Interviewer: *In what way?*

Patient: *Well, I'm not getting out of breath as much. I still get out of breath…and I will do, because that's asthma, but er… I'm feeling more… get up and go […] It'll make [activities] easier… yeah.*

(B2-02 Interview 2)

Many participants in Cohorts 1 and 2 indicated that they would continue to self-monitor their health beyond the end of the Test Bed, and some actively purchased their own equipment after the intervention finished. In one example (Figure 3.13), a Cohort 1 patient explained that she would be 'carrying on [the Test Bed] in my own little way' (A1-03 Interview 2) and showed the following record she had begun to keep:

Figure 3.13. Example of patient monitoring their readings beyond the end of the Test Bed (A1-03 Interview 2)



Weight	Pulse	Oxy	date
73.9	76	91	9/04
74.8	62	99	10/04
73.3	84	98	11/04
74.9	89	92	12/04
75.9	65	90	15/04
74.8	75	91	16/04
74.3	77	90	17/04
75.0	79	91	18/04
73.4	60	90	19/04
73.8	64	93	20/04
74.4	69	95	21/04
75.0	81	98	22/04
75.5	80	99	23/04
76.0	80	98	24/04
75.9	77	95	25/04
76.0	81	98	26/04
75.8	84	98	27/04
77.4	84	98	20/05
76.6	84	98	21/05

Cohort 3

In Cohort 3, there was very little evidence of increased confidence relating to health, with only one participant citing any increase in confidence. It is worth noting however, that Cohort 3 participants differed significantly from the other three cohorts in that they were younger, many were still in paid employment and did not consider themselves to have a long-term condition. As a consequence, this lack of evidence of any increase in confidence in comparison to the other cohorts was because most in this patient group did not lack in health-related confidence prior to becoming involved with the Test Bed programme.

Patients in Cohort 3 had a range of diagnosed illnesses, with some having more than one co-morbidity, including: anxiety, arthritis, asthma, back/neck/shoulder injury, chronic pain, COPD, depression, fibromyalgia, heart disease, hypertension, lymphedema, and stomach/bowel conditions. In Cohort 3, only ten patients took part in Phase 2 of the evaluation and it must therefore be acknowledged that these numbers are relatively small. Nevertheless, half of those patients interviewed (n=5) indicated that they had increased their health-related knowledge and skills as a result of taking part in the Test Bed. The learning

referred to by some Cohort 3 patients as a result of participation in the Test Bed related to the following:

- Diet and exercise;
- Identifying patterns in their own health data – for example, feeling better when drinking more fluids;
- Identifying patterns in their own health data and seeking medical advice / attention;
- Learning and gathering evidence to support a correct diagnosis by a healthcare professional.

There was little evidence of any impact on daily activities for patients in Cohort 3, with only one person stating there was any effect. As previously noted, this cohort had the lowest risk of hospital admission and many did not consider themselves to be unwell. Patients in Cohort 3 were often active, employed with fairly large social networks. These factors help to explain why increases in daily activities were not evident for this cohort; many participants explained that they were simply busy enough already:

> *I haven't got enough time in the day to do what I do, because I do sew, I do knit. I do other things, craft things with the [grand]kids, you know… all sorts.*
>
> (B3-01 Interview 1)

For others in Cohort 3, however, the Test Bed enabled them to improve their health, which had a positive impact on their quality of life. For example, for one Cohort 3 participant, the Test Bed programme led to a correct diagnosis of sleep apnoea, which then had a significant impact on his and his partner's quality of life.

> Patient: *With everything what's happened now, and the control of my sleeping, and knowing what's going on with me, I'm getting up now, I'm not tired […] Everything we were doing, the app when I was filling it out, you could see what was going on and it was bringing a regular pattern in […]*
>
> Interviewer: *Which eventually led to your correct diagnosis, didn't it?*
>
> Patient: *Yeah.*
>
> Family carer: *He's now the Treasurer of our Club […]*
>
> Interviewer: *Right, so you've kind of got a new role? […]*
>
> Family carer: *It's like given him a lease of life where he feels he's important? […] He's dead proud to do it, you know.*
>
> (A3-01 Interview 2)

It was particularly important for Cohort 3 engagement that patients saw the relevance of the technology to themselves and their own health. Many commented that they this was not the case and that they did not see the relevance of the technology to their own needs or were unsure why they had been given it to use. Our findings suggest that patients in Cohort 3 may

have benefitted more from the Test Bed had they been involved in decision-making processes regarding their healthcare and choice of technologies.

Cohort 4

Of the 13 patients who completed the initial and follow up interviews in Cohort 4, only three referred to an increase in health-related confidence as a result of participation in the Test Bed programme. For one participant, the Test Bed became part of his daily routine which he remembered to do without any prompting and was something he was able to do by himself without support (C4-11 Interview 2). In the other two cases, the increase in confidence related to the family carer, rather than the patient, and was a direct result of knowing the person with dementia was being monitored and that someone was looking after them. One carer explained that she found it frightening not knowing how her husband's dementia would progress and what the future may hold, and that the Test Bed monitoring went some way toward alleviating this anxiety (C4-17 Interview 1).

All participants in Cohort 4 had received a mild-to-moderate diagnosis of dementia. Of the 13 participants who completed the initial and follow up interviews, data showed that just under a third considered the Test Bed to have increased their knowledge and skills regarding their health condition. Importantly, however, in all four of these cases it was again the family carer who had increased their knowledge and skills, rather than the patient. One family carer explained that her husband was too confused to benefit from the Test Bed technology and that it was she who was learning about his condition from participation in the Test Bed (C4-05 Interview 2). Another family carer explained that the Test Bed helped her to remember her husband's dementia medication, as well as learn about his condition (C4-08 Interview 2), whilst another said that, as a result of the Test Bed, *'I learned it was normal to feel the way I do*' (C4-17 Interview 2).

There was little evidence of any impact on daily activities for patients in Cohort 4, with only one person stating there was any effect. However, findings from Cohort 4 do illustrate the importance of ensuring family carers are closely involved in decision-making processes regarding the implementation of combinatorial health technologies to support patients with dementia, as well as other long-term conditions.

Carers

There were two ways in which family carers participated in Phase 2 of the LCIA Test Bed. In addition to the 73 patients who participated in Phase 2 of the evaluation, 32 family carers indirectly took part by being present for interviews and contributing to discussions. Four of these carers made up an additional small cohort of family carers who took part in initial and follow up interviews, trialling the use of a text message technology focused on the health and wellbeing needs of carers. As a result, much data has been gathered in Phase 2 which relates directly to family carers and the impact of the Test Bed programme on them.

The family carer cohort

This small cohort was made up of four family carers, all of whom were women whose partners had received a mild-to-moderate diagnosis of dementia and who were taking part in Cohort 4. Three carers completed both interviews 1 and 2, whilst one woman withdrew from the Test Bed after interview 1 following her husband's death.

Caring responsibilities

All four women were providing increasing levels of care for their partners, including showering, dressing, and managing medication intake. In addition, carers were responsible for managing the household finances and affairs, along with medical appointments, cooking, cleaning and other household tasks. By interview 2, these responsibilities had increased. Two family carers also provided regular care for grandchildren.

> Family carer: *I don't mind the paperwork but I like to... if I get it, I like to do it: I never want to leave it. I like to, you know, do it there and then, and if it needs posting, get it posted. But I don't mind it […] There is a lot of paperwork.*
>
> Interviewer: *Yeah, and it can easily get...*
>
> Family carer: *Panic.*
>
> Patient: *You do mine, don't you, love?*
>
> Family carer: *Well...*
>
> Patient: *I can't do it.*
>
> (Carer-04 Interview 2)

All four carers were living with their own health conditions. Carer-01 suffered from depression, anxiety and high blood pressure, and Carer-05 has chronic renal failure for which she was awaiting dialysis and possibly a transplant. Carers 02 and 04 were each awaiting an operation, but both were delaying it because of their caring responsibilities and concerns about who would care for both their partner and themselves during this time.

> *I've just been for a scan and I've two options: one is an injection which would be temporary, he said it wouldn't solve the problem; and other than that it would be an operation. But I really don't know how I would cope with that, to be truthful […] I haven't got my head round it yet because, you know, apart from me looking after [my husband], I think to myself who's going to look after me? Because I wouldn't be able to drive or I'll probably be struggling to walk for a little while or on crutches, so I haven't kind of got my head round that. But I feel I need to do something rather than be in pain 24/7. It's just... just gets me down.*
>
> (Carer-04 Interview 2)

There was an acknowledgement from each of the four carers that they needed to attend to their own needs and begin to care more for themselves and their own wellbeing. However, this was difficult for them in the context of their increasing caring responsibilities, which limited their ability to focus on themselves.

[My husband] struggles with time. He'll look at the… like one of the daughters bought him that clock and he'll look at that and then he'll forget what time it was so, when I come in, it's 'Where've you been? Where've you been?' you know, and 'You don't have to be this long.' And so I tend not to go out so much. But the kids keep saying, 'You've got to go out because you've got to build up yourself to look after Dad.' […] I feel better if someone's here.

(Carer-01 Interview 1)

Family carers also talked about their coping strategies:

You know when you are having… you talked about bad days […] I always think if you, you know, if you can wash your hair put something fresh on and just… a bit of lipstick and your best coat, you know, and then you just project this. And if you can feel that you can project a look or, you know, a way of being, it's almost like role play, isn't it? […] You believe it and suddenly, before you know it, you know, you want to go out, you know, take the first few steps out of the door […] I'm okay as long as people don't ask me how I am because it's sort of… it's a bit like opening the floodgates.

(Carer-02 Interview 1)

More so than for any other participant cohort, there was a sense of transition and change for family carers and patients in Cohort 4. This included changes in the roles and responsibilities of those within a household, as well as significant changes in relationships brought about as the result of changes in health. Carer-05 talked about the uncertainty of the near future for her and her husband because of both of their health conditions. Having holidayed in the same location in Spain each winter for the past 14 years, they brought everything back with them this time explaining, 'this might be our last winter in Spain'. Other carers talked about similar changes taking place in their lives as a result of their partners' health conditions.

We sit down after tea, everything's washed up, done and finished, telly goes on and he falls fast asleep [….] And he can sleep from seven till ten […] I think... you know, like I'm here on my own […] you've nobody to converse with or I say... I'm watching and then I say something and I turn round and he's out of it, so... I think: Right, okay, talk to yourself.

(Carer-04 Interview 2)

I've decided to just break-up my teaching library which is […] a wall of massive books […] But my God it's a lot of taking down, you know, checking… getting rid of my name from all of the books and so on, and then deciding, you know, what we're going to do […] And it's all about clearing… I just feel that I need to be… you know, I don't know whether it's a control thing, but that I need to keep everything as clear as I can. And you know those years when you're putting your house together and, 'That would be nice…' and 'I've just got a place for that little vase,' we're in exactly the opposite [situation].

(Carer-02 Interview 1)

Benefits of the Test Bed for the family carer cohort

Although only a small cohort of family carers, the data provides an insight into the benefits of digital technologies for family carers' health and wellbeing.

Overall, carers felt that the text messages they received had a positive effect on them. Carer-01, for example, explained that 'the messages give me a boost' and 'put a smile on my face'. Similarly, Carer-05 referred to the text messages as 'cheering you up messages' and explained that she keeps them on her phone for a while and regularly reads them back to herself.

The technology also made carers feel better supported. Carer-04 commented that the text messages she received made her feel less alone and reminded her 'there's thousands like me'. Similarly, Carer-05 explained 'you feel like there's somebody out there looking out for you'.

> *[Flo tells you] don't think that you're alone and, you know, there's always somebody to help [...] [I agreed to take part in the Test Bed] because I felt that I wasn't on my own. That, if I wanted, you know, if I wanted to text her back or... at least I'd somebody to contact that maybe understood or... because I sometimes, some days I find it hard... really hard.*
>
> (Carer-04 Interview 1)

Suggestions for improvements to the Test Bed programme

The previous quote illustrates a point raised by all four family carers: that they would have liked the Test Bed programme to have facilitated two-way communication rather than only receiving messages. Carer-05, for example, explained that she wanted to be able to respond to Flo because 'when you receive a text, you automatically think 'I must reply to that', but Flo is a one-way conversation'. Similarly, Carer-02 felt that a text message isn't enough and that the interaction was missing. Carers explained how they did try to reply to the Flo text messages:

> *That's what I found hard because I did a message back about [my husband] being in hospital […] and I realised then… well, I showed my daughter and she said, 'You're not supposed to text them back.' But I think it would be… better if you could… answer them […] Because if she [Flo] sends you a text saying, you know, like about smiling and that, and if you feel really down, instead of worrying the kids about it, if you could just text back saying, 'Well, I don't feel great today.*
>
> (Carer-01 Interview 1)

> *I quite like Flo except you can't reply to her. That's the main thing because, at first, I sent a text back and then I got another message, 'Do not understand,' and I thought: How can she not understand what I'm saying? Then I thought: Oh, I'm talking to a machine, aren't I?*
>
> (Carer-05 Interview 2)

Family carers across all patient cohorts

As mentioned above, in addition to the small family carer cohort, a total of 32 family members indirectly took part in Phase 2 of the evaluation by being present for interviews and contributing to discussions. Within this data there is evidence of much carer burden across all patient cohorts.

Patient: *You see [my wife] had to go away because [she] was suffering from anxiety and depression.*

Family carer: *Depression, and I needed a break.*

Patient: *And the nurses said that she needed to go away […]*

Family carer: *I went with my friend and her sister and my sister-in-law on a river cruise […]*

Patient: *[To] give her more confidence about going, I booked myself into a care home for a week.*

(A1-05 Interview 2)

As discussed, there was also a sense of significant transition and change for family carers and patients related to Cohort 4, including changes in the roles, responsibilities and relationships within a household. The family carer is key to negotiating these ongoing changes and there were suggestions in the data that technologies should also address the needs of the family carer.

The Test Bed technology was often the responsibility of the family carer, with many patients saying they could not have taken part in the programme without the support of a family member of carer. Referring back to Figure 3.5 of the total 18 participants in Cohort 4, 83% (n=15) indicated in interview 1 that they were confident when using digital technologies at the outset of the Test Bed programme. However, it is worth noting that this figure includes family carers; when the family carer's confidence with technologies is removed from these figures, only 56% (n=10) of participants claimed that they themselves were confident with technologies in general. As a result of cognitive decline in participants in this cohort, it was often the case that patients said they were only able to participate in the Test Bed because of the support of their family carer.

Some family carers commented that the technology was more for them than their partner, with some commenting that they would have liked for the Test Bed technologies to have also addressed their own needs.

Family carer: *There was quite a lot that I didn't know that was [in the technology] you know, I thought: Oh well, you know... things that I didn't realise were part of the problem...part of the illness.*

Interviewer: *Has it been more useful for you than for [your husband]?*

Family carer: *Yes. Yes, I would say so... yes […] I think you'd get a truer picture if you aimed it at the person who was looking after the sufferer, i.e. the carer. I think because then you can put things down that maybe couldn't be said or wouldn't be said.*

(C4-20 Interview 2)

Staff

The following key findings relating to members of staff involved in the Test Bed are presented here:

- Benefits to members of staff
- Impact on everyday working practices
- Benefits to patients and family carers
- Impact on service utilisation
- Healthcare teams and the technologies

Benefits to members of staff

The Test Bed enabled members of staff to have more contact and connections with their patients, with many welcoming the added diversity to their role as a result of the programme.

I've enjoyed the contact with the patients and the feeling that you're actually helping them, aren't you, to manage their illness?

(Staff member, BCT)

Members of staff experienced increased confidence and reassurance in their daily roles as a result of the Test Bed. The monitoring of patient data and addressing of alerts increased levels of job satisfaction for many as a result of knowing that patients were stable and future issues were being prevented.

I find it quite satisfying that we're picking people up before they... before they're really unwell. I've found that... and blood pressures... a lot of the people with high blood pressure, COPD... now COPD patients go for the COPD annual review and often the blood pressure gets overlooked. So they're not having their blood pressure monitored and we've picked up loads, haven't we, with hypertension?

(Advanced Nurse Practitioner, BCT staff focus group)

It's not just patient reassurance, it's ours as well, because we do have very poorly patients and it has given us the confidence to know what we're doing is right, and if something isn't working, like medication, we can change it'.

(Staff member, FCV)

Interviewer: *Is it nice having that variety, having a bit of a different dimension to your day?*

Staff member: *Oh, definitely. We do the urgent surgery day in, day out, so that's*

chest infections, chest pain, you know, musculo-skeletal. [The Test Bed] *is more chronically unwell people that we don't deal with. We've both done that sort of thing in the past* […] *but we don't get it now unless they're acutely unwell. So it's actually nice to talk to people about how they're managing on a day to day basis.*

(Staff member, BCT)

As a direct result of their time spent on the tasks associated with the Test Bed, staff cited examples of their healthcare colleagues being able to better manage and prioritise their own workloads.

It has cut back on our home visits as well because we can see what we want to without going out to each person. We used to go out probably every two weeks […]. *Now, if people are quite stable, we've cut that back to when they want us. We just keep an eye on them on Motiva* […] *which can save a 25-minute drive each way.*

(Staff member, FCV)

Impact on everyday working practices

For the majority of staff involved in the Test Bed, their input came on top of their usual workload. Staff thus cited time as a key challenge for successful delivery of the Test Bed with the Test Bed resulting in additional workload for those operating on the front line. Depending on the number of patients using the technologies within a service, and the types of technologies being used, daily tasks associated with the Test Bed were often time-consuming - including the following:

- monitoring patient data and looking for trends;
- addressing alerts when patient data is outside of normal parameters;
- ongoing revision of individual patient settings, so system parameters reflect what is normal for the individual;
- providing support and reassurance to patients and family carers about their data and using the technologies;
- checking patient data against patient records (on a different system); and
- following up missing patient data where expected readings are not received.

As the above list reveals, staff were often required to make numerous telephone calls each day to ensure the appropriate and safe monitoring of patients taking part in the Test Bed. Members of staff stressed that protected time is needed for delivering a programme such as this, particularly in the implementation stage, and especially for patients with dementia.

Patients seemed to be put on a 'one size fits all' whereas everybody's obviously different so you need to spend time tweaking [the settings for each individual patient].

(Staff member, FCV)

[Cohort 4] *is such a small cohort of people* […] *it took such a lot of work to get such*

a few people using the Test Bed technology.

(Staff member, Cohort 4)

As a result of demands on staff time, speed of working is also an important factor in the adoption of new technologies. The Test Bed technologies proved to be incompatible with patient medical records, resulting in staff working across incompatible patient data systems. To add to this complexity, in one area where different GP practices merged during the period in which the Test Bed was operating, the practices themselves were also operating on different systems for some considerable time:

> *And so to log in takes me another 10 minutes, you know, into another practice to send them a message. And that shows to me how much more difficult it would be if you don't integrate* [the systems] *and don't give access to the clinical record for the staff doing it* […] *We need access, full access to the record* […]. *As we formed, they merged all our records for the five practices so you did have access to all, whereas when we started* [the Test Bed*] that didn't exist. And we weren't all the same... we were on different computers for a year*.
>
> (Staff member, BCT)

Benefits to patients and family carers

While some people required higher levels of support, staff felt that the vast majority of patients and carers across the two vanguard sites got on well overall with the Test Bed technologies. Members of staff cited many examples of patients and family carers developing the knowledge, skills and confidence to better manage their health conditions.

> *The technology was a visual reminder and patients could see what they were doing right.* [One patient] *was bad at taking her inhalers and things like that but when she took them correctly and then did her sats she could see the benefits and how much better she had got, purely from the graphs* […] [Patients with COPD] *could see the signs and feel the signs and knew when to start their rescue medication*.
>
> (Staff member, FCV)

> *The concept is good and people have felt empowered by it. It's encouraged interaction between patients and their family carers. I've heard family carers say, 'I didn't realise you felt that way' when a patient has answered a survey question such as 'Do you miss having a close friend?'*
>
> (Staff member, Cohort 4)

Impact on service utilisation

Some patients and family carers required a lot of reassurance and support in relation to their use of the technologies and their data. In these cases, service utilisation increased during the Test Bed programme. The Test Bed programme has also resulted in members of staff diagnosing and treating patients in relation to previously unknown conditions, with such instances increasing service and medication utilisation.

> *We've actually picked up a lot of* [patients with] *hypertension that we weren't aware of and messaged GPs, inputted all the data into their records, increased their medication or started medication, arranged blood tests, and got the blood pressure under control.*
>
> (Staff member, BCT)

There are many examples within the staff data of people engaging with, and receiving, better healthcare as a result of Test Bed participation. These short-term increases in service utilisation were referred to by members of staff as a positive outcome of the Test Bed because people were receiving better and more appropriate care. As a result of improved healthcare, many staff believe the Test Bed programme would result in a reduction of emergency care and hospital admissions in the long term.

> *I believe the Test Bed has avoided hospital admissions because* [patients with COPD] *can see the patterns for themselves and I can see they have acted quicker when they have got a chest infection, whereas previously they would have waited and waited and ended up in hospital.*
>
> (Staff member, FCV)

> Staff member 1: *Well, for some patients we may have reduced their risk of stroke quite massively, just by picking up on something* […]
>
> Staff member 2: *It would look as a negative if you were monitoring on cost, yet actually the cost of a stroke is a lot more than the cost of blood pressure drugs* […] *when I'm in meetings I've said, 'You wouldn't believe what we've picked up', because I see it. These are people that had life-threatening levels and had no idea because that wasn't being monitored.*
>
> (Staff members, BCT)

It is worth noting that due to the relatively short time-span of the Test Bed, the health economic data was only able to pick up on increases in service utilisation costs arising from identifying previously unknown conditions. It is unable to assess any potential longer-term reductions in more costly in-patient care arising from early identification of these conditions that have facilitated the delivery of lower cost treatment within community environments. Nevertheless, it is worth noting that the mean cost of stroke per patient is £46,049 – and these costs increase with older age where there is increased likelihood of stroke severity and intracerebral haemorrhage (Xu et al. 2018). The potential for cost reduction in in-patient admission through early identification of health issues that may lead to stroke or other health conditions with a higher prevalence in later life is substantial.

Healthcare teams and the technologies

Staff across both vanguards stated the importance of being part of a willing and engaged team when embarking on a programme such as the Test Bed. Good communication and working relationships are key. Where members of staff had ownership of the programme and were involved in decision-making, they believed in and supported the Test Bed. Conversely, when

staff members were not involved in decision-making, or where ownership was not encouraged, there was a negative effect on their engagement with, or experience of, the Test Bed.

> [The Test Bed] *was better with us doing it because we knew our patients* […]. *It needs to be controlled by us* […]. *The Test Bed became more complicated than it should have been because we weren't involved in the decision making*.
>
> (Staff member, FCV)

> *The team approach* [has been important]. *If it's too anonymous, people don't take... they don't follow it through. In a small team, people are bothered about what their colleagues think, as 'I haven't finished it off, I haven't done it right,' in my experience. In a large team, it can be lost... like 'occlusion of anonymity' they call it, no-one's responsible for it, then I'm not gonna... it doesn't matter today.*
>
> (Staff member, BCT)

A number of issues arose throughout the Test Bed as a result of clinical teams not being involved in decisions and programme design from an early stage. This included members of staff being expected to refer their patients to the Test Bed while not knowing what the technology entailed, along with technology content contradicting the advice given to patients by healthcare teams.

