Selwyn Telehealthcare Pilot: Research Report

Dr Karen Day,   The University of Auckland

k.day@auckland.ac.nz

Hilda Johnson,   GM- Selwyn Institute for Ageing and Spirituality

Acknowledgements

Citing this report

Cite this report as:

Day K, Johnson H. Selwyn Telehealthcare Pilot: Research Report. Auckland, New Zealand: Selwyn Institute for Ageing and Spirituality; April 2016.

Contents

Executive summary

Background

As longevity improves, more people develop long term health issues such as diabetes, airways disease and heart issues, to name a few. The Chronic Care Model (1) shows that healthcare professionals, e.g. doctors and nurses, should be prepared and proactive, and patients should be informed and activated so that productive interactions can happen.

Telehealth (technology-mediated healthcare from a distance) (2) shows promise in helping people track and record their healthcare plan, and progress and outcomes, and also give easier access to care via communications technologies, e.g. videoconference, in order to improve their overall wellbeing. People with long term health issues are at risk of avoidable hospitalisations, reduced life expectancy and quality of life. Anyone who is associated as a care giver is at risk of increased stress, anxiety and exhaustion. Caregiver burden is a strong indicator of hospitalisation of those for whom they care.(3) Telemonitoring has been shown to have an impact on preventing hospital admissions, reducing length of stay, and improving health outcomes.(4) Gee et al (5) have adapted the Chronic Care Model to explicitly frame it in ehealth terms, which includes telehealthcare.

The Selwyn Foundation proposes to establish a telehealthcare service for older people with long term health issues to help keep them living independently at home. The first step is to establish if such a service is appropriate and will work well when supplied by the Foundation. A pilot has been conducted. The broad objectives of the pilot were to

- Assess the functionality of the preferred telehealth system, equipment and service
- Develop internal capability and operational understanding of the preferred system (Telehealthcare by Feros).

The following research questions were examined:

1. Determine whether Telehealthcare technology could assist people with chronic conditions to remain at home longer and reduce avoidable acute admissions by
    i. Providing and supporting more continuous targeted care of people in their homes
    ii. Improving safety, independence and lowering the anxiety of people, their carers, and families
    iii. Reducing social isolation
    iv. Reducing carer burden

2. Determine whether telehealth technology can help people effectively manage their chronic condition by

      i.   Putting them in charge of their own health outcomes

     ii.   Providing early intervention and triage based on clinically determined thresholds

    iii.   Improving client / clinician partnership

3.   Improving client confidence through the reassurance of immediate regular feedback of relevant health indicators.

Methods

To answer the research questions we

- Recruited people 60 and older to participate, with their clinician's sign-off (NOTE 'Clinician' is defined in this research as the primary doctor, e.g. GP or specialist, caring for the participant regarding their long term health issue).

- Installed telehealth equipment in participants' homes after consenting processes were completed and a nurse assessment was conducted to determine individual needs. Equipment was installed according to participants' individual needs.

- Provided Telehealth services which consisted of participants using a touch-screen telehealth monitoring tablet and integrated vital signs measuring devices. The participants collected daily vital signs and answered health related questions. Results were automatically and securely transmitted to a secure triage website where they were monitored by the Selwyn Foundation's Telehealthcare nurses for triage monitoring. The Telehealthcare nurse would connect with participants using the same device's teleconferencing ability to discuss any health related issues. In addition the collected participants' health data were sent to their clinicians.

- At the end of the pilot surveys and interviews were completed with participants, their clinicians and the telehealth nurse to measure the success of the pilot.

Results

1. *Assisting people with chronic conditions to remain at home longer and reduce avoidable acute admissions*

Data revealed that aspects of this measure were achieved as described in the points below.

    a. *Providing and supporting more continuous and targeted care in people's homes*
       Patients could be discharged early from hospital and monitored safely from home. The daily measurements and discussions with the telehealth nurse kept the

patient safe and raised self-awareness about their health experiences. The PACIC and interview findings revealed that people developed a clearer understanding of their care plan and were more confident about taking care of their health.

b. *Improving safety, independence and lowering the anxiety of people, their carers, and families*

Participants received guidance from the telehealthcare nurse when making a decision to see a doctor or go to hospital, which reduced unplanned hospital or doctor visits. These decisions were made at an earlier stage than participants had done in the past.

Participants felt safe and cared for. They felt less anxious about their health, as shown in the Perceived Health Competence Scale, and more confident about their self-care decisions. Participants were helped to embed their treatment plan into their lives, gained insight into the effect of their actions on their health, and felt more involved.

c. *Reducing social isolation*

In our findings we note that social isolation changed with respect to how confident participants felt about their health. They felt more confident and therefore more able to participate socially. They also felt more energetic, in less pain, more active, and less bothered about their emotional and physical health. The interviews revealed a picture in which those who were isolated because of their health issues had re-emerged socially (“*I was hiding*”). Telehealth was less stressful and more convenient for participants than going to hospital or visit their doctor.

d. *Reducing carer burden*

We were unable to establish if carer burden existed because only two carers took part in the research.

e. *Helping people effectively manage their chronic condition*

The telehealthcare service helped people effectively manage their health issues. Participants learned about themselves, the meaning of their daily measurements, and how to make appropriate decisions about seeking help from their GP or hospital.

f. Putting patients in charge of their own health outcomes

The clinicians indicated that since the patient is the most important person in health care, they should be in the centre and telehealthcare achieved this. Telehealthcare supports self-care in terms of greater self-awareness and ability to adjust treatment plans to match daily activities. Participants felt more competent over time while using the telehealthcare service.

g. Providing early intervention and triage based on clinically determined thresholds

Participants had opportunities to talk about appropriate visits to the doctor or hospital earlier than a patient is likely to go. Conversations led to the discovery of additional issues or misunderstandings, e.g. a diabetic patient learning to match activity with food intake.

h. Improving client/clinician partnership

Improvement of the client/clinician partnership was most obvious in the interviews when participants described their relationships with the telehealthcare nurses. The ease with which the nurses linked participants to additional support services, helped solve their problems, and helped them decide to see a doctor or go to hospital, and how they made self-care activities fun, could influence how people relate to their doctor after the telehealth service was discontinued. The clinicians indicated that they found it easier to see if their patients were coping, especially knowing that the ones who had been discharged from hospital were being safely monitored.

i. Improving client confidence through the reassurance of immediate regular feedback of relevant health indicators

Participants became more confident about how they handled their health issues as they became more self-aware because of the monitoring. They became more disciplined about doing their measurements because it "*was like Weight Watchers….you can't cheat*". Others learned new insights as they discussed their measurements with the nurses.

