

Liverpool 5G

Health and Social Care Testbed

Benefits, Outcomes and Impact

November 2019



## Background and Scope

The Liverpool 5G Health and Social Care Testbed ran from April 2018 to November 2019.

The project aim was to see if 5G technology could provide measurable health and social care benefits in a digitally deprived neighbourhood.

A suite of reports have been produced as a summary of the Liverpool 5G Health and Social Care Testbed.

This report details the benefits and impact of the trial, other aspects are covered in the companion reports:

- **Liverpool 5G Health and Social Care Testbed: Overview**

Why we did it, what we did, who benefited, key learning and what's next

- **Liverpool 5G Health and Social Care Testbed: Benefits, Outcomes and Impact**

The project outcomes, who benefited, and the overall impact and analysis of combined data from use cases

- **Liverpool 5G Health and Social Care Testbed: Developing the Network**

Planning, installation and deployment of the network - 5G, WiFi, LoRaWAN - what we did, management and monitoring, and research and development as part of the project

All of the reports can be found on [the resources page of our website](#)

The project was delivered by the [Liverpool 5G Consortium](#).

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## 1. Key Outcomes Summary

- 70% of the products/services in the trial reported an increase in Technology Readiness Level (TRL) over the course of the project, with 55% reaching their target level during the project
- Over £1.1m additional funds spent on R&D due to the funded project
- Over 60 collaborations, partnerships and discussions with partner organisations or potential partner organisations.
- Liverpool 5G Health and Social Care testbed mentioned in over 160 press and media articles and consortium partners took part in over 60 conferences, events and dissemination activities
- Cumulatively, implementation of use cases could potentially result in cost savings to the Health and Social Care services of an estimated £247,688 per hundred users per year, after use case service costs (not including network costs). This assumes service users have multiple devices; any savings would be dependent on the needs of service users, their location, and the mix of devices that would be applicable.

### Use Case Outcomes

- **CGA Simulation - Loneliness Quizzing and Gaming App:**
  - Reduction in loneliness in users:
    - 28% decrease in those who said that they often felt that they lack companionship
    - 20% decrease in those who said that they often felt left out
    - 13% increase in those who said that they hardly ever felt isolated from others
    - 26% decrease in those who said that they often or sometimes felt lonely
  - Improved quality of life in service users, with an increase of an average of 1.4 points on the life satisfaction scale
  - Reduced digital exclusion, with users more confident to use technology
- **Defproc Engineering - Push to Talk:**
  - Reduction in loneliness in users:
    - 25% increase in those who said that they hardly ever felt that they lack companionship
    - 75% increase in those that said they hardly ever felt left out
    - 50% increase in those who said they hardly ever felt isolated from others
  - Reduction of over 30% in the number of people who visited their GP and 16% drop in average number of visits per user. Potential cost saving per 100 users per year: £868

- **The Medication Support Company - Paman:**
  - Potential cost savings to Health and Social Care Services of £208,800 per 100 users per year
  - Improved medication adherence levels: 40% higher than national average of 55%, at 95%.
  - Decrease in medication errors: 51% drop in the number of service users who had a medication error
  - Medication costs reduced by over 50%, and medication wastage reduced.
  - Reduction in carer hours needed to provide medication administration support. Potential saving per 100 users per year: 30600 hours (£464,500)
  - Improved quality of life for service users
    - 73% increase in those confident and happy to take medication
    - 53% increase in those who felt safe
    - 40% increase in service users who felt more independent
  - Improved safety in the home, with medicines securely stored
- **Safehouse Technologies – Safehouse Sensor**
  - Potential cost savings to Health and Social Care Services of £38,020 per 100 users per year
  - Reduced costs of telecare: Potential reduction of £14,280.00 per 100 users per year
  - Average hospital admissions reduced by 50%: Potential cost saving of £22,536 per 100 users per year
  - Reduction in average GP visits by 13%: Potential cost saving of £592 per 100 users per year.
  - Improved quality of life for service users: Average increase of 0.7 points on the life satisfaction scale
- **NHS/RLBUHT**
  - Telehealth in a box: Decreased use of primary health services and hospital services
  - Telehealth in a box: Improved health for service users and increased ability to manage their own health
  - VR Headsets in Palliative Care: Improved quality of life and wellbeing for patients
  - VR Headsets in Palliative Care: Some reduction in pain medication for patients
- **University of Liverpool: Chromatic Sensors**
  - Improved notification on incident to carer
  - Estimated reduction in carer time dealing with incident

## 2. Summary of Project Wide Benefits

### 2.1. Technology Readiness Levels (TRLs)

20 products/services were reporting on TRL Levels during the project

- 5 were at their intended TRL at the start of the project
- 14 reported an increase in TRL over the project
- 11 have reached their intended TRL target during the project

More information about the technology in the trial can be found in [Liverpool 5G Health and Social Care Testbed: Developing the Network](#)

### 2.2. Investment Stimulation

Additional funds spent on R&D due to the funded project was a total of £1,131,565.00

- Third party investment attracted (including grants): £550,000
- 7 organisations have had or are still in discussions about future investment, with a at least 14 potential investment sources (private and grant)

### 2.3. Partnerships and Collaboration

- Over 60 different discussions, collaborations and/or partnerships were reported. These were with a mix of SMEs, academic institutions, technology companies, community organisations and public sector organisations.

Organisation	Collaborations/discussions reported with:	
Public Sector	<ul style="list-style-type: none"> <li>• NHS 111</li> <li>• Brownlow Healthcare</li> <li>• Sefton CCG</li> <li>• Liverpool Local Pharmaceutical Committee</li> <li>• Liverpool Heart and Chest Hospital</li> </ul>	<ul style="list-style-type: none"> <li>• West Lancashire Council</li> <li>• Birmingham City Council</li> <li>• Perth And Kinross Council</li> <li>• Knowsley Council</li> <li>• Wirral Council</li> <li>• Norfolk Council</li> <li>• LCR activate program</li> <li>• Reading Council</li> </ul>
Social Care and Housing Sector	<ul style="list-style-type: none"> <li>• Bloom Care</li> <li>• BNENC</li> <li>• Bradbury Fields</li> <li>• Breckside Park Care Home</li> <li>• Christopher Grange</li> <li>• Community Integrated Care</li> <li>• Home Carers Liverpool</li> <li>• Chinese Wellbeing</li> <li>• Accomplish Group</li> </ul>	<ul style="list-style-type: none"> <li>• L8 Housing Association</li> <li>• Olive Mount</li> <li>• Prima Homes</li> <li>• Rowan Garth Care Home</li> <li>• Sterling Care</li> <li>• Steve Biko Housing Association</li> <li>• Frances Taylor Foundation</li> </ul>

Private Sector	<ul style="list-style-type: none"> <li>• RIBA</li> <li>• 5GRIT (5G Testbed)</li> <li>• DAMIBU</li> <li>• Cerno Sure Ltd</li> <li>• Finch Electronics Ltd</li> <li>• Zaiku</li> <li>• Intechnology Wifi</li> <li>• Immersive Interactive</li> <li>• HeartWatch</li> <li>• RobotsofLondon</li> <li>• Guided Meditation VR</li> <li>• Immersive Rehab</li> <li>• Studio Mundo</li> <li>• Docobo</li> </ul>	<ul style="list-style-type: none"> <li>• Legal and General PLC</li> <li>• Norgine</li> <li>• GEOSPOCK</li> <li>• SIGMA</li> <li>• My Sense</li> <li>• Mimerse – Calm Place</li> <li>• Cascade 3D</li> <li>• Virtue – Look Back</li> <li>• Immersive Rehab</li> <li>• Redzinc</li> <li>• MiRo - Consequential Robotics</li> <li>• Bleep Me</li> <li>• Insight/Samsung</li> <li>• ComCast</li> </ul>
Community Sector	<ul style="list-style-type: none"> <li>• Alt Valley Community</li> <li>• Asda Community Champions</li> <li>• Barnardos</li> <li>• Belong</li> <li>• Carers Link</li> <li>• Comfort Call</li> <li>• Deafblind</li> <li>• Everton in the Community</li> <li>• Hope Centre</li> </ul>	<ul style="list-style-type: none"> <li>• Innovate to Succeed program</li> <li>• Live Wire</li> <li>• Local Solutions</li> <li>• My Clubmoor</li> <li>• The Brain Charity</li> <li>• The Stroke Association</li> <li>• Torus Housing Association</li> <li>• Kensington Community Centre</li> <li>• Irish Community Care Centre</li> </ul>
Other	<ul style="list-style-type: none"> <li>• House of Memories (National Museums Liverpool)</li> <li>• South Korean delegation</li> <li>• Singapore 5G initiative</li> </ul>	<ul style="list-style-type: none"> <li>• Harbin Institute of Technology, China.</li> <li>• Zhejiang Sci-Tech University</li> </ul>

## 2.4. Knowledge Creation and Dissemination

- Liverpool 5G Health and Social Care testbed mentioned in over 160 press and media articles.
  - 46% of these were in technology focussed publications
  - 32% were in general publications
- Conferences and events attended by Liverpool 5G representatives:
  - Liverpool 5G took part in over 60 events and dissemination activities
  - At 45% of these, a representative of the consortium was a speaker or gave a presentation
  - Over 60% of these activities reached a national audience, and 20% an international audience



- Dissemination and information events organised by Liverpool 5G and partners:
  - June 18 – Adoption Readiness Event
  - October 2018 - Kensington Education and Training Community Centre community event
  - October 2018 - Care providers day at Cunard building in Liverpool to showcase all products and engage with care providers
  - February 2019 - Livernerds 5G hub launch at The Royal Liverpool and Broadgreen University Hospital.
  - March 2019 - End of project 'Showcase Event' on at Sensor City.
- Visits Hosted:
  - Oct-18: South Korea's 5G forum
  - Oct-18: Worcester 5G consortium
  - Oct-18: Ian Smith, Director of Testbed and Trials at DCMS
  - Feb-19: Ministerial visit by Margot James, Minister for Creative and Digital Industries
  - Aug-19: West Midlands 5G
  - Aug-19: Local Government Association
  - Aug-19: NHSX
- Liverpool 5G Award Nominations:
  - Leaders in Care Awards 2019: Shortlisted in Innovation in Care (residential and domiciliary) category
  - Laing Buisson Awards 2019: Finalist in Innovation in Technology category
  - Innovation Network Awards: shortlisted in the Partner Excellence category

See [Section 4](#) for further details

## 2.5. Other Benefits

- 60 staff across all organisations were allocated to working on the project at start, rising to 72, with 18 of these newly employed specifically for project

## 3. Trial Use Cases

### 3.1. Approach to Data Gathering

#### 3.1.1. Metric Identification

Working with DCMS, benefit metrics were identified and agreed for each use case, aiming to give an indication of impact. After the end of the first year these were reviewed, in the light of the practicalities of collecting and reporting, and some changes were made to facilitate manageable collection of data that reflected the aims of the use case.

The majority of data to be collected was quantitative, although some qualitative data was collected.

#### 3.1.2. Methods

Surveys were drawn up to collect data that would illustrate the metrics in the simplest way possible, with the minimum of questions. These would be used for collection of baseline and end-line data from users, in order to identify any changes that had taken place.

This approach was adopted as:

- Simple, minimal questions would be suitable for the vulnerable service users
- Short and simple questions meant that the surveys could be quickly understood and administered by external staff, given the short timescales.
- It would ensure that the same questions, which match the metrics, are used for both baseline and end-line data collection.
- Forms could be easily returned, via email, or mobile phone
- It was practical and manageable when dealing with small sample sizes

Due to the vulnerable nature of the majority service users in the trial, those working with them required a DBS certificate to comply with safeguarding practices. It was decided that surveys would be administered by existing care and support staff who were already checked, as obtaining clearance for use case companies' staff would not have been practicable in the timescales of the trial. In addition, the care staff had existing trusted relationships with the service users and knew what level of support they would need to complete the questionnaires.

Where possible, questions from existing surveys were used, for standardisation and possible comparison purposes. These included questions from DCMS Community Life Survey 2017-18<sup>1</sup> on quality of life and loneliness, and UCLA Three-Item Loneliness Scale<sup>2</sup> (recommended by ONS) on loneliness.

#### 3.1.3. Data Gathering

Data was gathered directly from service users and from those working with them in a care, support or managerial capacity, whichever was suitable for the service user.

Data collection started as soon as possible for each use case and was dependent on the timing of the implementation of the use cases with service users, which has been in turn, dependent of the availability of the 5G or LoRaWAN network. Unfortunately this led to delays in data gathering, which started for some cases in January, but was not available for others until the last two months of the project.

#### **3.1.4. Constraints**

All of the use cases being piloted had planned to engage with low numbers of users, and in some cases, difficulties in recruiting users led to numbers being lower than expected. This meant that sample sizes would be correspondently low, particularly given that not all service users would complete a survey, and not all users would necessarily be retained for the full duration of the trial.

Sample size was also affected by short timescales for implementation of some use cases, therefore fewer users could be recruited to the trial. A 2-3 year programme would have enabled larger sample sizes once the network was fully operational.

Data management and privacy constraints have meant that information aggregated from personal and medical data was not available from public bodies within the timescale of the trial. A longer trail period would have facilitated greater involvement of the relevant NHS data departments in the early stages, which could have led to improved data on the outcomes for service user cohorts.

#### **3.1.5. Caveats**

Data in this report should only be treated as an indication of the possible impacts of the use cases and of the potential, rather than actual, changes, and time and money savings.

- The figures are based on low numbers of users, and of user surveys
- Short timescales have meant that the data baseline and end-line data has often been gathered relatively close together, and therefore doesn't show change over a sustained period of time.
- No strong indication of causation should be drawn from the data and we cannot definitively assign changes to the technology being used, as there were no control or comparison groups, so it is not possible to say that definitively intervention was the cause.
- Some data collected, for example about the number of GP visits, was often based on the recollections of service users
- Extrapolation of the data to cover 100 users for one year gives a comparison between use cases, but should be viewed with caution - it is a potential, possible effect of these use cases, an illustration of potential impact.

Given the constraints and caveats, a conservative view has been taken when allocating impact, particularly cost and time benefits.

A longer study with larger numbers could make use of, for instance, the impact made on safeguarding incidents within the council for a specific ward (e.g. Kensington) or data from a cohort of users' NHS records (appropriately aggregated and anonymised).

## 3.2. CGA Simulation: Loneliness Quizzing and Gaming App



### 3.2.1. Description

CGA Simulation is Liverpool based games development and virtual simulation experts. They combine knowledge of developing computer games, with expertise in emerging technologies like machine learning, virtual/mixed reality, digital simulations and robotics.

CGA created the **Loneliness Quizzing and Gaming App**, a social gaming app that brings people together to take part in online quizzing, games and chat, to combat loneliness. It features video communication to allow users to meet and participate irrespective of location, allowing users to take part in a group situation, or from their own room.

The interactive games were co-created and tested with users, who gave feedback to shape app, with the user interface being made more accessible and participants to coming up with questions at an appropriate level of challenge. The system was also developed to support a variety of network configurations and performance.

There have been 40 users of the app, in differing situations:

- Kensington Community Centre: Two groups of users with varied learning difficulties, and other conditions.
- L'Arche supported living: A variety of users from amongst the residents who have different learning disabilities, some with mobility issues, and are a wide range of ages, from 30 to 80.
- Breckside Park Residential home: users in the 60+ age group, some with age related illnesses such as dementia.

The app is a perfect test case for 5G technology, as it needs the high bandwidth offered by 5G to drive the device-to-device video capability. To run effectively, the application requires around 80megabit bandwidth and low latency.

### 3.2.2. Timescale and Numbers

The trial started in March 2019, and completed in November 2019.