> *I think* [the lack of clinical input at the start of the Test Bed] *irritated me, to be honest. I felt dropped in and then I'd no actual say at the start, so therefore I had to follow something on for 18 months. I'm not sure I would have made huge changes, but the fact is I didn't have any real influence and, now we've got a lot of knowledge, I'd like to think* [we would do it differently in future]. *You'd want a couple of focus groups on it, or whatever, saying, 'Will this work or not? What do you think?' people on the ground.*
>
> (Staff member, BCT)

> *'Staff who are visiting patients, we know what our patients' needs are. There wasn't enough input at the start from clinicians and a chance to say what we need from* [the Test Bed technologies].
>
> (Staff member, FCV)

> *I think that was the most obvious thing* [regarding the content of the technology] *was a lack of understanding, like I say, of the variables and the sensitivity of dementia. It's not a... it's not a standard.*
>
> (Staff member, Cohort 4)

> *The technology looked fantastic, great in the lab, but it didn't seem to have any clinical input, particularly in relation to knowledge about dementia* […]. *It seemed*

to be a done deal: 'this is what we'll be doing and these are the questions we're doing to ask' […]. *You need to run these things by people who have been through it, but we were told there was no time to run it by an expert by experience group. I suspect the technology wasn't even piloted*.

(Staff member, Cohort 4)

When we were shown the videos early on, we were horrified. It felt like someone just took them off YouTube. When you are in a situation, as a clinician and patient, you may say something as you can judge person-to-person. You can tell whether someone is ready for that information, you can gauge their response. But technology can't make that decision.

(Staff member, Cohort 4)

It was considered important by staff to have continuity regarding the people working on the Test Bed to enable staff to build up knowledge about patients and 'get to know the patterns and readings' (Staff member, BCT). Members of staff also stressed the importance of having a team made up of experienced staff who are confident in their roles:

Interviewer: *You don't want to be calling patients unnecessarily?*

Staff member 1: *No, no.*

Staff member 2: *Which I believe more junior staff would, you know, because I've seen* [it happen] *and it's obvious, isn't it, if you've not got loads of years of experience and yet are working at a high level, you are going to resort to making sure, and that making sure actually worries* [patients] *even more because these are very anxious people we're dealing with, aren't they?*

(Staff members, BCT)

[A less experienced member of staff took over and] *was ringing everybody every minute of the day because he didn't know the patients* […]. *It's knowing what's normal for that patient'.*

(Staff member, FCV)

Staff believed the technologies to be most successful where the technologies had the flexibility for healthcare teams, patients and carers to tailor the content to a person's individual needs.

[There are some patients] *who are only just about managing to keep on board with* [the Test Bed]. *They do it three times a week and if you pushed them anymore they would stick it because it's too* [demanding}. *Some personal knowledge definitely helped once you knew them for a while. And I think if you were rigid about it, more people would leave the service.*

(Staff member, BCT)

Logic Model

As detailed in the 'Methods' section of this report, the logic model was developed by drawing on a range of data sources including interviews, focus groups, diaries and action learning meetings with key stakeholders. Following analysis of these data and several iterations, this draft Logic Model was presented and finalised through a process of 'backward mapping' during two deliberative panels. The final version of the logic model is presented below in Figure 5.14, along with an accompanying process map (Figure 3.14) and 'crib sheet' (see Figure 5.15).

Whilst the process and Logic Model developed from the Test Bed follows a similar process across both Vanguards, it is worth noting that within the LCIA Test Bed, two different models of care were in operation. These are detailed below:

Better Care Together

The North Lancashire Vanguard, Better Care Together, saw healthcare professionals working together in partnership to help people manage their own health conditions (Bay Health and Care Partners, 2017). This model focused on integrated primary and acute care settings, joining up GP, hospital, community and mental health services (NHS England, 2017a).

The Better Care Together approach to the Test Bed was to utilise a small GP-led team, acting as a hub for the Test Bed, to recruit to Cohorts 1, 2 and 3. Over an 18-month period, which coincided with the LCIA Test Bed programme, six GP practices in the Better Care Together Vanguard merged into one large practice. Three of the six practices were considered as failing, while the other three had strong reputations for patient care, quality and teaching, but were struggling with workload, national targets and to recruit new GPs.

As a result of the merger, all urgent phone calls were received at one site staffed by a GP, two nurse practitioners and five receptionists. If required, a patient would be seen by a GP on the day, while like many parts of the country a non-urgent appointment may result in a few weeks' wait.

Test Bed patients from Better Care Together who received the Motiva technology were monitored daily by advanced nurse practitioners and, where the system alerted due to a patient's readings, a nurse phoned the patient directly. Nurses had access to urgent appointments each day, along with GP appointments and home visits.

It was evident in the Phase 2 data from Better Care Together that many patients were unhappy with their merged GP service and had experienced difficulties in securing GP appointments through this new system.

Fylde Coast Vanguard

The Fylde Coast Vanguard[50] drew on the Extensive Care model, which brought together a range of services in the same location to achieve a co-ordinated team of healthcare

[50] The Fylde Coast Vanguard encompasses NHS Blackpool CCG, NHS Fylde & Wyre CCG and Blackpool Teaching Hospitals.

professionals, with patients each allocated a wellbeing support worker (NHS Blackpool CCG, 2017). This model focused on multispecialty community providers, moving specialist care out of hospitals and into the community (NHS England, 2017b).

The Fylde Coast Vanguard approach to the Test Bed was to utilise a number of services including Extensive Care (for Cohorts 1 and 2) and pulmonary rehabilitation teams (Cohort 2). GP surgeries were also used to recruit to Cohort 3 but faced the same barriers as Better Care Together with the cohort eventually being halted.

Patients were referred into the Extensive Care service by their GP and referred back to their GP following discharge. The length of time spent in the service differed for each patient, depending on clinical need. In the Extensive Care service, clinical care co-ordinators each had their own caseload of patients, conducting three-month reviews and providing home visits to unwell patients.

Test Bed patients from Fylde Coast Vanguard who received the Motiva technology were monitored daily by clinical care co-ordinators and, where the system alerted due to a patient's readings, a member of staff phoned the patient directly, arranging a home visit where needed.

Phase 2 data illustrate that patient experience of the Extensive Care service was incredibly positive, with patients often wishing to stay in the service. As part of this model of care, patients receive regular phone calls, home visits, and support in relation to more general aspects of their health and wellbeing.

Process

Process models as set out below were produced for the LCIA Test Bed, with different implementation versions created for the two different Vanguards sites involved in the programme. Each cohort also had its own process model; each was similar, but the staff/equipment/installation processes involved varied slightly. The example below relates to the implementation process for Cohort 2. These models emerged from training meetings conducted by the evaluation team with clinical partners involved in the delivering the Test Bed. Subsequent fine-tuning of these process models was undertaken by the Test Bed administrative partners as the implementation process developed.

The process model sets out all steps undertaken in implementing and evaluating the Test Bed programme, however in terms of wider roll-out, where independent evaluation may not be required, all steps outlined in red text can be by-passed or replaced with the service's own evaluation measures. The process of implementation should also consider the inputs, activities and outputs set out in the Logic Model alongside a Process Model adapted for the roll-out location and patient group together with the Crib Sheets provided. The Crib Sheets were developed with practitioners, drawing on the lessons learned in the process of implementing the LCIA Test Bed.

An important aspect of the rapid-response design of the LCIA Test Bed evaluation was the action learning meetings which took place at regular intervals throughout the Test Bed. The action learning meetings involved staff from each of the two Vanguards, colleagues from the

technology companies, and the evaluation team. These meetings enabled key issues to be identified and addressed and agreed improvements to be made on an ongoing basis. It provided an opportunity for partners from across the Test Bed to come together to explore early learning, what was working well / not so well for patients, staff and technology providers and to agree and changes required before the next action learning meeting.

The format of the meetings was as follows:

- A presentation of recent evaluation data (drawing on patient interviews and staff diaries as they were undertaken / gathered);
- Facilitated small group discussions around the issues raised by the data;
- Large group discussion to reach consensus about the key issues and points requiring action; and
- Agreement on actions to be undertaken before the next action learning meeting.

The action learning meetings were highly successful as evidenced by the high turnout of staff and partners involved in the delivery of the programme. They played an important role in contributing to the overall success of the Test Bed programme, as well as to the evaluation. Fundamental to the success of these meetings was the willingness and openness of those attending to engage in the process and address issues as they arose. The evaluation team received positive feedback from all those involved in the action learning meetings, with people valuing the opportunity presented by these meetings to share learning as it was taking place.

A number of issues were raised and discussed in the process of the action learning meetings, many of which were already being addressed by the Test Bed teams and technology companies. Some examples, along with the agreed actions, are outlined below.

- In Motiva, a number of error messages were being received by patients and they were unsure what to do; crib sheets were subsequently developed as a troubleshooting guide for both patients and members of staff: 'this is a message you might receive, and this is what to do'. Error messages within the technology were also altered to include a support line telephone number if patients wished to speak to someone about this;
- In Flo, patients and members of staff reported that too many text messages were being received; the frequency of messages was subsequently revised to three messages each week, a change which received positive feedback from patients and staff;
- In Flo, the requirement of a hashtag when replying about the colour of sputum was causing people problems; this was subsequently removed, making it easier for patients to use the technology;
- Within the Test Bed programme, both patients and members of staff reported a number of cases where people coming to the end of the 6 months in the Test Bed did not want to leave; this was raised with the Test Bed Board and efforts were made to offer alternative technologies for people to step down to.

Figure 3.14. Cohort 2 Test Best Recruitment and Implementation Process

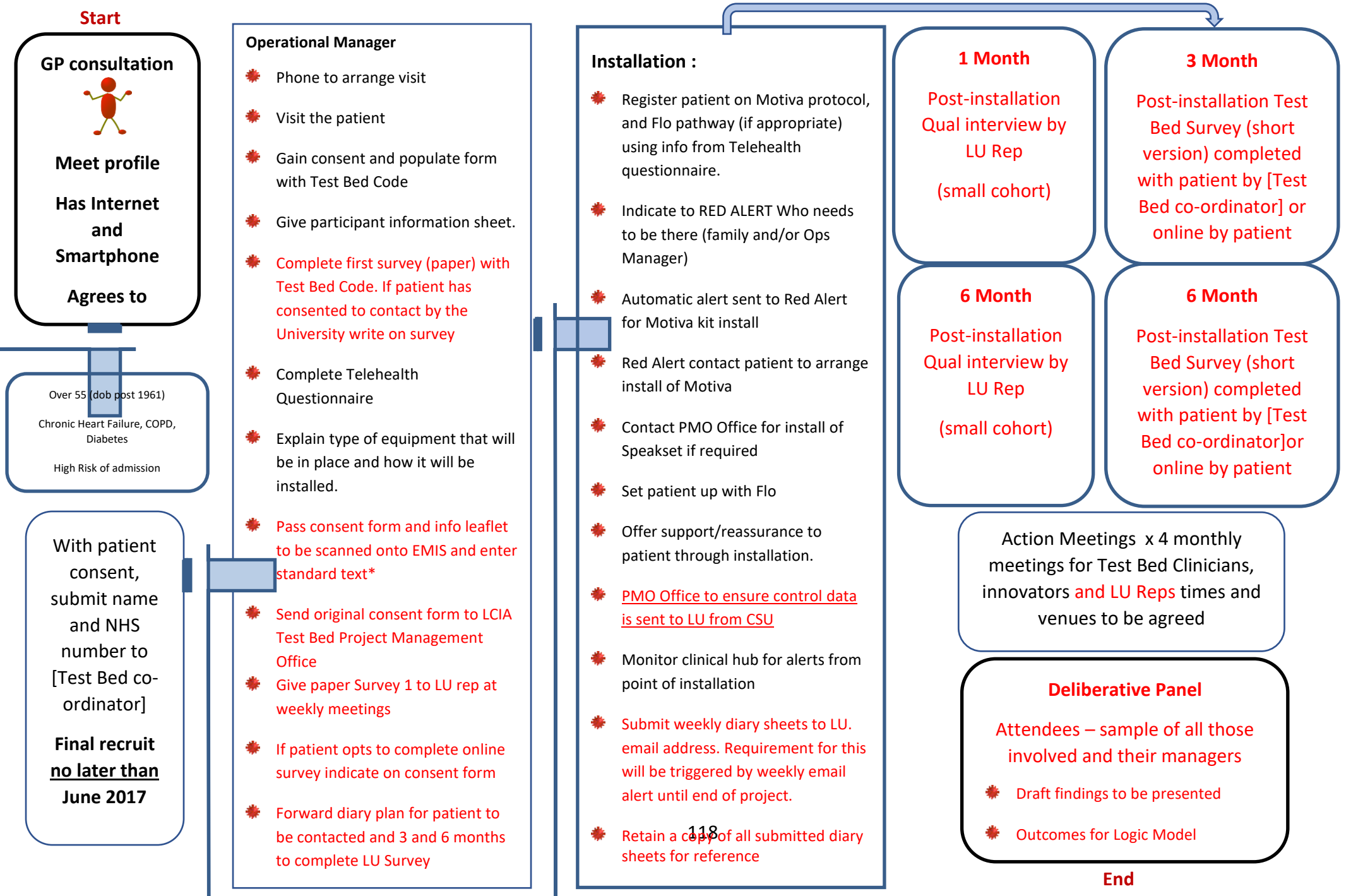


Figure 3.15. Final logic model

Usual practice before the LCIA Test Bed programme	Inputs	Activities	Outputs	Short/Mid-term goals	Long-term goals	Usual practice with the LCIA Test Bed programme
	Staff	- Recruiting new staff with appropriate skills and qualities - Transferring staff (syncing contracts) - Training new and existing staff - Cascade training - Clinical champions / peer support - Creating hybrid roles - Importance of flexibility within roles	- Training courses - Rota for monitoring - Trigger procedures - Key staff to follow programme through (continuity of staff) - New hybrid roles - Capacity – additional consultation time during set up	The right team is in place; team is versatile and ready to respond. Staff have the skills to complete the tasks involved. All tasks are covered. Clear communication and staff know what is going on. Flexibility within roles. It is clear to staff who is their first line of support for technology issues.	Intervention is administered smoothly. Intervention does not increase workload. Staff able to manage changing demands of programme. Staff are able to successfully monitor and treat a greater number of patients with more complex needs.	
	Patients and carers / family	- Selecting patients through GP records/in consultations/memory clinic based on long-term condition and risk of hospital admission - Patient conversations and choice - Inducting patients - Managing patient expectations and outcomes - Reassessment and review at regular intervals - Step up / step down patient care plan and technology used - Managing patient privacy within data flows	- Induction procedure and training programme - Review procedure - Step up / step down chart - Data flow agreements with patients - Privacy agreements for different technologies - Selection criteria - Patient matched carefully to technology - External digital training support	Matching patient with technology. Patient feels supported and not distressed otherwise more likely technology is unused. Flexibility built in so that patients can move between technologies. Support and contact available at an appropriate level. Awareness of patients' capabilities.	Patients are able to monitor their own health conditions at home. Patient's awareness of condition improves. Patient self-confidence, self-care and quality of life are improved.	

	Technology	- Making decisions around who receives tech and when - Installation and training - Making technology comfortable for patients within the home - Making technology inclusive for patients - Supporting patients to monitor themselves - Linking all to a centralised system - Resolving technical issues (by phone/in person) - Providing general IT skills training (patients/carers) - Identifying key stages for support/training - Providing follow-up training (patients/carers) - Following patients up when data is incomplete - Ensuring technology is available for patients	- Patient pathway / patient journey map - Support systems for patients - Technical support lines - Feedback loop when technology fails - Feedback system for participants - Leaflets/personalised (e.g. handwritten) instructions - General IT skills training course - Tools for tracking devices available/patients involved & communication of this data	Patient and technology will be appropriately matched, and technology will be received at most appropriate stage within patient's condition. Implementation of technology will run smoothly. Helping patients solve tech problems when they arise both supported and independently. Technology does not create anxiety and patients want to continue using it. Smooth running of technology is supported through a range of strategies, which provides flexibility within the programme.	Patients can use the technology. Patients transmit data to their local health professionals and tech problems are solved when arise. Technology meets patients' health needs. Technology stimulates patient's awareness of condition and supports self-care. Smooth running of technology motivates patients to self-care.	
	Partnerships	- Addressing complexities around data sharing - Accessing expertise on data sharing/data flows - Meeting face to face with partners - Supporting partners through organisational tools - Recognising/responding to needs/strengths of smaller/larger partners - Supporting tech companies to provide training to staff, and to	- Contract between NHS, tech providers and third sector as appropriate - Data sharing agreements - Privacy Impact Assessment of tech providers - Data flow mapping - Identification of data controllers/data processes - Collaboration with IG specialists - Electronic portals/online meeting points	The interests of different parties are managed effectively. All relevant parties are present from the outset. All partners are connected through a central portal/platform. Problems anticipated and needs of different organisations considered. There is greater knowledge around data management and how to prepare for this.	Relevant authorisations are in place. Delays to the programme due to data flow issues are minimum. Effective communication amongst partners. Partners working together and responding to problems when they arise. Partners deliver their services successfully.	

		patients and family members where appropriate	- Newsletters			
	Equipment/Materials	- Storing devices and equipment - Transporting devices and equipment - Leasing equipment (including cleaning and decontamination) - Choosing devices	- Rooms/space to store equipment - Transport/transport agreement - Equipment lease agreement packages - Equipment care packages	Patients receive technology on time. Technology is managed effectively when in transition between patient and hub/care teams. Systems in place to care for technology/replace.	Intervention is distributed smoothly. Services are implemented correctly. Patients feel motivated to self-care.	
	Governance	- Involving staff at key early stages - Key staff/clinicians learning how to tweak and adapt technologies - Early clinical involvement in technology content and how technologies will be used - Modifying technologies where appropriate - Decision making on the ground - Key clinical leads making decisions from the outset - Clinical leadership involved locally from the outset - Ensuring flexibility within technology packages offered	- Demonstration of technologies and technology workshops - Technology idea-storming sessions - Clear policies and protocols on clinical activity using technologies (including Risk procedure, Risk register and Risk management plan/Risk strategies) - Selection of technology packages available to choose from / flexibility for different practices	Staff will be informed about the programme and will have contributed to how tech will be used in practice and its clinical content. Potential problems are anticipated. Technologies and model of care are modified accordingly. Autonomy within teams to manage technology and teams involved and engaged.	Intervention is adopted with low levels of disruption and potential problems have been addressed/strategies in place to manage these. Staff on board at different levels to enable programme to move forward smoothly. Buy-in from key staff involved in the delivery of the intervention.	

Figure 3.16. Crib Sheet- Things to Consider

Staff	Monitoring of patient data: **This is considered to be more successful when carried out by senior staff. This is because less experienced members of staff may be more risk averse, which can create extra work for teams.** **For other teams (EC) monitoring by junior staff has been successful (important to note here the different ways in which BCT and EC are set up).** Incomplete data monitoring: **Patients may not always complete the monitoring tasks. Some data remains incomplete. Health professionals must follow this up (EC) which can create extra work. Consider with innovators from the outset how to manage this (e.g. alerts to the patient?)**
Patients	**Selecting patients:** Check patient's suitability – does the patient have other conditions that may affect, or be affected by, monitoring (e.g, anxiety/depression)? Are patients participating in trials? Also consider if patients have support from family/friends to assist with applying/removing the device? Will the patient be able to monitor alone or will they need support, and is this in place?
Technology	**Installing:** Technology may be installed by tech companies at additional costs. Alternatively, core teams can be trained to install and cascade. **Feedback:** Patients need to know if the data has been sent/if their task has ended. Some patients expect feedback (a 'no news is good news' approach may create anxiety for some patients). However, technologies may not be able to offer this feedback. Discuss with innovators from the outset how this will be managed. If no feedback/response is offered, this must be made clear to patients during the induction stage. **Self-monitoring:** In order to develop self-care, patients must also be shown how to view their data. Some training may also be needed on how the data should be interpreted (what is normal for the patient?). **Support for patients with monitoring:** Patients may need support with monitoring and with using the equipment at home, such as putting on the devices/removing clothing. Who can fulfil this role? Private agencies may accept/refuse this role. How to incorporate this into existing roles? **Technical Support:** Patients often experience multiple minor technical issues. Online support is necessary however tech companies may be reluctant to be the first point of contact in case patient queries are clinical. An intermediary is necessary in order to direct patients concerns. This may be a member of the admin team within a clinical practice. The team member must also track if these technological issues are resolved forming a feedback loop. The technical line should be continuously

	staffed – an answering machine will lead to some patients attempting to make further calls to other numbers, often leading to frustration and lost messages. **Patient consent:** Patients to sign a document consenting to receiving the technology in their home. This would also explain that the tech will be removed if not used by the patient. **General IT skills training:** Some patients need basic IT skills training (troubleshooting/turning off flight mode/managing notifications). This was offered to patients when invited onto the programme and then a phone number provided for them to book a training session. However, this approach can lead to low levels of take up – patients may be reluctant to make that initial step. Consider booking patients on training courses at the moment of recruiting. Alternatively, request patient permission to pass their details on to training co-ordinators (patient confidentiality would need consideration/possibly new agreements to be arranged for this). **Tech training for staff:** If training is needed for staff, innovators (in particular smaller companies) need advance warning of when / how many staff in order to prepare for this. **Technology timelines:** Ensure the technology is ready and available for distribution before agreeing dates with patients.
Partnerships	**Collaboration agreements:** Bringing relevant partners together (in person) to draw up draft agreements will reduce the complexity of making such agreements. Teams need to involve those with contractual/legal backgrounds and to consider additional costs if agreements are commissioned to solicitors. **Information governance restrictions:** Information sharing between innovators - particular skills are needed here for understanding what can be shared and how. Important to establish this at the beginning as parties involved may not be willing to recruit patients or supply technology until agreements are signed. **Data sharing:** Restrictions are in place about the circulation of patient information outside of the NHS – the creation of a governance portal (Electronic Portal) can support this process but specialist skills and training are needed on how to use such tools. **Newsletters:** Can help to update partners in the development of the programme and to ensure partners are involved. If partners fall out of the loop, technology partners may need to reintroduce their technologies/the purpose of their involvement leading to frustration and a sense of disconnection to the project.

	Needs of smaller/larger enterprises: Important to consider the work flows of different enterprises and plan for this. Smaller enterprises may be able to move/respond quicker to increased demands for services but also may have less flexibility around specific times of the year (end of the financial year). For smaller companies, plan ahead to enable timing with other projects and programmes. For smaller companies it may be difficult to absorb the costs (financial and time) of meeting regularly in person.
Equipment /Materials	**Storing:** Consider where to store technologies if devices are to be distributed by clinical teams. How will the devices be kept secure? Leaflets/instructs may also need to be stored. How will technologies information packs be transported to patients?
Governance	**Involve relevant teams early in the programme**: Decisions about the technologies (and how they will be used) are made by people working on the ground. To avoid delays, those involved in the delivery of the programme need to be on board from the outset (clinical teams and those who deliver the programme). Relationships must be established between innovators and clinical teams to avoid re-introducing the technologies down the line/reversing decisions made. **Technology Content:** It is important to identify the right clinical teams from the outset so they may be involved in establishing the most suitable content for the technologies used. Without the involvement of clinical teams early on, the content of the technology may not be appropriate causing disruption to both patients and staff at later stages in the service. **Engaging Staff:** Key figures from the delivery team must be involved in the programme from the outset in order to engage the front line team in the programme.

Ranking Activity

A ranking exercise was conducted following the two deliberative panels. The approach used for this is set out in the Methodology section.

The survey was sent to all 27 participants who attended the two deliberative panels. Responses were received from 18 people, with a 67% response rate.

Question 1 of the survey contained 11 statements for participants to rank in order of importance (see Appendix 26 for the full list). This question focused on statements relating to patients and family carers. The four statements considered most important are presented in Table 3.22.