Unexpected findings

As with any research, there were some unexpected findings, which included

- Telehealthcare as a step down service from hospitalization.
- Telehealthcare as a means to collect data about a patient to refine a treatment plan.
- The importance of the telehealth nurse's training, background, network, and interpersonal skills is key to the success of telehealthcare.

Conclusions and recommendations

We set out to determine if telehealthcare technologies and processes could (1) assist older people with long term health issues remain at home longer and reduce avoidable acute admissions, and (2) help older people effectively manage their long-term condition. The results show that the telehealthcare service was able to assist people remain at home and reduce avoidable acute admissions, and that older people learned to manage their long-term conditions. Unexpected findings include discovering the value of using telehealthcare as a step down service from hospital, the ability to collect data to refine long-term conditions care plans, and the importance of the telehealth nurse's training, background, network, and interpersonal skills in the success of a telehealthcare service.

The following recommendations are noted.

- Subject to the success of the pilot the Selwyn Foundation is considering implementing telehealthcare as a service to people living with a long-term disease in the community.
- The enrolment and clinical processes should be documented, and policies be designed to enable and support a sustainable service.
- Since care giver burden was not measured and is a strong indicator for hospitalisation, it would be useful to do so in the future should the opportunity appear.
- Future research should take advantage of larger numbers to be able to draw strong conclusions about the effectiveness of the service in terms of outcomes.
- Careful selection of telehealthcare nurses is central to the success of a telehealthcare service. It is recommended that a specific job description is written for telehealthcare nursing, starting with the competencies outlined in the literature.

In summary, we set out to see if telehealthcare could be delivered as a service to older adults with long term health issues, and we showed that it could be done. Telehealthcare makes a difference in terms of keeping older people independent and out of hospital, and in control of their health.

Introduction

As longevity improves, more people develop long term health issues such as diabetes, airways disease and heart issues, to name a few. The Chronic Care Model (1) shows that healthcare professionals, e.g. doctors and nurses, should be prepared and proactive, and patients should be informed and activated so that productive interactions can happen.

Telehealth (technology-mediated healthcare from a distance) (2) shows promise in helping people track and record their healthcare plan, and progress and outcomes, and also give easier access to care via communications technologies, e.g. videoconference, in order to improve their overall wellbeing. People with long term health issues are at risk of avoidable hospitalisations, reduced life expectancy and quality of life. Anyone who is associated as a care giver is at risk of increased stress, anxiety and exhaustion. Caregiver burden is a strong indicator of hospitalisation of those for whom they care.(3) Telemonitoring has been shown to have an impact on preventing hospital admissions, reducing length of stay, and improving health outcomes.(4)

As people age and their health deteriorates there is a need for ongoing care in the home environment to support them.(6) For many, an option is care support that is available in residential aged care facilities, but research does not reflect what role, if any, telehealth could play in preventing people from requiring additional nursing support in that kind of setting. It is usually assumed that telehealth is initiated and managed as a service or mode of service provided by District Health Board (DHB) hospitals or outpatient clinics, or Primary Healthcare Organisations (PHOs). Recent research based in New Zealand settings (urban hospitals and rural primary care) shows that quality of life, self-efficacy and disease-specific measure did not improve significantly. What was significant was that patients became more active in self-care as a result of raised self-awareness and the sense of safety and feeling more cared for.(7)

In New Zealand, health and care services are primarily provided by the government, free at the point of care, i.e. in hospitals and associated services. Primary care is semi-private and patients pay a co-payment for services. Non-governmental organisations supplement these services, and private aged care services are available, e.g. retirement facilities such as Selwyn Foundation. Some of the services provided by such organisations include rest homes, hospital care, medication management, falls prevention, and other care giver services. Telehealthcare could play a role in the context of these services, and help people age at home, support self-care of long term health issues, identify problems and/or exacerbations

early and address them, and assist people to make decisions about seeing a doctor or going to hospital.

Aims and objectives

The Selwyn Foundation proposes to establish a telehealthcare service for older people with long term health issues to help keep them living independently at home. The first step is to establish if such a service is appropriate and will work well when supplied by the Foundation. A pilot (feasibility study) has been conducted. The broad objectives of the pilot were to

- Assess the functionality of the preferred telehealth system, equipment and service
- Develop internal capability and operational understanding of the preferred system (Telehealthcare by Feros)

The following research questions were examined:

1. **Determine whether Telehealthcare technology could assist people with long-term conditions remain at home longer and reduce avoidable acute admissions by:**
   a) Providing and supporting more continuous targeted care of people in their homes
   b) Improving safety, independence and lowering the anxiety of people, their carers, and families
   c) Reducing social isolation
   d) Reducing carer burden.

2. **Determine whether telehealth technology can help people effectively manage their long-term condition by:**
   a) Putting them in charge of their own health outcomes
   b) Providing early intervention and triage based on clinically determined thresholds
   c) Improving client / clinician partnership
   d) Improving client confidence through the reassurance of immediate regular feedback of relevant health indicators.

To answer the research questions we

- Recruited people 60 and older to participate, with their clinician's sign-off (NOTE 'Clinician' is defined in this research as the primary doctor, e.g. GP or specialist, caring for the participant regarding their long term health issue).
- Installed telehealth equipment in participants' homes after consenting processes were completed and a nurse assessment was conducted to determine individual

needs. Equipment was installed according to participants' individual needs, daily vital signs were collected and monitored by the telehealth nurse, and trend reports were sent to their clinicians. Arrangements were made to initiate/respond to videoconference calls from participants, and respond to alarms.

- Collected surveys and interviews from people and their clinicians about self-efficacy, perceptions of care, and changes in access to care and care processes, and experience with the technology.

Methods

This was a mixed methods exploratory study to establish the effectiveness and feasibility of providing telehealthcare services to older people with long term health issues. The research question is: 'What benefit does telehealthcare offer older people living with long term conditions at home?'

Who was involved?

We aimed to recruit older people with health issues, their usual clinicians, and their caregivers to participate in this study. They included:

- 20 people with long term health issues, such as diabetes and respiratory/heart issues. These people were recruited from services primarily associated with the District Health Boards and some primary care practices in the Auckland region.
- The doctors who usually take care of the participants with long term health issues.
- Two caregivers participated, as only two participants had caregivers.
- Two telehealth nurses were recruited to provide telehealthcare services, with one of the nurses filling the project management role as well.