Users each came to a weekly session over several weeks, to play the game in a group situation. There were several groups of users across different locations.

Target number of end users:	Actual Number of end users	Number of baseline user surveys	Number of follow-up user surveys
50	49	49 (100%)	20 (41%)

### 3.2.3. Outcomes and Impact Summary

Outcomes	Potential Impact
Reduction in loneliness in service users: <ul style="list-style-type: none"> <li>• 28% decrease in those who said that they often felt that they lack companionship</li> <li>• 20% decrease in those who said that they often felt left out</li> <li>• 13% increase in those who said that they hardly ever felt isolated from others</li> <li>• 26% decrease in those who said that they often or sometimes felt lonely</li> </ul>	<ul style="list-style-type: none"> <li>• Better health outcomes for the individual</li> <li>• Reduced reliance on services</li> <li>• Reduced medication wastage</li> <li>• Reduced costs to Health and Social Care services</li> </ul>
Improved quality of life in service users <ul style="list-style-type: none"> <li>• Service users had a decrease of an average of 1.4 points on the life satisfaction scale</li> <li>• Support workers and users report quality of life has been improved and loneliness decreased</li> </ul>	<ul style="list-style-type: none"> <li>• Better health outcome for service users</li> <li>• Reduced reliance on services</li> <li>• Reduced costs to Health and Social Care services</li> </ul>
Reduced Digital Exclusion: <ul style="list-style-type: none"> <li>• Tablets have been loaned to service users and service users helped to use them. Several users now show more confidence with technology.</li> </ul>	<ul style="list-style-type: none"> <li>• Better health outcomes for service users</li> <li>• Reduced reliance on services</li> <li>• Reduced costs to Health and Social Care services</li> </ul>

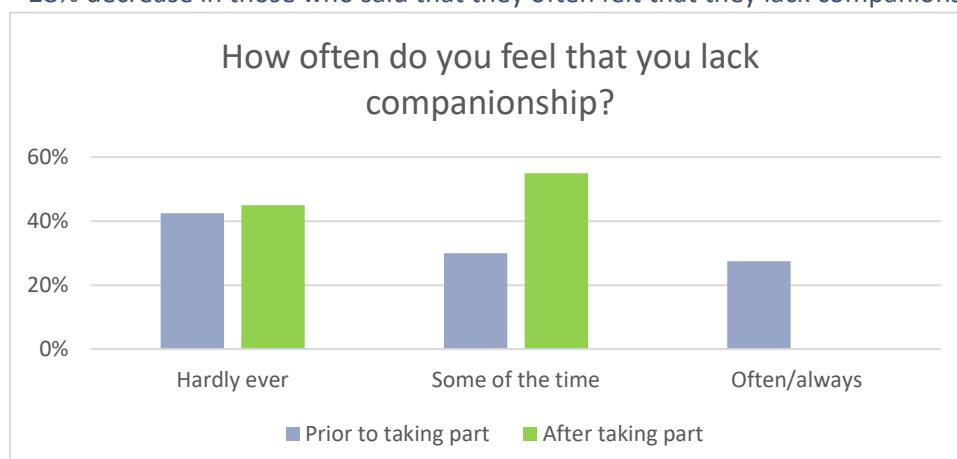
### 3.2.4. Outcomes

#### 3.2.4.1. Loneliness and Quality of Life

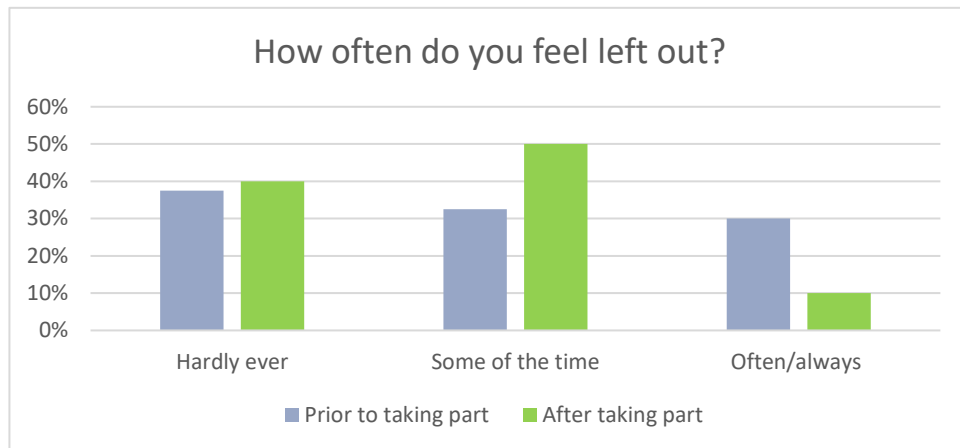
For the survey, loneliness questions were taken from the DCMS Community Life Survey 2017-18<sup>1</sup> and the UCLA three-item loneliness scale<sup>2</sup> (following the ONS guidance)

Using the UCL Loneliness scale, there was:

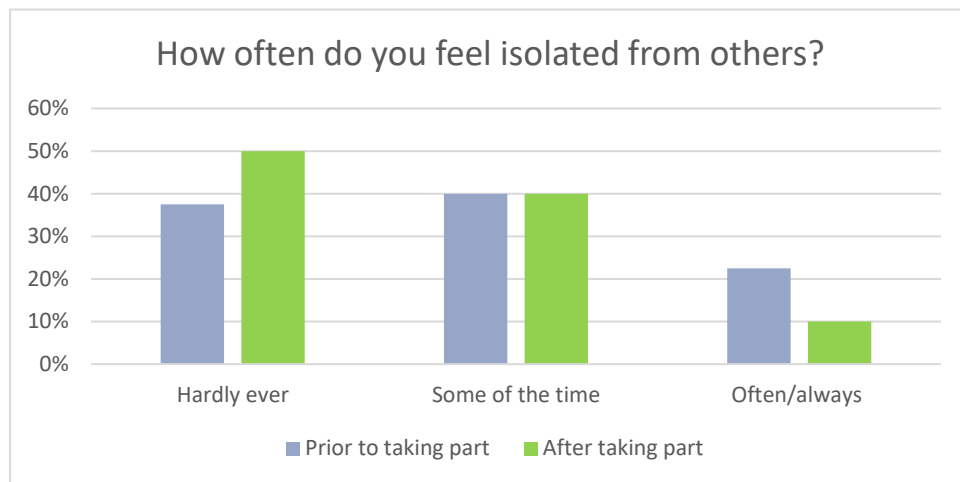
- 28% decrease in those who said that they often felt that they lack companionship



- 20% decrease in those who said that they often felt left out

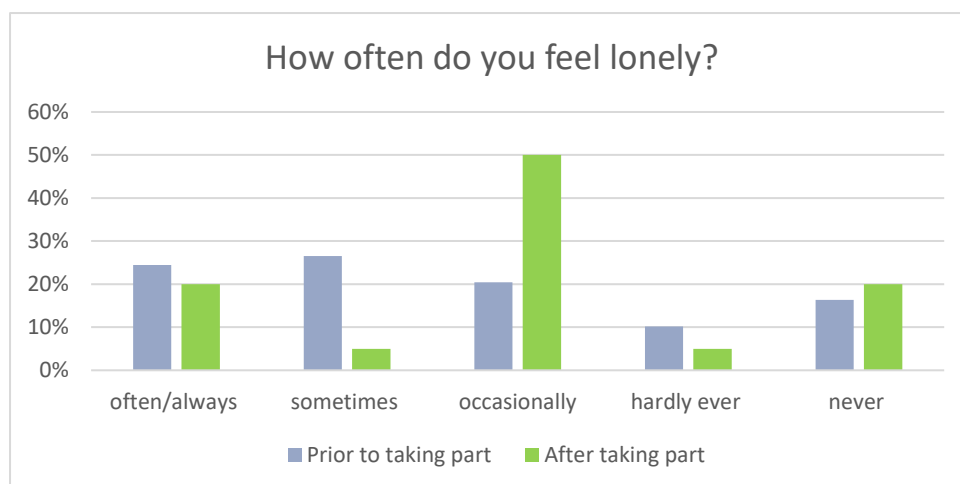


- 13% increase in those who said that they hardly ever felt isolated from others



The DCMS Loneliness Strategy 2018<sup>3</sup> notes that “Feeling lonely frequently is linked to early deaths. Its health impact is thought to be on a par with other public health priorities like obesity or smoking”

- Using the Community Life Survey question, there was a decrease of 26% in those who reported that they often or sometimes felt lonely:



- Service users had an increase of an average of 1.4 points on the life satisfaction scale<sup>4</sup>. Improved life satisfaction improves wellbeing, and health, reducing reliance on Health and Social Care services. According to *Relationship between Wellbeing and Health*<sup>5</sup>, “There are a number of correlations between wellbeing and physical health outcomes, improved immune system response, higher pain tolerance, increased longevity, cardiovascular health, slower disease progression and reproductive health
- Support workers and users report quality of life has been improved and loneliness decreased:
  - Feedback from users and support staff has been very positive, including:
    - Staff member said he could see a real difference when all the residents are playing the games together and socialising and thinks it is really good for their mental health.
    - Users said they had fun playing the game and thought that it was different from any activities they usually play.
    - One user said that the activity every week has given her a focus and she has enjoyed that she can talk to other residents about it while she plays the game.

#### Case Study: Reducing Isolation, Loneliness and Digital Exclusion

Kensington Community Learning Centre C.I.C. is a non-profit adult learning centre. They promote learning, development and social inclusion.

A group of people with a learning disability met at KCLC each week to take part in activities and games. For some this is the only opportunity they get during the week to meet other people with similar interests, take part in group activities and chat.

The care providers working with the group put a lot of effort into creating a range of activities that are interesting and stimulating for the group. Part of their remit is to enable the group to make use of available technologies and to reduce the ‘digital divide’ in areas like Kensington, where not everybody has access to the internet or their own laptops or tablets.

A lot of users had never used a tablet or computer before and they thought this would be something that was out of their comfort zone. Using the app gave users the confidence to use the tablets, and some users at KCLC now want to buy tablets to use in their day to day life as they know they have the ability to use them.

One user who suffers from tunnel vision was usually unable to join in with this type of game but was able to view the questions to the quiz by holding the tablet up to his face. He had tried all different types of computers and laptops in the past, and now realises that a tablet is the right solution for him as he can easily move it to be within reading distance.

As part of the Liverpool 5G Health and Social Care project, the community centre was supplied with tablets that the group used to take part in the quiz activity. The community building was fitted with 5G, enabling users of the Loneliness Quiz and Gaming App to enjoy the game more effectively, without loss of connectivity.

Alan Tapp, Managing Director of KCLC, said: “Here at KCLC, we are dedicated to promoting digital inclusion and are delighted to be working on a project like Liverpool 5G Health and Social Care that encourages people in the Kensington area to take advantage of emerging technology. Our groups are getting the chance to use innovative technologies they may not otherwise get the chance to use.”

- Digital exclusion has been reduced, by providing tablets for some users during the sessions, and helping users to become familiar with them. Several users now show more confidence and want their own devices.

“Why digital inclusion matters to health and social care”<sup>6</sup>, says that the benefits to patients and carers include:

- improved self-care for minor ailments
- improved self-management of long-term conditions
- improved take-up of digital health tools and services
- reduced loneliness and isolation

And benefits for the health and care system, including:

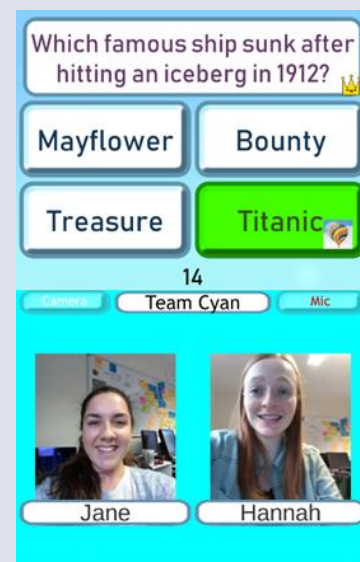
- lower cost of delivering services digitally
- more appropriate use of services, including primary care and urgent care
- better patient adherence to medicines and treatments

### Case Study: Co-creation to Reduce Digital Exclusion

Kensington Community Learning Centre C.I.C. is a non-profit adult learning centre. A group of people with a learning disability from KCLC worked with CGA Simulation to adapt and develop the Loneliness Quiz and Gaming App.

The group of testers met at KCLC each week to take part in activities and games, testing and feeding back on the app. Jane Davies, CGA Simulation’s Producer, said: “Working with people with a learning disability from KCLC to develop the app has been a brilliant process. We have been able to adapt the colours, font size and other features used in the game to better aid people with different conditions to use the app. In a co-creation session, we wrote new quiz questions and discussed topics of interest with the group. This has enabled us to tailor the quiz appropriately taking age and ability into consideration.”

A lot of users had never used a tablet or computer before and they thought this would be something that was out of their comfort zone. By changing the colours and font on the application it made the technology more accessible and gave users the confidence to use the tablets.





Jon Wetherall, CGA Simulation's Managing Director, added: "We weren't sure at first what the focus of this app would be, whether individual people would be using the app in their own homes. However, we've found that using the app in a setting where a group can split into teams and play the game as friends is ideal. The app has also turned out to be a perfect test case for 5G technology, as we need the high bandwidth offered by 5G to drive the device-to-device video capability."

With the users' assistance, CGA Simulation has been able to create a gaming app that is accessible, usable and enjoyable for people with learning disabilities to use.

### 3.2.5. User Survey and Feedback Outcomes

#### 3.2.5.1. User Surveys

49 baseline surveys were received, gathered March-November 2019. 20 follow-up surveys were received, gathered November 2019.

	Prior to taking part	After taking part*	Difference
<b>No. of respondents</b>	49	20	
average life satisfaction:	6.5	7.8	1.4
How often do you feel lonely?			
often/always	24%	20%	-4%
sometimes	27%	5%	-22%
occasionally	20%	50%	30%
hardly ever	10%	5%	-5%
never	16%	20%	4%
How often do you feel that you lack companionship?			
Hardly ever	43%	45%	3%
Some of the time	30%	55%	25%
Often/always	28%	0%	-28%
How often do you feel left out?			
Hardly ever	38%	40%	3%
Some of the time	33%	50%	18%
Often/always	30%	10%	-20%
How often do you feel isolated from others?			
Hardly ever	38%	50%	13%
Some of the time	40%	40%	0%
Often/always	23%	10%	-13%

\* number of sessions varies

### 3.2.5.2. Feedback from Support Staff

- L'Arche Supported Living:  
One staff member said it was the only time that he has seen the residents meet up in the kitchen and chat together, when usually residents would stay in their rooms. He also said he could see a real difference when all the residents are playing the games together and socialising and thinks it is really good for their mental health.
- Breckside Park Care Home:  
One carer said that more people participated in the activity than usual and the ability to have teams meant that it got the residents chatting about other things.

The manager of Breckside Park said that there are two residents in rooms who want to play with the group using the video chat. This will be the first time that these residents are able to join in with group activities in the care home.

### 3.2.5.3. Feedback from Users

- L'Arche Supported Living:  
One resident had suffered a bereavement and said that the activity every week has given her a focus and she has enjoyed that she can talk to other residents about it while she plays the game.
- Breckside Park Care Home:  
All residents said they had fun playing the game and thought that it was different from any activities they usually play. A lot of residents were reluctant to play at first because they said they couldn't usually do quizzes and can't write out answers but because it was touch screen it made it accessible to everyone in the group

### 3.3. Defproc Engineering – Push to Talk



#### 3.3.1. Description

DefProc Engineering is a Liverpool based SME that works with individuals and businesses to support them with their products, services and developing ideas, through to manufacturing fully functioning prototypes.