Table 3.22. Ranking activity question 1 results

Statement	Percentage of respondents who ranked this statement between 1 and 4 in importance
Decisions about what technologies to give to a patient should begin with the individual's healthcare needs, and not what technologies are available	83.33%
Patients should be involved in the decision-making about what technologies they are to use	66.66%
The technologies offered to patients should be tailored to the needs of the individual patient	66.66%
The healthcare technologies will not be suitable for all patients, and therefore patients and clinicians need to work together to understand who best the technologies will work for	41.66%

Question 2 of the survey focused on staff and contained 7 statements for participants to rank in order of importance (see Appendix X for the full list). The four statements considered most important are presented in Table 3.23.

Table 3.23. Ranking activity question 2 results

Statement	**Percentage of respondents who ranked this statement between 1 and 4 in importance**
It is important that staff teams receive support and training to understand the value of the technologies to their patients	83.33%
Staff involved in the Test Bed need appropriate and regular training and support related to the technologies used by their patients	75%
Healthcare staff must be given the appropriate resources, training and time to enable them to tailor the technologies to the individual needs of the patient	66.67%
Continuity in the staff responsible for identifying and managing patients using healthcare technologies is important to its successful implementation	66.66%

4. Discussion

The LCIA Test Bed focused on taking a combinatorial approach to the use of heath technology to assess their potential for improving the health and well-being of older people living with long-term conditions. The evaluation of the programme was complex. In the discussion section we summarize some of the main findings from the evaluation and address both the strengths and limitations of the approach used. We also address the different models of care adopted within each Vanguard site and comment on the strengths and challenges these presented for implementation of the Test Bed.

Impact of combinatorial technologies: costs and services

Somewhat disappointingly, the evaluation found that, overall, the use of combinatorial health technologies made little difference to hospital service usage for older people with long-term conditions. Further, while patients in some cohorts (e.g. Cohort 1) showed cost savings in all three measures of secondary care, the overall costs of the intervention exceeded any cost savings. However, it is important to bear in mind a number of factors when considering these results:

Firstly, without access to the actual costs of the innovator technologies, all costings for the technologies are based on open market sources. Whilst this is accepted practice within economic evaluation, it does mean that the technology costs are conservative. It is possible that economies of scale could be made through bulk purchasing or exploring alternative models of funding the technologies (such as lease models).

Secondly, our data reveal that the combinatorial health technologies promoted a strong level of engagement and patient activation amongst both patients and carers and that this increase in activation was manifest in improved confidence and a better understanding of the patients' health conditions and how to manage these conditions. Indeed, there is some evidence that this is manifest in behavioural change of some patients as they take increased responsibility for monitoring and managing their own health.

Thirdly, whilst cost is clearly an important issue, our data reveal other important impacts on patients such as the identification of previously undiagnosed conditions, that have potential for considerable cost savings 'downstream'. This is discussed in more detail below, but due to the relatively short time-span of the Test Bed we are unable to verify these potential cost savings.

Identification of previously undiagnosed conditions

A number of the survey responses included messages inserted by patients relating to feelings of depression and loneliness. Around eight patients in Better Care Together left a message requiring mental health support as a result of being part of the Test Bed resulting in a GP reaching all those patients. As a result, the clinical teams were able to identify and treat previously undiagnosed health issues that may not otherwise have been detected until reaching a more serious stage requiring higher level (and more costly) intervention. This, of course was not revealed as a result of the technology use itself, but the technology does allow for the inclusion of surveys related to mental health so it would be perfectly feasible for the

technology protocols to include assessment of mental health status for those at risk of loneliness and depression.

In addition to the identification of previously undiagnosed health issues through the surveys, the recruitment process itself (based on both CSU risk and long-term conditions records and clinical judgement by the clinical teams involved) identified previously undiagnosed conditions. The clinical teams were able to identify patients with a number of additional previously undiagnosed conditions such as hypertension and atrial fibrillation. As a consequence, these participants received treatment that they not otherwise have received, and whilst this had an immediate cost impact on the Test Bed programme, there are potential cost savings to the NHS further 'downstream' that we are unable to include in the evaluation. For example, figures from Public Health England (2014) revealed that over 5 million people int eh UK have undiagnosed hypertension – not only is it one of the biggest risk factors from premature death and disability in England, but diseases caused by diseased caused by high blood pressure account for 12% of all GP visits in England and are estimated to cost the NHS over £2 billion per year[51]. Similarly, a Kings Fund report on the projected cost of mental health care in England estimates that the cost of depression in England will rise to £12.15 bn by 2026[52]

The impact of combinatorial technologies on patients

The evaluation identified a number of benefits of the Test Bed programme to patients and staff. A significant number of patients with LTCs experienced an increase in health-related confidence. For Cohort 1 patients, this was the result of the reassurance of co-monitoring: that is, a combination of being monitored by healthcare staff and of feeling confident enough to monitor their own health. In Cohort 2, increased health-related confidence in patients was the result of increased knowledge and skills, predominantly in COPD patients, and their subsequent ability to better manage their health condition.

For these patients, an important aspect of the Test Bed was the relevance of the technology to their own health condition(s). In Cohort 1, for example, where patients were among the most unwell, the technology – with its focus on co-monitoring – offered reassurance to both patients and their family carers. For Cohort 2, where many patients' primary condition was COPD, the technologies were seen as highly relevant to this condition and so helped them to increase their knowledge, skills and ability to self-manage their long-term condition. The need for decisions about the allocation of health technologies to start with the needs of the patient and not the technologies available was reinforced in both the final logic model and the ranking activity arising from the final deliberative panels.

Good training, induction and ongoing support are essential for the successful implementation of Test Bed technologies. In general, patients found the Test Bed technologies easy to use and they quickly became part of the patient's daily routine. While some Test Bed participants

[51] https://www.gov.uk/government/news/new-figures-show-high-blood-pressure-costs-nhs-billions-each-year [accessed 12/07/18).

[52] McCrone, P., Dhansiri, S., Patel, A., Knapp, M., and Lawton-Smith, S. (2008) Paying the Price: the costs of mental healthcare in England to 2026. Available at: https://www.kingsfund.org.uk/sites/default/files/Paying-the-Price-the-cost-of-mental-health-care-England-2026-McCrone-Dhanasiri-Patel-Knapp-Lawton-Smith-Kings-Fund-May-2008_0.pdf [accessed 12/07/18]

required formal support when issues arose with their equipment, most did not find this off-putting, the main problems arose when support channels were not clear to them or if they felt seeking help made them a burden to busy NHS staff.

Experiences of training and initial support differed across the cohorts depending on the equipment a patient received. While Cohorts 1 and 4 received formal training from an external company, patients in Cohorts 2 and 3 receiving different technologies, including apps, with little support or training in how to use them. Initial one-to-one training and support in the early stages of using the technology – including help with personalising the technologies to meet their own needs - by someone who themselves had received training in using the technology would have been beneficial to them. The availability of a live version of the technology at an initial meeting would also have been useful. It is important that these findings regarding training and support needs are considered for future programmes.

The importance of the ability to individualise the technologies arose throughout the Test bed evaluation. Some patients would have liked the ability to adapt the technologies to meet their own specific health care needs, to address their own likes and preferences, and to change the times they received messages. For example, Cohort 3 participants, unlike patients in Cohorts 1 and 2, did not necessarily want to use the equipment every day and patients did not understand that there was some flexibility within the technology to do this. Others would have liked the ability to tailor the technologies to their own level of knowledge regarding their health condition. Participants in Cohort 3 for example, were confident and experienced with using technologies in general, and the technology provided to people in this cohort did not meet with their expectations. This patient cohort are different in many ways to the other participant cohorts and it is important that these differences are considered in future programmes. Individualisation of the technology was particularly important for Cohort 4 where it was clear that patients had different preferences about when, in their dementia journey, they received information. The majority of Cohort 4 participants had only recently received a dementia diagnosis, and many patients and family carers were still coming to terms with the diagnosis.

Patients highlighted the importance of being involved in decisions about the healthcare technologies they receive, along with having regular opportunities to review progress with healthcare staff. Whilst numbers were small in Cohort 3, it was clear that it was particularly important to this group that they understood the relevance of the technology to their own health, many feeling unsure about its relevance and why they had been given it to use. These issues are important as it is already well known from the evidence base that older people are more likely to adapt positively to the use of technology where they see a clear relevance and utility for their own lives (see for example Age UK, 2011[53]).

A common theme across all cohorts was the lack of clarity about exactly who had access to their data, and the purposes for which it was being used. Patients clearly wished to be better informed about how their data were being used, and while patients were informed of this during the induction process, this was clearly a point at which they were receiving a whole

[53] Age UK (2011) Technology and Older People Evidence Review. Available at: https://www.ageuk.org.uk/documents/en-gb/for-professionals/computers-and-technology/evidence_review_technology.pdf?dtrk=true [accessed 12/07/18]

host of other information so staging this delivery of information may be needed to avoid information overload.

Combinatorial technologies and family carers

Family carers played a crucial role in the Test Bed programme. The technologies were often the responsibility of the family carer, with many patients indicating that they could not have taken part in the programme without the support of a family member of carer. This was particularly the case for Cohort 4, where patients were experiencing cognitive decline. An important point to consider when reflecting on the use and applicability of combinatorial technologies for improving the health and wellbeing of patients with LTCs, therefore, is that for a good number of patients, the technology either required the presence of, or was directly used/applied by the family carer rather than the patient themselves. This is not to deny its effectiveness, indeed our findings suggest that this led to carers gaining both health literacy (a better understanding of the patient's health conditions or a better ability to monitor aspects of the patient health condition/s) and technology literacy. Both of these factors were deemed by carers to be important in helping the older person with a LTC to manage their condition but also to help them, as carers, to support the patient and help reduce their own stress and anxiety.

The evaluation revealed evidence of significant carer burden across all patient cohorts, with some experiencing depression and anxiety. Family carers involved in the Test Bed were providing increasing levels of care for their partners, and many were also living with their own health conditions. For many carers, the Test Bed technology made them feel better supported. In Cohort 4, for example, it was often the family carer who benefited from the Test Bed, rather than the patient, with carers noting that the technology helped them feel better informed and better prepared for future changes in the condition of the person with dementia. They also felt reassured as a result of monitoring.

This highlights the need for clinicians and technology providers to consider the whether it may be appropriate to involve family carers in decision-making and training around the implementation of combinatorial health technologies. Given carer breakdown is a major factor in the institutionalisation of frail older people (whether that be in hospital or care home settings), our findings suggest that supporting family carers through these combinatorial technologies, and designing technologies specifically targeted at the needs of the family carer, offers potential for enabling older people with LTCs to remain at home for longer.

The Test Bed: impact on staff

For staff, the Test Bed programme enabled more contact and connections with patients and added diversity to their daily role. Like patients, members of staff experienced increased confidence and reassurance as a result of monitoring their patients, with increased levels of job satisfaction for many as a result of knowing that patients were stable and future issues were being prevented. Staff also cited examples of their colleagues being able to better manage and prioritise workloads as a result of the work being undertaken in the Test Bed programme.

However, staff also cited time as a key challenge for successful delivery of the Test Bed, with it resulting in additional workload for those operating on the front line. Members of staff

stressed that protected time is needed for delivering a programme such as this, particularly in the implementation stage. This is particularly the case for patients with dementia. Speed of working is also an important factor in the adoption of new technologies, which need to be compatible with patient medical records to avoid staff working spending valuable time working across a number of incompatible patient data systems.

Staff need to be given the necessary resources to understand and feel able to tailor technologies to their patients' individual needs. As with patients, staff felt the Test Bed was most successful where the technologies had the flexibility for healthcare teams, patients and carers to tailor the content to a person's individual needs.

It is also important to also note that a number of issues arose throughout the Test Bed as a result of clinical teams not being involved in decisions and programme design from the outset. In large part this arose as a result of the short lead in time to the submission of the initial Test Bed bid and the expectation of a quick start-up following notification of the success of the bid. As a result, clinical staff at all levels felt disengaged from a process in which they had not been involved but were expected to deliver on. Members of staff were expected to refer their patients into the Test Bed while not being involved in decisions about the technologies chosen and not knowing what the technology entailed. Some of the technology content contradicted the advice given to patients by healthcare teams resulting in technology protocols having to be re-written.

It is thus clearly important to the implementation of a programme like this, that clinical teams are involved in decisions and programme design from an early stage. This includes training and support for staff regarding the technologies being used, so a mismatch between clinical advice and technology content can be picked up at the outset. It would also ensure that informed choices can be made between healthcare professionals and patients regarding the selection of appropriate technologies.

Staff across both Vanguard sites emphasised the importance of being part of a willing and engaged team when embarking on a programme such as the Test Bed; and where staff have sufficient continuity in their Test Bed posts to enable them to develop knowledge about their patients and become familiar with the patterns of their daily readings.

Strengths and Limitations of the Evaluation Design

Overall the evaluation design was robust in that it was designed as a mixed method evaluation with sample sizes for each cohort that were calculated through known statistics of the older population with long-term conditions across the north west. Overall, the strength and quality of the evaluation design was recognised through the peer review process and subsequent publication in BMJ Open (2018).

Key strengths of the Test Bed Evaluation:

- The impact of healthcare technology was monitored in as close to real-time as possible using self-reported data from Test Bed participants;
- The evaluation approach, using matched control group, was novel and has advantages for measuring intervention effects;

- The ‘real-life’ evaluation design was novel in that unlike RCT-type designs, it recognised the requirement for flexibility and rapid cycle review to meet the ongoing changes of the Test Bed environment;
- The action learning meetings allowed for rapid cycle review and key learning to be identified and implemented by all partners throughout the Test Bed programme;
- The deliberative panels were novel and facilitated ‘bottom up’ agreement and validation of the qualitative findings through representation of all key stakeholders;
- The ‘lessons learned’ activity undertaken as part of the evaluation, allowed early learning from the set-up of the Test Bed programme to be disseminated and fed-in to the planning of future test beds at the national level;
- The strength of the qualitative work in Phase 2 of the evaluation allowed us to develop a more nuanced understanding of who the technologies did/did not work for and why.
- Whilst the recruitment to Cohort 3 was laid down, some patients had already been recruited. The qualitative phase of the evaluation enabled us to gain some insights into the potential of combinatorial technologies for this cohort.

Whilst overall, the evaluation design was robust in terms of both its Phase 1 and Phase 2 methodologies, in practice, like any design, this real-life evaluation raised a number of issues that were challenging – particularly for Phase 1 of the evaluation - and which are worth considering for those planning to undertake evaluation in similar real-life situations:

- Recruitment to the Test Bed was a significant issue throughout, with the Test Bed only recruiting 46% of its original target. This was due to a number of factors including: delays in starting recruitment; lack of early consultation with clinicians resulting in dis-engagement with the Test Bed programme; delays arising from technical and protocol problems with the technology; delays in appointing key staff to deliver the Test Bed; failure to allocated dedicated clinical staff time to the delivery of the Test Bed (particularly within the Fylde Coast model); high levels of attrition; instances of poor handover of clinical staff resulting in the loss or failure to ensure completion of some surveys; and the inability to recruit to Cohort 3.
- The significantly lower than anticipated recruitment levels had an impact on the evaluation. Overall, there were 460 active participants with 293 included in the cost analysis. When estimating a potentially relatively small intervention effect the statistical power of the analysis is reduced with a smaller sample size.
- For patients taking part in the Test Bed we obtained self-reported data from a survey distributed by the Test Bed clinical teams. However, the control data were obtained from administrative records held by the Midlands and Lancashire CSU. Data for the controls were taken from the year prior to the Test Bed programme to avoid contamination between control and intervention groups. Ideally these data would be obtained from the same source for both groups and over the same time period.
- CSU data does not include health related quality of life and wellbeing outcome data. Hence, we were unable to gather this data for our controls so were unable to attribute changes in health outcomes, such as quality adjusted life years, to the use of the technology.

- Due to the complexity of the data only those Test Bed participants who completed all three surveys were included in the resource use and cost analysis. The number of participants with an incomplete set of surveys was higher in Cohort 2 (40 in cohort 2 compared to 27 in Cohort 1). We are unable to assess the direction or magnitude of any potential bias arising from this decision.
- The timeframe of the Test Bed overall was two years, (2.25 years with the extension). The original plan was to assess patients over a nine month period. However, the delays in recruitment meant we had to shorten this timeframe to six months. It is thus possible that the timeframe for our study was too short to enable us to accurately measure any statistical change in admissions and in secondary care use.
- A longer time frame for the evaluation would also be likely to be able to demonstrate a reduction in the costs of the intervention due firstly to the costs of technology decreasing over time; and secondly to an increase in the effectiveness of the programme on secondary care use in the long term.
- To gain a better understanding of the impact of the technology on primary care, community health care and social care, it would have been useful to have this data for the control group.

Data Access and the Collaboration Agreement

Throughout the Test Bed period, the Evaluation Team explored different alternatives to accessing the required data for the analysis. During the first year of the programme we explored the use of both Hospital Episode Statistics (HES) and CSU data. The team liaised with multiple actors with experience in working with similar data within the NHS but communication proved difficult. We were unable to gain access to HES data which would have given us a wider national comparison. However, in November 2016, it was confirmed that CSU data would be made available to the Evaluation Team. To ensure compliance with the Data Protection Act, the evaluation was required to receive approval from the Fylde Coast and North Lancashire CCG Caldicott Guardians. Before this data could be released, however, the LCIA collaboration agreement was required to include a section on data governance. Data governance and the IP data protection issues attached to this are important issues for all partners and particularly so for NHS and industry partners. Developing and finalising the Collaboration Agreement was thus a lengthy process. For Information Governance (IG), completed questionnaires and privacy impact assessments were required from each party within the LCIA Test Bed partnership. These assessments were uploaded on to an electronic Information Sharing Gateway portal to which all parties were given access. Parties were then asked to sign off the project data sharing agreement.

In total, the collaboration agreement and administrative paperwork took around six months. This had a knock-on effect in terms of recruitment to the Test Bed as innovators did not feel able to engage with the Test Bed and until the agreement was signed off. It also meant that the CSU was unable to share the first sample of control data with us until June 2017. AS the early findings from our 'lessons learned' activity suggested, the development of a pro forma collaboration agreement at a national level could help considerably in overcoming these issues.

Models of Test Bed implementation

The LCIA Test bed was implemented using two different models of care, each taking a different approach to the overall delivery and management of the programme in their respective Vanguard areas. In Better Care Together the model adopted utilised a small GP-led team, which acted as a hub for the Test Bed. Within the Fylde Coast the model was more dispersed, utilising a number of services in the area including Extensive Care, pulmonary rehabilitation teams and GP practices.

As noted above, the aim of the Fylde Coast Vanguard area, had been to build on the existing Extensive Care service. It was envisaged that this would have the advantage of a ready-made service with an existing team that could be extended. In reality there were insufficient numbers of patients meeting the criteria for the Test bed coming through the Extensive Care service meaning the Test bed had to be extended to the pulmonary rehabilitation service and GPs making it more dispersed and less cohesive. Many of these staff had not been actively involved in the process and its associated decision-making regarding the delivery of the Test Bed. As a result, staff did not feel ownership of the programme. While they could see benefits of the Test Bed to both their patients and their working teams, staff in the Fylde Coast Vanguard often felt less engaged from the overall process. One consequence of this was that the Fylde Coast Vanguard area found it much more difficult to recruit and retain patients on the Test Bed, resulting in far lower numbers of active patients.

The approaches to team working and overall communication between staff were different in each of these models of care. For the purposes of implementing the Test Bed, Better Care Together developed a new service in which a small GP-led team, acted as a hub for the Test Bed. This proved a more effective model of delivery. Staff in the GP-based hub had been involved in the process and its associated decision-making from an early stage and thus felt a greater sense of ownership and buy-in to the programme. As a small, geographically proximate team, communication was easier and staff also had a better understanding of each other's roles, resulting in a better ability to support each other and the process of implementing the Test Bed.

Key to the success of the Better Care Together approach was the appointment of one overall operational manager who had oversight of and involvement in all aspects of the Test Bed within that Vanguard. The small GP-led hub approach also ensured continuity in the staff responsible for identifying and managing patients using healthcare technologies, which was key to the successful implementation and management of the programme. Within this team, there were excellent working relationships and communication, which were enhanced by the role and commitment of the operational manager.

Despite differences in the models of delivery used in each Vanguard, and the fact that the Better Care Together model was a new service rather than one building on existing infrastructure, as the Phase 1 findings revealed, there was little difference in the cost per patient. The success of this hub model could thus be replicated elsewhere with a relatively small but committed team.

5. CONCLUSION

The Lancashire and Cumbria Innovation Alliance (LCIA) Test Bed was one of seven Test beds awarded by NHS England. The LCIA Test Bed was delivered through two neighbouring Vanguard sites – the Fylde Coast Local Health Economy and Morecambe Bay Health Community (Better Care Together). Located in Lancashire and South Cumbria. Over a period of thirty months, it implemented and evaluated a combination of innovative technologies and practices aimed at supporting older people with long-terms conditions to remain well in the community, avoiding unnecessary hospital admissions. Focusing on older people with long term conditions including COPD, heart failure, asthma, diabetes and dementia, the Test Bed evaluation aimed to focus on two key outcomes:

- Firstly, the extent to which supported self-care telehealth technology might improve patient outcomes and the patient experience for frail older people living with long-term conditions in Lancashire and Cumbria; and

- Secondly, the potential cost effectiveness of the intervention and how this might be scaled up to provide better value for both patients and taxpayers.

The evaluation of the programme was complex and required the development of a 'real life' evaluation methodology that allowed for rapid review and cycles of change throughout the programme.

Whilst our evaluation found that, overall, the use of combinatorial health technologies made little difference to hospital service usage for older people with long-term conditions, it is important to take account of the relatively short timescale over which the Test Beds were implemented. Our data revealed examples of increased service utilisation due to the identification of previously undiagnosed conditions and/or the need for additional or increased medication. These short-term increases in service use are likely to be offset by longer-term cost-savings, but this was not verifiable within the time-span of the Test Bed programme.

When considering the overall costs of the Test bed it is also important to consider whether alternative models of funding could improve the cost effectiveness of the Test Bed programme and the extent to which the NHS could use its bulk purchasing power to achieve economies of scale in the purchase of the technologies.

The evaluation did, however, reveal that the use of combinatorial health technologies promoted a strong level of engagement and increased patient activation amongst both patients and carers. The increase in activation was manifest in improved confidence and a better understanding of the patients' health conditions and how to manage these. Indeed, there is some evidence to suggest that is promoting behavioural change amongst some patients as they take increased responsibility for monitoring and managing their own health. There was also clear potential for increasing the health and wellbeing of family carers of older people with LTCs, enabling them to manage the older person's healthcare at home for longer.

Future directions

The ‘lessons learned’ from this Test Bed provide some valuable insights into how Test Beds can be set up more effectively in the future and how some of the early learning from this Test Bed partnership can be used to overcome potential challenges to successful implementation in the future.

The overall timescale only allowed us to follow participants for a period of six months. While we were able to observe encouraging signs of behavioural change that have significant implications for enhancing older people’s ability to better manage their own care at home; and potential longer-term cost savings of identifying and treating previously undiagnosed health conditions, a longer period of follow up would enable more definitive answers to these questions.

It was also clear from the evaluation that there is real potential for combinatorial health technologies to support family carers and enable them to care for longer whilst monitoring and managing their own health conditions.

Finally, more work is needed to understand the complex needs of dementia patients and family carers, and how these might be addressed using technologies

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Competing Interests Statement

The authors declared no potential conflicts of interest that may be relevant to the submitted Evaluation Report.