Inclusion criteria

The criteria for recruiting participants with long term health issues included

1. Aged 60 years and over,
2. Cognitively intact and able to consent to participation and use telemonitoring equipment (as determined in the nurse assessment prior to installation of the equipment)
3. Residing in a location with adequate cellular network coverage, and
4. Deemed clinically appropriate for telemonitoring by their GP or specialist, i.e. it was deemed clinically safe for them to participate in the research.

The telehealthcare package and intervention

A suite of services and associated equipment was installed in participants' homes, according to their individual needs, as per the nurse assessment. They consisted of vital signs monitoring and videoconference equipment. Internet service for 4G capability was installed in all the participant clients' homes to ensure consistency with the telehealthcare service.

"My Health Clinic at home" - The Telehealth Monitor

The telehealth monitoring consists of the participant using a touch-screen telehealth monitor (tablet) which is integrated with a set of vital signs measuring devices (thermometer, blood pressure monitor, weighing scales, blood glucose monitor, and pulse oximeter). The participant interacts with the monitor in response to voice prompts in the form of a health interview.

The health interview

At a scheduled time each day, the participant conducted their health interview using the touch screen monitor/tablet. The interview prompted the participant to use each measuring device in a pre-set order. It then asked a series of questions tailored to the participant's condition(s). Each of the measuring devices transmitted its results to the monitor/tablet. Once the health interview was completed, the vitals and participant's responses to health questions were automatically and securely transmitted via the Internet to a secure triage website where they were monitored by Selwyn Foundation's Telehealth nurses.

Triage Monitor

Each day the triage nurses reviewed the participants' health data on the secure website. The nurses used each participant's vital sign measurements and responses to health questions to assess his or her health status. If the participant failed to complete their scheduled interview, or if any of their measurements fell outside of their normal range (as set by the participant's usual doctor), the system provided clear alerts to the nurse on the triage screen. The nurses determined if a follow-up phone or videoconference call to the participant was required. The nurse may escalate the call to the participant's usual doctor/case manager, providing the clinician with a graphical report of trends in client vitals. This service was available during office hours and was not a 24/7 emergency support.

Video conferencing

The participant could use the monitor to accept and initiate video conference calls. The technology facilitates secure video conferencing with participants' doctors. This was explored with the referring doctors at ADHB. Although they were willing to attempt it, the

service could not be made available within the timeframe of this study. The technology also supports personal video calls between participants and family and friends, but this use was not tested at this pilot.

"Lifelink" - Telecare smart home technologies

The Feros Care Lifelink provides a range of environmental, movement and personal triggers that automatically ring through to an emergency response centre 24/7. Different types of sensors, e.g. inactivity sensors, bed and mat sensors, environmental sensors and personal alarms, can be set up according to the client's situation and risk factors. The sensors are linked to a system that generates daily charts of activity which can be viewed online. Certain triggers can be set up to alert the response centre which will forward the alert as predetermined to either the carer, neighbour or emergency agency. Devices and equipment have been chosen for their user-friendliness and are easy to install in an existing home. They connect wirelessly and communicate over the mobile network.

This installation was not done because all but three participants already had a medical alarm service. The organizational decision was to not affect usual care, and replacing an existing alarm monitor amounted to affecting usual care. The three people who did not have a medical alarm installed were offered the service, but declined, saying that because they lived with family they did not need the service.

What was involved for participants

Each participant was issued a small touch screen computer tablet (Figure 1).

Figure 1: Monitor for entering data

They were also issued with monitoring devices that were deemed appropriate by their doctor, such as weighing scales, pulse oximeter, blood glucose monitor, sphygmomanometer, and/or thermometer (Figure 2).

Figure 2: Devices used for scheduled vital sign measurements

At a set time(s) each day the participant pressed the 'vital signs' button on the tablet's screen to take their recordings, as can be seen in Figure 3, where a person is interacting with a telehealthcare nurse while doing the self-monitoring activities. They were then prompted to answer long-term condition specific questions around their general wellness. They touched a 'yes' or 'no' button on screen to get audible and visual responses. The Selwyn telehealthcare nurse received the results sent through wirelessly to the triaging software programme prior to the daily video conference with each participant to see how they are managing.

Figure 3: Demonstration of telehealthcare

Video conferencing could also be set up with the client's GP, consultant, case managers as part of the person's individual programme. This was not done in our study.

The telehealthcare process, as depicted in Figure 4, involved video interviews between participants and the telehealthcare nurse, self-monitoring activities, follow up (when required), and proactive health management by both the nurse and patient.

1. Daily Health Interview
Client prompted to conduct their interview answering relevant health questions and measuring vital signs using the Telehealth devices and monitor.

4. Proactive Management of Health
A visit to the GP may be necessary, or some other minor adjustment of lifestyle.

2. Telehealth Triage Monitoring Station
Readings and responses transmitted securely to the monitoring station to be analysed by registered nurse.

3. Follow Up
If any of the readings or responses are outside of the Client's normal or acceptable ranges (as defined by the Client's GP), a follow up call to the Client is instigated. If necessary the registered triage nurse will escalate to the Client's GP.

Figure 4: Telehealth care process

Ethical approval

Ethical approval was granted by the Health and Disability Ethics Committee on 20 May 2015, reference number 15/NTB/84.

Gathering the research data

Since this was a small study, involving a small number of people with long term health issues (rather than a single health issue, e.g. respiratory issue) and a single vendor's telehealth monitoring equipment, it was designed to be multi-faceted to enable rich data collection and rich descriptive analysis.

Participants: People with long term health issues

People with long term health issues were recruited from GPs and hospital specialists. Informed consent was completed. Each person was assessed by the telehealth nurse for suitability (clinically and personally) to telehealthcare. Equipment was installed in their homes according to their needs. Participants were trained on how to use the equipment. Ongoing support was supplied to ensure they could continue to use the technology appropriately.

Once the equipment was installed participants were asked to complete a survey that was compiled from validated questionnaires. These included:

- Quality of Life Measure (8),
- Perceived Health Competence Scale (9),
- Perceptions of quality of care delivery (PACIC or Patient Assessment of Long-term Illness),
- Computer competency (10),
- Interviews with the participants about their experience with the telehealthcare service, and
- Some questions used in a Feros research project about ease of use of the equipment and aspects of the service provided (11).

During the time they were using the telehealthcare service participants completed the self-monitoring activities. Their data was sent to the telehealth nurse, who uploaded the trend reports generated by the triaging software onto the Shared Care Records for their doctors to access and view. This data was used for the participants' planning of care, and to assess if the telehealth made a difference to health outcomes. The telehealthcare nurses communicated with the participants' doctors if and when clinically required, or indicated that the participant should make an appointment to see their clinician for additional care.