The Push to Talk device allows users to press a button, indicating that they want a chat, and be connected via their phone to another user who has also pushed their button. Users are grouped into 'communities' of people in similar situations. The groups include people with learning difficulty, carers and isolated individuals.

The low powered Push to Talk device doesn't require the user to have WiFi or broadband internet connection in their home. The unit works using community 5G wireless and the LoRaWAN gateway technology and works with both landline and mobile handsets.

DefProc Engineering have provided a public access LoRaWAN Network using the Things Network with 5G backhaul. 5G offers the opportunity of the ease of networking to type of position of LoRaWAN gateways — providing a high bandwidth, stable connection in outdoor locations that can be placed without the cost associated with having to dig or wire the entire route — with the low latency that benefits the end devices using LoRaWAN.

Note: It was expected that Push to Talk would be used in the new NHS Royal Liverpool Hospital. Hospital completion is delayed so no users were available for the trial. Those with care responsibilities at home, within the pilot area, were identified as alternative users.

#### 3.3.2. Timescale and Numbers

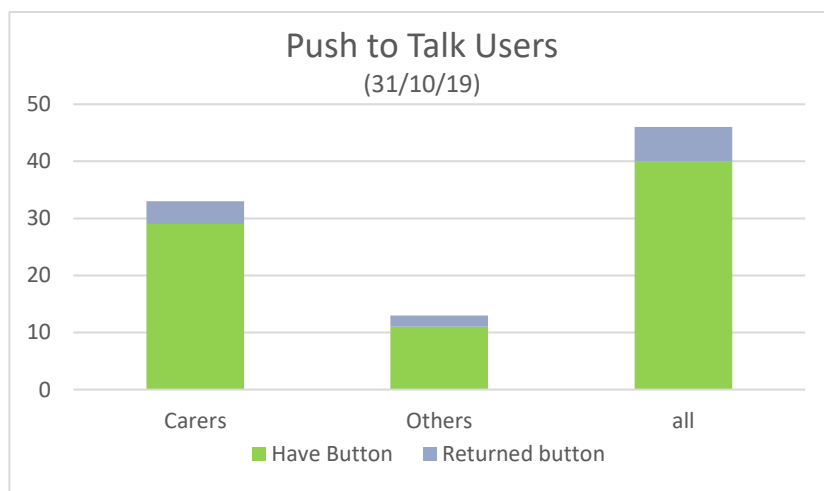
The trial started in January 2019 , and completed in November 2019.

Target Number of end users:	Number of users in trial	Actual trial end users at 30/11/19	Number of baseline user surveys	Number of follow-up user surveys
280	41	40	41 (100%)	17 (41%)

### 3.3.3. Outcomes and Impact Summary

Outcomes	Potential Impact
<ul style="list-style-type: none"> <li>Reduction in loneliness in users:               <ul style="list-style-type: none"> <li>25% increase in those who said that they hardly ever felt that they lack companionship</li> <li>75% increase in those that said they hardly ever felt left out</li> <li>50% increase in those who said they hardly ever felt isolated from others</li> </ul> </li> <li>Reduction of over 30% in the number of people who visited their GP</li> <li>Average number of GP visits dropped by 16%, giving a potential cost saving of £947 per year for 40 users, or £2,368 per 100 users per year (£868 allowing for cost of service)</li> </ul>	<ul style="list-style-type: none"> <li>Better health outcomes for the individual</li> <li>Reduced reliance on services</li> <li>Reduced costs to Health and Social Care services</li> </ul>
	<ul style="list-style-type: none"> <li>Reduced reliance on services</li> <li>Reduced costs to Health and Social Care services</li> </ul>

### 3.3.4. Outcomes



- 46 people have been issued with a Push to Talk button since January 2019, six have returned them, with 40 buttons still in place

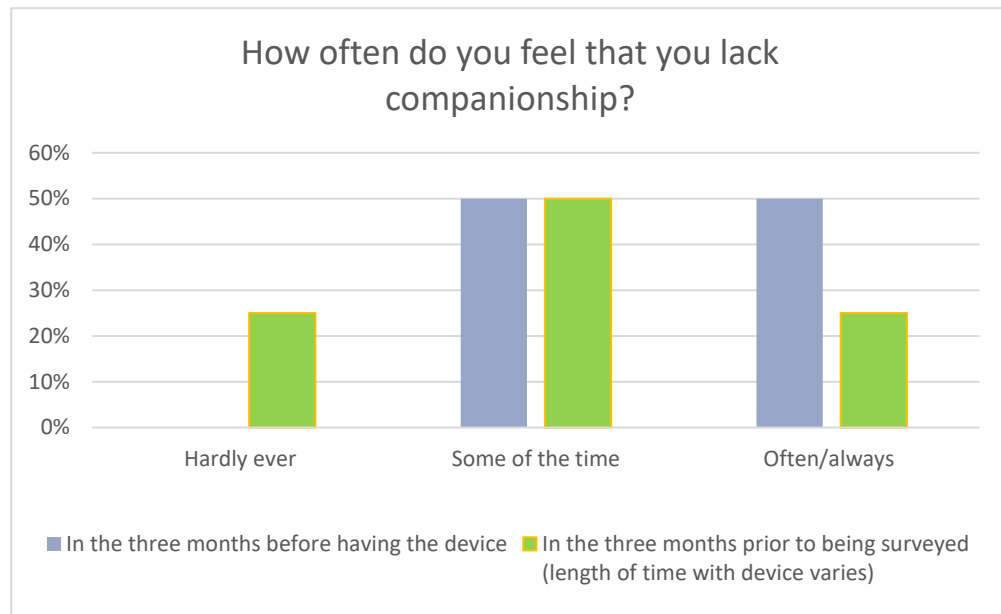
### 3.3.4.1. Loneliness and Quality of Life

The number of survey responses was disappointing with only 41% of those who completed baseline surveys completing follow-up surveys.

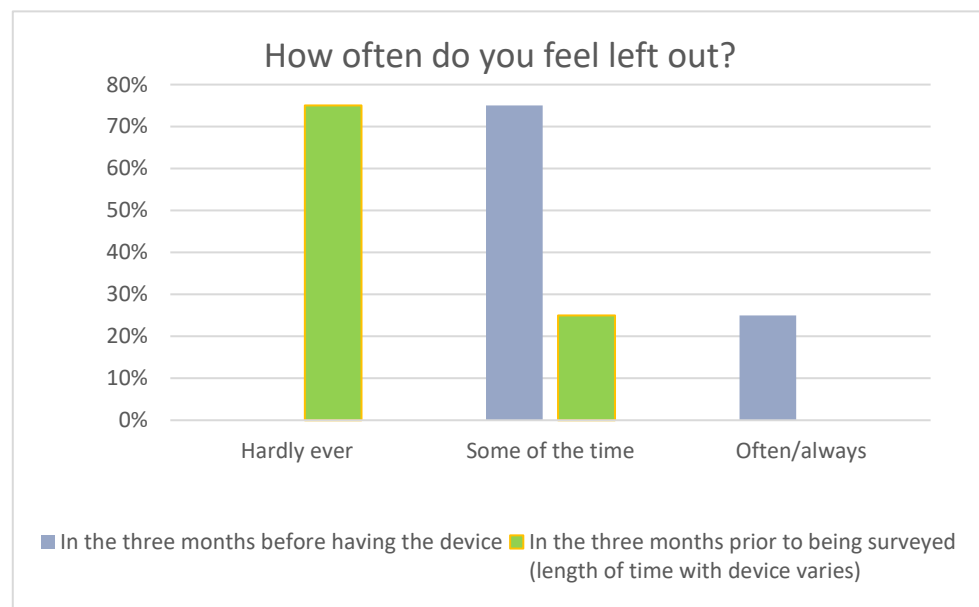
For the survey, loneliness questions were taken from the DCMS Community Life Survey 2017-18<sup>1</sup> and the UCLA three-item loneliness scale<sup>2</sup> (following the ONS guidance)

Using the UCL Loneliness scale, there was:

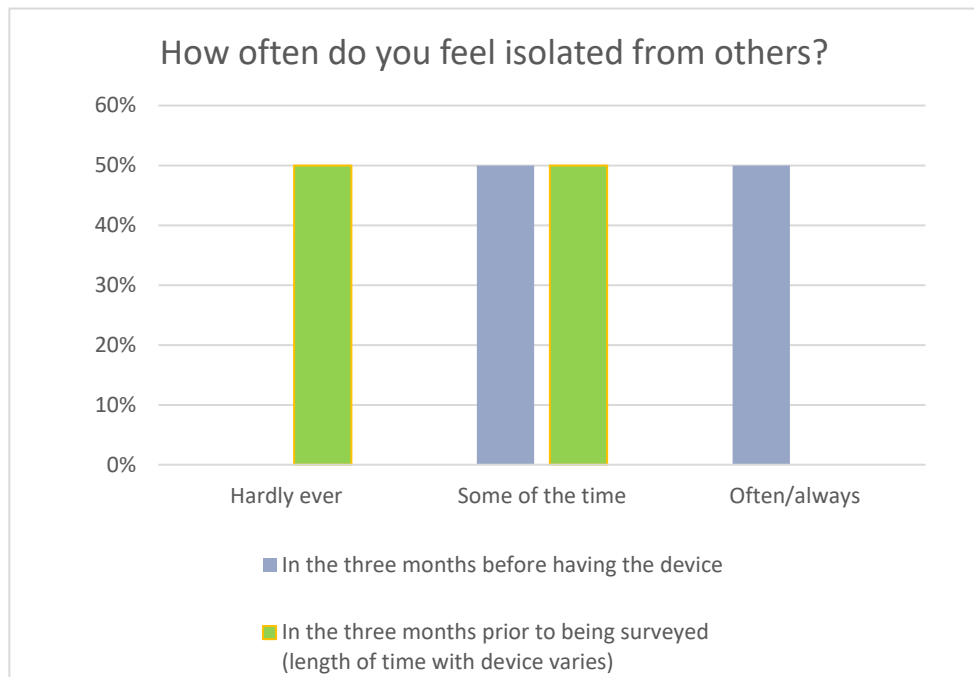
- 25% increase in those who said that they hardly ever felt that they lack companionship



- 75% increase in those that said they hardly ever felt left out, and a 25% decrease in those who often or always felt left out

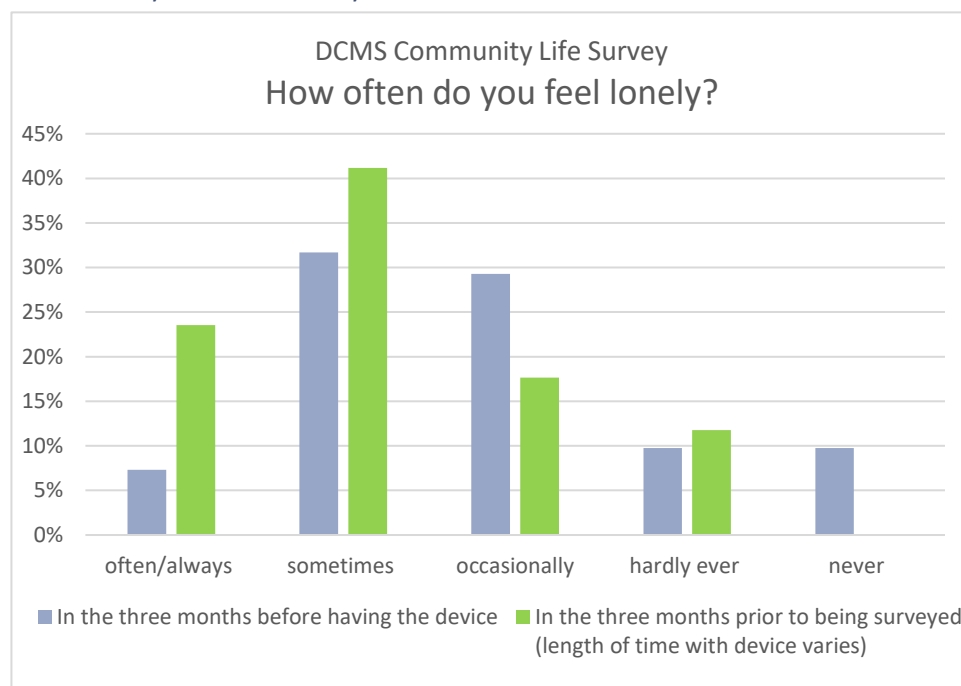


- 50% increase in those who said they hardly ever felt isolated from others, with a 50% decrease in those who said they often or always felt isolated from others



The DCMS Loneliness Strategy 2018<sup>3</sup> notes that “Feeling lonely frequently is linked to early deaths. Its health impact is thought to be on a par with other public health priorities like obesity or smoking”

- Using the Community Life Survey question, there was an increase of 26% in those who reported that they often or sometimes felt lonely, and a decrease on those who said that they never felt lonely:



- Service users had a decrease of an average of 0.5 points on the life satisfaction scale<sup>4</sup>. Improved life satisfaction improves wellbeing, and health, reducing reliance on Health and Social Care services. According to *Relationship between Wellbeing and Health*<sup>5</sup>, “There are a number of correlations between wellbeing and physical health outcomes, improved immune system response, higher pain tolerance, increased longevity, cardiovascular health, slower disease progression and reproductive health

#### 3.3.4.2. Using Services

- There was a reduction of over 30% in the number of people who visited their GP (or who were visited by their GP)
- The average number of GP visits for all users dropped by 16%
- 40 users with a drop in average GP visits per user of 0.16 in a 3 month period, multiplied by the average GP visit cost of £37<sup>7</sup> means that there was a potential cost saving of £947 per year. Extrapolated to 100 service users this would be £2368 per year, (£868 after cost of service)

#### Case Study: Reducing Loneliness and Isolation

Mary Brandt is from Kensington and was introduced to the “Push to Talk” device by her Liverpool Carers Centre, Local Solutions team. She says it’s brought her great comfort: “When Chris from Local Solutions came with the Push to Talk box my family said, ‘what do you need that for?’ I told them it was for carers in the same situation as me, people caring and living on their own who don’t always have somebody to talk to.

“I love using it. I contact other carers and we talk and have a laugh, it does everybody good. We don’t always talk to each other about our problems, we just chat.”

She added: “ My son who I cared for for many years doesn’t live with me anymore, although I see him a lot of him. When I cared for him I hid it from people at work as I knew their thoughts about people with mental illnesses and didn’t want my son talked about that way. It made me feel quite lonely. When I met with people from Local Solutions who introduced me to Push to Talk I felt like they were giving a voice to the carers.”

Over half of all unpaid carers, who are caring for family members or friends, say they don’t like talking about caring to their friends and never get the time to socialise. Push to Talk is a valuable tool for those who feel isolated.



Mary Brandt, who uses Push to Talk, with Chris King from Local Solutions

### 3.3.5. User Survey and Feedback Outcomes

41 baseline surveys were received, gathered April-November 2019. 17 follow-up surveys were received, gathered April -November 2019.