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APPENDICES

Appendix 1. Surveys received and missing surveys per Cohort

All Cohorts (1, 2 and 4)

A.	Three surveys completed:	310	71%
B.	Missing baseline survey:	24	6%
C.	Missing second survey:	23	5%
D.	Missing third survey:	15	3%
E.	Missing baseline and second survey:	9	2%
F.	Missing baseline and third survey:	5	1%
G.	Missing second and third survey:	30	7%
H.	Missing all surveys:	18	4%
	TOTAL	434	100%

Cohort 1

A.	Three surveys completed:	169	78%
B.	Missing baseline survey:	13	6%
C.	Missing second survey:	10	5%
D.	Missing third survey:	6	3%
E.	Missing baseline and second survey:	2	1%
F.	Missing baseline and third survey:	2	1%
G.	Missing second and third survey:	12	6%
H.	Missing all surveys:	4	2%
	TOTAL	218	100%

Cohort 2

A.	Three surveys completed:	126	63%
B.	Missing baseline survey:	11	5%
C.	Missing second survey:	13	6%
D.	Missing third survey:	9	4%
E.	Missing baseline and second survey:	7	3%
F.	Missing baseline and third survey:	3	1%
G.	Missing second and third survey:	18	9%
H.	Missing all surveys:	14	7%
	TOTAL	201	100%

Cohort 4

A.	Three surveys completed:	15	100%
B.	Missing baseline survey:	0	0%
C.	Missing second survey:	0	0%
D.	Missing third survey:	0	0%
E.	Missing baseline and second survey:	0	0%
F.	Missing baseline and third survey:	0	0%
G.	Missing second and third survey:	0	0%
H.	Missing all surveys:	0	0%
	TOTAL	15	100%

Appendix 2. Healthcare Unit Costs Data Sources and Assumptions

Service	Notes
Hospital Services	
Accident and Emergency	This cost was calculated using the following weighted average costs: -If A&E attendance does not led to an admission: Emergency medicine and no admission: All ambulance services + A&E attendance = £119 + £140 [a] = £259 [a] The weighted average cost given in the reference costs spreadsheets is £137.74 for 2015-16 which when uprated using the HCHS inflator is £140.
General Hospital Inpatient Admission	Elective inpatient stays
Community Hospital Inpatient Admission	
Day Hospital*	Day cases HRG data (finished consultant episodes), weighted average of all stays
Outpatients Visits to Clinical Based at Hospital Site	Outpatient attendances, weighted average of all outpatient attendances
Primary Care, Community Health Services	
General Practitioner (GP)	General Practitioner excluding direct care staff costs (without qualification costs)
Paramedic (Ambulance Service)	Band 5- Physiotherapist, Occupational therapist, Speech and language therapist, Podiatrist, Clinical psychology assistant practitioner (higher level), Counsellor (entry level).
Community Matron	Assumption that community matron and district nurse require similar skills Band 7
Community/District Nurse	
Practice Nurse	Band 5 of nurse scales
Specialist Nurse	Band 8a
Social Care Services	
Social Worker or Care Manager	Cost including qualifications
Home Care/Home Help Worker	Cost per weekday hour

Community Mental Health Services	
Psychiatrist / Psycho-geriatrician	Hospital-based doctor, Consultant:psychiatric
Community psychiatric nurse / Community mental health nurse	Band 8a
Other mental health professional	NHS community mental health team (CMHT) for older people with mental health problems
Other Community-Based Services	
Telecare	Band 5 of nurse scales
Dentist/ Oral Hygienist	NHS dentist- Performer-Only
Optician	Band 6 (Physiotherapist specialist, Occupational therapist specialist, Speech and language therapist specialist, Podiatrist specialist, Clinical psychology trainee, Counsellor, Pharmacist, Arts therapist (entry level)) Assumption: I took the cost per working hour of a physiotherapist/OTs

*Day hospital refers to a medicat treatment that has to be administered at the hospital but does not require overnight stay.

Appendix 3. Technology Data Sources and Assumptions

Care Pathway	License/Equipment/Data	Data sources and assumptions
Technology: Motiva toolkit (Cohort 1)		
Cohort 1 (all participants HF or COPD)	License Fee	Assumption: IBM SPSS Statistics software £79.13 per user per month (no other fees apply, does not include VAT) No additional charge per day per patient using the software. No data storage fee. For a year (considering 12 months) the cost per patient would be £79.13*12= £949.56 Source: IBM SPSS Statistics software Available at: https://www.ibm.com/uk-en/marketplace/spss-statistics/purchase#product-header-top Accessed on 28 February, 2018.
	Installation	£135 per patient
	Tablet	Assumption: ASUS ZenPad Z380M 8.0" Tablet - 16 GB, Grey Only consider a tablet and not a TV box. Source: Currys PC World Available at: https://www.currys.co.uk/gbuk/computing/tablets-and-ereaders/tablets/149_3402_32003_xx_xx/xx-100_xx-100_xx_xx_5-6-7-8-9-10-11-12-13-14-15-16-criteria.html Accessed on 28 February, 2018.
HF	Wireless weighing scale	Assumption: Philips Smart Body Analysis Scale for BMI, Body Fat and Weight Measurements, Bluetooth connectivity, White Source: Amazon Available at: https://www.amazon.co.uk/Philips-Analysis-Measurements-Bluetooth-connectivity/dp/B01FHJ4R3O Accessed on 28 February, 2018.

	Blood pressure meter	Assumption: Philips Wireless Upper Arm Blood Pressure Monitor, Bluetooth Connectivity Source: Amazon Available at: https://www.amazon.co.uk/Philips-Wireless-Pressure-Bluetooth-Connectivity/dp/B01FHJ4QSK Accessed on 28 February, 2018.
	Tympanic Ear Thermometer	Assumption: MSR Tympanic 1 Second Ear Thermometer (including VAT) Source: Medisave Available at: https://www.medisave.co.uk/msr-tympanic-1-second-ear-thermometer.html Accessed on 28 February, 2018.
COPD	Pulse oximeter (SPO2 monitor)	Assumption: ChoiceMMed MD300-D Finger Pulse Oximeter (Including VAT) Source: Medisave Available at: https://www.medisave.co.uk/md300d-finger-pulse-oximeter-p-6895.html Accessed on 28 February, 2018.
	Tympanic Ear Thermometer	Assumption: MSR Tympanic 1 Second Ear Thermometer (including VAT) Source: Medisave Available at: https://www.medisave.co.uk/msr-tympanic-1-second-ear-thermometer.html Accessed on 28 February, 2018.

Care Pathway	License/Equipment/Data	Data sources and assumptions
Technology: Intelesant (Cohort 2)		
Cohort 2 Intelesant	License App	£200 in total (notes from Board Meeting 21 September 2017) License per patient = £9.53 (200/21) Source: LCIA Test Bed Clinical Operations Group Meetings. [Confirm we can give this as a source]
Technology: Florence/NHS Simple toolkit (Cohort 2)		
Cohort 2 Flo	License fee	Assumption: Approximately £8,000 in total per year License per patient= £109.11 (8,000/74) Source: LCIA Test Bed Clinical Operations Group Meetings. [Confirm we can give this as a source]
	Message fee	Assumption: 3 messages sent per week. 8p (£0.08) per message Cost of sending 3 messages per week --> £0.24 per week. For a year (considering approximately 2 weeks of bank holidays) the cost would be £0.24*50= £12 Source: Discussion with Clinical Teams. [Confirm we can give this as a source]
	Tympanic ear Thermometer	Assumption: MSR Tympanic 1 Second Ear Thermometer (including VAT) Source: Medisave Available at: https://www.medisave.co.uk/msr-tympanic-1-second-ear-thermometer.html Accessed on 28 February, 2018.
	Pulse Oximeter (SPO2 Monitor)	Assumption: ChoiceMMed MD300-D Finger Pulse Oximeter (Including VAT) Source: Medisave Available at: https://www.medisave.co.uk/md300d-finger-pulse-oximeter-p-6895.html Accessed on 28 February, 2018.
	Blood Pressure Monitor	Assumption: Philips Wireless Upper Arm Blood Pressure Monitor, Bluetooth Connectivity Source: Amazon

		Available at: https://www.amazon.co.uk/Philips-Wireless-Pressure-Bluetooth-Connectivity/dp/B01FHJ4QSK Accessed on 28 February, 2018.
	Phone (basic cellphone)	Assumption: MobiWire Pictor Source: Which magazine Available at: https://www.which.co.uk/reviews/simple-mobile-phones/mobiwire-pictor Accessed on 28 February, 2018.
Technology: Philips Health Watch (Cohort 2)		
Cohort 2 Health Watch	Philips Health Watch	Assumption: Philips Bluetooth Health & Activity Watch with Heart Rate Monitor – for iOS & Android Source: Amazon Available at: https://www.amazon.co.uk/Philips-Bluetooth-Health-Activity-Monitor/dp/B01FHJ4QOY Accessed on 28 February, 2018.
Technology: CANTAB Mobile (Cohort 1 & 2)		
Cohort 1 and 2	Access to the tool	Assumption: There is no data storage fee. License per patient= £0.85 (250/293) Source: Alzheimers' patients online forum Available at: https://forum.alzheimers.org.uk/threads/cantabmobile-new-memory-test.46583/ [Confirm we can give this as a source] Accessed on 28 February, 2018.

Healthcare Staff-time:

Care Pathway	Staff	Data sources and assumptions
Fylde Coast: **Motiva Cohort 1 (all participants HF or COPD)**	Staff (2 nurse practitioners band 8 and 1 GP Consultant) Reading, interpreting (excluding alerts)	Assumption: 1 GP Registrar and 1 band 6 Nurse doing the readings and interpreting information using Motiva. GP (Registrar) - cost per working hour £43 Nurse band 6 - cost per working hour £45 The nurse and GP alternate to do the monitoring from Monday to Friday (not weekends or bank holidays). GP's monitoring is done 3 days per week for around 2 hours per day and nurse's monitoring is done 2 days per week for around 2.5 hours per day. GP Registrar --> 2 hours per day is £86 per day --> 3 days per week is £258 per week Nurse --> 2 hours per day is £90 per day--> 2 days per week is £180 per week The total cost of a week for doing the readings and interpreting information is £438. For a year (considering 52 weeks in a year) the cost would be £438*52= £22,776.00 Source: Discussion with Clinical Teams and PSSRU Unit Costs 2016-17
	Staff (2 nurse practitioners band 8 and 1 GP Consultant) Only alerts to patients	Assumption: 0.5 hour a day is used for alerting patients and following those cases. Then the total cost of alerting patients per week would be £438/4= £109.50. For a year (considering 52 weeks in a year) the cost would be £109.5*52=£5,694.00 Source: Discussion with Clinical Teams and PSSRU Unit Costs 2016-17
Better Care Together: **Motiva Cohort 1 (all participants HF or COPD)**	Staff (2 nurse practitioners band 8 and 1 GP Consultant) Reading, interpreting (excluding alerts)	Assumption: 3 Nurse Practitioners and 1 GP consulting doing the readings and interpreting information using Motiva. Nurse practitioners band 8a - cost per working hour £62 GP (Consultant: medical) - cost per working hour £106 The nurses and GP alternate to do the monitoring. Monitoring is done everyday for around 2 hours from Monday to Friday (not weekends or bank holidays) Nurse practitioner --> 2 hours per day is £124 per day--> 3 days per week is £372 per week GP (Consultant: medical) --> 2 hours per day is £212 per day--> 2 days per week is £424 per week The total cost of a week for doing the readings and interpreting information is £796. For a year (considering 52 weeks in a year) the cost would be £796*52= £41,392.00 Source: Discussion with Clinical Teams and PSSRU Unit Costs 2016-17

	Staff (2 nurse practitioners band 8 and 1 GP Consultant) Only alerts to patients	Assumption: 0.5 hour a day is used for alerting patients and following those cases. Then the total cost of alerting patients per week would be £796/4= £199. For a year (considering 52 weeks in a year) the cost would be £199*52=£10,348.00 Source: Discussion with Clinical Teams and PSSRU Unit Costs 2016-17
Fylde Coast: **Flo, Intelesant, Health Watch Cohort 2**	Staff (GP consultant) Reading, interpreting (excluding alerts)	There were no readings being taken or checked. Assumption: 1 Physiotherapist and 1 clinical support worker helps patients using the watches and checking how they were using it as part of the pulmonary rehab classes. 1 Physiotherapist specialist band 6 - cost per working hour £43 1 Clinical support worker (Physiotherapy) band 4- cost per working hour £28 Assistance is given 0.5 hour once a week. Physiotherapist specialist supports patients with the watch 15 minutes and the clinical support worker gives guidance for around 15 minutes. Physiotherapist specialist --> 15 minutes per week is £10.75 per week Clinical support worker (Physiotherapy) --> 15 minutes per week is £7 per week The total cost of a week is £17.75. For a year (considering 52 weeks in a year) the cost would be £17.75*52= £923.00 Source: Discussion with Clinical Teams and PSSRU Unit Costs 2016-17
	Staff (GP consultant) Only alerts to patients	No alerts being generated. Source: Discussion with Clinical Teams
Better Care Together: **Flo and Intelesant Cohort 2**	Staff (GP consultant) Reading, interpreting (excluding alerts)	GP (Consultant: medical) - cost per working hour £106 2 hours 3 times a week GP (Consultant: medical) --> 6 hours per week is £636 per week The total cost of a week is £636. For a year (considering 52 weeks in a year) the cost would be £636*52= £33,072 Source: Discussion with Clinical Teams and PSSRU Unit Costs 2016-17
	Staff (GP consultant) Only alerts to patients	Assumption: 1 hour a week is used for alerting patients and following those cases. Then the total cost of alerting patients per week would be £106. For a year (considering 52 weeks in a year) the cost would be £106*52= £5,512.00 Source: Discussion with Clinical Teams and PSSRU Unit Costs 2016-17

Appendix 4. Protocol for handling partially missing or incomplete medication data

If medication name (and route preparation) was incomplete in order to get the appropriate unit price, we made the following assumptions:

a) Generally, prioritise the cheapest presentation of a medication among the different available presentations
b) Do not prioritise liquid presentations because they are more expensive
c) If there is capsule and tablet presentations for the same medication, prioritise tablets
d) Do not prioritise modified-release presentation of a medication
e) If there is emollient and cream presentation, prioritise emollient
f) If there is gastro-resistant and capsules, prioritise capsules
g) In inhalers, prioritise preservative free
h) In inhalers, do not prioritise breath actuated

If medication name was missing or not found in the Drug Tariff or in MIMS, the medication was not included in the analysis.

If medication dose was missing for solid forms: assumed that 1 dose was taken per day. In some cases (as suggested by a lead GP) doses per day were assumed as 3 or 4 per day.[54]

If medication dose was missing for non-solid forms: assumed that each prescription lasts 1 month.

If dose frequency had more than one value (e.g. 1 or 2 times a day): to ensure cost estimations were conservative, we assumed the lowest dose frequency.

If frequency was 'as necessary' or 'as required': assumed is dose per day.

We assumed that the number of days the patient has used the medication within the yeas is 365 days for LT medications, 90 days for MT medications, and 14 days for ST medications.

Approach to estimating daily costs of prescribed medications

Unit costs are calculated per solid and non-solid unit dosage form of medication based on most efficient pack size:

- Solid unit dosage form includes: tablet, capsule, suppository, patch, pessary, plaster, sachet;
- Non-solid dosage form includes: oral suspension/suspension, nebuliser liquid, gel, mouthwash, inhaler, cream, ointment, eye drops, nasal spray;
- Basic price chosen as reported in Drug Tariff (November 2017) and MIMS online data (November 2017 and January 2018)

Cost per day per solid unit applied to medication-level data according to dose and number of doses taken per day

- Unit cost of solid unit dosage is unit price of tablet (=basic price/quantity);

[54] Due to the amount of data collected, we identified those medications reported more than 10 times using baseline, 12 week and 24 week surveys. From this sample, a lead GP suggested us to assume of 3 doses per day for Carbocisteine 375mg capsules and Metformin 500mg tablets.
Assumption of 4 doses per day for Co-codamol 30mg/500mg tablets and Paracetamol 500mg tablets.

- Cost per day is generated by multiplying doses taken per day by unit cost

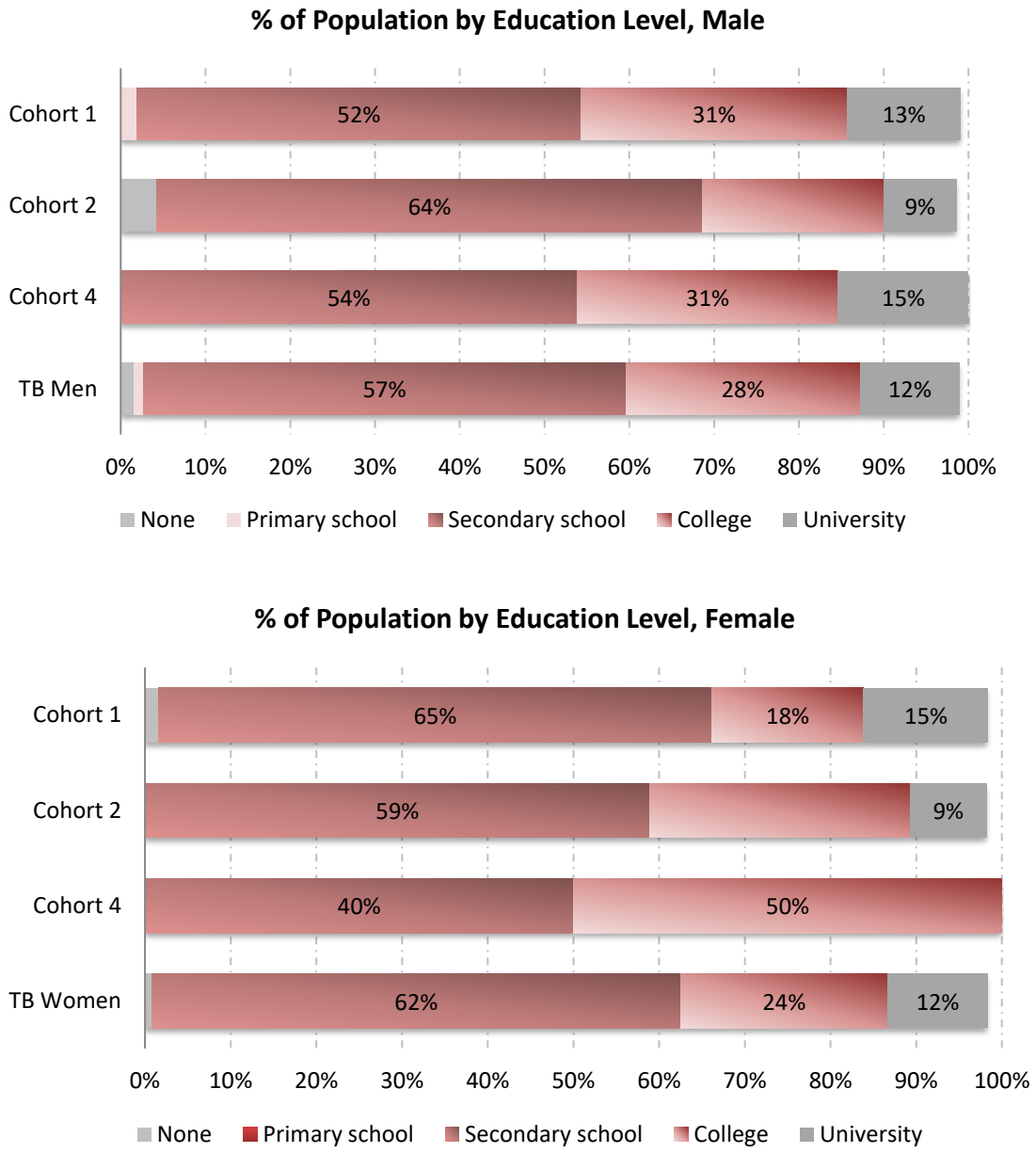
Cost per day per non-solid unit applied to medication-level data according to unit price per day taken

- For all non-solid forms assumed 1 tube (or unit presentation) lasts a month and use the biggest tube;
- Unit cost of non-solid unit dosage is an average item cost per day (=basic price/(365/12))

To obtain the annual average cost we have classified the medications based on a physician's judgement specialised in chronic health conditions into long, medium or short term.

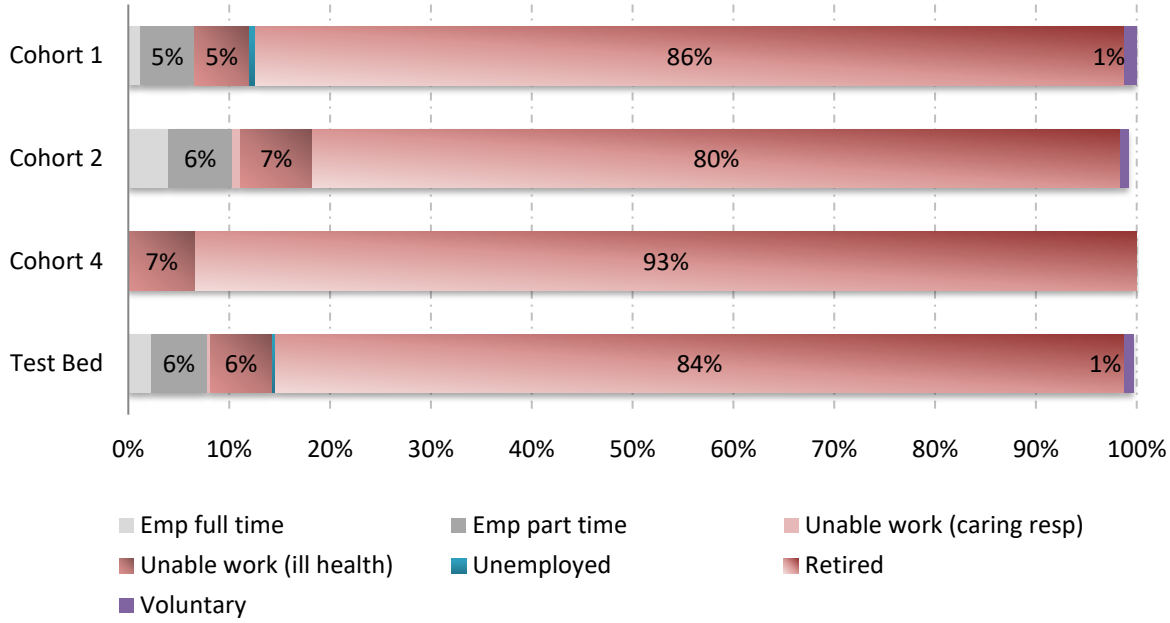
Appendix 5. Socio-demographic characteristics

Figure A. Percentage of Participants by Education Level, Gender and Cohort



Source: Test Bed, Information from 14 October 2016 to 27 April 2018.

Figure B. Percentage of Participants by Employment Condition and Cohort



Source: Test Bed, Information from 14 October 2016 to 27 April 2018.