Participants were also asked to note when they had appointments with their doctor/s, attended emergency services or were admitted to hospital.

At the end of the six months planned for their telehealthcare usage (or when telehealth was deemed no longer necessary, whichever happened first), participants were invited to complete the research questionnaires again as well as to participate in an exit interview in which they were asked about their experience with the telehealthcare service.

Clinicians of participants

Recruitment of participants resulted in nine clinicians who forwarded the 20 participants (their patients) for the study. At the beginning of the study, clinicians were asked to provide clinical diagnoses of their participating patient and any other clinical data deemed relevant by the clinician. The usual doctor for each participant was asked to define the vital signs parameters to be used in the telehealthcare service. These parameters were used by the telehealth nurse to triage daily if a person needed additional care. When the study ended, i.e. when all participants had finished using the service, their clinicians (specialists and GPs) were asked to complete a survey. The questionnaire contained questions about the telehealth service (11).

Caregivers

We anticipated that several participants would have care givers (e.g. family or friends or paid care givers). Only two participants had caregivers and they completed a questionnaire measuring the burden of care (3) at the time that their care recipient started using the telehealthcare service. We did not receive a completed repeat of this questionnaire from these care givers at the end of the use of telehealthcare service.

Data from the technology

The technology keeps an audit trail of alarms that were set off, videoconference usage, daily data collections and issues arising from the technology and its software, e.g. bugs. The data from the technology was not collected for this study.

Nurse field notes

Field notes were kept by the telehealth nurse about incidents, technology support requests and repairs of technology problems, and any other observations about how participants were using the telehealth service, observations about how clients were coping with the service. This is reported in the operational report.

Data analysis

Questionnaires. The 'before' and 'after' questionnaires were paired and compared. Data were analysed descriptively to observe and describe any emerging patterns. The results were descriptively analysed for indications that

- Clients became more confident about their health and quality of life, and they felt less socially isolated
- Caregivers felt a different burden of care (we anticipated that the burden would appear lighter but the number of participants with a carer was big enough to draw conclusions), and
- The telehealth service was perceived to be useful by health professionals.

Field notes by the research nurse were used to support the analysis of the questionnaires.

The interviews were qualitatively analysed for patterns and insights into the participants' experience of the telehealthcare experience. This analysis was conducted in an Excel spreadsheet.

Results

Five Hospital specialists and GPs identified 20 patients. One person referred herself because a friend was participating but after a week withdrew when she realized that her blood pressure did not require monitoring as her health was already stable. Recruitment began in June and the first participant signed up on 8 July and began using the service on 14 July. The last participant discontinued the service on 18 December.

According to Figure 3: Number of days of telehealthcare service for participants the shortest duration was eight days, and the longest was 5 months and two weeks (156 days). Almost a third of participants (seven) used the service for four and a half months (120 – 134 days). We had planned to enroll participants for a duration as close to 6 months (180 days) as possible but certain factors influenced the duration that added to our learning.

1. Participants used the service according to clinical need and some were discharged from the service after an appropriate number of days,
2. One participant used the service for a fortnight to collect measurements that otherwise were not reasonable to collect, i.e. blood pressure readings twice a day
3. Another participant was monitored for a short period after hospital discharge while her diabetes stabilized.
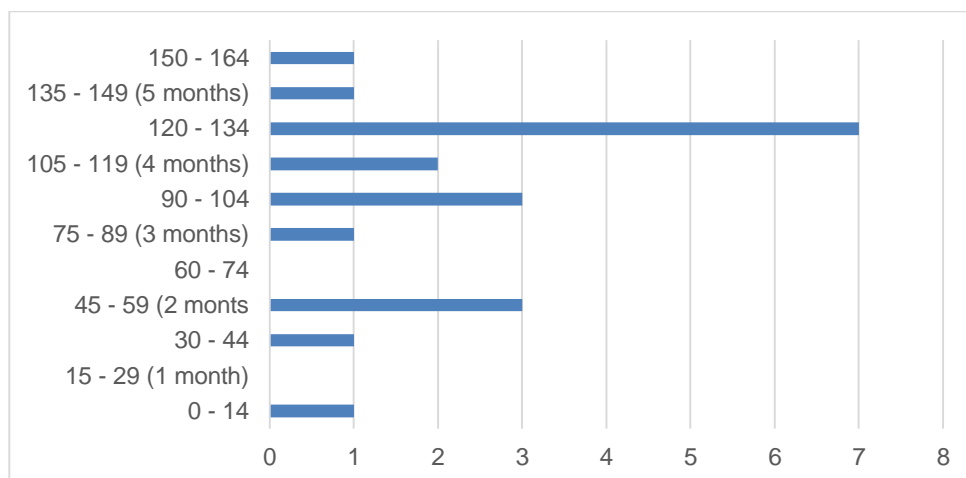
Figure 3: Number of days of telehealthcare service for participants

Summary of nurse assessment

Before Selwyn Foundation could commit to providing a telehealth service to individuals, each person needed to be assessed clinically to establish the appropriateness of health monitoring from a distance. All twenty people were recruited via hospital services and general practices.

Life circumstances and demographics

The demographics of the group include age, gender, and ethnicity. There were 17 women and three men enrolled in the study. Their ages ranged from 61 to 90 years with the majority of persons between 70 and 84 years old. (Figure 4: Age range of participants).
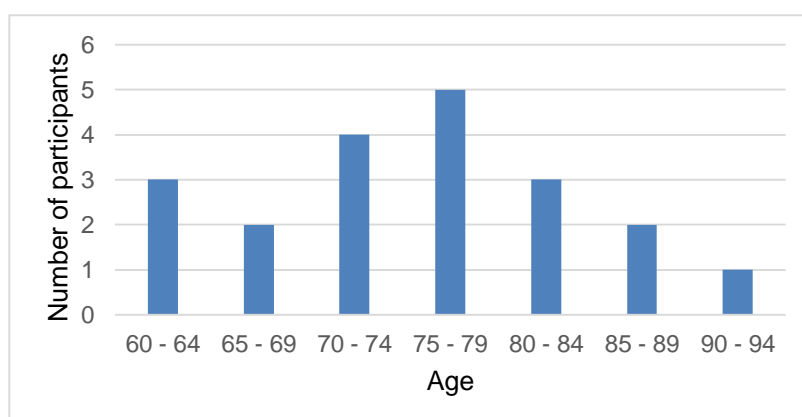
Figure 4: Age range of participants