	In the three months before having the device	In the three months prior to being surveyed*	Difference
Service users returning surveys	41	17	
Service users who visited a GP (or who a GP visited)	66%	29%	-36%
Average number of GP visits (for all service users)	0.98	0.82	-0.2
<b>How often do you feel lonely?</b>			
often/always	7%	24%	16%
sometimes	32%	41%	9%
occasionally	29%	18%	-12%
hardly ever	10%	12%	2%
never	10%	0%	-10%
<b>How often do you feel that you lack companionship?</b>			
Hardly ever	0%	25%	25%
Some of the time	50%	50%	0%
Often/always	50%	25%	-25%
<b>How often do you feel left out?</b>			
Hardly ever	0%	75%	75%
Some of the time	75%	25%	-50%
Often/always	25%	0%	-25%
<b>How often do you feel isolated from others?</b>			
Hardly ever	0%	50%	50%
Some of the time	50%	50%	0%
Often/always	50%	0%	-50%
<b>On a scale of 1 to 10, how satisfied are you with your life nowadays?</b>			
Average life satisfaction:	6.4	5.8	-0.6

\* length of time with device varies

#### 3.3.5.1. Early Feedback March 2019

3 respondents were asked for early feedback

- 100% had used the service
- Asked what they liked about the service so far, users said:
  - *I like the night-time availability because the carers aren't available in the evenings and that's when I get the most lonely, it gives you an opportunity to have a talk or maybe a rant with others.*
  - *I enjoy being able to connect with people, it stops me feeling isolated.*
  - *I like that you can use it at any time, especially at night-time.*
- Asked how they found having calls with people they hadn't met before, users said:
  - *I've always found it easy to talk to people so it hasn't been a problem for me. It's been nice to get to know other people.*
  - *I don't think that there are enough people on the system, I've tried a few times and not been able to speak to anyone. One person I spoke to before heard me speak and hung up - he probably thought 'not her again'!*



- *It was a bit daunting the first few times but the people I've spoken to have been very pleasant.*
- Asked if they had noticed any improvements in their wellbeing at this stage, users said:
  - *Yes, I have. I now look forward to getting a call at 7pm, I know I can call at any time but having a chance of talking to someone new is something I look forward to every night.*
  - *Not yet, I haven't used it very many times but I had one call that really lifted my mood. I've been a bit busy lately so I haven't had much of a chance to use it, but once I have a bit more time next week I'll use it more, and I'm sure I'll feel the benefit.*
  - *Not at the moment, I've only had the button set up for a few days.*
- Asked for other comments about their experience so far, users said:
  - *All around it's a really good idea and I've found it very useful.*
  - *I don't have much more to say, but I think the system is great and it's a cracking idea.*
  - *I wondered if there's a chance of having the voice call through the button instead of the phone? It's just that I've missed a few calls because I haven't been near my phone and I keep forgetting what it is I'm supposed to do once I've pushed the button.*
- 100% said they would like the service to continue

### 3.3.5.2. Carer Evaluations June 2019

A random sample 10 carers who had had the Push-to-Talk device for several months were surveyed.

- 30% were still using the service
- Of those who were using the service:
  - 100% were still finding it useful
  - 100% said they still enjoyed using it
  - One person was using it a few times per week, others 'not very often'.
  - Asked what they would like to be different, they said:
    - *More people. May work better in winter*
    - *Timing half an hour earlier, but besides that it's very valuable*
    - *More people on service*
- Of those no longer using the service:
  - Asked why they had stopped using it, they said:
    - *Is deaf and can't understand people - needs people to communicate slower (would otherwise really enjoy it)*
    - *Not suitable for him in trial version*
    - *Personal reasons*
    - *No longer needs it*
    - *Does not have the time, and has already got lots of support*
  - 43% said they'd be willing to try again
  - Of those who had unplugged their device (60%), 33% would consider plugging it back in again.

### 3.4. The Medication Support Company – Paman

#### 3.4.1. Description



The Medication Support Company (previously Protel Health) provide the Paman remote monitoring medication administration service giving on call access to pharmacy assistant for vulnerable people in their own home. Service users are first assessed at home in a comprehensive medication review with a clinical pharmacist, and then provided with a Medihub device, which connects to the Paman team of pharmacy assistants. Users are monitored taking their medication at pre-arranged times via a 4k video link, ensuring the medicines are taken correctly. The Paman team also answer user questions and concerns, liaise with pharmacies and GPs, and can arrange for repeat prescriptions to be ordered. The 5G connection provides faster internet speeds for video and reduced lag times.

#### 3.4.2. Timescale and Numbers

The trial started in January 2019, and completed in October 2019. The core group of 30 users were recruited by April 2019.

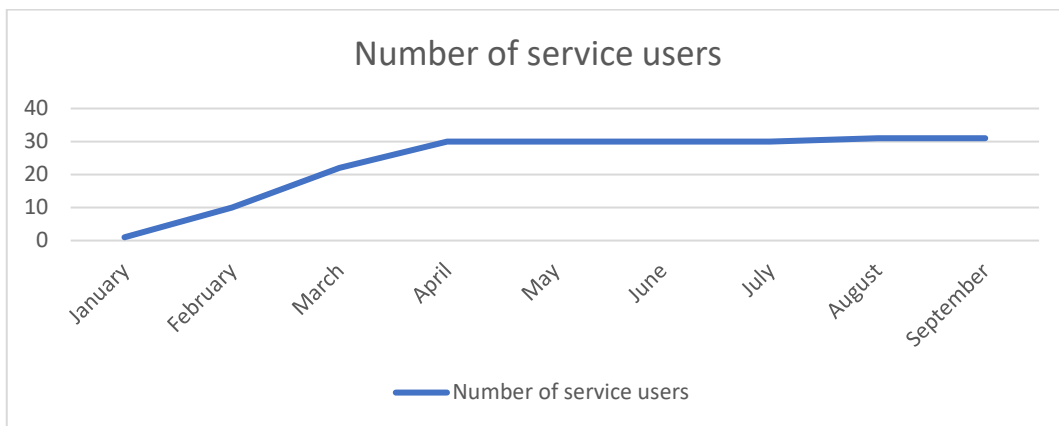
Target Number of end users:	Number of users in trial	Actual trial end users at 30/9/19	Number of baseline user surveys	Number of follow-up user surveys
30	35	31	35 (100%)	30 (97%)

#### 3.4.3. Outcomes and Impact Summary

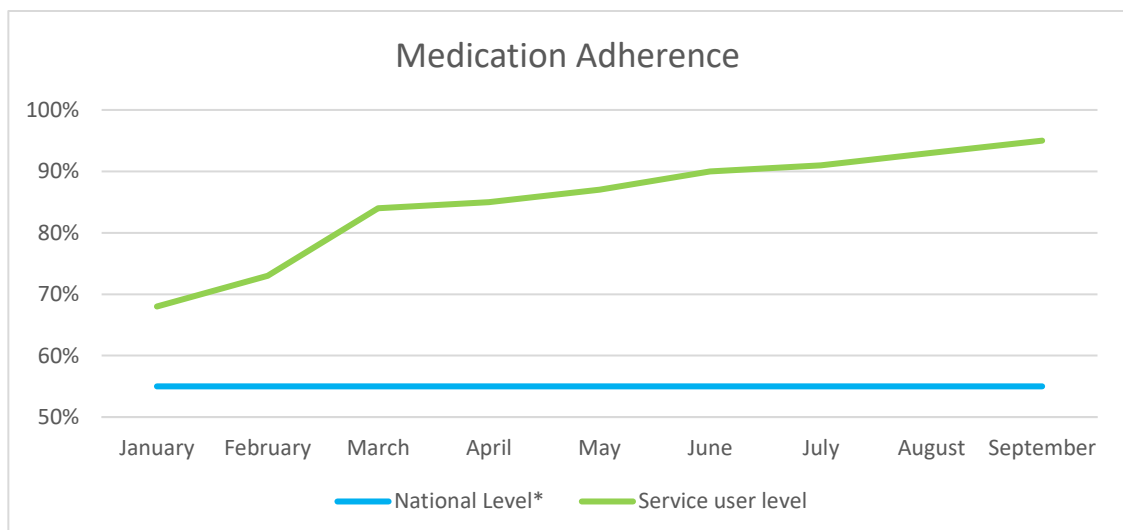
Outcomes	Potential Impact
<ul style="list-style-type: none"> <li>Overall cost saving - Including the cost of the Paman system, there are potential cost savings of £208,800 per 100 users per year. See full data in section <a href="#">3.4.4.9</a></li> </ul>	<ul style="list-style-type: none"> <li>Reduced costs to Health and Social Care services</li> </ul>
<ul style="list-style-type: none"> <li>Medication adherence levels at end of trial were 40% higher than national average of 55%, meaning that service users were taking their medication in accordance with the prescribed instructions.</li> </ul>	<p>Good adherence means the service user receives the full benefit of the medicines prescribed, as is also less likely to be admitted to hospital. This means:</p> <ul style="list-style-type: none"> <li>○ Better health outcomes for the individual</li> <li>○ Reduced reliance on services</li> <li>○ Reduced medication wastage</li> <li>○ Reduced costs to H&amp;SC services</li> </ul>

Outcomes	Potential Impact
<ul style="list-style-type: none"> <li>There was a 51% drop in the number of service users who had a medication error (e.g. did not take medication correctly, or did not have right medication), while using Paman</li> </ul>	<ul style="list-style-type: none"> <li>Better health outcome for service users</li> <li>Reduced reliance on services</li> <li>Reduced costs to H&amp;SC services</li> <li>One of the main causes of hospital admissions for the over 70's is complications caused by medication errors or poor medicine adherence.</li> </ul>
<ul style="list-style-type: none"> <li>Medication costs reduced by over 50%, and medication wastage reduced.</li> </ul>	<ul style="list-style-type: none"> <li>Better health outcome for service users, through removal of medicines that could pose a significant clinical risk</li> <li>Reduced costs to H&amp;SC services</li> </ul>
<ul style="list-style-type: none"> <li>Reduction in carer hours needed to provide medication administration support.               <ul style="list-style-type: none"> <li>- Potential reduction of 306 hours (£4,645) per user, per year, or 30600 hours (£464,500) per 100 users per year</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Increased availability of trained carers, in under-staffed services, allowing existing commitments to be delivered and new services to be developed</li> <li>Reduced carer recruitment and training costs</li> <li>Improved forecasting of costs of managing medication administration support</li> </ul>
<ul style="list-style-type: none"> <li>Reduction in District Nurse hours needed to provide medication administration support for diabetic patients.               <ul style="list-style-type: none"> <li>- Potential reduction of 360 hours (£9,000) per year.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Increased availability of District Nurses, in under-staffed services.</li> <li>Increased patient independence, confidence and safety, leading to               <ul style="list-style-type: none"> <li>Better health outcomes for the individual</li> <li>Reduced reliance on services</li> <li>Reduced costs to H&amp;SC services</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>Reduction in hospital admissions for non-medication issues. No admissions for medication errors. Percentage of service users with at least one admission to hospital had dropped by 2%</li> </ul>	<ul style="list-style-type: none"> <li>Good adherence means that the service user receives the full benefit of the medicines prescribed. This means:               <ul style="list-style-type: none"> <li>Better health outcomes for the individual</li> <li>Reduced reliance on services</li> <li>Reduced costs to H&amp;SC services</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>Improved quality of life               <ul style="list-style-type: none"> <li>73% increase in those confident and happy to take medication</li> <li>53% increase in those who felt safe</li> <li>40% increase in service users who felt more independent</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Better quality of life means:               <ul style="list-style-type: none"> <li>Better health outcomes for the individual</li> <li>Reduced reliance on services</li> <li>Reduced costs to H&amp;SC services</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>Improved safety in the home               <ul style="list-style-type: none"> <li>Out of date and unsafe medications were removed from service user homes</li> <li>Required medication was stored in the Medibox.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Rationalisation of medications and safe storage mean:               <ul style="list-style-type: none"> <li>Better health outcomes for the individual</li> <li>Improved health and safety in the home for service users' families and visitors</li> <li>Reduced costs to H&amp;SC services</li> </ul> </li> </ul>

### 3.4.4. Outcomes



#### 3.4.4.1. Medication Adherence



*\* National average medication adherence level is 55%<sup>8</sup>, which means that only 55% of service users are taking their medication in accordance with the prescribed instructions.*

- At the end of the trial, medication adherence levels had risen from 68% to 95%

#### Case Study A: Medication Adherence Improvement

Service user A has several health issues, and, amongst other medication, requires an inhaler and strong pain medication.

At the initial medication review, Protel Health's clinical pharmacist found that A had been without her medication for almost 4 months. On enquiry, the pharmacy had medication waiting to be collected, and they were unable to deliver it. Carers were unaware of these difficulties.

She also found that, when available, A was taking her medication incorrectly. For instance, one medication was being taken with milk which negated its benefit by

rendering it non-absorbable. Unfortunately, the labelling on blister packs did not give enough information about how and when to take them.

After the review, the Paman clinical pharmacist collected A's medication from the pharmacy, gathered up all the empty medicine packages, discontinued and out of date medicines scattered around her home, and put the new medicines in one location in the Medibox.

The clinical pharmacist liaised extensively with the pharmacy and GP surgery and the medication issues were addressed. The Paman team now manage the repeat prescription request process, making sure appropriate medication is ordered and in the correct quantities, and this is now delivered to A at home.

The Paman team continue to monitor, to manage and communicate to the pharmacy and GPs as well as in reports to service commissioners. They continue to resolve any medication issues that arise for A and monitor administration of her medicines closely.

A is now well organised and feels safer with her medicines as well as being confident to ask questions of the Paman pharmacy technicians and pharmacists. A's medicine adherence level at the outset of the Paman implementation was zero. At the end of the trial it was 97%

#### 3.4.4.2. Medication errors

- There was a 51% drop in the number of service users who had a medication error (e.g. did not take medication correctly, or did not have right medication), while using Paman
- There was an 81% drop in average number of errors made by those who did make an error
- The medication review accompanying the service user's implementation was a significant factor in identifying and rectifying errors, and the number of errors falls substantially as the support from Paman starts to have an impact the medication administration process.
- One frequent cause of hospital admissions for the over 70's is complications caused by medication errors or poor medicine adherence<sup>9</sup>.

#### 3.4.4.3. Medication costs

Medication costs were compared between April and September, where there were a comparable number of users.

- Monthly cost of medications for all service users dropped by over 50% (to £2,199<sup>10</sup>)
- The average monthly medication costs per user decreased by over 50% (to £71)
- The average number of prescriptions for each service user dropped by over 10%
- Medication wastage dropped, with the average value of items returned to the pharmacy decreasing by over 80%
- Over £10,000 worth of medications were returned to the pharmacy

- During the medication review by the Paman clinical pharmacist, medicines were found that were not needed and others that had been prescribed even though replaced by other medicines. Medicines were returned to the pharmacy for the following reasons:
  - Discontinued medicines being prescribed on repeat prescriptions in error
  - Medicines being prescribed on repeat prescriptions even though there were enough stocks already
  - Medicines not taken and being allowed to go out of date
  - Medicines prescribed by different GPs without reference to the service user's medication regime
  - Accumulation of medicines hoarded in service user's home
- Many of these medicines constituted a significant clinical risk to the service users had they been taken.
- The savings in medicine costs and reduction in prescription numbers was primarily through the impact of the Paman medication review.
- With a specific focus on medicine cost reduction and the reduction of prescription numbers through medicine rationalisation, savings could be significantly higher.

### **Case Study B: Reducing Medication Wastage**

The Protel Health clinical pharmacist's initial medication review highlighted many issues with B's medication. Medicines were distributed throughout B's home, many of them incorrectly stored at too high a temperature, rendering them less effective. Some medication was out of date, there were broken bottles of liquid medicine, medicines no longer prescribed for B were still available, and there were unused prescribed medications, for example, B was prescribed a 7-day course of antibiotics but only three days been taken.

Following the review, unusable medicines were taken to the pharmacy for disposal. The value of the wasted medicines was £1,245.78

Communication between the pharmacy, GP surgery and the Paman team improved the service user's medicines management substantially, and the correct medication regime was established. Medicines are now stored in one designated place in the home, away from any heat source, and those that require special storage conditions are highlighted. Several medicines have been discontinued as a result of the Paman medication review

The Paman team also manages the repeat prescription process, ensuring that the repeat prescription request is sent to the GP surgery in time for the prescription to be produced and sent to the pharmacy for dispensing and delivery to B's home in good time.