Appendix 6. Background characteristics of the Test Bed population at baseline per Vanguard Site

Fylde Coast		Cohort 1 (n=31) *N (%)*	Cohort 2 (n=39) *N (%)*	Test Bed population (n=70) *N (%)*
Gender				
	Male	21 (67.7)	21 (53.9)	42 (60.0)
	Female	10 (32.3)	18 (46.1)	28 (40.0)
Age				
	[55,59]	-	3 (7.7)	3 (4.3)
	[60,64]	3 (9.7)	2 (5.1)	5 (7.1)
	[65,69]	5 (16.1)	10 (25.6)	15 (21.4)
	[70,74]	8 (25.8)	10 (25.6)	18 (25.7)
	[75,79]	3 (25.1)	9 (23.1)	12 (17.1)
	[80,84]	11 (35.5)	2 (5.1)	13 (18.6)
	[85,89]	1 (3.2)	1 (2.6)	2 (2.9)
	[90,94]	-	2 (5.1)	2 (2.9)
	Average	74.42	72.44	73.31
Ethnicity				
	White	31 (100.0)	39 (100.0)	70 (100.0)
	Mixed	-	-	-
	Other	-	-	-
	Prefer not to say	-	-	-
Marital Status				
	Single	2 (6.5)	1 (2.6)	3 (4.3)
	Married	19 (61.3)	22 (56.4)	41 (58.6)
	Civil Partnership	-	-	-
	Separated	-	1 (2.6)	1 (1.4)
	Divorced	5 (16.1)	4 (10.3)	9 (12.9)
	Widowed	5 (16.1)	11 (28.2)	16 (22.9)
	Prefer not to say	-	-	-
Living arrangements				
	Spouse/partner	20 (64.5)	22 (56.4)	42 (60.0)
	Living alone	10 (32.3)	16 (41.0)	26 (37.1)
	Parent(s)	-	-	-
	Children	-	1 (2.6)	1 (1.4)
	Friend(s)	-	-	-
	Other	2 (6.5)	-	2 (2.9)
	Spouse and children	-	-	-
	Education			
	None	-	-	-
	Primary school	-	-	-
	Secondary school	18 (58.1)	29 (74.4)	47 (67.1)
	College	8 (25.8)	7 (17.9)	15 (21.4)
	University	5 (16.1)	3 (7.7)	8 (11.4)
	Prefer not to say	-	-	-

Employment			
Employed full time	-	-	-
Employed part time	1 (3.2)	-	1 (1.4)
Unable to work due to caring responsibilities	-	-	-
Unable to work due to ill health	1 (3.2)	2 (5.1)	3 (4.3)
Unemployed	-	-	-
Retired	28 (90.3)	37 (94.9)	65 (92.9)
Voluntary	1 (3.2)	-	1 (1.4)
Prefer not to say	-	-	-
Access to the internet			
No	5 (16.1)	6 (15.4)	11 (15.7)
Yes	26 (83.9)	33 (84.6)	59 (84.3)
Intermittent or poor quality	-	-	-
Prefer not to say	-	-	-

Notes:

[a] Participants for Cohort 4 are being recruited through the Memory Assessment Service (MAS) in Fylde & Wyre and Better Care Together. For this reason, Cohort 4 figures are not shown.

[b] Living arrangements categories are not mutually exclusive.

[c] Percentages may not add up to 100% due to rounding.

Better Care Together	**Cohort 1 (n=136)** ***N (%)***	**Cohort 2 (n=87)** ***N (%)***	**Test Bed population (n=223)** ***N (%)***
Gender			
Male	84 (61.8)	49 (56.3)	133 (59.6)
Female	52 (38.2)	38 (43.7)	90 (40.4)
Age			
[55,59]	7 (5.1)	8 (9.2)	15 (6.7)
[60,64]	13 (9.6)	17 (19.5)	30 (13.4)
[65,69]	28 (20.6)	31 (35.6)	59 (26.5)
[70,74]	34 (25.0)	18 (20.7)	52 (23.3)
[75,79]	30 (22.1)	7 (8.0)	37 (16.6)
[80,84]	17 (12.5)	4 (4.6)	21 (9.4)
[85,89]	6 (4.4)	2 (2.3)	8 (3.6)
[90,94]	1 (0.7)	-	1 (0.4)
Average	72.41	68.32	70.82
Ethnicity			
White	134 (98.5)	84 (96.5)	218 (97.8)
Mixed	-	1 (1.1)	1 (0.4)
Other	1 (0.7)	-	1 (0.4)
Prefer not to say	1 (0.7)	2 (2.3)	3 (1.3)
Marital Status			
Single	10 (7.3)	9 (10.3)	19 (8.5)
Married	73 (53.7)	48 (55.1)	121 (54.3)
Civil Partnership	2 (1.5)	1 (1.1)	3 (1.3)
Separated	-	1 (1.1)	1(0.4)
Divorced	21 (15.4)	12 (13.8)	33 (14.8)
Widowed	30 (22.0)	13 (14.9)	43 (19.3)

Prefer not to say	-	3 (3.4)	3 (1.3)
Living arrangements			
Spouse/partner	82 (60.3)	54 (62.0)	136 (61.0)
Living alone	43 (31.6)	27 (31.0)	70 (31.4)
Parent(s)	1 (0.7)	-	1 (0.4)
Children	18 (13..2)	2 (2.3)	20 (8.9)
Friend(s)	-	-	-
Other	7 (5.1)	5 (5.8)	12 (5.4)
Spouse and children	13 (9.6)	1 (1.1)	14 (6.3)
Education			
None	1 (0.7)	3 (3.4)	4 (1.8)
Primary school	2 (1.5)	-	2 (0.9)
Secondary school	77 (56.6)	49 (56.3)	126 (56.5)
College	36 (26.5)	25 (28.7)	61 (27.3)
University	18 (13.2)	8 (9.2)	26 (11.7)
Prefer not to say	2 (1.5)	2 (2.3)	4 (1.8)
Employment			
Employed full time	2 (1.5)	5 (5.7)	7 (3.1)
Employed part time	8 (5.9)	8 (9.2)	16 (7.2)
Unable to work due to caring responsibilities	-	1 (1.1)	1 (0.4)
Unable to work due to ill health	8 (5.9)	7 (8.0)	15 (6.7)
Unemployed	1 (0.7)	-	1 (0.4)
Retired	116 (85.3)	64 (73.6)	180 (80.7)
Voluntary	1 (0.7)	1 (1.1)	2 (0.9)
Prefer not to say	-	1 (1.1)	1 (.4)
Access to the internet			
No	26 (19.1)	16 (18.4)	42 (18.8)
Yes	107 (78.7)	67 (77.0)	174 (78.0)
Intermittent or poor quality	2 (1.5)	3 (3.4)	5 (2.2)
Prefer not to say	1 (0.7)	1 (1.1)	2 (0.9)

Notes:

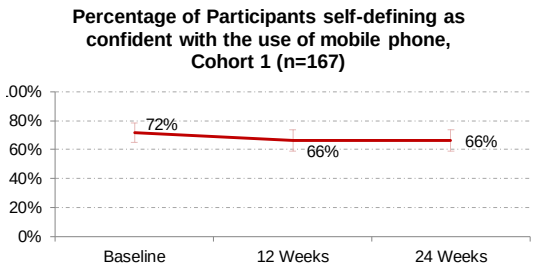
[a] Participants for Cohort 4 are being recruited through the Memory Assessment Service (MAS) in Fylde & Wyre and Better Care Together. For this reason, Cohort 4 figures are not shown.

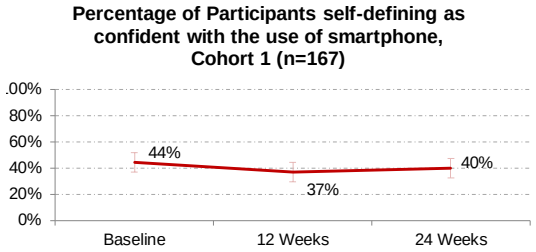
[b] Living arrangements categories are not mutually exclusive.

[c] Percentages may not add up to 100% due to rounding.

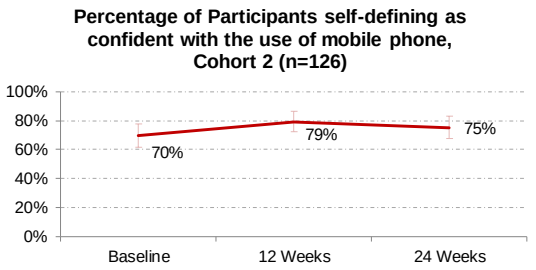
Appendix 7. Percentage of Participants self-defining as confident or somewhat confident with the use of technology at baseline, 12 weeks and 24 weeks intervention

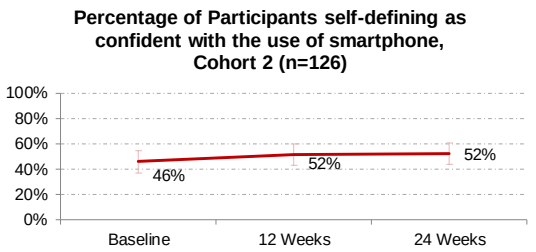
A. Cohort 1



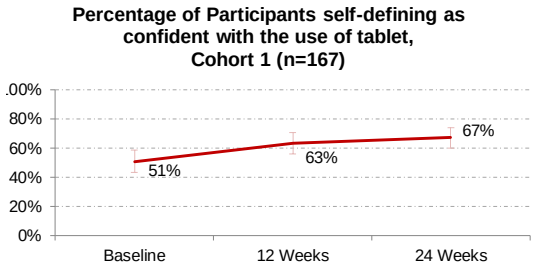


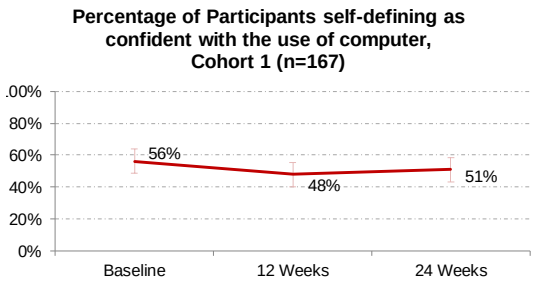
B. Cohort 2



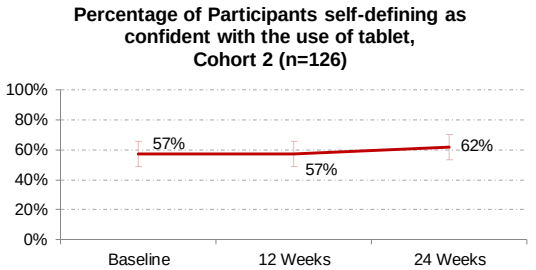


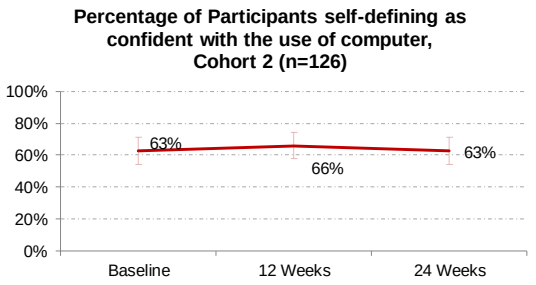
B. Cohort 1





C. Cohort 2





Note: Percentages were calculated per device. For instance: 42% of participants feels confident using a mobile phone, 29% feels somewhat confident, 22% does not feel confident, and 7% did not respond about their level of confidence. Therefore, the sum of the proportions of level of confidence per device is 100%. These figures are not shown in the table.

Non-response rate in the level of confidence on technology at baseline ranges from 6% to 11%. At 12-weeks, non-response rate goes from 13% to 23% and at 24-weeksranges from 10% to 16%.

Vertical bars represent 95% Confidence Intervals.

Source: Test Bed, Information from 14 October 2016 to 27 April 2018.

Appendix 8. Sample size, maximum and minimum values per Validated Instrument to Assess Health Related Quality of Life and Wellbeing of Participants at Baseline, 12 weeks and 24 Weeks Intervention

Instrument (min/max value)	Cohort 1 (N=167) n (min / max values)			Cohort 2 (N=126) n (min / max values)			Cohort 4 (N=15) n (min / max values)			Test Bed population (N=308) n (min / max values)		
	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks
EQ-5D-5L (-0.285/1)	157 (-.218/1)	157 (-.214/1)	157 (-.116/1)	116 (-.094/1)	116 (-.153/1)	116 (.098 /1)	15 (.087/1)	15 (.149/1)	15 (.363/1)	288 (-.218/1)	288 (-.214/1)	288 (-.116/1)
EQ-5D-3L (-0.594/1)	157 (-.367/1)	157 (-.283/1)	157 (-.248/1)	116 (-.107/1)	116 (-.160/1)	116 (-.127/1)	15 (.155/1)	15 (.066/1)	15 (.378/1)	288 (-.367/1)	288 (-.283/1)	288 (-.248/1)
PAM13 (0/100)	167 (40.7/ 100)	167 (34.2/ 100)	167 (24.4/ 100)	126 (34.2/ 100)	126 (33/ 100)	126 (35.5/ 100)	15 (20.5/ 75)	15 (34.2/ 63.1)	15 (34.2/ 72.5)	308 (20.5/100)	308 (33/100)	308 (24.4/100)
WEMWBS (14/70)	148 (20/70)	148 (18/69)	148 (15/70)	117 (21/69)	117 (23/69)	117 (22/70)	15 (29/63)	15 (32/64)	15 (34/62)	280 (20/70)	280 (18/69)	280 (15/70)
De Jong G (0/11)	150 (0/11)	150 (0/11)	150 (0/11)	109 (0/11)	109 (0/11)	109 (0/11)	14 (0/8)	14 (0/10)	14 (0/9)	273 (0/11)	273 (0/11)	273 (0/11)

Notes:

[a] Decimal figures are rounded to the nearest hundredth.

[b] EQ-5D-5L, PAM13 and WEMWBS scores, the higher the value the better quality of life. In the DeJong Gierveld score, the lower the value the better (less loneliness).

[c] The EQ-5D-5L and EQ-5D-3L index values have been calculated considering data at all time points on 288 participants. The PAMs scores were estimated using data on 308 patients. The WEMWBS was calculated considering data on 280 participants and the De Jong Gierveld Scale on 273 participants. Exclusion of participants is due to non-response and methodological considerations per instrument.

Source: Test Bed, Information from 14 October 2016 to 27 April 2018.

Appendix 9. Mean values of validated instruments to assess health related quality of life and wellbeing of participants per Vanguard Site

Mean values per instrument and time point: Fylde Coast

Instrument	Cohort 1 (n=31)			Cohort 2 (n=39)			Test Bed population (n=70)		
	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks
EQ-5D-5L	0.63	0.73	0.67	0.71	0.75	0.71	0.68	0.74	0.69
PAM13	58.13	59.67	63.83	59.82	60.63	58.84	59.07	60.21	61.05
WEMWBS	48.07	50.64	50.06	50.14	50.86	50.68	42.23	50.77	50.41
DeJongG	4.33	3.53	3.63	4.00	3.97	4.50	4.15	3.76	4.09

Sample size, maximum and minimum values per instrument and time point- Fylde Coast

Instrument (min/max value)	Cohort 1 (n=31) N (min / max values)			Cohort 2 (n=39) N (min / max values)			Test Bed population (n=70) N (min / max values)		
	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks
EQ-5D-5L (-0.285/1)	29 (-.04/.879)	29 (.384/1)	29 (.076/1)	35 (-.094/1)	35 (.363/1)	35 (.098 /1)	64 (-.094/1)	64 (0.363/1)	64 (0.076/1)
PAM13 (0/100)	31 (48.9/ 84.8)	167 (42.2/ 77.7)	167 (40.7/ 84.8)	39 (34.2/ 100)	39 (33/ 100)	39 (35.5/ 100)	70 (34.2/ 90.7)	70 (33/ 90.7)	70 (35.5/ 84.8)
WEMWBS (14/70)	30 (27/65)	30 (31/67)	30 (30/66)	38 (31/63)	38 (29/69)	38 (31/66)	68 (27/65)	68 (29/69)	68 (30/66)
DeJongG (0/11)	30 (0/11)	30 (0/8)	30 (0/10)	34 (0/10)	34 (0/11)	34 (0/11)	64 (0/11)	64 (0/11)	64 (0/11)

Notes: [a] Participants for Cohort 4 are being recruited through the Memory Assessment Service (MAS) in Fylde & Wyre and Better Care Together. For this reason, Cohort 4 figures are not shown. [b] Decimal figures are rounded to the nearest hundredth.

[c] EQ-5D-5L, PAM13 and WEMWBS scores, the higher the value the better quality of life. In the DeJong Gierveld score, the lower the value the better (less loneliness). [d] The EQ-5D-5L and EQ-5D-3L index values have been calculated considering data at all time points on 64 participants. . The PAMs scores was estimated using data on 70 patients. The WEMWBS was calculated considering data on 68 participants and the De Jong Gierveld Scale on 64 participants. Exclusion of participants is due to non-response and methodological considerations per instrument.

Source: Test Bed, Information from 14 October 2016 to 27 April 2018.

Mean values per instrument and time point: Better Care Together

Instrument	Cohort 1 (n=136)			Cohort 2 (n=87)			Test Bed population (n=223)		
	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks
EQ-5D-5L	0.68	0.67	0.67	0.76	0.72	0.74	0.71	0.69	0.70
PAM13	60.26	59.60	61.68	62.07	62.44	62.16	61.26	60.70	61.57
WEMWBS	52.27	51.02	51.18	51.04	50.19	50.65	51.78	50.68	50.97
DeJongG	3.97	4.37	4.26	3.99	3.97	4.23	3.97	4.37	4.26

Sample size, maximum and minimum values per instrument and time point- Better Care Together

Instrument (min/max value)	Cohort 1 (n=136) N (min / max values)			Cohort 2 (n=87) N (min / max values)			Test Bed population (n=223) N (min / max values)		
	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks
EQ-5D-5L (-0.285/1)	128 (-.218/1)	128 (-.214/1)	128 (-.116/1)	81 (.090/1)	81 (-.153/1)	81 (-.173 /1)	209 (-.218/1)	209 (-.214/1)	209 (-.116/1)
PAM13 (0/100)	136 (40.7/ 100)	136 (34.2/ 100)	136 (24.4/ 100)	87 (39.4/ 100)	87 (39.4/ 100)	87 (40.7/ 100)	223 (39.4/ 100)	223 (34.2/ 100)	223 (24.4/ 100)
WEMWBS (14/70)	118 (20/70)	118 (18/69)	118 (15/70)	79 (21/69)	79 (23/69)	79 (22/70)	197 (20/70)	197 (18/69)	197 (15/70)
DeJongG (0/11)	120 (0/11)	120 (0/11)	120 (0/11)	75 (0/11)	75 (0/11)	75 (0/11)	195 (0/11)	195 (0/11)	195 (0/11)

Notes: [a] Participants for Cohort 4 are being recruited through the Memory Assessment Service (MAS) in Fylde & Wyre and Better Care Together. For this reason, Cohort 4 figures are not shown.

[b] Decimal figures are rounded to the nearest hundredth.

[c] EQ-5D-5L, PAM13 and WEMWBS scores, the higher the value the better quality of life. In the DeJong Gierveld score, the lower the value the better (less loneliness).

[d] The EQ-5D-5L and EQ-5D-3L index values have been calculated considering data at all time points on 209 participants. . The PAMs scores was estimated using data on 223 patients. The WEMWBS was calculated considering data on 197 participants and the De Jong Gierveld Scale on 195 participants. Exclusion of participants is due to non-response and methodological considerations per instrument.

Source: Test Bed, Information from 14 October 2016 to 27 April 2018.

Appendix 10. Correlations of sociodemographic characteristics and EQ-5D-5L dimensions, Cohort 1

	Gender	Age	Risk	Marital Status	Lone dwelling	Education	Employment	Access to internet	Mobility			Self-care			Usual activity			Pain/discomfort			Anxiety/depression		
									Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks
Gender	1																						
Age	0.1707*	1																					
Risk	0.1162	0.2122*	1																				
Marital Status	-0.1967*	0.111	0.0496	1																			
Lone dwelling	-0.0086	0.1118	0.0603	0.6244*	1																		
Education	0.0346	0.1245	0.0573	0.0685	0.0661	1																	
Employment	-0.0154	0.3592*	0.0298	0.0663	0.1034	0.0045	1																
Access to internet	0.103	0.0583	0.092	-0.1299	-0.1302	-0.0064	-0.0324	1															
Mobility at Baseline	-0.126	-0.0359	0.3043*	0.2296*	0.1081	0.011	0.0459	-0.0221	1														
Mobility at 12 weeks	-0.2364*	-0.0156	0.2485*	0.1979*	0.1526*	0.0806	0.0673	-0.079	0.5752*	1													
Mobility at 24 weeks	-0.2647*	0.0265	0.3426*	0.1402	0.0662	0.0565	0.1745*	-0.0188	0.6112*	0.5693*	1												
Self care at Baseline	-0.1313	-0.1779*	0.0625	0.0931	0.0155	-0.033	-0.0163	0.0554	0.5514*	0.3826*	0.3773*	1											
Self care at 12 weeks	-0.1625*	-0.0958	0.0703	0.1954*	0.1662*	0.0746	0.0395	0.0463	0.4009*	0.7164*	0.4260*	0.5548*	1										
Self care at 24 weeks	-0.2104*	-0.1874*	0.1562*	0.0732	0.1097	0.0817	-0.0594	-0.0621	0.3096*	0.3019*	0.4926*	0.4451*	0.3856*	1									
Usual Activity at Baseline	-0.1395	-0.0741	0.2081*	0.1298	-0.0149	0.0078	0.0121	0.0333	0.6141*	0.3955*	0.4977*	0.5836*	0.4232*	0.3183*	1								
Usual Activity at 12 weeks	-0.0916	0.0189	0.1661*	0.0864	0.0627	0.0357	0.0767	-0.0736	0.3724*	0.6472*	0.4114*	0.3377*	0.6493*	0.3143*	0.3877*	1							
Usual Activity at 24 weeks	-0.1404	-0.0129	0.3130*	0.1342	0.1377	0.0478	0.1157	-0.0159	0.4655*	0.4240*	0.6909*	0.4087*	0.4458*	0.5163*	0.5021*	0.4528*	1						
Pain/discomfort at Baseline	-0.2333*	-0.2523*	0.1009	0.1132	0.0407	-0.059	-0.0498	-0.1091	0.4863*	0.3527*	0.3768*	0.3550*	0.2501*	0.2357*	0.3113*	0.1465	0.2890*	1					
Pain/discomfort at 12 weeks	-0.2178*	-0.0507	0.1128	0.2036*	0.2057*	-0.0535	-0.0036	0.0668	0.3272*	0.6507*	0.3720*	0.2266*	0.5898*	0.1664*	0.1712*	0.3952*	0.2661*	0.4297*	1				
Pain/discomfort at 24 weeks	-0.2618*	-0.1544*	0.1481	0.0249	0.093	0.0619	0.0925	-0.0449	0.3263*	0.2689*	0.5868*	0.1796*	0.2586*	0.3707*	0.2083*	0.2202*	0.5344*	0.5432*	0.4307*	1			
Anxiety/depression at Baseline	-0.2036*	-0.2523*	-0.0495	0.0452	0.1112	-0.1079	0.0136	-0.2007*	0.2450*	0.1452	0.1487	0.2695*	0.1569*	0.1577*	0.2154*	0.0843	0.1141	0.3259*	0.1417	0.2658*	1		
Anxiety/depression at 12 weeks	-0.2184*	-0.1672*	-0.0056	0.1712*	0.1445	-0.0311	-0.0909	0.0404	0.1533*	0.5903*	0.2449*	0.2203*	0.7195*	0.0878	0.1268	0.4593*	0.2210*	0.1832*	0.6364*	0.1874*	0.2354*	1	
Anxiety/depression at 24 weeks	-0.2416*	-0.2021*	0.123	0.0949	0.0869	0.0146	0	0.0493	0.1761*	0.1273	0.4681*	0.1787*	0.2055*	0.3791*	0.1917*	0.1384	0.4071*	0.2679*	0.2131*	0.5802*	0.2868*	0.3137*	1

Notes:

[a] N=308 Test Bed participants (Cohort 1=167, Cohort 2=126, Cohort 4=15).