The participants identified with ethnicities as per Figure 5: Distribution of people who identified with ethnicities. As expected (12), NZ European dominated, followed by Maori. If we had recruited more people, we may have found more identifying with other ethnicities. We used the Statistics New Zealand census question to ask about ethnicities.
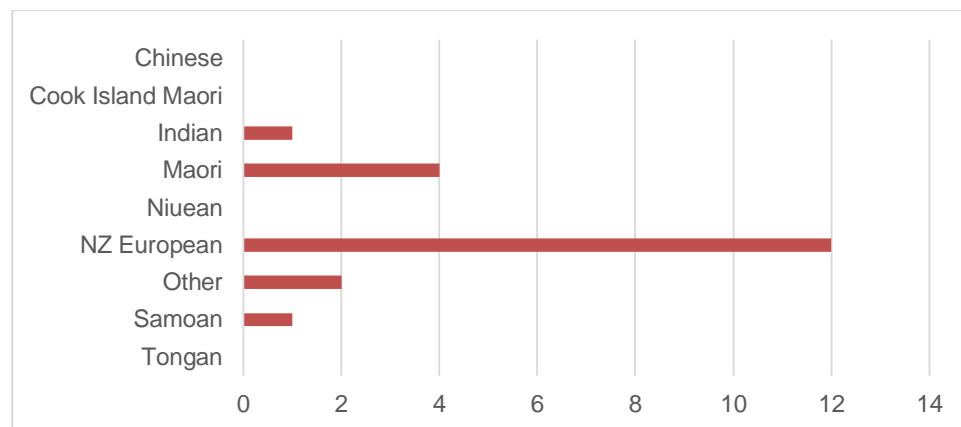
Figure 5: Distribution of people who identified with ethnicities

With the exception of one person, all spoke English as their main language. The Samoan person requested an interpreter as she/he spoke Samoan as the main language.

Most of the participants owned their own homes (15/20). Five lived in rental homes. Four of the homes were multi-story buildings. Twelve people lived alone. Nine people indicated that they didn't live alone; they lived with a close family member as demonstrated in Table 1.

**Table 1: Who participants live with**

Who	Number
Daughter and grandchildren	1
Husband	3
Husband and granddaughter	1
Son	1
Wife	2
Wife and daughter	1

Health profile

### *Diagnoses and medications*

Since participants were recruited via hospital and GP services, they already fitted the health profile required for the research by the time the nurse assessment appointment was made, i.e. over age of 60, with at least one long term health issue, and living in metro Auckland.

Three participants were living in a Selwyn Retirement Village in their Independent living unit. Participants' health issues were grouped according to the list in Figure 8. The number of persons affected by COPD and blood pressure issues dominated the group. Most participants had Co-morbidities as demonstrated by the total number of 54 health issue entries for 20 people.
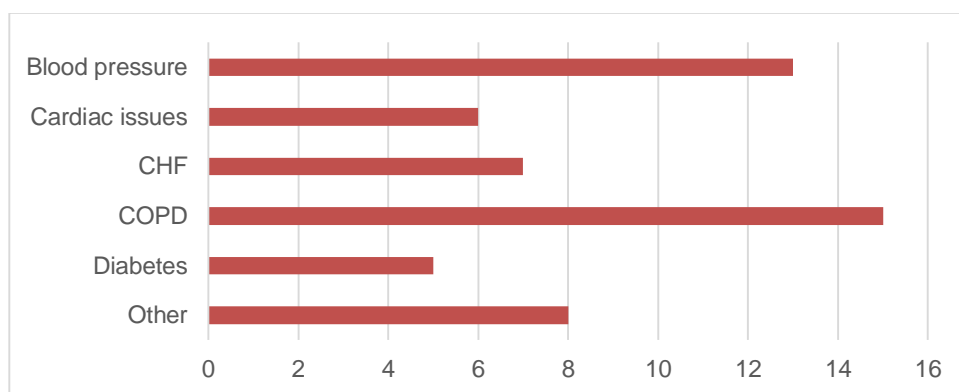
Figure 6: Diagnostic groupings of participants

Following the listing of their health issues, we asked about their medications. The number of medications prescribed indicates a high degree of polypharmacy (more than five medications). The more co-morbidities a person has, the more likely they are to have polypharmacy. The co-morbidity pattern from Figure 8 shows up in the nine people who are taking five or more medications (Figure 9).
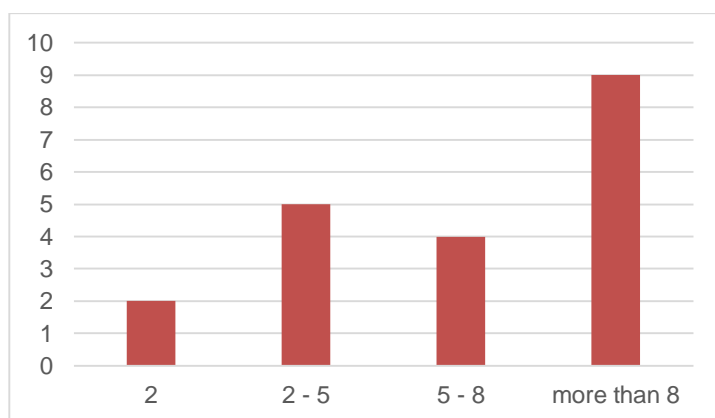
**Figure 7: Number of medications taken by participants**

Medication management appears to be mostly in the hands of the person taking the medicines, with one person's care giver helping, one person self-managing by using a Dosette box, and seven people using Webster packs (9 use original packs and 17 self-manage). There is a combination of methods (35 responses by 20 people), e.g. someone self-managed by putting their medicines into a Dosette box. There were six responses to the question asking if there were any issues about taking medicines. Two indicated there were no issues, two indicated that a close family member measures their oral Morphine. One participant was not taking any medication treatment and *'doesn't want to start antihypertensives'*. Another participant recently started using Morphine for back pain and felt dizzy from the medication.

In response to the question about allergies/adverse reactions to medications, 12 persons said they had no allergies or adverse reactions, and five did not answer the question. Of those who reported they had reactions,

- One described a rash with Tegretol and Sulfonamides, and that she/he is unable to use NSAIDs due to a gastric ulcer,
- Another indicated that she/he gets vasculitis when taking certain anti-hypertensives (but did not name these medications)
- The third person gets thrush when on antibiotics, while codeine phosphate makes her/him nauseous and Symbicort gives her/him headaches.