B is more independent and feels more confident and safer taking her medicines, and her medicine adherence level has increased from 43% to 94%. Medicine costs have been reduced, and wastage has been reduced.

#### 3.4.4.4. Indicative carer time and cost savings

- During the trial period (January to November 2019), carer visits continued to take place for the service users in the trial, however, many of these visits could be discontinued under larger-scale implementation in the future.
- Notional carer visits that could be discontinued if Paman use replaced carer visits for medication administration are calculated from the number of times per day a service user had help administering their medication multiplied by average 30 minutes per carer visit.
- For example, in September service users had an average of 102 visits; for 30 service users this was 3064 visits; at 30 minutes per visit, this was 1532 hours of carer time that could potentially be released. 1532 hours of carer time costs Liverpool City Council £23,225<sup>11</sup>
- Conservatively assuming that, in future, 50% of these visits could be replaced, each user with the Paman device could release 26 hours per month, per user, or 306 hours per year. Savings would be £387 per month, per user, or £4,645 per year. This equates to £464,500 for 100 users per year
- Where all visits are replaced, 613 carer hours are released per year, per user, at £9,290 cost. For 100 service users, this equates to £929,000 per year

#### 3.4.4.5. District Nurse hours and costs

There is one example among the trial users where a district nurse was administering insulin. In this case, use of Paman for medication monitoring would result in 30 hours of district nurse time released per month, or 360 hours per year. This has a cost of £750 per month; £9,000 per year.

##### Case Study C: Reduced Need for Services

74 year old Peggy Cullen lives in Kensington and has diabetes, and this is treated through management of diet, and taking time-sensitive insulin injections and medication.

At the initial medication review, Protel Health's clinical pharmacist found that external factors were disrupting her medication regime. Peggy was waiting up to three hours for her carer to visit to give her breakfast, with which she could take her medication, and she was often given her evening meal very early. The district nurse also visited daily at 10.30 am to administer insulin injections; ideally, this should have been administered at 8.am, with breakfast taken as soon after as possible.

As a result of her medication not being taken correctly, Peggy often suffered from "hypos" due to reduced blood sugar caused by lack of food and had experienced several falls. She lacked confidence in taking medication and did not use her glucometer to check her blood



sugar level - a significant problem, as the amount of insulin administered depends on the glucose level reading. Her eyesight had also deteriorated recently, increasing her fall risk.

At the initial review, Peggy felt that with support from Paman she would be able to self-administer her insulin, and was happy for Paman to support her in taking blood glucose readings to help ensure that her insulin dosage was appropriate. She was looking forward to reduced reliance on the timing of carer visits, and to being able to ask questions about her insulin and medicines

Since Paman has been implemented, the medication issues have been resolved. The Paman team now call at 8:00am and monitor as Peggy draws up the insulin dose and self-administers, and takes any other medication due. She takes the medicine exactly as it is prescribed – the right dose, at the right time – which means she is less likely to spend time in hospital. Peggy also has her blood sugar levels monitored by the Paman team using a glucometer four times a day. Repeat prescription requests are made to the GP surgery in good time for the prescription to be delivered to the pharmacy for dispensing.

Peggy's blood sugar levels are being kept within acceptable limits and she no longer experiences falls. As Peggy completes the insulin administration and medication administration under the supervision of the Paman team, this has removed the need for a district nurse and a "time-critical" carer visit. She is also less likely to need other Health and Social Care services.

The medication administration process is completed by 8:15am and Peggy has more freedom to leave the house and do shopping and meet friends without having to wait for nurse and carer. Managing her condition at home, long-term, means she has increasing her independence and quality of life, and she'll retain the skills she'll need to live independently at home into her old age.

Peggy says: "I thought I'd give PAMAN a try because I was getting frustrated with having to wait in for my carer and district nurse to arrive each day. Now I get a call at the same time every day to take my medicine, which means I can arrange to go out to the shops and see my family without feeling tied to the house.

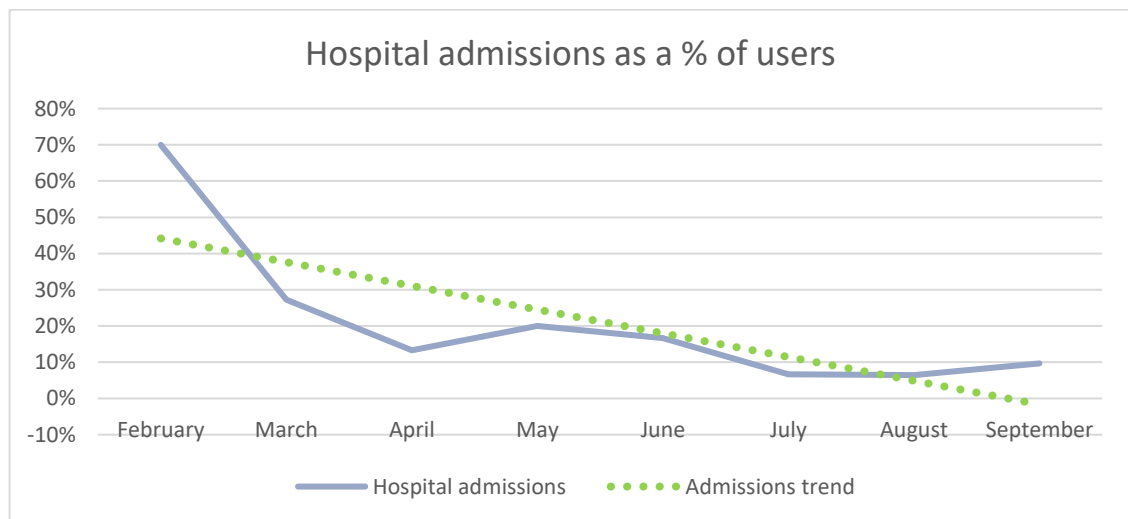
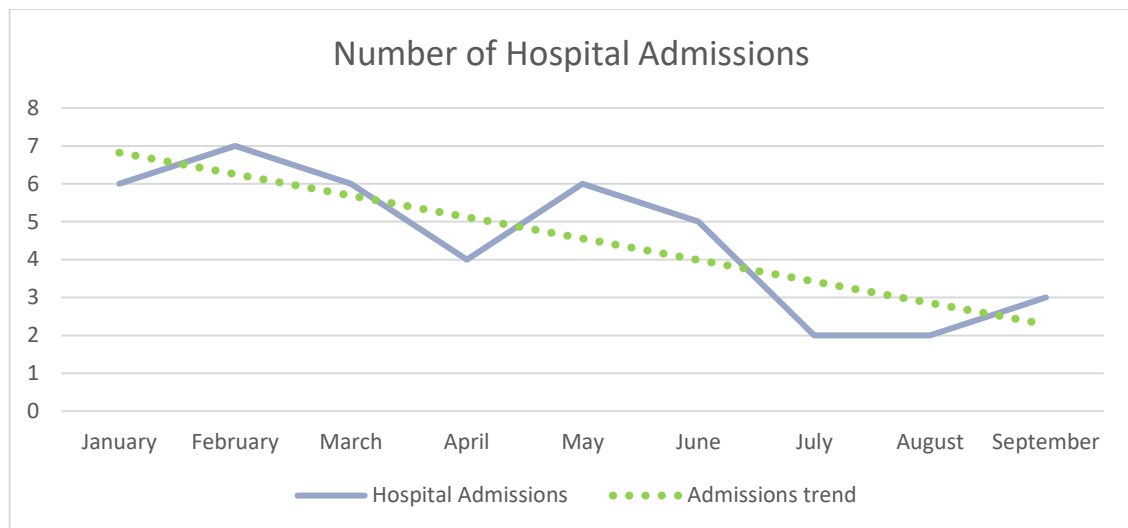
"I feel confident using PAMAN because the pharmacists that call me are always so polite and explain everything really well. My prescriptions were all over the place, but they helped me get everything into one blister pack and now I know what I'm taking and when. I don't forget to take my medications anymore and I don't feel like it's a chore."

She added: "My family were a bit surprised at first to see that I'd be using technology, but I showed them how simple it is to use. Other people should have a go at using these new technologies. There are probably loads of people out there with lots more medications than me, and using this kind of system makes everything really simple and easy.

"I'm not very good at technology but I can easily press a button which is all I have to do. I can just about work my TV remote! At my age, we don't do technology really but it's great to hear that Liverpool is the first place to be trying out these new things. It's great how technology can really help people."



### 3.4.4.6. Hospital Admissions



(January omitted due to low user numbers)

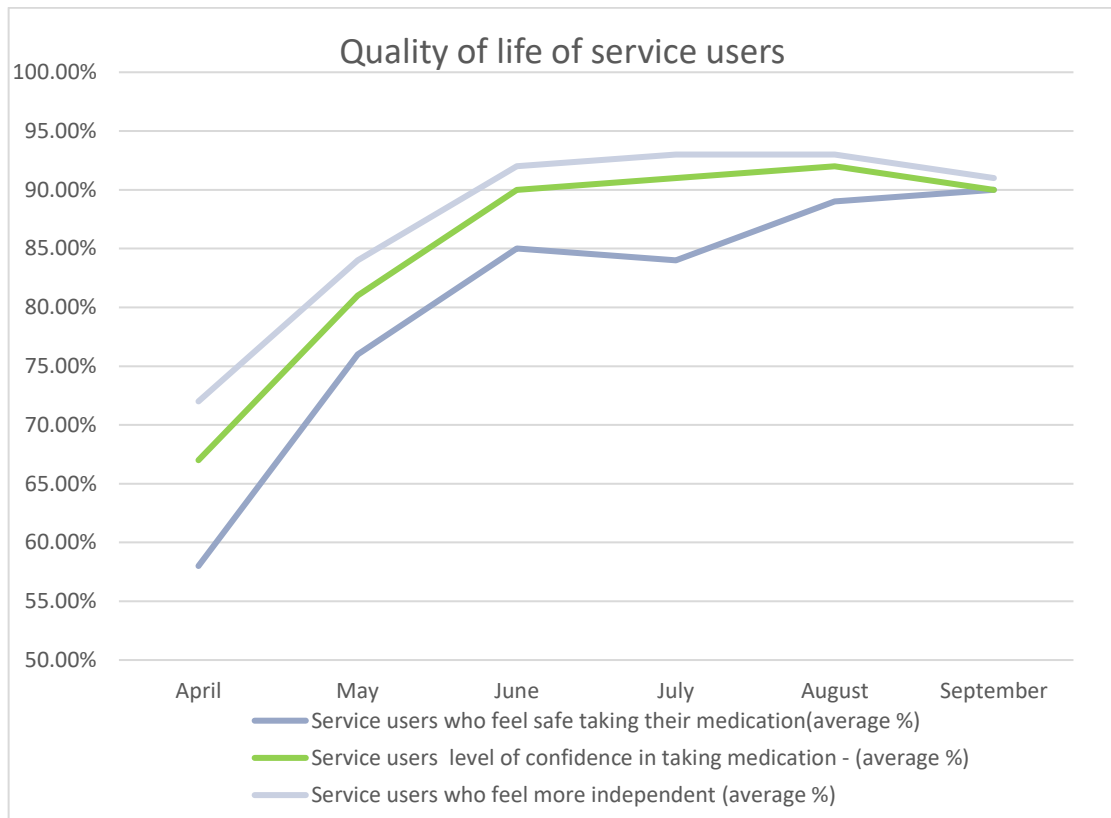
- All service user hospital admissions were for illness, with no admissions due to medication errors.
- Service user hospital admissions per month dropped from a high of 7 in February 2019 to 3 in September 2019
- The percentage of service users with at least one admission to hospital had dropped by 2%
- Service user surveys reported a drop from 3 admissions to 2 admissions in the three months prior to the surveys (surveys in March or July and October 2019). This represents a reduction of costs to NHS of £626<sup>12</sup>

### 3.4.4.7. GP Visits

- There was a 250%+ increase in GP visits - asked how many times they'd visited the GP, or been visited by the GP, in the three months prior to the survey, service users reported an increase of 33 visits. This was an average increase of 1.1 visits per user. No reason was evident for this change, although the question was unanswered in many baseline surveys, which may have skewed the result.

### 3.4.4.8. Quality of Life

- Service users had an increase of average of 1 point on the life satisfaction scale<sup>4</sup>  
Improved life satisfaction improves wellbeing, and health, reducing reliance on Health and Social Care services. According to *Relationship between Wellbeing and Health*<sup>5</sup>, “There are a number of correlations between wellbeing and physical health outcomes, improved immune system response, higher pain tolerance, increased longevity, cardiovascular health, slower disease progression and reproductive health



- 73% increase in those confident and happy to take medication, from 15% to 88%.  
This reduces the need for external services, reduces medication errors and improves self-esteem. Lack of confidence and low self-esteem “can have a harmful effect on our mental health and our lives”<sup>13</sup>
- 53% increase in those who felt safe, from 37% to 90%<sup>14</sup>
- 40% increase in service users who felt more independent (from personal feedback information and verbal discussions)  
Independence of service user has been improved by their no longer have to wait several hours each day for the carer to arrive to support with medication administration, and instead receive their Paman call at the time they have agreed. This allows the service user to spend more time with friends and reduces social isolation significantly (as does the regular Medihub sessions with the Paman monitors).  
Research shows that healthy personal relationships can be a protective factor against stress and other health issues (Kreitzer, 2016).<sup>15</sup> The DCMS Loneliness Strategy 2018<sup>16</sup> notes that “Feeling lonely frequently is linked to early deaths. Its health impact is thought to be on a par with other public health priorities like obesity or smoking”

### Case Study D: Increasing Independence

Service User D is active and mobile and is regularly out of the house visiting friends, family and going to social events.

He was frustrated that he needed a carer to oversee his medication management, as he felt he did not need one, and he said that carer's visits were at "unhelpful" times, restricted his social life and stopped him being as independent as he wanted to be.

D accepted that he needs support with his medicines but was happy knowing that he could have more flexibility with the Medihub.

The medication review carried out by the Protel Health clinical pharmacist highlighted some clinically significant issues for the service user that had not been picked up by the carer, pharmacy or GP. These were discussed with the pharmacy and GP and appropriate changes made.

D's medication adherence has improved from 42% when he started using Paman to 96% at the end of the trial. He has taken to the Medihub very well and is now enjoying the freedom of being able to get out and meet friends and relatives without having to wait in for carers. D is delighted with his new-found independence and feels safer taking his medicines and more confident.

#### 3.4.4.9. Overall Potential Cost Savings

- Potential Cost savings to Health and Social care Services of £208,800 per 100 uses per year

	per user per year	for 30 users per year	per 100 users per year
Paman costs (based on cost data from the Medication Support Company)	£2,808	£84,240	£280,800
Cost saving from potential reduction in carer hours*	£4,645	£139,350	£464,500
Cost saving from potential reduction in medication costs by cancelling unnecessary medications	£71	£2,130	£7,100
Cost saving from potential reduction in District Nurse hours**	£180	£5,400	£18,000
Total potential cost savings	<b>£4,896</b>	<b>£146,880</b>	<b>£489,600</b>
<b>Potential cost savings including Paman system costs</b>	<b>£2,088</b>	<b>£62,640</b>	<b>£208,800</b>

\* Assuming 50% of current visits are replaced

\*\* Assuming one in 50 no longer needs district nurse

### 3.4.5. User Survey and Key Performance Indicator Outcomes

35 baseline surveys were received, gathered March - July 2019. 30 follow-up surveys were received, gathered October 2019.