[b] Gender (1=Male, 0=Female); Marital Status (1=Single, 2=Married, 3=Civil part, 4=Separated, 5=Divorced, 6=Widowed); Lone Dwelling (1=Living Alone, 0=Otherwise); Education (1=None, 2=Primary, 3=Secondary, 4=College, 5=University); Employment (1=Full time emp, 2=Part time, 4=Unable work ill health, 6=Retired, 7=Voluntary) Access to internet (0=No, 1=Yes, 2=Intermittent).

[c] *Correlation coefficients significant at the 5% level or better.

Source: Test Bed, Information from 14 October 2016 to 27 April 2018.

Appendix 11. Correlations of sociodemographic characteristics and EQ-5D-5L dimensions, Cohort 2

	Gender	Age	Risk	Marital Status	Lone dwelling	Education	Employment	Access to internet	Mobility			Self-care			Usual activity			Pain/discomfort			Anxiety/depression		
									Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks
Gender	1																						
Age	0.1117	1																					
Risk	0.0992	0.064	1																				
Marital Status	0.0572	0.1053	0.0523	1																			
Lone dwelling	0.0143	0.059	0.0666	0.4044*	1																		
Education	0.0071	-0.0638	0.0459	0.4010*	0.4893*	1																	
Employment	0.1042	0.0811	0.0469	0.5867*	0.7060*	0.6911*	1																
Access to internet	0.0956	0.0062	0.0405	0.5723*	0.7019*	0.7092*	0.9869*	1															
Mobility at Baseline	0.1038	-0.0453	0.1204	-0.1937*	-0.3721*	-0.2467*	-0.4070*	-0.4240*	1														
Mobility at 12 weeks	0.1631	-0.0456	0.1664	0.0968	-0.0112	0.0264	0.1087	0.0987	0.5829*	1													
Mobility at 24 weeks	0.0806	-0.0306	0.1588	0.113	-0.017	0.0214	0.0968	0.0813	0.4536*	0.5542*	1												
Self care at Baseline	-0.0101	-0.1636	0.1331	-0.3199*	-0.5955*	-0.4163*	-0.6282*	-0.6281*	0.6997*	0.3190*	0.2696*	1											
Self care at 12 weeks	0.1214	-0.1289	0.1074	0.0942	-0.0696	-0.0032	0.0532	0.0551	0.5474*	0.6168*	0.4895*	0.5794*	1										
Self care at 24 weeks	0.0458	-0.1271	0.1425	0.0887	-0.037	-0.0388	0.0529	0.0567	0.3732*	0.4320*	0.6832*	0.4061*	0.5927*	1									
Usual Activity at Baseline	0.0479	-0.0668	0.0744	-0.2234*	-0.3829*	-0.2535*	-0.4242*	-0.4387*	0.8904*	0.5577*	0.3782*	0.7192*	0.5877*	0.3590*	1								
Usual Activity at 12 weeks	0.2209*	0.0105	0.1177	0.0474	-0.019	0.027	0.1194	0.1023	0.5110*	0.7561*	0.5049*	0.3011*	0.6493*	0.3334*	0.5314*	1							
Usual Activity at 24 weeks	0.1019	-0.0353	0.2006*	0.1176	-0.0224	0.0236	0.1041	0.0938	0.4358*	0.5629*	0.7965*	0.3382*	0.5552*	0.7682*	0.4342*	0.5789*	1						
Pain/discomfort at Baseline	0.0092	-0.1249	0.0203	-0.1963*	-0.5416*	-0.2188*	-0.3840*	-0.3864*	0.6439*	0.2949*	0.2050*	0.6423*	0.4074*	0.2702*	0.6562*	0.2595*	0.2638*	1					
Pain/discomfort at 12 weeks	0.0548	0.0566	-0.0226	0.1663	0.0308	0.0264	0.1097	0.089	0.3452*	0.5521*	0.3241*	0.2201*	0.4628*	0.2521*	0.3454*	0.5167*	0.3760*	0.2670*	1				
Pain/discomfort at 24 weeks	-0.0551	-0.0437	0.074	0.1273	-0.0486	-0.0037	0.0383	0.0294	0.2727*	0.3844*	0.7325*	0.1798*	0.2690*	0.5244*	0.2010*	0.3286*	0.6546*	0.1599	0.3248*	1			
Anxiety/depression at Baseline	-0.0581	-0.2317*	0.0555	-0.2492*	-0.4354*	-0.3861*	-0.5264*	-0.5178*	0.3638*	0.1185	0.1002	0.5468*	0.2462*	0.1742	0.4073*	0.1306	0.1358	0.6012*	0.0288	0.0713	1		
Anxiety/depression at 12 weeks	-0.108	-0.3289*	0.0215	0.1057	-0.0585	0.0184	0.0369	0.0688	0.1568	0.2964*	0.2300*	0.2163*	0.4201*	0.3177*	0.2288*	0.3282*	0.3014*	0.1439	0.2034*	0.1750*	0.4410*	1	
Anxiety/depression at 24 weeks	0.0073	-0.1646	0.0864	0.0837	-0.0323	-0.032	0.0345	0.0538	0.0324	0.1206	0.3884*	0.0886	0.1676	0.5299*	0.0554	0.0616	0.4646*	0.0189	0.0163	0.3449*	0.2125*	0.3792*	1

Notes:

[a] N=308 Test Bed participants (Cohort 1=167, Cohort 2=126, Cohort 4=15).

[b] Gender (1=Male, 0=Female); Marital Status (1=Single, 2=Married, 3=Civil part, 4=Separated, 5=Divorced, 6=Widowed); Lone Dwelling (1=Living Alone, 0=Otherwise); Education (1=None, 2=Primary, 3=Secondary, 4=College, 5=University); Employment (1=Full time emp, 2=Part time, 4=Unable work ill health, 6=Retired, 7=Voluntary) Access to internet (0=No, 1=Yes, 2=Intermittent).

[c] *Correlation coefficients significant at the 5% level or better.

Source: Test Bed, Information from 14 October 2016 to 27 April 2018.

Appendix 12. Correlations of sociodemographic characteristics and validated instruments at baseline, 12 weeks and 24 weeks intervention

	Gender	Age	Risk	Marital Status	Lone dwelling	Education	Employment	Access to internet	EQ-5D-5L Score			PAM13 Score			WEMWBS Score			De Jong Gierveld Score		
									Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks	Baseline	12 weeks	24 weeks
Gender	1																			
Age	0.1745*	1																		
Risk	0.0771	0.2093*	1																	
Marital Status	0.0267	0.0994	0.0751	1																
Lone dwelling	0.0175	0.057	0.0634	0.4104*	1															
Education	0.026	0.0396	0.0407	0.2872*	0.3476*	1														
Employment	0.0764	0.1122*	0.0592	0.5796*	0.6995*	0.4817*	1													
Access to internet	0.1004	0.0337	0.0539	0.3868*	0.4905*	0.3512*	0.6834*	1												
EQ-5D-5L score Baseline	0.1521*	0.1575*	-0.2168*	-0.0715	-0.0491	-0.0114	-0.0196	0.0949	1											
EQ-5D-5L score 12 weeks	0.1135*	0.1471*	-0.1803*	-0.1088	0.0067	-0.0354	-0.0689	-0.0295	0.7389*	1										
EQ-5D-5L score 24 weeks	0.1895*	0.1404*	-0.2612*	-0.1101	0.0441	-0.0355	-0.0647	-0.0325	0.7079*	0.7665*	1									
PAM13 Score Baseline	-0.107	0.0285	-0.0227	0.0168	0.0079	0.0507	0.0229	0.0181	0.2543*	0.2423*	0.2462*	1								
PAM13 Score 12 weeks	0.0298	0.0678	0.0329	-0.0599	-0.0682	-0.0361	-0.1195*	-0.1037	0.2413*	0.3247*	0.3591*	0.5393*	1							
PAM13 Score 24 weeks	0.0234	-0.0052	-0.013	-0.0372	0.0395	0.0378	0.0164	-0.049	0.2403*	0.3039*	0.4072*	0.4953*	0.5876*	1						
WEMWBS Score Baseline	0.0663	0.2387*	-0.0817	0.0058	0.043	0.0539	-0.0028	0.0349	0.4550*	0.3848*	0.4388*	0.4705*	0.3720*	0.3524*	1					
WEMWBS Score 12 weeks	0.0348	0.2491*	-0.0275	-0.0686	-0.0329	-0.0385	-0.0625	-0.0713	0.3774*	0.4453*	0.3575*	0.2379*	0.4063*	0.2943*	0.5196*	1				
WEMWBS Score 24 weeks	0.0256	0.1904*	-0.0685	-0.089	-0.0356	0.1083	-0.0652	0.0746	0.3340*	0.2989*	0.4213*	0.2095*	0.3053*	0.3582*	0.4872*	0.5654*	1			
De Jong G Score Baseline	0.0548	-0.1777*	-0.004	0.028	-0.0867	-0.1247*	0.0567	0.0123	-0.2243*	-0.2537*	-0.2032*	-0.2798*	-0.2222*	-0.2107*	-0.5478*	-0.3223*	-0.2799*	1		
De Jong G Score 12 weeks	-0.014	-0.1638*	0.0152	0.0654	0.0025	0.0092	0.0231	0.032	-0.2211*	-0.2861*	-0.2233*	-0.2103*	-0.2739*	-0.2385*	-0.4512*	-0.4509*	-0.3280*	0.7625*	1	
De Jong G Score 24 weeks	-0.003	-0.2240*	-0.0368	0.0858	0.0176	0.0245	0.0692	0.0701	-0.2131*	-0.3116*	-0.3020*	-0.2208*	-0.2641*	-0.2849*	-0.4467*	-0.3804*	-0.3922*	0.7439*	0.8111*	1

Notes:

[a] N=308 Test Bed participants (Cohort 1=167, Cohort 2=126, Cohort 4=15).

[b] Gender (1=Male, 0=Female); Marital Status (1=Single, 2=Married, 3=Civil part, 4=Separated, 5=Divorced, 6=Widowed); Lone Dwelling (1=Living Alone, 0=Otherwise); Education (1=None, 2=Primary, 3=Secondary, 4=College, 5=University); Employment (1=Full time emp, 2=Part time, 4=Unable work ill health, 6=Retired, 7=Voluntary) Access to internet (0=No, 1=Yes, 2=Intermittent).

[c] *Correlation coefficients significant at the 5% level or better.

Source: Test Bed, Information from 14 October 2016 to 27 April 2018.

Appendix 13. Use of Health and Social Care Services - Fylde Coast

Hospital services	Mean use of service- Test Bed population			Mean use - Cohort 1			Mean use - Cohort 2		
	Baseline	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**
Accident & Emergency	0.01	0.09	0.03	0.00	0.19	0.03	0.03	0.00	0.03
General hospital inpatient admission	0.00	0.09	0.03	0.00	0.19	0.03	0.00	0.00	0.03
Community hospital inpatient admission	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.03
Day hospital	0.07	0.11	0.21	0.10	0.13	0.26	0.05	0.10	0.18
Outpatient visits to clinic based at hospital site	0.77	0.61	0.50	0.97	0.65	0.68	0.62	0.59	0.36
Other	0.04	0.07	0.00	0.00	0.10	0.00	0.08	0.05	0.00
Mean use of hospital services	**0.90**	**0.97**	**0.79**	**1.06**	**1.26**	**1.00**	**0.77**	**0.74**	**0.62**
Patients who have used at least one of hospital services	22	37	33	14	20	19	12	17	14
%	*31%*	*53%*	*47%*	*45%*	*65%*	*61%*	*31%*	*44%*	*36%*
N	*70*	*70*	*70*	*31*	*31*	*31*	*39*	*39*	*39*

Primary Care, Community Health or Emergency Services	Mean use of service- Test Bed population			Mean use - Cohort 1			Mean use - Cohort 2		
	Baseline	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**
GP	0.26	0.60	0.59	0.16	0.65	0.42	0.33	0.56	0.72
Paramedic (Ambulance service)	0.00	0.07	0.14	0.00	0.16	0.06	0.00	0.00	0.21
Community matron	0.13	0.09	0.07	0.03	0.00	0.10	0.21	0.15	0.05
Community/District nurse	0.51	0.74	0.66	1.16	1.68	1.48	0.00	0.00	0.00
Practice nurse	0.24	0.50	0.51	0.29	0.87	0.97	0.21	0.21	0.15
Specialist nurse	0.14	0.13	0.31	0.19	0.13	0.35	0.10	0.13	0.28
Mean use of primary care services	**1.29**	**2.13**	**2.29**	**1.84**	**3.48**	**3.39**	**0.85**	**1.05**	**1.41**
Patients who have used at least one of primary care services	28	41	43	16	26	23	12	15	20
%	*40%*	*59%*	*61%*	*52%*	*84%*	*74%*	*31%*	*38%*	*51%*
N	*70*	*70*	*70*	*31*	*31*	*31*	*39*	*39*	39

Social Care Services	Mean use of service- Test Bed population			Mean use - Cohort 1			Mean use - Cohort 2		
	Baseline	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**
Social worker or Care manager	0.14	0.04	0.01	0.26	0.10	0.03	0.05	0.00	0.00
Home care/home help worker	1.34	1.50	1.24	2.06	2.42	1.84	0.77	0.77	0.77
Private home help/cleaner	0.60	0.96	1.14	1.26	1.61	1.87	0.08	0.44	0.31
Mean use of social care services	**2.09**	**2.50**	**2.40**	**3.58**	**4.13**	**3.74**	**0.90**	**1.21**	**1.33**
Patients who have used at least one of social care services	14	19	17	10	12	11	4	7	6
%	*20%*	*27%*	*24%*	*32%*	*39%*	*35%*	*10%*	*18%*	*15%*
N	*70*	*70*	*70*	*31*	*31*	*31*	*39*	*39*	39

Community Mental Health Services	Mean use of service- Test Bed population			Mean use - Cohort 1			Mean use - Cohort 2		
	Baseline	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**
Psychiatrist / psycho-geriatrician	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00
Community psychiatric nurse / Community mental health nurse	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other mental health professional	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mean use of community mental health services	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.03**	**0.00**	**0.00**
Patients who have used at least one of the community mental health services	1	0	0	0	0	0	1	0	0
%	*1%*	*0%*	*0%*	*0%*	*0%*	*0%*	*3%*	*0%*	*0%*
N	*70*	*70*	*70*	*31*	*31*	*31*	*39*	*39*	39

Other community-based services	Mean use of service- Test Bed population			Mean use - Cohort 1			Mean use - Cohort 2		
	Baseline	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**
Telecare	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dentist, oral hygienist	0.13	0.21	0.09	0.03	0.10	0.00	0.21	0.31	0.15
Optician	0.06	0.04	0.03	0.10	0.03	0.06	0.03	0.05	0.00
Mean use of other community-based services	**0.19**	**0.26**	**0.11**	**0.13**	**0.13**	**0.06**	**0.23**	**0.36**	**0.15**
Patients who have used at least one of the other community-based services	8	12	6	3	4	2	5	8	4
%	*11%*	*17%*	*9%*	*10%*	*13%*	*6%*	*13%*	*21%*	*10%*
N	*70*	*70*	*70*	*31*	*31*	*31*	*39*	*39*	39

Day activity services	Mean use of service- Test Bed population			Mean use - Cohort 1			Mean use - Cohort 2		
	Baseline	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**
Day care – local authority social services department	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Day care – voluntary organisation	0.00	0.00	0.03	0.00	0.00	0.06	0.00	0.00	0.00
Day care – NHS (community-based)	0.01	0.01	0.00	0.00	0.00	0.00	0.03	0.03	0.00
Lunch club	0.01	0.01	0.00	0.00	0.03	0.00	0.03	0.00	0.00
Social club	0.03	0.06	0.04	0.03	0.00	0.03	0.03	0.10	0.05
Exercise class	0.76	0.76	0.60	0.26	0.06	0.00	1.15	1.31	1.08
Other services	0.31	0.11	0.04	0.10	0.10	0.10	0.49	0.13	0.00
Mean use of day activity services	**1.13**	**0.96**	**0.71**	**0.39**	**0.19**	**0.19**	**1.72**	**1.56**	**1.13**
Patients who have used at least one of the day activity services	31	34	23	3	4	3	28	30	20
%	*44%*	*49%*	*33%*	*10%*	*13%*	*10%*	*72%*	*77%*	*51%*
N	*70*	*70*	*70*	*31*	*31*	*31*	*39*	*39*	39

Appendix 14. Use of Health and Social Care Services - Better Care Together

Hospital services	Mean use of service- Test Bed population			Mean use - Cohort 1			Mean use - Cohort 2		
	Baseline	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**
Accident & Emergency	0.08	0.05	0.09	0.11	0.07	0.12	0.02	0.06	0.21
General hospital inpatient admission	0.06	0.04	0.04	0.07	0.06	0.06	0.03	0.12	0.07
Community hospital inpatient admission	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00
Day hospital	0.15	0.16	0.22	0.18	0.23	0.18	0.83	0.24	2.08
Outpatient visits to clinic based at hospital site	0.39	0.49	0.43	0.49	0.65	0.54	1.67	1.24	1.83
Other	0.11	0.09	0.04	0.08	0.11	0.06	0.25	0.12	0.00
Mean use of hospital services	**0.79**	**0.83**	**0.83**	**0.93**	**1.12**	**0.96**	**0.45**	**0.34**	**0.59**
Patients who have used at least one of hospital services	88	82	78	66	60	53	12	17	14
%	*39%*	*37%*	*35%*	*49%*	*44%*	*39%*	*14%*	*20%*	*16%*
N	*223*	*223*	*223*	*136*	*136*	*136*	*87*	*87*	87

Primary Care, Community Health or Emergency Services	Mean use of service- Test Bed population			Mean use - Cohort 1			Mean use - Cohort 2		
	Baseline	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**
GP	0.51	0.53	0.45	0.69	0.60	0.45	1.58	3.00	3.33
Paramedic (Ambulance service)	0.05	0.02	0.04	0.07	0.04	0.06	0.02	0.00	0.00
Community matron	0.02	0.01	0.00	0.04	0.02	0.01	0.00	0.00	0.00
Community/District nurse	0.11	0.12	0.17	0.18	0.18	0.24	0.00	0.01	0.08
Practice nurse	0.20	0.20	0.14	0.26	0.26	0.16	0.67	0.75	0.83
Specialist nurse	0.12	0.13	0.18	0.12	0.20	0.18	0.92	0.17	1.25
Mean use of primary care services	**1.01**	**1.01**	**0.99**	**1.36**	**1.30**	**1.10**	**0.46**	**0.55**	**0.83**
Patients who have used at least one of primary care services	101	94	84	78	66	54	12	15	20
%	*45%*	*42%*	*38%*	*57%*	*49%*	*40%*	*14%*	*17%*	*23%*
N	*223*	*223*	*223*	*136*	*136*	*136*	*87*	*87*	87

Social Care Services	Mean use of service- Test Bed population			Mean use - Cohort 1			Mean use - Cohort 2		
	Baseline	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**
Social worker or Care manager	0.07	0.03	0.02	0.12	0.04	0.03	0.00	0.00	0.00
Home care/home help worker	0.50	0.35	0.48	0.70	0.57	0.78	4.25	0.01	0.01
Private home help/cleaner	0.45	0.41	0.72	0.41	0.39	0.76	0.75	4.25	0.67
Mean use of social care services	**1.02**	**0.78**	**1.22**	**1.23**	**1.00**	**1.57**	**0.23**	**0.21**	**0.26**
Patients who have used at least one of social care services	33	25	32	23	15	21	4	7	6
%	*15%*	*11%*	*14%*	*17%*	*11%*	*15%*	*5%*	*8%*	*7%*
N	*223*	*223*	*223*	*136*	*136*	*136*	*87*	*87*	87

Community Mental Health Services	Mean use of service- Test Bed population			Mean use - Cohort 1			Mean use - Cohort 2		
	Baseline	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**
Psychiatrist / psycho-geriatrician	0.02	0.00	0.01	0.00	0.01	0.01	0.05	0.00	0.00
Community psychiatric nurse / Community mental health nurse	0.03	0.01	0.03	0.04	0.02	0.04	0.00	0.00	0.01
Other mental health professional	0.04	0.08	0.05	0.01	0.07	0.03	0.08	0.09	0.09
Mean use of community mental health services	**0.08**	**0.09**	**0.09**	**0.05**	**0.10**	**0.09**	**0.13**	**0.09**	**0.10**
Patients who have used at least one of the community mental health services	5	7	8	2	5	5	1	0	0
%	*2%*	*3%*	*4%*	*1%*	*4%*	*4%*	*1%*	*0%*	*0%*
N	*223*	*223*	*223*	*136*	*136*	*136*	*87*	*87*	87

Other community-based services	Mean use of service- Test Bed population			Mean use - Cohort 1			Mean use - Cohort 2		
	Baseline	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**
Telecare	0.01	0.11	0.01	0.01	0.09	0.01	0.00	0.15	0.00
Dentist, oral hygienist	0.12	0.11	0.09	0.10	0.13	0.11	2.40	1.40	1.20
Optician	0.08	0.07	0.05	0.09	0.07	0.05	1.20	1.40	1.00
Mean use of other community-based services	**0.21**	**0.30**	**0.16**	**0.21**	**0.29**	**0.18**	**0.21**	**0.31**	**0.13**
Patients who have used at least one of the other community-based services	29	37	21	18	26	15	5	8	4
%	*13%*	*17%*	*9%*	*13%*	*19%*	*11%*	*6%*	*9%*	*5%*
N	*223*	*223*	*223*	*136*	*136*	*136*	*87*	*87*	87

Day activity services	Mean use of service- Test Bed population			Mean use - Cohort 1			Mean use - Cohort 2		
	Baseline	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**	**Baseline**	**12 weeks**	**24 weeks**
Day care – local authority social services department	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Day care – voluntary organisation	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00
Day care – NHS (community-based)	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00
Lunch club	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.00
Social club	0.02	0.07	0.03	0.01	0.08	0.04	0.01	0.05	0.02
Exercise class	0.04	0.02	0.06	0.07	0.01	0.05	0.52	0.59	0.48
Other services	0.13	0.13	0.11	0.10	0.03	0.11	0.22	0.06	0.00
Mean use of day activity services	**0.22**	**0.22**	**0.21**	**0.20**	**0.14**	**0.21**	**0.77**	**0.70**	**0.51**
Patients who have used at least one of the day activity services	48	51	41	14	14	16	28	30	20
%	*22%*	*23%*	*18%*	*10%*	*10%*	*12%*	*32%*	*34%*	*23%*
N	*223*	*223*	*223*	*136*	*136*	*136*	*87*	*87*	87

Appendix 15. Summary of mean use of services per Cohort and per Vanguard

Mean Use of Services	Cohort 1 & 2			Cohort 1			Cohort 2		
	A. Baseline	B. 12 weeks	C. 24 weeks	D. Baseline	E. 12 weeks	F. 24 weeks	G. Baseline	H. 12 weeks	I. 24 weeks
Hospital services									
Test Bed Population (both Vanguards)	0.82	0.87	0.82	0.96	1.14	0.97	0.63	0.5	0.61
Fylde Coast	0.9	0.97	0.79	1.06	1.26	1	0.77	0.74	0.62
Better Care Together	0.79	0.83	0.83	0.93	1.12	0.96	0.45	0.34	0.59
Primary care services									
Test Bed Population (both Vanguards)	1.08	1.28	1.3	1.45	1.71	1.52	0.58	0.71	1.01
Fylde Coast	1.29	2.13	2.29	1.84	3.48	3.39	0.85	1.05	1.41
Better Care Together	1.01	1.01	0.99	1.36	1.3	1.1	0.46	0.55	0.83
Social care services									
Test Bed Population (both Vanguards)	1.28	1.19	1.5	1.66	1.58	1.97	0.76	0.68	0.88
Fylde Coast	2.09	2.5	2.4	3.58	4.13	3.74	0.9	1.21	1.33
Better Care Together	1.02	0.78	1.22	1.23	1	1.57	0.23	0.21	0.26
Community mental health services									
Test Bed Population (both Vanguards)	0.06	0.07	0.07	0.04	0.08	0.07	0.1	0.06	0.07
Fylde Coast	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00
Better Care Together	0.08	0.09	0.09	0.05	0.1	0.09	0.13	0.09	0.1
Other community-based services									
Test Bed Population (both Vanguards)	0.2	0.29	0.15	0.19	0.26	0.16	0.21	0.33	0.13
Fylde Coast	0.19	0.26	0.11	0.13	0.13	0.06	0.23	0.36	0.15
Better Care Together	0.21	0.3	0.16	0.21	0.29	0.18	0.21	0.31	0.13
Day activity services									
Test Bed Population (both Vanguards)	0.43	0.4	0.33	0.23	0.15	0.2	0.7	0.73	0.49
Fylde Coast	1.13	0.96	0.71	0.39	0.19	0.19	1.72	1.56	1.13
Better Care Together	0.22	0.22	0.21	0.2	0.14	0.21	0.77	0.7	0.51

Appendix 16. Participant information sheet – Phase 1

Participant Information Sheet (Patients) – Phase 1

Testing New Models of Care for Older Adults in the Home

I would like to invite you to take part in an evaluation of the new Test Bed Programme in which you are involved. The evaluation is being undertaken by a team of researchers from the Centre for Ageing Research at Lancaster University. Before you decide, I would like you to understand why the evaluation is being done and what it would involve for you. I will go through the information sheet with you and answer any questions you have. You can also talk to others about the study if you wish.