Health services utilization

Participants were asked what other services they already in place. Only seven participants said they had a long-term disease management plan (which may have influenced their answers to the PACIC questionnaire). Figure 10 shows what services were already in use by participant and shows that the highest number used home based support services.
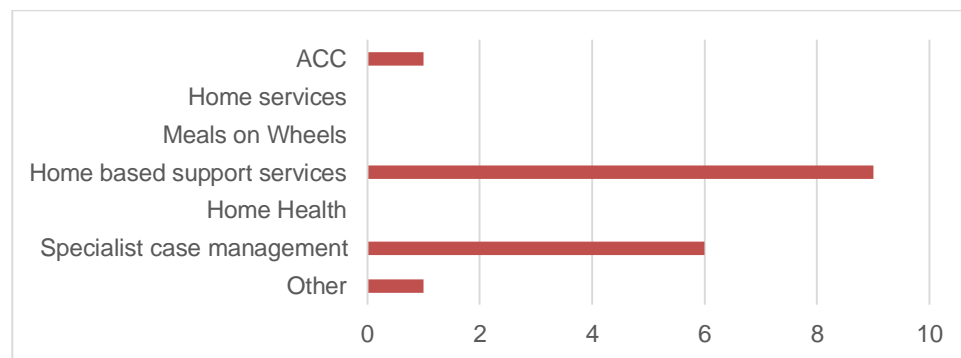
Figure 8: Services already in use by participants

In addition we asked how often in the six months leading up to their participation in the study, participants had used the following health services: hospital admissions, Accident and Emergency room attendance (A & E), General Practitioner, and specialist appointments. This was compared against the utilization of the same services during their use of the telehealthcare service (Figure 11).
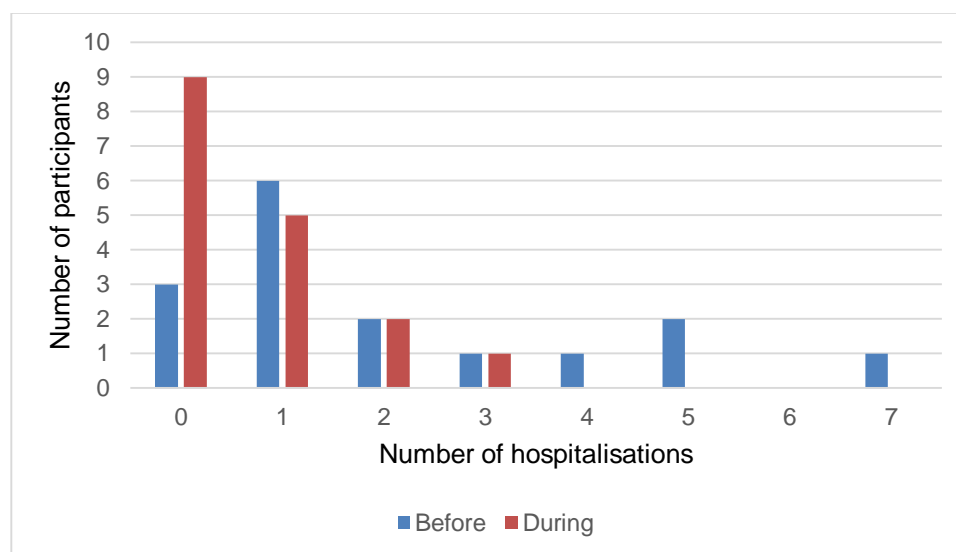
Figure 9: Hospitalizations before and during telehealthcare

Since some of the participants had only used the telehealthcare service for a fortnight, this graph may be misleading. From Figure 9, it appears that more people did not go to hospital during the service than went in the six months prior. Since we are not comparing two six month periods, no conclusions can be drawn.

A comparison with the interview data reveals that one person had spent every winter in hospital and that due to the telehealthcare service had not been in hospital for the winter that spanned the service. Another participant was monitored after discharge from hospital, thus actively avoiding re-hospitalisation for what was at the time unstable diabetes.

General Practitioner (GP) visits
We asked about visits to their GP six months before and during the telehealthcare services to see if the service affected the frequency of these visits. Figure 12 shows a shift to fewer GP visits. Because of the variable duration of the service, we are unable to conclude from the answers to this question if frequency of visits to GPs were reduced.

The nurse field notes and the exit interviews revealed that people changed how they decided to make an appointment to see their GP, rather than to avoid or delay seeing the

GP. One participant indicated that she was encouraged by the telehealth nurse to see her doctor when she would have waited a little longer. In which case she would have been sicker when finally making the appointment. Another participant indicated that she received help from the telehealth nurse in making a decision to see the GP and learned new ways of deciding to see the doctor.

The time intervals in Figure 12 reflect how participants report the frequency of their visits to the GP, e.g. '2 – 3 times a month' or '3 to 5' times (we did not provide an interval list because we did not know what to expect for the answers).
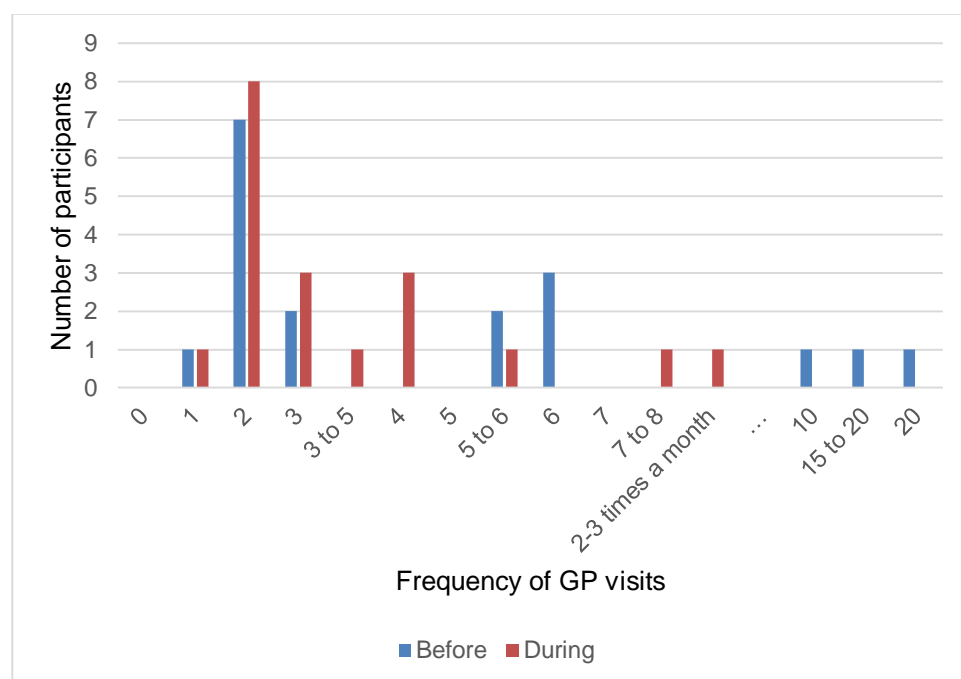
Figure 10: Visits to GP before and during the service