	Baseline "in the 3 months before having the device"	Follow-up "in the 3 months prior to being surveyed"*	Difference
<b>No. of respondents</b>	35	30	
Does a carer manage medication for this user?	89%	100%	11%
Carer hours per week	243.5	204.1	39.4
Average no. visits per week	12.32	13.47	-1.14
Average hours per week	7.9	6.8	-1.1
Average number of medications per user	8.5	7.1	-1.4
Percentage of service users who had a medication error or incident	74%	23%	-51%
Average errors per service user who made an error	6.8	1.3	-5.5
Average seriousness of errors (on scale of 1-5)	2.3	1.3	-1.0
Total GP visits of all users	12.0	45.0	33.0
Average No. GP visits	0.4	1.5	1.1
No. hospital admission in past 3 months	3.0	2.0	-1.0
Percent with admissions to hospital in past 3 months	8.6%	6.7%	-1.9%
Average No. admittances for those who were admitted	1.7	3.5	1.8
Percentage of those admittances due to medication error	33.3%	0.0%	-33.3%
<b>How confident do you feel about taking your medicines?</b>			
I am confident, and happy to take them without help	15%	87.5%	73%
I am mostly confident, but sometimes I like some help	30%	12.5%	-18%
I am sometimes confident, but usually I like some help	45%	0%	-45%
I am not confident, and need help to take them	10%	0%	-10%
<b>Which of the following statements best describes how safe you feel?</b>			
I feel as safe as I want	37%	90%	53%
Generally I feel adequately safe, but not as safe as I would like	60%	10%	-50%
I feel less than adequately safe	3%	0%	-3%
I don't feel at all safe	0%	0%	0%
<b>On a scale of 1 to 10, how satisfied are you with your life nowadays?</b>			
Average satisfaction level of all respondents	7.17	8.10	1

\* length of time with device varies

#### From Paman Monthly KPI Data

Comparison of April and September, reflecting the period with the core group of 30 users

Medication	April	September	Difference
Total cost of medicines for all service users	£4,409	£2,199	-£2,211
Average medication costs per user	£147	£71	-£76
Average number of prescriptions per user	6.1	5.5	-0.6
Value of medication returned to the pharmacy unused	£6,390	£1,002	-£5,388.00
Average value of medication returned to the pharmacy unused	£213	£32	-£180.68

### 3.5. Safehouse Technologies – Safehouse Sensor



#### 3.5.1. Description

Safehouse Technology Ltd provides an end-to-end IoT service (infrastructure, sensors and cloud services).

The Safehouse sensors monitor and highlight conditions and environments that may adversely affect the health and well-being of service users, and can connect to other commercially available sensors. Data is transmitted via a Low Powered Radio Network (LoRa) and gateway connected via 5G to Safehouse's cloud-based system, and from there to an app or dashboard.

Telecare alerts are generated by sensors and notify the community (friends, family & professional carers) via a mobile application. Safehouse also supplies a dashboard used by organisations for monitoring or to produce regular reports that highlight "at risk" properties in terms of fuel poverty and abnormal behaviour, including temperature, humidity, audio alarm and power outage. Additional devices were deployed to monitor door and window opening and alarm buttons for individuals (run in parallel with existing tele-care services). By the end of the pilot, this had been integrated into traditional back office tele-care response systems to notify the emergency services of situations requiring support.

By enabling the early discovery of adverse environmental factors, and alerting care providers through the app dashboard, action can be taken swiftly to forestall the escalation of health problems for the user, thereby decreasing reliance on Health and Social care services.

Safehouse sensors are installed in a variety of home care, sheltered living and care home locations. Safehouse sensors are estimated by LCC to be suitable in around a third of cases.

#### 3.5.2. Timescale and Numbers

The trial started in April 2019, and completed in November 2019.

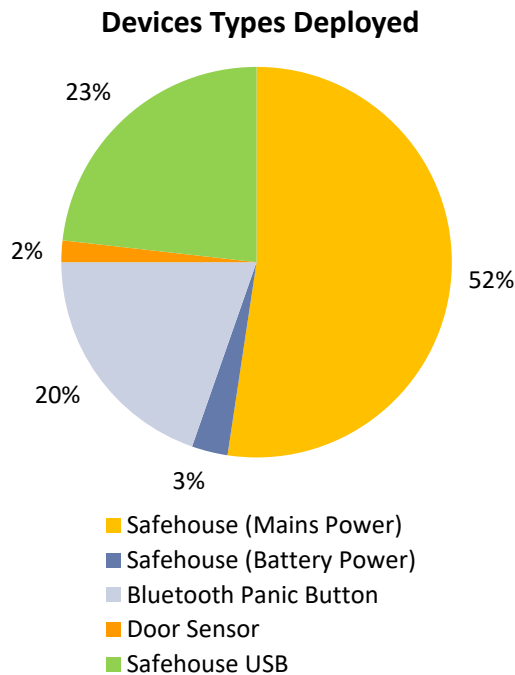
Target Number of end users:	Actual trial end users at 30/11/19	Number of baseline user surveys	Number of follow-up user surveys
60	81	52 (64%)	35 (43%)

### 3.5.3. Outcomes and Impact Summary

Outcomes	Potential Impact
<ul style="list-style-type: none"> <li>Using Safehouse rather than the current telecare system results in an overall reduction of costs of £142.80 per user per year, and £14,280.00 per 100 users per year.</li> </ul>	<p>Although Safehouse sensors are not suitable for all users, this means:</p> <ul style="list-style-type: none"> <li>Reduced costs to Health and Social Care services</li> </ul>
<ul style="list-style-type: none"> <li>Reduction of 41% in the number of people who were admitted to hospital.</li> <li>Average number of hospital admissions dropped by 50%, giving a potential cost saving of £18,254 per year for 81 users, or £22,536 per 100 users per year.</li> </ul>	<ul style="list-style-type: none"> <li>Better health outcome for service users</li> <li>Reduced reliance on services</li> <li>Reduced costs to Health and Social Care services</li> </ul>
<ul style="list-style-type: none"> <li>Reduction of 17% in the number of people who visited their GP</li> <li>Average number of GP visits dropped by 13%, giving a potential cost saving of £480 per year for 81 users, or £592 per 100 users per year.</li> </ul>	<ul style="list-style-type: none"> <li>Reduced reliance on services</li> <li>Reduced costs to Health and Social Care services</li> </ul>
<ul style="list-style-type: none"> <li>Reduced use of carer time:               <ul style="list-style-type: none"> <li>The number of emergency incidents and the carer time to deal with them dropped to 0 from 5.25 hours</li> <li>The average drop in carer time used gives a potential cost saving of £496 per year for 81 users, or £612 for 100 users per year.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Reduced reliance on services</li> <li>Reduced costs to Health and Social Care services</li> </ul>
<ul style="list-style-type: none"> <li>Improved quality of life               <ul style="list-style-type: none"> <li>Increase of 0.7 points on the life satisfaction scale</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Better quality of life means:               <ul style="list-style-type: none"> <li>Better health outcomes for the individual</li> <li>Reduced reliance on services</li> <li>Reduced costs to Health and Social Care services</li> </ul> </li> </ul>

### 3.5.4. Outcomes

A total Of 81 devices have been installed.



- Door Sensors – Monitor the opening and closing of doors, along with temperature and humidity.
- Safehouse (Mains Power) – a LoRa device that monitors the temperature, humidity, power cuts, and has the ability to listen for fire/smoke/gas alarms.
- Safehouse (Battery Power) – A LoRa device that monitors the temperature, humidity, light and motion.
- Bluetooth Panic button – Bluetooth panic buttons / pendants
- Safehouse USB – A Bluetooth device that monitors Temperature, Humidity, CO<sub>2</sub>, Light, Noise, Volatile Organic Compounds (VOCs) and Air Pressure.

#### 3.5.4.1. Telecare Costs

Safehouse sensors are estimated by LCC to be suitable in around a third of cases. This device does not give the option for calls to and from the service user, which is required in cases where there is not a carer to respond to immediate alarms. This service will continue to be provided by current telehealth providers for those that require it.

- Given that this service is suitable for approximately one third of current telecare recipients, and there are approximately 6,500 Liverpool City Council and CCG telecare users annually, 2,100 could benefit from this technology
- Overall reduction in telecare costs, for 81 users over one year: £11,566.80, which is £142.80 per user per year, and £14,280.00 per 100 users per year

#### 3.5.4.2. Health and Social Care costs

##### Reduction in GP visits

- Number of service users who visited a doctor reduced by 17%, dropping from 17% to 14%
- The average number of GP visits across all users dropped by 13%
- Actual GP visits dropped by 7, a potential saving to the NHS of £259<sup>7</sup> over three months
- 81 users with a drop in average GP visits per user of 0.04 in a 3 month period, multiplied by the average GP visit cost of £37<sup>7</sup> means that there was a potential cost saving of £480 per year. Extrapolated to 100 service users this would be £592 per year.

### Reduction in hospital admissions

- The number of service users with a hospital admission reduced from Hospital admissions reduced from 10% to 6%, a reduction of 41%
- The average number of hospital admissions across all users dropped by 50%
- Actual admissions dropped by 6, a potential saving to the NHS of £3,756<sup>12</sup> over three months
- 81 users with a drop in average admissions per user of 0.09 in a 3 month period, multiplied by the average admission cost of £626<sup>12</sup> means that there was a potential cost saving of £18,254 per year. Extrapolated to 100 service users this would be £22,536 per year.

### Reduced Reliance on Carers

- The number of service users with an 'emergency incident' in a three month period dropped from 15% to 0%
- The average carer time used on emergency incidents for all users dropped from 6.06 minutes to 0 minutes, a reduction of 100%
- The actual carer hours used dropped by 5.25, a potential saving of £80<sup>11</sup>
- 81 users with a drop in average carer time per user of 6.06 minutes in a 3 month period, multiplied by the hourly carer cost of £15.16<sup>11</sup> means that there was a potential cost saving of £496 per year. Extrapolated to 100 service users this would be £612 per year.
- There was an increase of 25% in the number of carers using the app or dashboard to monitor service users, but the 13% of family using the app had dropped to 0%
- The time spent by carer organisation staff answering family queries dropped by 73%

### 3.5.4.3. Quality of Life

- Service users had an increase of average of 0.7 points on the life satisfaction scale<sup>4</sup>  
Improved life satisfaction improves wellbeing, and health, reducing reliance on Health and Social Care services. According to *Relationship between Wellbeing and Health*<sup>5</sup>, "There are a number of correlations between wellbeing and physical health outcomes, improved immune system response, higher pain tolerance, increased longevity, cardiovascular health, slower disease progression and reproductive health



### 3.5.5. User Survey and Cost Outcomes

#### 3.5.5.1. Telecare Costs

Cost of telecare network and support			
• Current cost: £3.48 per user per week (Data provided by Liverpool City Council)	81 users x 52 weeks x £3.48	£14,657.76	
• Safehouse cost: £0.58 per user per week (Costs data provided by Safehouse)	81 users x 52 x 0.58	£2,442.96	
Difference:			£12,214.80
Cost of monitoring equipment and maintenance			
Current cost: £113.36 per user per year (Data provided by Liverpool City Council)	£113.36 x 81 =	£9,182.16	
Safehouse cost: £121.36 per user per year (Cost data provided by Safehouse)	£121.36 x 81 =	£9,830.16	
Difference:			-£648.00
<b>Overall reduction in telecare costs for 81 users per year:</b>			<b>£11,566.80</b>

#### 3.5.5.2. Service User Surveys

51 baseline surveys were received, gathered March - November 2019. 35 follow-up surveys were received, gathered November 2019.

	<b>Baseline</b> “in the 3 months before having the device/completing the survey”	<b>Follow-up</b> “in the 3 months prior to being surveyed”*	<b>Difference</b>
<b>No. of respondents</b>	52	35	
Service users with doctor visit	17%	14%	-3%
Average number of GP visits (all service users)	0.33	0.29	-0.04
Service users with hospital visit	12%	6%	-6%
Average hospital visits (all)	0.19	0.09	-0.11
Service Users with hospital admission	10%	6%	-4%
Average admissions (all)	0.17	0.09	-0.09
Service user with ‘emergency’ incidents:	15%	0%	-15%
Average incidents (all)	0.23	0.00	-0.23
Average extra carer time per all users (minutes)	6.06	0.00	-6.06
Actual carer hours used	5.25	0.00	-5.25
Average staff time spent answering family enquiries about user (all)	3.75	1.00	-2.75
Service user carers use app to monitor**	29%	54%	25%
Service user family uses app to monitor**	13%	0%	-13%
Average life satisfaction:	5.61	6.31	0.70

\* length of time with device varies

\*\* some service users had been using the device prior to completing a baseline survey

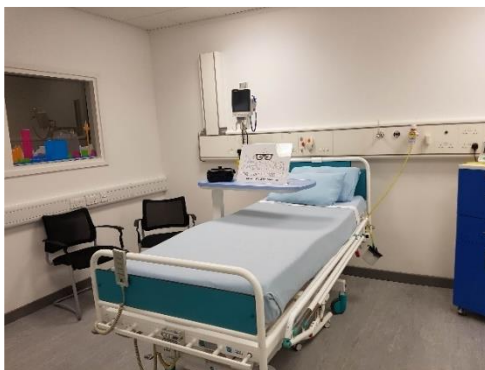
### 3.6. NHS/ RLBUHT\* - Telehealth in a box, VR Headsets in Palliative Care, 'Hospital to Home' SME Testbed

\*(Royal Liverpool and Broadgreen University Hospital Trust)

#### 3.6.1. Description

NHS/RLBUHT (Royal Liverpool and Broadgreen University Hospital Trust) delivered three elements under the Liverpool 5G Testbed and Trial:

- Telehealth in a Box - Use of assistive technology to support early discharge of patients from hospital, into their own homes with telehealth technology. This was delivered by Merseycare, Liverpool CCG and their telehealth supplier, Docobo.
- VR Headsets in Palliative Care, where headsets are used as a distraction in Palliative Care for pain management. VR headsets use 5G signals to allow streaming of a full range of virtual reality experiences, rather than viewing limited pre-loaded experiences.
- 'Hospital to Home' SME testbed – a “smart room” in Liverpool’s Life Sciences Accelerator building which provides technology SMEs with a development environment for testing 5G connectivity of products. Two testing environments are available – a replica single inpatient bedroom, and a mock-up house with bedroom and kitchen facilities. End user device connectivity in the accelerator smart room is provided using WiFi, LoRa and Ethernet connections. The 5G test bed brings together these technologies to provide a combination of services (private networking, internet access and back-haul for the LoRa) and delivers them using mmWave inter-building links, city-owned fibre and independent data-centre for hosting and peering.



### 3.6.2. Outcomes and Impact Summary

Outcomes	Potential Impact
<ul style="list-style-type: none"> <li>• Telehealth in a box - Patients reported decreased use of primary health services and hospital services</li> </ul>	<ul style="list-style-type: none"> <li>• Reduced reliance on services</li> <li>• Reduced costs to Health and Social Care services</li> </ul>
<ul style="list-style-type: none"> <li>• Telehealth in a box - Patients reported improved health, and increased ability to manage their own health</li> </ul>	<ul style="list-style-type: none"> <li>• Better health outcome for service users</li> <li>• Reduced reliance on services</li> <li>• Reduced costs to Health and Social Care services</li> </ul>
<ul style="list-style-type: none"> <li>• VR Headsets in Palliative Care - Patient quality of life and wellbeing was improved</li> </ul>	<ul style="list-style-type: none"> <li>• Improved patient experience</li> <li>• Reduced reliance on services</li> <li>• Reduced costs to Health and Social Care services</li> </ul>
<ul style="list-style-type: none"> <li>• VR Headsets in Palliative Care - Patient often had a reduction in pain medication</li> </ul>	<ul style="list-style-type: none"> <li>• Improved patient experience</li> <li>• Reduced reliance on services</li> <li>• Reduced costs to Health and Social Care services</li> </ul>

### 3.6.3. Telehealth in a Box

#### 3.6.3.1. Timescale and Numbers

Under this project three telecare users in the Kensington area used the Telehealth in a box system with 5G connection, from September 2019 to November 2019.