Please ask if there is anything that is not clear.

Part 1: Information about the Study

What is the study about?
You are currently involved in the Lancashire and Cumbria Innovation Alliance (LCIA) Test Bed programme and the purpose of this study is to evaluate the programme. The programme will implement and evaluate a combination of innovative technologies and practices aimed at supporting frail older people and people with dementia and other long term conditions to remain well in the community, avoiding unnecessary hospital admissions. This new model of care is designed to help older people to monitor their own health conditions at home using technology and with the support of local care teams. We would like to know about your experiences of receiving this model of care; how it is impacting on your quality of life, what is working well, what is not working so well and what action needs to be taken to improve service delivery.

Why have I been approached?
You have been approached because the study requires information from those people who have been selected to take part in the new Extensive / Better Care programme with technology. The study is designed to evaluate the programme and to understand the extent to which this model of care can provide a cost effective way of improving the patient experience.

Do I have to take part?
No. Taking part in the study is completely voluntary.

What will I be asked to do if I take part?
If you decide to receive the technology and take part in the study, you will be asked to sign a consent form to say that you agree to take part. You will have time to read the consent form carefully and to ask any questions about this or about the study. You will then receive a survey three to four times over the time that you are using the technology (only those starting the programme before July 1st 2018 will be asked to complete a fourth survey).

The survey is designed to help us understand the current state of your health, your knowledge and ability to confidently manage your own healthcare and the extent to which technology may be helping you to improve these aspects of your life over time.

The survey will take about twenty minutes to complete. If you do not feel able to complete the survey on your own, you can ask a family member, friend or paid care-worker to help you. It is important though that you complete as many answers as accurately as you are able to.

Will my data be identifiable?
The information you provide is confidential and we will ensure confidentiality in the following ways:

- Your surveys will be given an anonymised code linked to your NHS number. We will only receive your anonymised code so will not be able to link this to you as an individual.
- All your personal data will be confidential and held by the NHS on a secure server.

It is important to note that if it is thought that there is a risk of harm to you or others, the researcher may need to share this information with his/her research supervisor.

The survey data will be stored in a password-safe and encrypted file using the software *TrueCrypt,* on a computer kept in a locked room. The survey material will be accessed only by the team of researchers from Lancaster University. The material from the survey will be combined with other survey data for analysis and may be used for reports and published articles on the topics of ageing, technology and health. We will only use this summarised data in these reports or articles; your name and any identifying information will not be attached to them. So that we can publish articles from this research, and meet the requirements of publishers, we will keep the material for a maximum of 10 years.

Specific Language Support
If you would like to take part in the survey but need support with English or have specific language needs, please let the researcher know about this.

What if I wish to withdraw from the study?
You are free to withdraw from participating in the study at any time without giving any reason. If the request to withdraw comes after the data has been anonymised and incorporated into the database, it might not be possible for it to be withdrawn, though every attempt will be made to extract the data, up to the point of publication. Withdrawing from the study will not affect your involvement in the Extensive/Better Care programme, the standard of care or treatment you receive now or may receive in the future.

What will happen to the results?
The results will be written up in a report for the NHS and may contribute to a National Evaluation of all seven Test Bed sites across England. The results will be used to refine the service and help other regions in the UK to understand how best to introduce this new models of care for older people. The results will also be summarised and reported in

academic or professional journals on the topic of medicine, healthcare technologies and ageing.

Are there any risks?

There are no risks anticipated with participating in this evaluation study. However, if you experience any distress after or whilst taking part in this study, you are encouraged to inform the researcher, your care provider, or contact someone from the support centres listed at end of this document.

Are there any benefits to taking part?

Your participation will help to identify how technology, when combined with the delivery of a new model of care, may be able to provide a cost-effective means of improving patient activation of older people with chronic health conditions and enable their ability to self-care. It will also help us understand how this impacts on the working practices of those involved in the delivery of care services.

Who has reviewed the project?

This study has been reviewed by the NHS Research Ethics Committee, and approved by the University 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:

Alejandra Hernandez and Dr. Sandra Varey
Senior Research Associate
Division of Health Research
Faculty of Health and Medicine
Furness Building
Lancaster University
Lancaster
LA1 4YT
Tel: 01524 592128

Complaints

If you wish to make a complaint or raise concerns about any aspect of this study and do not want to speak to the researcher, you can contact:

Professor Christine Milligan
Director Centre for Ageing Research
Division of Health Research
Faculty of Health and Medicine
Furness Building
Lancaster University
Lancaster
LA1 4YT
Tel: 01524 592128

If you wish to speak to someone outside of the Lancashire and Cumbrian Innovation Alliance study group, you may also contact:

Professor Roger Pickup
Associate Dean for Research
Faculty of Health and Medicine
(Division of Biomedical and Life Sciences)
Lancaster University
Lancaster
LA1 4YG
Tel: +44 (0)1524 593746
Email: r.pickup@lancaster.ac.uk

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 in the study or in the future, the following resources may be of assistance:

The Silver Line
The Silver Line is the only free confidential helpline providing information, friendship and advice to older people, open 24 hours a day, every day of the year.
Tel: 0800 4 70 80 90
https://www.thesilverline.org.uk

Age UK
Age UK provides free information and advice to older people on health and well-being, home and care, money matters, work and learning, and travel and lifestyle.
Tel: 0800 169 2081
http://www.ageuk.org.uk

Independent Age
Independent Age provides advice and support for older people on a variety of topics including: care options, benefits, housing, and health and well-being.
Tel: 0800 319 6789
http://www.independentage.org

Appendix 17. Participant information sheet (patients)

Health and Medicine | Lancaster University

07/10/16 Version 4 IRAS ID: 208395

Participant Information Sheet (Patients)

Evaluation of Lancashire and Cumbria Innovation Alliance Test Bed

My name is Sandra Varey and I am a researcher at the Faculty of Health and Medicine at Lancaster University, Lancaster, United Kingdom. I would like to invite you to take part in an evaluation of the new Testbed Programme in which you are involved. The evaluation is being undertaken by a team of researchers from the Centre for Ageing Research at Lancaster University. Before you decide, I would like you to understand why the evaluation is being done and what it would involve for you. I will go through the information sheet with you and answer any questions you have. You can also talk to others about the study if you wish.

Please ask if there is anything that is not clear.

Part 1: Information about the Study

What is the study about?
You are currently involved in the Lancashire and Cumbria Innovation Alliance (LCIA) Testbed programme and the purpose of this study is to evaluate the programme. The programme will implement and evaluate a combination of innovative technologies and practices aimed at supporting frail older people and people with dementia and other long term conditions to remain well in the community, avoiding unnecessary hospital admissions. This new model of care is designed to help older people to monitor their own health conditions at home using technology and with the support of local care teams. We would like to know about your experiences of receiving this model of care; how it is impacting on your quality of life, what is working well, what is not working so well and what action needs to be taken to improve service delivery.

Why have I been approached?
You have been approached because the study requires information from those people who have been selected to take part in the new Extensive / Better Care programme with technology. The study is designed to evaluate the programme and to understand the extent to which this model of care can provide a cost effective way of improving the patient experience.

Do I have to take part?
No. Taking part in the study is completely voluntary.

What will I be asked to do if I take part?
If you decide you to take part in the study you will be asked to sign a consent form to say that you agree to take part. You will have time to read the consent form carefully and to ask any questions about this or about the study. A member of the research team will then arrange with you to visit you in your home. In total, you will receive two visits from the researcher over the six months in which you will be trialling the service.

The researcher will ask you about your experiences of using the technology including whether you feel:

- Your health has improved from using it
- More confident managing your healthcare
- The technology has improved your life generally and, if so, how
- You have encountered any difficulties while using the technology

The researcher may observe how you use the technology and, with your consent, will record the interviews with a voice recorder. You may also be asked to complete a short weekly diary about how often you use the technology, your experiences of receiving the intervention, of using it and the service around it.

Will my data be identifiable?

The information you provide is confidential and we will ensure confidentiality in the following ways:

- The recordings from the interviews will be typed up and any identifying information will be removed
- All your personal data will be confidential and will be kept separately from your interview responses.

It is important to note that if it is thought that there is a risk of harm to you or others, the researcher may need to share this information with his/her line manager.

The transcribed interviews will be stored in a password safe and encrypted file using the software *TrueCrypt,* on a computer kept in a locked room. After the interviews have been analysed, we will delete them from the recorder. The material will be accessed only by the team of researchers from Lancaster University. The material from the interviews may be used for reports and published articles on the topics of ageing, technology and health. We may use direct quotations from your interviews in these reports or articles, but your name, or any identifying information, will not be attached to them. So that we can publish articles from this research, and meet the requirements of publishers, we will keep the material for a maximum of 10 years.

Specific Language Support

If you would like to take part in the interviews but need support with English or have specific language needs, please let the researcher know about this.

What if I wish to withdraw from the study?

You are free to withdraw from participating in the study at any time without giving any reason. If the request to withdraw comes after the data has been anonymised and incorporated into themes, it might not be possible for it to be withdrawn, though every attempt will be made to extract the data, up to the point of publication. Withdrawing from

the study will not affect your involvement in the Extensive/Better Care programme, the standard of care or treatment you receive now or may receive in the future.

What will happen to the results?
The results will be written up in a report for the NHS and may contribute to a National Evaluation of all seven Testbed sites across England. The results will be used to refine the service and help other regions in the UK to understand how best to introduce this new models of care for older people. The results will also be summarised and reported in academic or professional journals on the topic of medicine, healthcare technologies and ageing.

Are there any risks?
There are no risks anticipated with participating in this evaluation study. However, if you experience any distress after or whilst taking part in this study, you are encouraged to inform the researcher, your care provider, or contact someone from the support centres listed at end of this document.

Are there any benefits to taking part?
You participation will help to identify how technology, when combined with the delivery of a new model of care, may be able to provide a cost-effective means of improving patient activation of older people with chronic health conditions and enable their ability to self-care. It will also help us understand how this impacts on the working practices of those involved in the delivery of care services. In exchange for participating in the study, you will receive one voucher of £20.00.

Who has reviewed the project?
This study has been reviewed by the NHS Research Ethics Committee, and approved by the University 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:

Dr Sandra Varey
Senior Research Associate
Division of Health Research
Faculty of Health and Medicine
Furness Building
Lancaster University
Lancaster
LA1 4YT
Tel: 01524 592128

Complaints
If you wish to make a complaint or raise concerns about any aspect of this study and do not want to speak to the researcher, you can contact:

Professor Christine Milligan
Director Centre for Ageing Research
Division of Health Research
Faculty of Health and Medicine
Furness Building
Lancaster University
Lancaster
LA1 4YT
Tel: 01524 592128

Independent complaints process

If you wish to speak to someone outside of the Lancashire and Cumbrian Innovation Alliance study group, you may also contact the following independent contact:

Professor Roger Pickup
Associate Dean for Research
Faculty of Health and Medicine
(Division of Biomedical and Life Sciences)
Lancaster University
Lancaster
LA1 4YG
Tel: +44 (0)1524 593746
Email: r.pickup@lancaster.ac.uk

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 in the study or in the future, the following resources may be of assistance:

The Silver Line
The Silver Line is the only free confidential helpline providing information, friendship and advice to older people, open 24 hours a day, every day of the year.
Tel: 0800 4 70 80 90
https://www.thesilverline.org.uk

Age UK
Age UK provides free information and advice to older people on health and well-being, home and care, money matters, work and learning, and travel and lifestyle.
Tel: 0800 169 2081
http://www.ageuk.org.uk

Independent Age

Independent Age provides advice and support for older people on a variety of topics including: care options, benefits, housing, and health and well-being.

Tel: 0800 319 6789

http://www.independentage.org

Appendix 18. Consent form: parts 1 and 2

Health and Medicine | Lancaster University

07/10/2016 Version 5 IRAS ID: 208395

Testbed Code: 1 2 — 3 4 5 6

Consent Form Part 1 – (Patients)

Evaluation of Lancashire and Cumbria Innovation Alliance Test Bed

We are asking if you would like to take part in a project which evaluates older people's experiences of using technologies to monitor health and illness at home with support from health professionals and care teams.

If you have any questions or queries before completing this consent form, please speak to the Test Bed team member helping you today. Alternatively, you can contact either Alejandra Hernandez or Dr Sandra Varey at Lancaster University (details included in the participant information sheet).

Before you consent to participate in the study, please read the information sheet. If you are happy to take part, please complete the following by marking each box below with your initials if you agree.

	Please initial each statement
1. I have read the information sheet and I have had the opportunity to ask questions and to have them answered.	☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason; while the technology would be withdrawn, this would not affect my medical care or legal rights.	☐
3. I understand that the technology provided is an enhancement to my current care. The system is not a replacement for medical care and I should still consult my named Healthcare Professional as normal if required. In case of emergency, I should always dial 999.	☐
4. I understand that the equipment will be provided for approximately 24 weeks; after which my named Healthcare Professional or the Extensive Care Service Hub will contact me to discuss my options.	☐
5. I understand that the equipment continues to be the property of the Lancashire and Cumbria Innovation Alliance (LCIA) and will need to be returned at the end of the trial period.	☐
6. I agree that the equipment can be installed in my house with the purpose of monitoring my health by the healthcare staff in the Extensive Care Service Hub. In order to monitor my health, the healthcare staff will have access to my medical records.	☐
7. I understand that I need to have a broadband connection with internet access and a television set to be able to participate in the project *(delete if not applicable)*.	☐
8. I understand that my contact information will be shared with Philips and its subcontractors for the purpose of installing and servicing the equipment. I understand that my contact information will not be passed to anyone outside the Test Bed programme.	☐

9. I fully understand the information discussed and agree to take part in the Lancashire and Cumbria Innovation Alliance Test Bed Programme and Evaluation. ☐

10. I understand that the information from my survey data will be pooled with other participants' responses, made anonymous and may be published. ☐

11. I understand that any information I give will remain strictly confidential and anonymous unless it is thought that there is a risk of harm to myself or others, in which case the principal investigator/Test Bed team member may need to share this information with his/her line manager. ☐

12. I consent to my NHS patient records being made available to the researchers regarding data which is relevant to the evaluation. I understand that my data will be anonymised. ☐

13. Optional: We wish to speak in person with some people about their experiences of using the technology. It will not be possible to speak to everyone, but please tick this box if you are happy to be contacted about this by researchers from Lancaster University. ☐

Participant Name / Signature		
Participant NHS Number		
Name of the Test Bed team member completing the consent form with the participant / Signature		
Date		

Testbed Code: 1 2 — 3 4 5 6

Consent Form Part 2 – (Patients)

Evaluation of Lancashire and Cumbria Innovation Alliance Test Bed

You are currently taking part in a research project which evaluates older people's experiences of using technologies to monitor health and illness at home with support from health professionals and care teams. You have volunteered to speak in person with a researcher about your experience. Before you consent to participate in this part of the evaluation, we ask that you read the participant information sheet and mark each box below with your initials if you agree. If you have any questions or queries before signing the consent form please speak to Dr Sandra Varey at Lancaster University (details included in the participant information sheet).

	Please initial each statement
1. I have read the information sheet and I have had the opportunity to ask questions and to have them answered.	
2. I understand that my interview will be audio recorded and then made into an anonymised written transcript.	
3. I understand that audio recordings will be kept until the research project has been completed.	
4. 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.	
5. 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.	
6. I understand that the information from my interview will be pooled with other participants' responses, anonymised and may be published	
7. I consent to anonymised information and quotations from my interview being used in reports, conferences and training events.	
8. I understand that any information I give will remain strictly confidential and anonymous unless it is thought that there is a risk of harm to myself or others, in which case the principal investigator may need to share this information with his/her line manager.	
9. I consent to Lancaster University keeping written transcriptions of the interview for 10 years after the study has finished.	
10. I consent to take part in the above study.	

An original copy of the participant information sheet and completed informed consent form is to be given to the participant, in addition to the original copy that is filed in the investigator file.

Name of Participant_____ **Signature**_____ **Date** _____

Name of Researcher _____**Signature** _____**Date** _____

Appendix 19. Consent forms – action learning meetings and focus groups

Health and Medicine | Lancaster University

07/10/16 Version 5 IRAS ID: 208395

Consent Form – Action Learning Meetings

Evaluation of Lancashire and Cumbria Innovation Alliance Test Bed

We are asking if you would like to take part in an evaluation of the Lancashire and Cumbria Innovation Alliance (LCIA) Test Bed programme. The programme will implement and evaluate a combination of innovative technologies and practices aimed at supporting frail older people and people with dementia and other long term conditions to remain well in the community, avoiding unnecessary hospital admissions. Before you consent to participating in the study we ask that you read the participant information sheet and mark each box below with your initials if you agree. If you have any questions or queries before signing the consent form please speak to Dr Sandra Varey at Lancaster University (details included in the participant information sheet).

	Please initial each statement
1. I have read the information sheet and I have had the opportunity to ask questions and to have them answered.	☐
2. I understand that my participation will be audio recorded and then made into an anonymised written transcript.	☐
3. I understand that audio recordings will be kept until the research project has been completed.	☐
4. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason.	☐
5. 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.	☐
6. I understand that the information from my participation will be pooled with other participants' responses, anonymised and may be published.	☐
7. I consent to anonymised information and quotations from my participation being used in reports, conferences and training events.	☐
8. I understand that any information I give will remain strictly confidential and anonymous unless it is thought that there is a risk of harm to myself or others, in which case the principal investigator may need to share this information with his/her line manager.	☐
9. I consent to Lancaster University keeping written transcriptions of the discussion for 10 years after the study has finished.	☐
10. I consent to take part in the above study.	☐

An original copy of the participant information sheet and completed informed consent form is to be given to the participant, in addition to the original copy that is filed in the investigator file.

Name of Participant_____ **Signature**_____ **Date** _____

Name of Researcher _____**Signature** _____**Date** _____

Consent Form (Focus Groups)

Evaluation of Lancashire and Cumbria Innovation Alliance Test Bed

We are asking if you would like to take part in an evaluation of the Lancashire and Cumbria Innovation Alliance (LCIA) Testbed programme. The programme will implement and evaluate a combination of innovative technologies and practices aimed at supporting frail older people and people with dementia and other long term conditions to remain well in the community, avoiding unnecessary hospital admissions. Before you consent to participating in the study we ask that you read the participant information sheet and mark each box below with your initials if you agree. If you have any questions or queries before signing the consent form please speak to Dr Sandra Varey at Lancaster University (details included in the participant information sheet).

	Please initial each statement
1. I have read the information sheet and I have had the opportunity to ask questions and to have them answered.	☐
2. I understand that my participation will be audio recorded and then made into an anonymised written transcript.	☐
3. I understand that audio recordings will be kept until the research project has been completed.	☐
4. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason.	☐
5. 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.	☐
6. I understand that the information from my participation will be pooled with other participants' responses, made anonymous and may be published.	☐
7. I consent to anonymised information and quotations from my participation being used in reports, conferences and training events.	☐
8. I understand that any information I give will remain strictly confidential and anonymous unless it is thought that there is a risk of harm to myself or others, in which case the principal investigator may need to share this information with his/her line manager.	☐
9. I consent to Lancaster University keeping written transcriptions of the discussion for 10 years after the study has finished.	☐
10. I consent to take part in the above study.	☐

An original copy of the participant information sheet and completed informed consent form is to be given to the participant, in addition to the original copy that is filed in the investig☐

Name of Participant_____ **Signature**_____ **Date** _____

Name of Researcher _____**Signature** _____**Date** _____

Appendix 20. Observational interview 1 with patients

LCIA Test Bed Evaluation

Participant name:

……

Test Bed number:

……

Date of interview:

……

Observational interview 1 with patients

- ☐ **Provide copy of Stage 2 participant information sheet**
- ☐ **Talk through Stage 2 consent form and complete**
- ☐ **Discuss and answer any patient questions**
- ☐ **Start audio recording**

Opening question: Why were you interested in taking part in the Test Bed?

Then: Tell me about your condition. What about the medication you take / use?

Topic 1: Patient understanding of how the technology works

- How did you first learn to use the technology? Who was involved in this?
- What was your experience of it being installed in your home?
- How does it fit in your home? Did you have to change the layout of your home?
- Tell me about the training you received. How did you feel when the trainer had left?
- Can you tell me about what it was like using it the first few times?
- What aspects of the technology do you find easy / difficult?

How is the technology improving your existing healthcare (GP or Extensive Care)?

CAN YOU SHOW ME WHERE YOU KEEP THE EQUIPMENT? (TAKE PHOTO)
CAN YOU SHOW ME YOU USING THE EQUIPMENT? (TAKE NOTES)

Topics 2 & 3: Self Care / User's Health

- How is the technology helping you manage your health conditions?
- Have you begun to manage these conditions differently? If so, in what ways?

Topic 4: External Support

- What kinds of support do you need to use this technology?
- What support are you receiving to use this technology?
- Are you receiving any other kinds of support at the moment? (care workers, family carers, personal care, day centres, help with medication, etc.)

Topics 5: Independence

- What activities do you currently take part in? (e.g. daily / weekly / monthly)
- How do you expect the technology might help you to begin new activities?
- How do you expect the technology might make some activities easier?

Topics 6: Knowledge/Information

- What kinds of information / feedback do you receive about your health?
- How is the technology helping you learn about your condition / your health?