Specialist visits

No significant change appeared to happen with visits to specialists, as can be seen in Figure 13, bearing in mind the reservation that comparison between a before period of six months and variable periods during the service is not feasible.
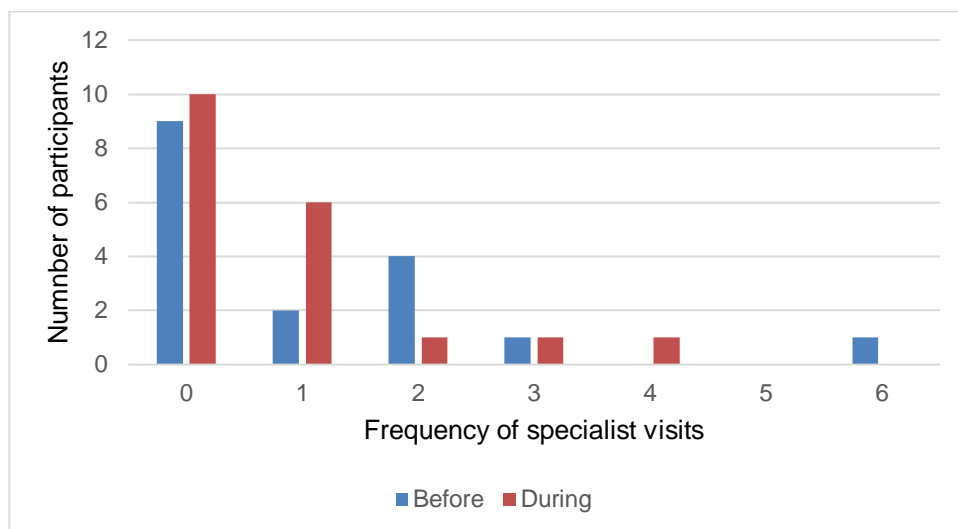
Figure 11: Specialist visits before and during telehealthcare service

Accident and Emergency (A&E) department visits

A&E visits did not appear to change between the before and during periods (Figure 14). The same reservation about variability of service duration applies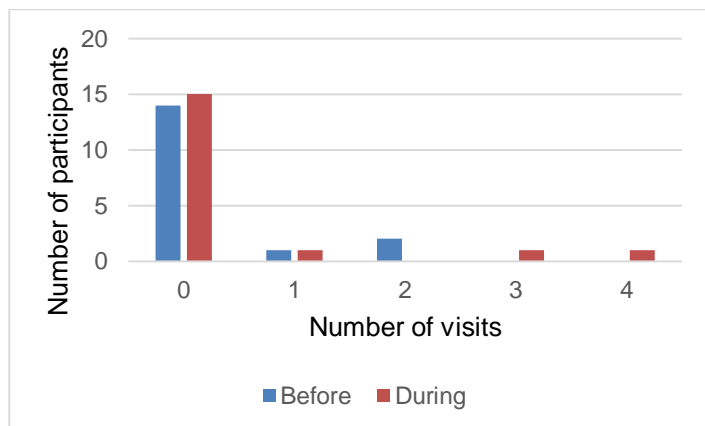 to this analysis, therefore conclusions should be drawn with caution. We did not ask specifically about Emergency Department visits (in hospitals), assuming that participants considered these to be hospital visits.

Figure 12: A&E visits before and during telehealthcare service

While it is difficult to draw conclusions about any before and during periods from the questionnaires the interviews revealed that some participants had not gone to hospital when they normally would have expected to, and others changed how they made their decisions to go to hospital or make an appointment to see their GP or specialist.

Senses, mobility and cognitive status

A nursing assessment about their senses, mobility, and cognitive status was conducted. When asked what communication devices participants used, of the nine who responded, seven said that they don't use communication assistive devices, one uses large text when reading, and one is 'very deaf in left ear'.

Vision

Participants were asked what vision issues they had and their responses (Figure 15) differed from the sensory assessment of their eyes (Figure 16).
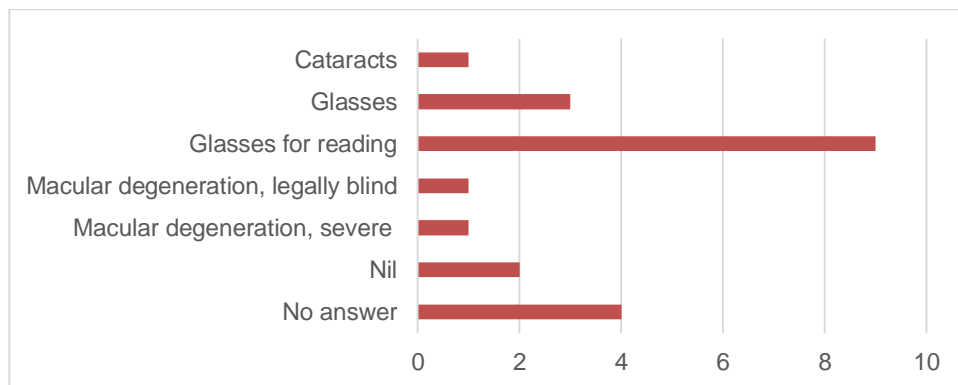
Figure 13: Self-reported issues with vision