To demonstrate the potential we have also included data from 181 RLBUHT patients from South Liverpool, who had been using telecare for a least 12 weeks, who completed a November Telehealth Patient Survey.

#### 3.6.3.2. Outcomes

- In July 2019 a study of the impact on emergency admission of telehealth by Philips Research Cambridge, NHS Liverpool Clinical Commissioning Group and Liverpool Community Health (MerseyCare), was published in BMJ Open<sup>17</sup>. 3562 patients with chronic obstructive pulmonary disease, heart failure or diabetes were included in the study, which compared the Telehealth patients to a control group (that didn't have it) and showed an average percentage decrease in emergency admissions of 22.7%.
- To understand the potential impact, prior to testing under 5G connectivity, some data was collated by the CCG who provided this context-free summary for 82 users of the system, who had the following outcomes:
  - 31% reduction in GP and Hospital attendance
  - 74% reporting more confidence in their ability to manage their condition
  - 76% willing to use Telehealth in the future.

- November Telehealth Patient Survey results for the South Locality, which are compared to the same survey in September, show that:
  - Higher number of patients (+12%) reported making a change to their lifestyle since using telehealth
  - Higher number of patients (+6%) felt their health had improved since using telehealth
  - Decreased use of NHS resources:
    - Increased number of patients (+11%) said they had reduced the number of times they had seen their GP, Nurse or Community Matron since using telehealth
    - Increased number of patients (+14%) said they had reduced the visits to hospital since using telehealth
  - Increased number of patients (+8%) said telehealth has helped them to become more confident to manage their own health
  - Increased number of patients (@19%) said that people around them, carers or family, had benefited from telehealth

While these are not compared to a cohort on non-telecare users, some of the November respondents will be service users who have been using the service for a longer period, and therefore showing an increased benefit.

- The data from the three Telehealth patients in the Kensington trial area showed a 33% increase in the number of hospital admissions while using Telehealth, however as this is based on a very small cohort over a short time period (only a 3 month view when normally this longer) it is difficult to assign this any significance.

#### Kensington Service User Trial Data

This data was provided by MerseyCare, from patient records. Patients started using Telehealth between February and July 2019, two finished in October 2019, and one remains using TeleHealth

	Number	Average
Number of Users	3	
In the three months prior to using telehealth in a box, how many hospital admissions did the user have?	0	0
In the last three months how many admissions have they had?	1	0.33 (33%)

### 3.6.3.3. Survey Outcomes

#### Telehealth in a Box Patient Surveys

(from Liverpool South Telehealth Patient Survey, provided by Merseycare. This is not collated at ward level, and therefore covers a wider area than Kensington)

How confident are you that you can manage your own health?		Very Confident	Somewhat Confident	Not Confident	
Nov-19		27%	44%	29%	
Sept 19		31%	51%	19%	
		-4%	-7%	10%	
In the past year, how often have you been to A&E or have you been admitted to hospital (in relation to your long term conditions)?		No Visits	1 Visit	2-3 Visits	4+ Visits
Nov-19		24%	28%	38%	10%
Sept 19		63%	17%	15%	5%
		-39%	11%	23%	5%
In the past year, how often have you been to see your GP/practice nurse (in relation to your conditions)?		No Visits	1 Visit	2-3 Visits	4+ Visits
Nov-19		7%	11%	40%	42%
Sept 19		7%	15%	35%	43%
Change		0%	-4%	5%	-1%
Have you made any changes to your lifestyle as a result of using telehealth?			Made Change	No Change	
Nov-19			45%	55%	
Sept 19			33%	67%	
Change			12%	-12%	
Do you feel your health has improved since you have been using telehealth?			Improved	No Change	
Nov-19			47%	53%	
Sept 19			41%	59%	
Change			6%	-6%	
Do you feel the number of times you have seen your GP, Nurse or Community Matron has reduced since you have been using telehealth?			Reduction	No Change	
Nov-19			50%	50%	
baseline comparison (to Sept 19)			39%	61%	
Change			11%	-11%	
Do you feel you have reduced the number of visits you have made to Hospital since you have been using Telehealth?			Reduction	No Change	
Nov-19			55%	45%	
baseline comparison (to Sept 19)			41%	59%	
Change			14%	-14%	
Has telehealth helped you become more confident to manage your own health?			More Confident	No Change	
Nov-19			82%	18%	
baseline comparison (to Sept 19)			74%	26%	
Change			8%	-8%	
Have the people around you, carers or family, benefitted from Telehealth?			Yes	No	
Nov-19			75%	25%	
baseline comparison (to Sept 19)			56%	44%	
Change			19%	-19%	

### 3.6.4. VR Headsets in Palliative Care

#### 3.6.4.1. Timescale and Numbers

The trial started in February 2019 , and completed in November 2019.

Target Number of end users:	Actual trial end users at 30/11/19	Number of user surveys	Number of practitioner surveys
12	22	22 (100%)	8

#### 3.6.4.2. Outcomes

Practitioners were asked about the effect using the VR headsets had on patients:

- 38% said that patients' quality of life was very often improved, 50% said it was quite often improved, and 13% that it was sometimes improved. None said that it was rarely or never improved.

Improved life satisfaction improves wellbeing, and health, reducing reliance on Health and Social Care services. According to *Relationship between Wellbeing and Health*<sup>5</sup>, "There are a number of correlations between wellbeing and physical health outcomes, improved immune system response, higher pain tolerance, increased longevity, cardiovascular health, slower disease progression and reproductive health

- 50% said that patients' general wellbeing was very often improved
- 63% of practitioners reported that patients quite often had a reduction in pain medication

Of the 22 patients using the VR headset during the trial:

- 95% reported the overall experience as 'good'
- 100% said they would use the VR headsets again
- 85 % said they had no complications using the equipment

#### 3.6.4.3. Survey Outcomes

##### VR Practitioners' Survey

The survey was answered by 8 practitioners from a range of roles, who had worked with patients who use the VR headsets:

- Deputy Ward Manager
- Staff Nurse
- Healthcare assistant
- Physiotherapist
- Consultant - Palliative medicine
- Doctor – Palliative Care
- Doctor (Registrar) – Palliative Care
- Palliative care speciality doctor – VR lead

Since April 2018, approximately how many patients have you cared for who have used the VR headsets?	67			Note: this number includes duplication		
Thinking about the effect using the VR headsets had on these patients, in general ...						
	Never	Rarely	Some-times	Quite often	Very often	Always
Did they have a reduction in the use of strong pain medication?	25%	0%	13%	63%	0%	0%
Do you think their general wellbeing was improved?	0%	0%	13%	38%	50%	0%
Do you think that their quality of life was improved?	0%	0%	13%	50%	38%	0%

Any comments you'd like to make about the changes you've seen in the patients?

- There was a significant reduction in patient anxiety from those who used the system; with overall feelings of relaxation and calm. Relatives liked the idea of VR headsets and feel reassured.
- The patient really enjoyed using the headset. He felt calm and relaxed; and felt he could 'switch-off' for at least a short period of time.
- Often, improvements where in holistic aspects of patients care (e.g. psychological distress). Our patients are highly complex and their condition can change hour by hour; making it extremely difficult to assess whether their analgesia has changed.
- Some patients appreciated alternative methods to the usual the treatment/management approach (as it's something different)
- It improved anxiety and provided distraction for patients in pain or with nausea and other symptoms as well as mental health. It's a service we offer almost routinely to patients if they are anxious or if they would like some "escapism" from the hospice environment.
  - For example, I used a Liverpool football VR tour for a patient obsessed with football which had a profound effect on his mood and wellbeing.
  - Very little negative comments other than "could be louder" or some mild discomfort with the bulky headset
  - Has permitted patients to experience the countryside or seaside one last time before death (which is a privilege to provide for someone)
  - I hope to continue to use this technology into the future and for it to become to norm to offer this to patients.
- In the patients I have used VR with, I would say it has brought them happiness, the chance to escape from the situation they are in, and the opportunity to be or see something else. I have also seen it help with anxiety and shortness of breath.  
I would love the opportunity to use it more with patients in critical care

#### VR Patient Feedback

Of the 22 patients using the VR headset during the trial:

- 95% reported the overall experience as 'good'
- 100% said they would use the VR headsets again
- 85 % said they had no complications using the equipment

## **VR in Palliative Care Overview Paper**



## Virtual reality in palliative care: a project to determine the feasibility of using innovative technology in hospital and hospice settings

Palliative Care Institute  
Liverpool



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### Background

Previous studies demonstrate that virtual reality (VR) is beneficial in certain clinical scenarios (e.g. distraction therapy for pain management). There is little evidence about the benefits and feasibility of virtual reality distraction therapy in palliative care inpatient settings.

### Aims

This project aims to determine the feasibility of using virtual reality distraction therapy in specialist palliative care hospital and hospice inpatient settings.

### Methods

Samsung Gear VR headsets were used to provide the virtual reality experience over 3 months. Participants were recruited from a hospice and two wards in a University teaching hospital (the Specialist Palliative Care Inpatient Unit and the Intensive Care Unit). Participants used virtual reality distraction therapy for 10 minutes. Participant feedback (about their experience) and data relating to adverse effects were recorded.



Dr Simon Roughneen (left) and Dr Mark Mills (right) providing a demonstration of the application of virtual reality (VR) at the *Palliative Care, Architecture and Design Symposium (PADS)*, University of Liverpool, 2018.



Talk to me about  
this poster!

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NHS  
The Royal Liverpool  
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University Hospitals  
NHS Trust

Academic  
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End of Life  
Care Centre



### Results

Twenty-two individuals (16 palliative care patients, 3 relatives and 3 staff members) participated in the project. All participants had a positive experience of virtual reality and indicated that they would like to use this again. No adverse effects were reported. However, four (18%) reported minor difficulties with using the device. Problems included: issues with the heaviness of the headset, discomfort from the head-strap and some difficulty with focusing the image. All participants stated that they believed that virtual reality could improve symptom management.



A patient uses virtual reality for distraction therapy during her inpatient stay in the hospital specialist palliative care unit.

### Discussion and conclusions

Our data suggests that it is feasible to use virtual reality distraction therapy in hospital and hospice settings. Further work is needed to examine whether virtual reality distraction therapy is effective as a method to improve symptom management in palliative care.

### 1 POSTER ABOUT VR HEADSET USE

### 3.6.5. 'Hospital to Home' SME Testbed

#### 3.6.5.1. Timescale and Numbers

The trial started in March 2019 , and completed in November 2019.

#### 3.6.5.2. Outcomes

The testbed facility was officially opened in February 2019, with attendees from local SME, Health, government and social care organisations. Testbed trails were started in March 2019.

- 46 organisations expressed an interest in involvement in the project
- 18 actively engaged with the project
- 4 organisations used the testbed, testing 5G capability:

##### Health and Care Solution

##### Organisation

- |   |            |
|---|------------|
| • Monitoring wellbeing with a variety of home/wearable sensors  | MySense AI |
| • VR platform for phobias, social anxiety and stress  | Mimerse AB |
| • Connected Care analytics platform connecting elderly and vulnerable people to their families, health and social care workers and emergency services | Cascade 3D |
| • VR reminiscence for dementia that links with remote healthcare provider and family members.   | Virtue     |
- These organisations also demonstrated their products to a group of health and care professionals

## 3.7. University of Liverpool: Chromatic Sensors



### 3.7.1. Description

The University of Liverpool have developed a chromatic sensor for use in home care, where they are intended to provide people with the opportunity to live independently either in their own home or in residential care, with intervention only occurring when necessary.

The Chromatic Sensor provides alerts to carers, with any unusual event (e.g. a fall, seizure, intrusion etc.) raising the level of concern and an alert being sent or other actions initiated as required. The system detects patterns of behaviour which are precursors to developing age or health related problems and can be used to intervene before situations deteriorate and medical intervention becomes necessary.

The chromatic sensor units are placed on the ceiling and look similar to conventional smoke detectors. 5G connection allows high speed data transmission, critical for time-sensitive alerts.

### 3.7.2. Timescale and Numbers

The trial started in September 2019, and completed in November 2019, with one service user. Two sensors were also installed in Sensor City in June 2019, which allowed the devices and accompanying software dashboard to be tested.

### 3.7.3. Outcomes

- For the test period there were no severely elevated alerts generated by system although there were some slight increases in concern levels from the system that were insufficient to trigger an alert.
- One sensor was installed in Breckside Care Home, and fed back that:
  - The sensor indicated a slight increase in concern level (but was not enough to trigger an alert), and the care support worker checked on the user, and saw that there was a problem.
  - This problem could have developed into an emergency, but was dealt with immediately
  - The care support worker estimated that 60 minutes of their time was saved by responding earlier.
  - Prior to the sensor being in place, the user had had an emergency incident, which did not result in medical attention, but which had taken up two hours of carer time and one hour of manager time.
- The two on-site units worked continuously over three months without any technical issues. They reported data back to the remote server which processed and analysed the data into useable information.

### 3.8. DigiCreDis: WarnHydrate



#### 3.8.1. Description

Digicredis (Digital Creativity in Disability) is a company that develops products and services for disabled and older people. The Warn Hydrate device is designed to assist adult domiciliary care services in identifying dehydration in elderly clients via urine analysis. The device connects to the 5G internet via LoRaWAN and then to the council and care provider IT systems.

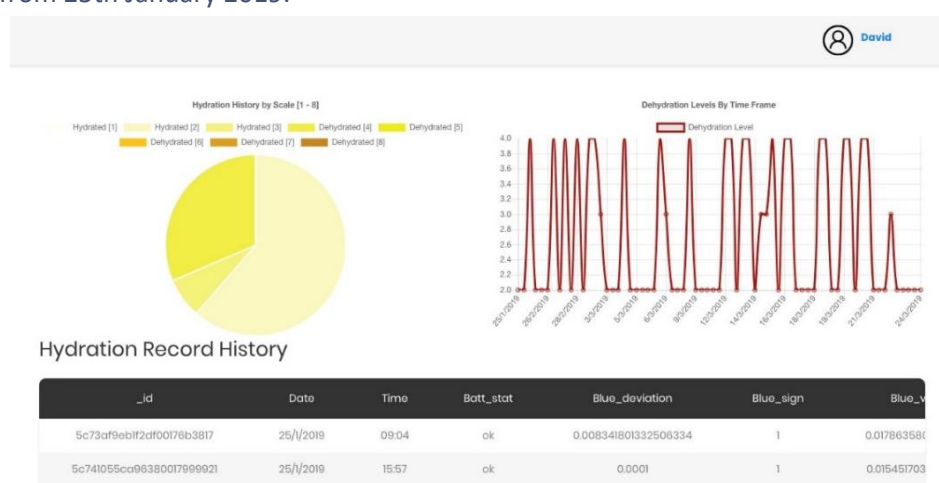
The aim of the Digicredis work package within the Liverpool 5G consortium was to develop and trial a prototype of WarnHydrate with social care providers, who would use it with their clients in the context of domiciliary care to detect early signs of reduced hydration.

An associated mobile app was jointly created with DAMIBU to provide a dashboard for care organisations and support workers.

This use case ran for the first year of the project – April 2018 to March 2019.