- ☐ **Stop recording**
- ☐ **Does the patient have any other comments or questions?**
- ☐ **Discuss the next interview - will phone in _____ to arrange this**
- ☐ **Leave my contact details / card**

LCIA Test Bed Evaluation

Participant name:

……

Test Bed number:

……

Date of interview:

……

Observational interview 2 with patients

☐ **Discuss and answer any patient questions**

☐ **Start audio recording**

Topic 1: Patient understanding of how the technology works

- Can you tell me about what it has been like to use the technology over the past ___ months?
- What aspects of the technology have you found to be easy / difficult?

CAN YOU SHOW ME YOU USING THE EQUIPMENT? (TAKE NOTES)

Topics 2 & 3: Self Care / User's Health

- Tell me about your health condition(s). How are you and how has this changed since we last met?
- Have you been unwell while using the technology? Have you been in hospital and, if so, for how long? Explore how serious the illness was and if the technology was supportive.
- How has the technology helped you to manage your health conditions?
- Have you been managing these conditions differently? If so, in what ways?

Topic 4: External Support

- What kinds of support have you needed to use this technology?
- What support have you received to use this technology?
- Are you receiving any other kinds of support at the moment? (care workers, family carers, personal care, day centres, help with medication, etc.) Have there been any changes to this since we last met?

Topic 5: Independence

- What activities do you currently take part in? (e.g. daily / weekly / monthly)
- Has the technology help you to begin new activities?
- Has the technology helped to make some activities easier for you?
- Do you think these changes will continue when you stop using the technology?

Topics 6: Knowledge/Information

- What kinds of information / feedback have you receive about your health?
- How has the technology helped you learn about your condition / your health?

Leaving the Test Bed / service

- Overall, what has been your experience of taking part in the Test Bed?
- How has using the technology changed your experience of healthcare? (GP or Ext Care)
- How do you feel about coming to the end of the Test Bed? (explore removal of the equipment, changes in healthcare service and impact on patient health and wellbeing)
- What you for has been the most positive experiences/changes in your life since using the technology? And what has been the most difficult?

☐ **Stop recording. Does the patient have any other comments or questions? Ensure participant has my contact details**

Appendix 21. Information leaflet for patients

What will happen to the results?

The results will be written up in a report for the NHS and will be used to refine the service and help other regions in the UK to understand how best to introduce this new models of care for older people.

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

More information can be found in the participant information sheet attached. Alternatively, if you have any questions about the study, please contact the principal researcher:

Dr Sandra Varey
Senior Research Associate
Division of Health Research
Faculty of Health and Medicine
Furness, Lancaster University
Lancaster, LA1 4YT
Tel: 01524 592128

Evaluation of Lancashire and Cumbria Innovation Alliance Test Bed

Information for Patients

Health and Medicine | Lancaster University

Why have I been approached?

We would like to know about your experiences of receiving this model of care: how it is impacting on your quality of life, what is working well, what is not working so well and what action needs to be taken to improve service delivery.

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

The researcher will ask you about your experiences of using the technology and may observe how you use it. The researcher will ask whether you feel your health has improved by using it, to what extent you feel more confident managing your healthcare, how you feel it may have improved your life generally, and whether you have encountered any difficulties while using it.

Appendix 22. Patient Consent form – part 2

Health and Medicine | Lancaster University

07/10/2016 Version 5 IRAS ID: 208395

Testbed Code: 1 2 — 3 4 5 6

Evaluation of Lancashire and Cumbria Innovation Alliance Test Bed

Patient Consent Form - Part 2 (Cut out version)

1. I have read the information sheet and I have had the opportunity to ask questions and to have them answered. ☐

2. I understand that my interview will be audio recorded and then made into an anonymised written transcript. ☐

3. I understand that audio recordings will be kept until the research project has been completed. ☐

4. 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. ☐

5. 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. ☐

6. I understand that the information from my interview will be pooled with other participants' responses, anonymised and may be published. ☐

7. I consent to anonymised information and quotations from my interview being used in reports, conferences and training events. ☐

8. I understand that any information I give will remain strictly confidential and anonymous unless it is thought that there is a risk of harm to myself or others, in which case the principal investigator may need to share this information with his/her line manager. ☐

9. I consent to Lancaster University keeping written transcriptions of the interview for 10 years after the study has finished. ☐

10. I consent to take part in the above study. ☐

An original copy of the participant information sheet and completed informed consent form is to be given to the participant, in addition to the original copy that is filed in the investigator file.

Name of Participant: …….

Signature: …….

Date: …….

Name of Researcher: ……

Signature: …….

Date: …….

Appendix 23. Additional patient information

Participant payment

Participants taking part in the qualitative elements of the study will receive a voucher of £20 as a thank you in recognition of the time they have given to taking part in the evaluation. In the quantitative elements of the evaluation we are unable to offer any incentive because of the large numbers of participants.

Data storage

Personal data is being stored on a password safe university computer accessible only to the researchers. The research data is stored in an encrypted file using the software TrueCrypt.

All data is being stored securely in line with the Data Protection Act [11] and will be kept no longer than necessary.[12] Written data will be kept for a maximum of 10 years in a secure cabinet. Any electronic copies of data will be kept on the University server, which is a password protected system and will be encrypted. If electronic data requires transfer, this is done on an encrypted USB device. Any emails sent from participants (e.g. electronic diaries) are sent to a password secured email address that has been set up for the purpose of the study. Emails are saved electronically with any other electronic copies of data, with the email then being deleted. Where emails and interview/focus group data are printed for the purposes of analysis, they are stored with other written data in a secure cabinet. At the end of the study, the email account will be deleted. The paper copies of any participant contact details will be scanned and stored electronically, and paper copies destroyed.

Participant benefit

Participants have the direct benefit of using the technology during the two years of the Test Bed; however the Test Bed team recognise the need to make clear for those in Cohorts 1 and 4 that this is time-limited. Patients (particularly those in cohorts 2 and 3) for whom the intervention is a text messaging system or an app, will have access to these beyond the six month timeframe of the Test Bed programme. Given a key objective of the service is to enhance patient activation and ability to self-care, it is also anticipated that potential ongoing benefits will support older people with chronic health problems to remain in their own homes longer.

Patients and health professionals also have an opportunity to share directly with researchers their experiences of using and implementing this model of care. In this way, all participants can take an active part in shaping current and future healthcare services in place for older people with chronic conditions or dementia who are living at home.

Potential risk to participants

For patients participating in Phase 1 of the evaluation, there are no anticipated risks from participation in the project. All validated tools are validated for completion by proxy, and patients and family members are therefore made aware that the patient can be supported to complete the surveys if required.

For patients taking part in Phase 2 of the evaluation research, no specific risks are anticipated. However, the following considerations have been made:

1. It is possible that a patient may become distressed by the presence of the researcher in their home during the observational interviews. To avoid this risk, the researcher will take care to check with the patient at the beginning of the interview to ensure they are happy to continue taking part in the study. The researcher will also do this at the end of the session and for the second interview.

2. If a patient should become distressed for any reason during an observational interview, the researcher will provide the patient with the contact details of different support networks for older people, as outlined in the participant information sheet. A member of the Test Bed hub will also be alerted should this be necessary, in order to assess whether a visit from a member of the hub is required.

Participants involved in the action learning meetings and the focus groups will be reminded that discussion in these settings is confidential and information shared (other than the shared and agreed action learning) should not be discussed with others outside of the meeting.

Withdrawal

Participants may choose to leave the study at any time and are assured that their data can be withdrawn up to four weeks after collection. The rationale for this four week time period is that, beyond four weeks, analysis will have begun. Those participating in focus groups are advised that, although every effort will be undertaken to remove their data should they request it during the timeframe, this may not always be possible. This is due to difficulties in identifying/attributing specific comments to individuals and because focus group data is often the outcome of group discussion, making it hard to distil to whom individual thoughts/comments should be attributed.

Researcher risk

There is limited risk to the quantitative researchers as they have very limited direct engagement with the participants (survey completion is largely through technology or telephone).

The qualitative researcher is interviewing participants in their own homes and is experienced in undertaking this type of fieldwork. The researcher is adhering to the University's lone worker policy. In order to minimise any potential risks, for each home visit conducted, the researcher identifies a 'buddy' (a member of staff within the University) with whom to remain in contact with: before the interview commences; when the interview has been terminated; and when the researcher has left the patient's home. The buddy is informed of the time and place of the interview, along with a contact telephone number.

Researchers within the team have the opportunity to debrief with other members of the team if required and have full access to counselling services if necessary.

References

11 Data Protection Act (1998) Data Protection Act. Available at: http://www.legislation.gov.uk/UKPGA/1998/29/contents [Accessed on 17 February 2017].

12 Bryman A. Social Research Methods, Sixth Edition. Oxford, UK: Oxford University Press 2016.

Appendix 24. Logic model diaries

Health and Medicine | Lancaster University

Lancashire & Cumbria Innovation Alliance

Logic Model Diaries

Question	**Week:**
Can you state your role in the Test Bed intervention?	
Who else has been involved in the delivery of Motiva this week?	
How much time have you/each person referred above spent working on this?	
What resources (non-human) have you needed to help with your work with Motiva this week?	
What aspects of Motiva worked well this week for you/your team? Why?	
What aspects have not worked well for you/your team? Why?	
Overall is the Test Bed programme reducing your workload? If yes, say how. If no, explain why.	
What aspects of the system work well with patients? Why?	
What aspects are not working well with patients? Why?	
What difficulties did you encounter?	
Any other aspects of the programme that need to be raised this week?	

Please submit your completed diary each Friday to the following email address: testbedsproject@lancaster.ac.uk. Thank you

Appendix 24. Staff focus group

Staff focus group

NB: have one hour
Do info sheets and consent forms at beginning

INTRODUCTION

Key points to emphasise at the beginning:

- The purpose of the focus group is to get your views on how the use of the technology in the Test Bed is changing or could change working practices
- Whether that would be for the better or worse, and why
- And overall, whether you feel it could be an improvement/useful addition to current and future practice
- We are not focusing on the challenges that the evaluation and recruitment have presented as this would not be part of any 'usual practice' that included the technology
- Instead we are interested in how the technology changes your working practices
- Whether you feel it has the potential to decrease/increase workload and how/why

START RECORDING

1) As a team, what does your average day / week look like?

2) What has been your involvement in the Test Bed? What has this entailed for you as a team?

3) How has your involvement in the Test Bed changed your day to day working?

- Explore the impact both on the Advanced NPs and the GP

4) In terms of the Test Bed technologies:

- Who was involved in the content design?
- And what are your thoughts about who should have been involved in this?

5) How do the technologies fit into the clinical pathway? *Explore their ideas on this (e.g. who monitors)*

6) What has been working particularly well about your team's involvement in the Test Bed?

7) What challenges have you faced in your involvement in the Test Bed?

8) What feedback have you received from patients about the Test Bed?

- What are your thoughts about how effective the technologies have been for patients?
- How do you think the technologies are changing caring practices for family carers and patients?

9) If the Test Bed was rolled out, what would you suggest should be kept the same / changed?

10) What suggestions do you have for improving the Test Bed for the patients / carers / staff members involved?

11) Any other comments or reflections?

Appendix 25. Lancaster Deliberative Panel

LCIA TEST BED EVALUATION

LANCASTER DELIBERATIVE PANEL

APRIL 2018

Timing	Who	What
13.00-13.10	Christine	Introduction
13.10-13.30	Sandra	Patient and family carer draft findings
13.30-13.55	CM, JW & SV	Small group discussion (see pink handout)
13.55-14.10		Break
14.10-14.25	Sandra	Staff draft findings
14.25-14.50	CM, JW & SV	Small group discussion (see green handout)
14.50-15.05	Joann	Logic model
15.05-15.30	CM, JW & SV	Small group discussion
15.30-16.00	Christine	In small groups, come up with the three most important things to have come out of the Test Bed Share as a whole group (and capture these in notes) Get email addresses for all – ranking exercise will be emailed out in the next couple of weeks

Appendix 26. LCIA Test Bed ranking activity

Lancashire and Cumbria Innovation Alliance (LCIA) Test Bed ranking activity

Thank you for attending the recent LCIA Test Bed event.

Please reflect on this meeting, and the presentations and discussions from the day.

If the Test Bed became part of everyday healthcare, we would like to know what you think would be the most important learning from the Test Bed project.

This survey contains only two questions and should take no longer than a few minutes to complete.

Question 1: Patients and Family Carers

Please read the following statements related to patient and carer involvement in the Test Bed.

In the blank column, please rank the statements in order of importance (1 being the most important).

	Decisions about what technologies to give to a patient should begin with the individual's healthcare needs, and not what technologies are available
	Patients should be involved in the decision-making about what technologies they are to use
	The technologies offered to patients should be tailored to the needs of the individual patient
	The technologies offered to patients need to be interactive and enable communication between patients, carers and healthcare staff
	The technologies provided to patients need to be flexible and enable people to use them in a way which best meets their needs and different daily living patterns
	Patients and family carers need appropriate and regular training related to the technologies provided to them
	Healthcare technologies should be offered to family carers, as well as to patients
	The timescale for using a technology needs to be flexible, with opportunities to move between different technologies as a patient's healthcare needs change
	Opportunities must be available for patients, carers and staff to have ongoing conversations and reviews about the use of the technologies
	There needs to be more early patient and carer involvement in the decisions about the implementation of health technologies
	The healthcare technologies will not be suitable for all patients, and therefore patients and clinicians need to work together to understand who best the technologies will work for

Question 2: Staff

Please read the following statements related to staff involvement in the Test Bed.

You may notice that some statements are similar to the previous page; this is intentional as some statements are relevant to patients, carers and staff.

In the blank column, please rank the statements in order of importance (1 being the most important).

	Staff involved in the Test Bed need appropriate and regular training and support related to the technologies used by their patients
	Continuity in the staff responsible for identifying and managing patients using healthcare technologies is important to its successful implementation
	It is important that staff teams receive support and training to understand the value of the technologies to their patients
	Opportunities must be available for staff, patients and carers to have ongoing conversations and reviews about the use of the technologies
	Technology companies need to work closely with healthcare staff to provide technical support if issues arise with the technologies being used by patients, carers and staff
	Healthcare staff must be given the appropriate resources, training and time to enable them to tailor the technologies to the individual needs of the patient
	There needs to be more early patient and carer involvement in the decisions about the implementation of health technologies

Thank you for taking the time to complete this survey.

Your responses will be collated with those of others taking part in the deliberative panels to provide an overall ranking of the most important learning from the Test Bed. These results will be included in the evaluation's final report and may inform future service development.

Appendix 27. Lessons learned slides

Lancashire & Cumbria Innovation Alliance

Centre for Ageing Research | Lancaster University

Lancashire and Cumbria Innovation Alliance (LCIA) Test Bed

Lessons learned

LCIA Test Bed Evaluation Team
Centre for Ageing Research, Lancaster University
July 2017

Introduction

Lancaster University

- The LCIA Test Bed involves fourteen partners, which has presented significant benefits and challenges in the setting up and management of such a large and complex programme
- The evaluation team undertook research to identify lessons learned from the LCIA Test Bed experience that might prove useful for similar complex multi-organisational programmes
- Four focus groups and five individual interviews were undertaken with key partners to explore benefits, barriers and lessons learned
- Participants included members of the LCIA Test Bed from the clinical operations groups (n=11), the technology innovators (n=4), the evaluation team (n=2) and the project management board (n=5)
- The data were transcribed and thematically analysed
- All participants then had opportunity to comment and verify the lessons identified

Lancaster University

Lesson 1:
A longer and more realistic lead-in time is needed for future programmes

Issue	Lesson learned
Project start-up was a long process involving information governance (IG) processes, ethical approvals and the collaborative agreement	Time for such activities needs to be clearly built into the project timeframe; the project cannot proceed without these things in place
The start-up phase is important for establishing good relationships, communication and trust within the project team – important because of the different organisational cultures	Suggest a six month run-in period is needed for a project of this scale This would also enable project planning to start immediately
Collaboration and getting to know each other at the outset is not a measurable outcome but is important given the complexity of the programme	As above, it is important that there is time for this collaboration to take place

Lancaster University

"The set-up of something like a Test Bed [...] you are expecting massive organisations to work with other massive organisations, so you need to build in a much, much longer timescale for the set-up [...] Whereas in actual fact there was almost no time set aside for [all the agreements] and there is a sense that, because it's technology and it's rapid and [NHS England] want things to move quickly, that actually, you know [...] everyone should go out of their way to speed things up. But I actually think that there is a limit to what is actually physically feasible in terms of speeding up some of these things."

Lesson 2: An initial mobilisation plan needs to be in place for the programme start-up

Issue	Lesson learned
The LCIA Test Bed is a large programme and includes a vast number of people (over 70) working in different roles and across a variety of organisations	Mapping of the Test Bed is very important. Ramp-up was easier once this had been done; this needed to be done earlier e.g. who is involved, what their role/area is; and a clear plan of how the programme maps on to existing teams and roles

"The other thing is around the vast amount of people in a project of this size that you need to keep track of [we've] got to about 73 key people – not just incidental people but key people who you've needed to make a decision for you to be able to move forward in some respect or another [...] on the one hand it's wonderful, on the other hand it can be a bit overwhelming sometimes."

Lesson 3: Clinicians need to be engaged in decisions about the design of the programme and technologies to be used from the outset

Issue	Lesson learned
Frustration for some clinicians who were expected to deliver the Test Bed but not involved in early key decisions about the technologies to be rolled out to their patients	Prior to technology design decisions being made, clinicians need to be involved to validate that an intervention's target objective is recognised by clinicians as relevant to their patients At the outset of the programme, clinicians should continue to be involved, particularly in relation to the technologies to be used with their patients By engaging clinicians in these ways, it would ensure that they are more informed and engaged with technology choices early in the programme

Lesson 3 continued ...

Issue	Lesson learned
Clinicians and other programme members were unsure in the early stages exactly what the technologies were	Early in the project, it is important that all project members understand what the kit actually is, what is available and what it involves for practitioners and patients This would ensure that any potential problems are identified and rectified immediately

"One of the very, very first things I would do if we did this again is […] have a clinical conference with those leads […] get them in, bring them together, get them in a small auditorium somewhere and do the presentation and let them get engaged, let them have their say […] and then everything should be seen to be guided by them and their clinical judgement and their advice to the application of these technologies into those Cohorts."

Lesson 4: It is important to recruit the 'right people' to the programme

Issue	Lesson learned
An overall programme manager was not in place at the start of the Test Bed	It is crucial that this person is in post at the outset of the programme
Appropriate people not always introduced to the programme at an early enough stage	Having the right people involved quickly removes barriers and means that decisions are able to be made It is important to ensure that the team is made up of enthusiastic, committed individuals It is important to recruit senior colleagues who recognise the potential long-term benefits of the programme and who are willing in the short-term to commit to the project on top of their current workloads

"And getting the right people in the room […] who have the right expertise and knowledge […] to make whatever needs to happen happen […] identifying the key people: I think it's really important. When that's happened, things have happened really quickly, barriers have been removed really quickly."

"It's the willingness of people to help […] just their absolute willingness to help you and guide you and support you. I would say 98% of people I've talked to have been really helpful, you know […] the majority of people it's just really refreshing that they're so willing to help and support and move things for you."

Lesson 5: A clear and coherent project governance structure is needed at the outset

Issue	Lesson learned
In the LCIA Test Bed there was confusion about roles and the number of changing roles in the early stages of the programme	It is important to have an open and coherent approach at the beginning of the programme, with a clear project structure

- "The governance of [the Test Bed] was muddled, to say the least, with lots of people on lots of Boards, but lots of people potentially wanting to make the decisions but not many people doing the doing, or facilitating the doing, so that somebody could make a decision."
- "On paper [the Test Bed's governance is] good isn't it? But actually when it comes into operation, I think there's gaps [...] when things aren't working out [...] where's the lines of communication? Where's the lines of governance and leverage? They seem to vanish."

Lesson 6: A more streamlined collaboration agreement is needed for future programmes

Issue	Lesson learned
The collaboration agreement was a frustrating, time-consuming and drawn-out process for everyone involved	The collaboration agreement needs to be a priority at the start of the programme It is important to recognise the different needs of different partners in the collaboration agreement The activity could have been made easier if there had been adequate time for relationships and trust to become established between project members
The document became lengthy and complex	A shorter and less-detailed document was needed It would have been useful to receive some templates and support from NHS England

Lesson 7: Information governance must be addressed before the programme commences

Issue	Lesson learned
A range of standards are set out within the NHS framework relating to NHS interactions with third party organisations regarding IG. In some cases, organisations' IG processes were incompatible with NHS requirements. This resulted in considerable delays to the project and absorbed extensive resources to resolve.	When partnering Trusts with Innovators in future programmes, NHS England should carry out a thorough due diligence process including a company's ability to comply with the Data Protection Act and NHS standards in respect of information governance. This is specialist work and needs to be done before the start of the programme.

"I would have thought things like the Collaboration and the IG Agreements would have been something that NHS England would have potentially have had sort of some templates that they would have given out, and whether that would have just been like the basis of 'This is what you can do, this is what you can't do,' and you can sort of add to that as per different Test Bed. But I would have thought there would have been something standard to work with."

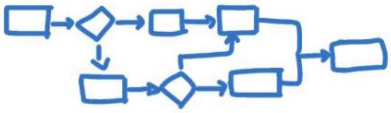
Lesson 8: Communication and collaboration are the key ingredients to a successful programme

Issue	Lesson learned
It is important to regularly bring together all project partners and to value their different contributions This is a complex undertaking with so many partners involved	The Clinical Operational Group (COG) meetings have been very important for relationship building, communication, information sharing and problem solving Something similar to the COGs is needed to include innovators and help them feel more engaged
Face to face meetings, as opposed to emails, are important in setting up and managing a complex project – but this is not always possible	Technologies should be explored to facilitate regular contact between programme partners, particularly when they are geographically dispersed

"The strength for me undoubtedly has been meeting people face to face and people becoming human beings rather than somebody at the end of an email [...] I just don't think you can beat that approach because, from then on in, once you've done that and once you've met somebody, your working relationship's on a completely different footing."

"Using technology more then potentially might have helped [...] we're innovators in technology, yet we're not using that technology for this programme [...] So all the technology's there and that's what I'd definitely recommend doing next time. That's what we're about: we're about technology."

"And I think, again, that it would be for learning going forward, is getting that training in with staff earlier, like [the evaluation team did], because I think for me I'd gone on a journey and thought I had bits of it but there was big gaps in my knowledge. But actually that training really just helped cement it to me. I was like, 'Ah, I now get that bit then, I now understand and how it needs to fit into the process.'"



Lesson 9: Organisational reputations are important in healthcare programmes

Issue	Lesson learned
In the recruitment of patients to the Test Bed, it is proving useful to be able to cite reputable partners	The backing of NHS England is important in the recruitment of patients (i.e. that the project is not funded by a drug company) The involvement of a local university with a good reputation is also important Involvement in the Test Bed is also helpful to the reputation of the innovators and is one of the motivators for getting (and staying) involved

"when I'm recruiting on the phone, I think it's been helpful to have the backing of NHS England […] I'm able to use the local thing of 'We've been very lucky to be granted this,' and then I use Lancaster University which, you know, I think people have got affinity with local things. I say, 'It'll be evaluated by the local university' […] the big picture is NHS England are supporting this, it's not a small drug company who's trying to sell you [their] equipment."

Summary

1. Longer and more realistic lead-in time
2. Initial mobilisation plan to be in place for the programme start-up
3. Clinicians to be engaged in technology design decisions at the outset
4. Recruit the 'right people' to the programme
5. Clear and coherent project governance structure
6. Streamlined collaboration agreement
7. Information governance to be addressed before the programme commences
8. Communication and collaboration the key ingredients to a successful programme
9. Importance of organisational reputations