#### 3.8.2. Outcomes

- Positive feedback on the device was received from Commissioners, users and Care Providers during development consultations. This also led to the identification of additional features that would need to be developed to make the device fully useful in a social care situation.
- Five users tested the device, with their care organisation having access to the dashboard
- WarnHydrate was trialed with the following social care providers:
  - Homecarers Liverpool: 4 devices.
  - Chinese Wellbeing: 1 device
- One device installed in a house supported by Chinese Wellbeing with twice daily readings from 25th January 2019.



*Dashboard with sample data for control and sharing purposes*

### 3.8.3. Feedback

#### 3.8.3.1. Feedback Gathered During Development

Feedback from care providers, clinicians, commissioners and the clients cared for by the care providers included:

- Needs to be in a commode for Domiciliary Care, a toilet for self-funders, a nappy or accessible from a nappy for Residential.
- Lawyers who used to target PPI are switching to other markets – including Care Providers – having a cheap and convenient way of demonstrating they were keeping clients hydrated would be useful Care Providers for defending themselves against frivolous law suits.
- For the NHS urine concentration alone would not be useful. With another factor added to the testing the product would go to being essential.
- What is clinically ‘Hydrated’ is not clear, or how to test for it. A simple guide needs to be synthesized from existing work (which everyone in the ecosystem would like and an academic partner should be found for this).
- Existing official advice using Urine Concentration as a simple proxy for dehydration in home settings exists but is poorly distributed and understood by Care Providers and some guidance/prompting would be gratefully received.
- Care Providers have no time – any solutions have to save them time – including monitoring dashboards.
- GPs also don’t want to see any more data. They would recommend devices they felt would cut down the number of people attending surgery.

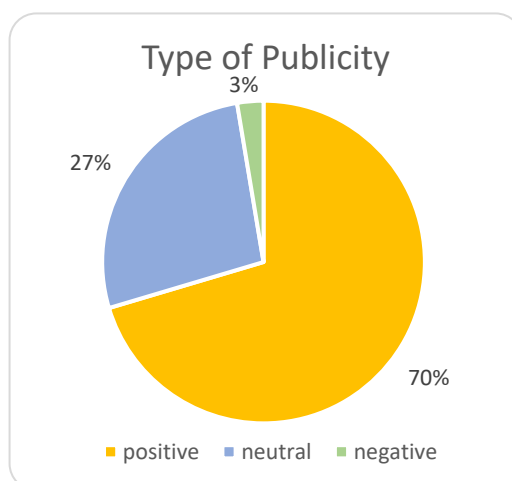
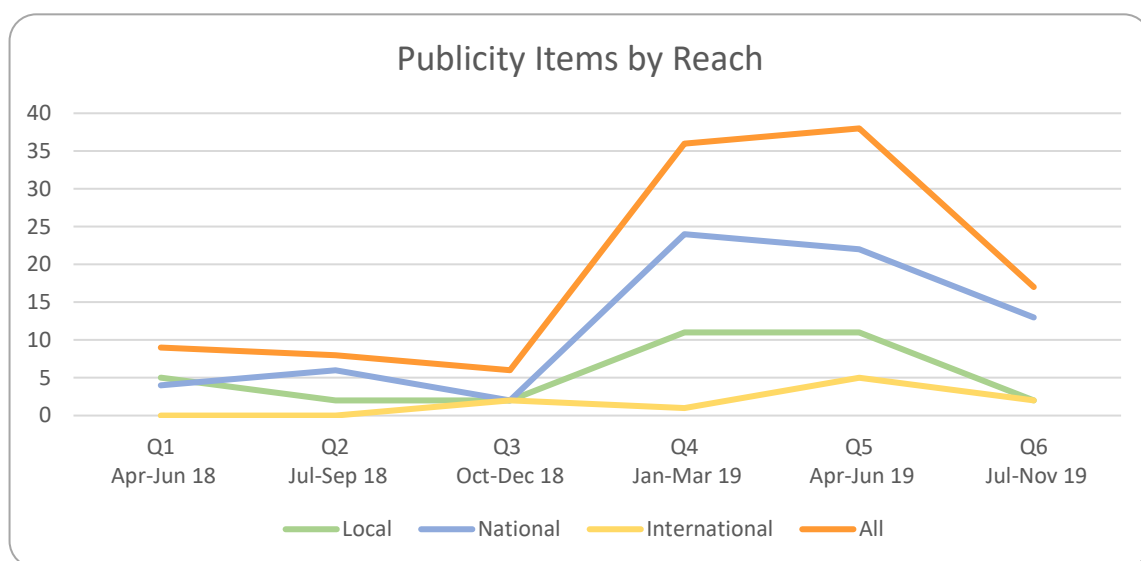
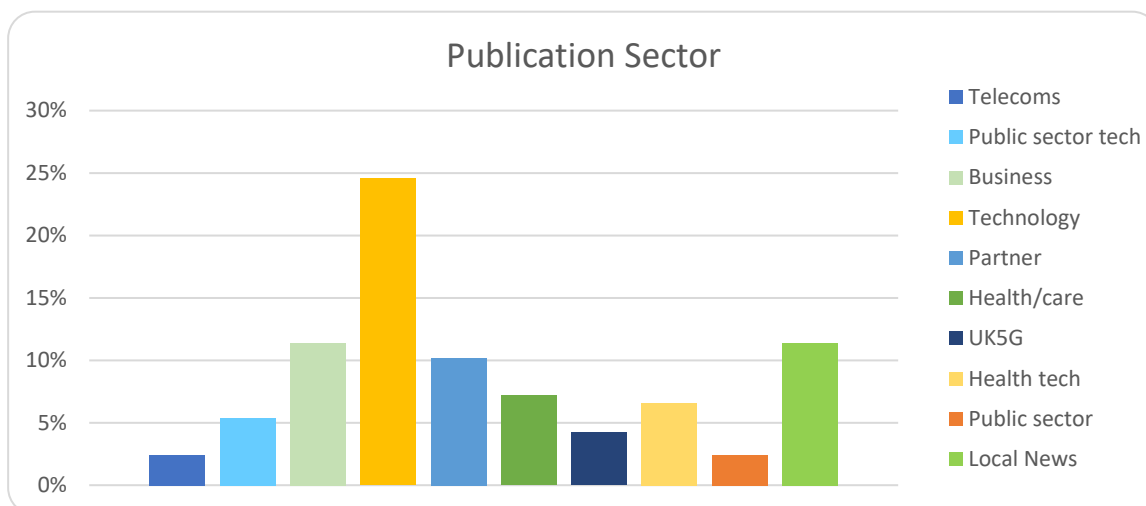
#### 3.8.3.2. Provider Feedback

The care provider, Chinese Wellbeing, were keen to understand the data to help them care for their service user in a more responsive manner. In reality, although the trial proved that the technology worked, the interface with the care organization would need to be developed further for the care providers to make effective use of the readings.

## 4. Publicity and Dissemination Outputs

### 4.1. Press and publication coverage

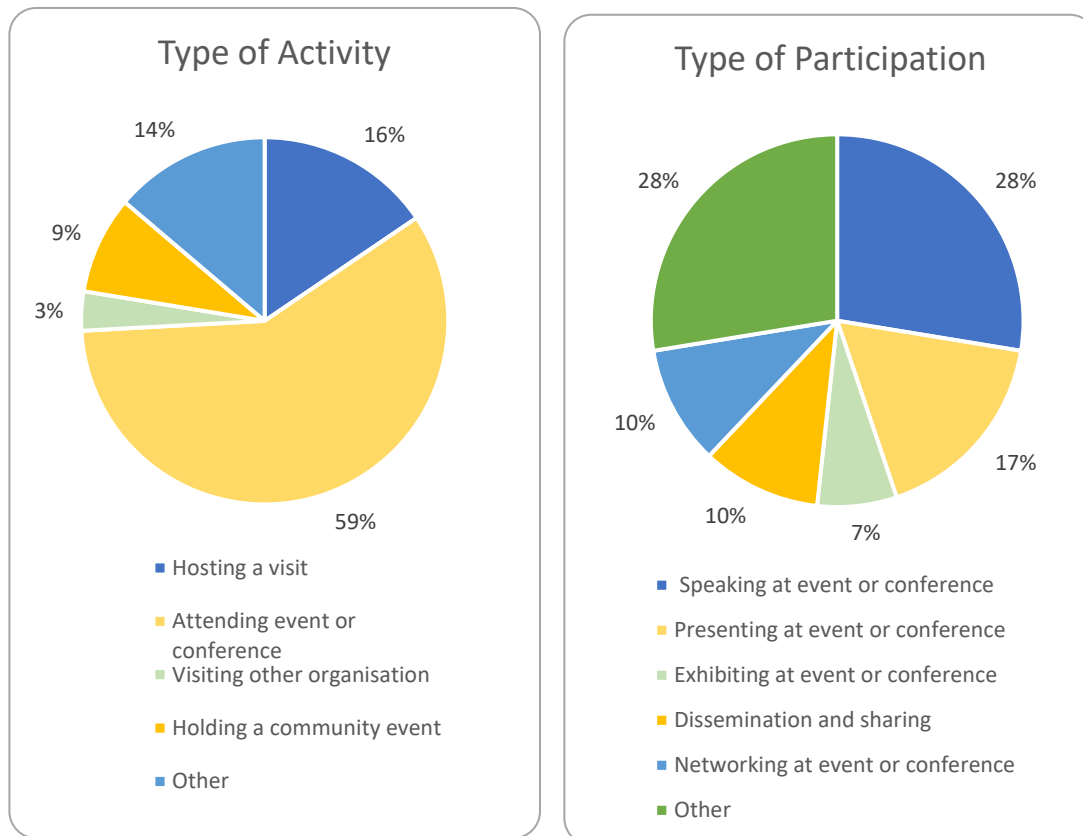
- Liverpool 5G Health and Social Care testbed mentioned in over 160 press and media articles.



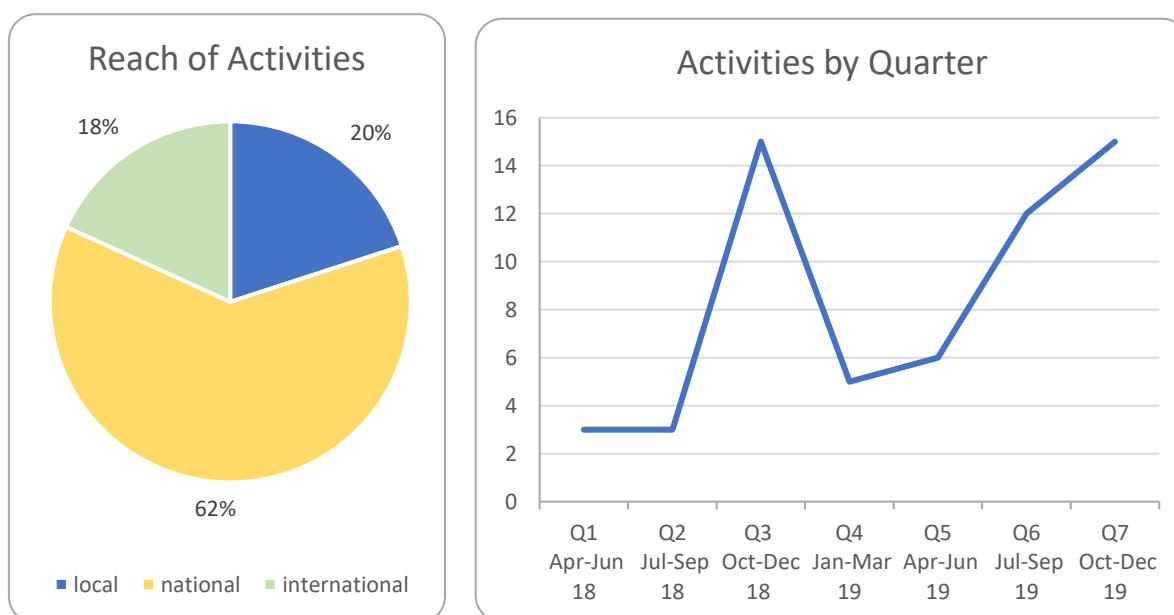


## 4.2. Events and Dissemination

- Liverpool 5G Health and Social Care testbed took part in over 56 events and dissemination activities
- At 45% of these, a representative of the consortium was a speaker or gave a presentation



- Over 60% of activities reached a national audience, and 20% an international audience



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- <sup>1</sup> DCMS Community Life Survey 2017-18: <https://www.gov.uk/government/statistics/community-life-survey-2017-18> Question 49
- <sup>2</sup> ONS guidance on UCLA three-item loneliness scale  
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- <sup>3</sup> A connected society: A strategy for tackling loneliness, DCMS 2018  
[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/750909/6.4882\\_DCMS\\_Loneliness\\_Strategy\\_web\\_Update.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/750909/6.4882_DCMS_Loneliness_Strategy_web_Update.pdf)
- <sup>4</sup> DCMS Community Life Survey 2017-18: <https://www.gov.uk/government/statistics/community-life-survey-2017-18> Question 45
- <sup>5</sup> DoH: Relationship between Wellbeing and Health, 2014  
[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/295474/The\\_relationship\\_between\\_wellbeing\\_and\\_health.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/295474/The_relationship_between_wellbeing_and_health.pdf)
- <sup>6</sup> Why Digital Inclusions Matters to Health and Social Care <https://digital.nhs.uk/about-nhs-digital/our-work/digital-inclusion/digital-inclusion-in-health-and-social-care>
- <sup>7</sup> Number of visits x £37.00 per GP visit. From PSSRU (personal social services research unit) Unit Costs of Health and Social Care 2018, Page 127, 10.3b General practitioner unit costs: Per surgery consultation lasting 9.22 minutes = £37 <https://improvement.nhs.uk/resources/reference-costs/#rc1718>
- <sup>8</sup> Medication Non-Adherence Among Elderly Patients Newly Discharged and Receiving Polypharmacy  
Pasina, L., Brucato, A.L., Falcone, C. et al. Drugs Aging (2014) 31: 283.  
<https://doi.org/10.1007/s40266-014-0163-7>
- <sup>9</sup> [https://www.sps.nhs.uk/wp-content/uploads/2018/03/Medication\\_Safety\\_Programme\\_BW\\_June\\_2018.pdf](https://www.sps.nhs.uk/wp-content/uploads/2018/03/Medication_Safety_Programme_BW_June_2018.pdf) and <https://digital.nhs.uk/blog/transformation-blog/2018/transforming-pharmacy-services-with-technology> and <https://www.pharmaceutical-journal.com/learning/learning-article/medicines-related-admissions-you-can-identify-patients-to-stop-that-happening/11073473.article?firstPass=false> and <https://www.bmj.com/content/329/7456/15>
- <sup>10</sup> Based on actual costs from NHS cost per item from NHS Electronic Drug Tariff
- <sup>11</sup> Liverpool City Council hourly carer rate: £15.16  
<http://councillors.liverpool.gov.uk/ieListDocuments.aspx?CId=1201&MID=16770#AI135366>
- <sup>12</sup> NHS Improvement: National Schedule of Reference Costs 2017-2018  
<https://improvement.nhs.uk/resources/reference-costs/#rc1718> NHS Reference costs for hospital services: Non-elective inpatient stays (short stays) - National average cost = £626
- <sup>13</sup> NHS: <https://www.nhs.uk/conditions/stress-anxiety-depression/raising-low-self-esteem/>



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<sup>14</sup> Using 4(A) from Adult Social Care Outcomes Framework 2018-19

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<sup>15</sup> <https://www.takingcharge.csh.umn.edu/why-personal-relationships-are-important>

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<sup>17</sup> Retrospective observational study of the impact on emergency admission of telehealth at scale delivered in community care in Liverpool, UK

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