When assessed in more detail about their eyes, a clearer picture emerges. When asked earlier if they have issues with vision, only eight responded that they wear glasses, but here 14 people wear glasses. This could be that eight participants used reading glasses and six used glasses for other reasons. Three people have macular degeneration – two were in the early stage of the condition and one was legally blind. At least one person (the legally blind person) could possibly have had difficulty with the touch screen technology. In the interview with this person, she said that although it was frustrating at times, she was able to use the touch screen. The monitor was set up with very large font and the answers (yes and no) to the questions were always in the same place on the monitor, which made it possible for this visually impaired person to participate.
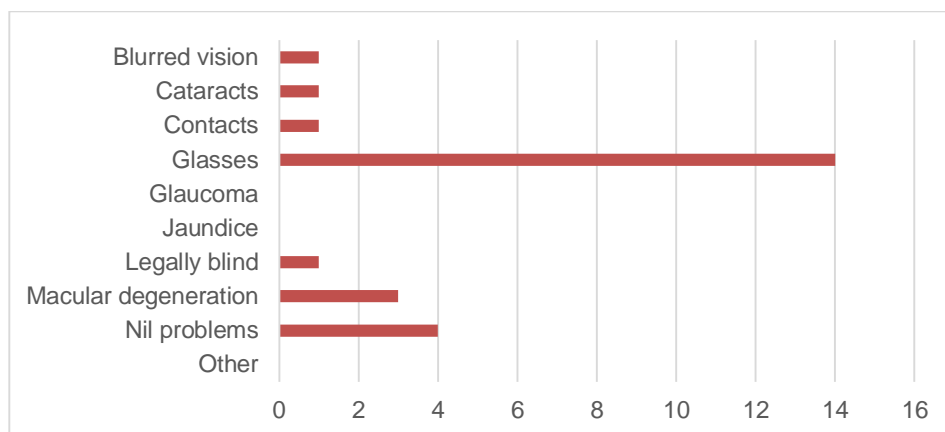
Figure 14: Sensory assessment of participants' eyes

Hearing

Eighteen (of 20) participants said they have no issues with their hearing (Figure 17). One has tinnitus. Two have hearing loss but are not using hearing aids. These latter two participants could have issues with the voice questions in the technology, but it appears that they managed well (as per the nurse field notes and the interviews). We did not do a detailed hearing test on them to match their hearing ability to the technology's voice. The exit interviews revealed that only one person had appeared to have an issue with hearing. This issue was with one of the nurse's accent and not with the technology.
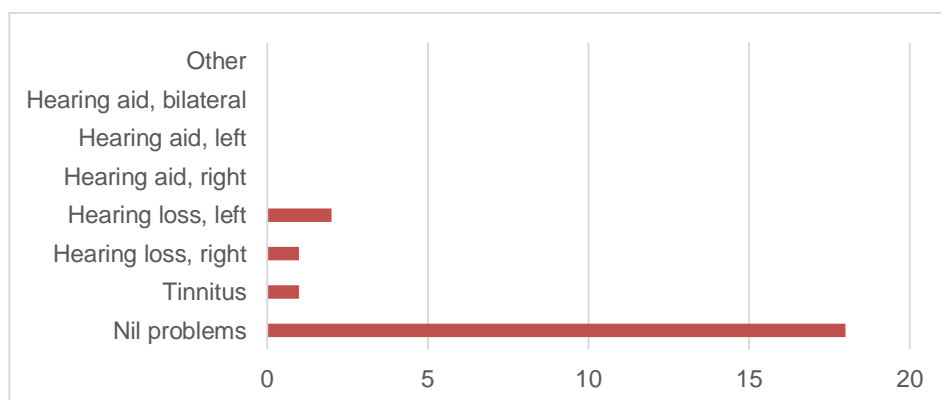

Figure 15: Sensory assessment of participants' ears and hearing

Mobility

In terms of ability to move around without assistance, there were combinations of limited movement, weakness, stiffness, unsteadiness (total of 32 responses) as seen in Figure 16. One person, when asked if physical assistance was required for telemonitoring, said yes.

Cognitive status

They were all orientated to time, place and person, with the exception of one person not being orientated to time and person at the time that the question was asked. The cognition and memory loss question showed one person struggling with short term memory loss and one person who has had episodes of confusion. One of these two people was cognitively borderline and forgetful, requiring some reminder calls from the nurses. Their ability to understand instructions was good (15), adequate (4) and poor (1), and one did not respond. The care plan for the person who was poor at understanding instructions was simplified and only one measurement (her weight) was prioritised.
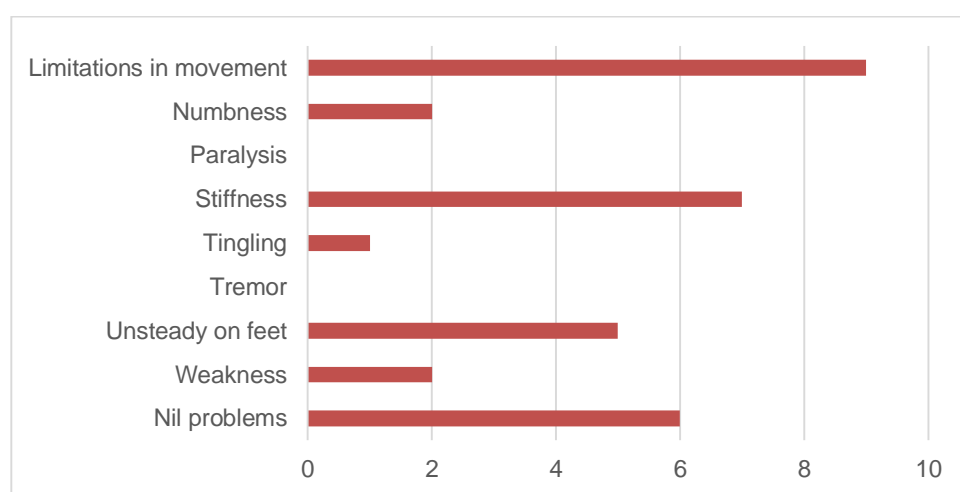
Figure 16: Mobility assessment

Twelve people could step on and off scales independently (only those whose diagnosis required weight measurements were asked about stepping onto scales). It was deemed safe for eleven to use scales, and not safe for one person. That person had a walking frame (but no grab rails) and a carer to help.

Technology assessment

The question about attitude to the technology revealed that 12 people had a good attitude, 7 were adequate, one had a poor attitude, and one did not respond. It is possible that there is a selection bias here where people were selected who accepted the use of technology for health purposes. No record was kept of any telehealth suitability assessment by done by the hospital clinicians and general practices during their recruiting activities. Thus we don't

know how many people were concluded to be not suitable for the project on the basis of their attitude and or skills about technology.

Regarding technology, the participants had suitable environments for installing telehealth services and equipment:

- 11 of the 20 participants had cell phones
- All had 4G internet available to their address, which was installed by Selwyn Foundation for the purposes of this research
- Power points were readily available where the telehealth kit was to be installed
- There was enough space to set up the kit
- And the person had somewhere to sit while using the kit

In total 81 devices were installed in 20 homes (Figure 1: Monitor for entering data; Figure 2: Devices used for scheduled vital sign measurements). They included tablets for people to enter data and do videoconference appointments with the telehealth nurse. The biometric kit was distributed as per Figure 17: Biometric equipment installed for participants. Many participants had more than one device installed (this detail is in the operational report).
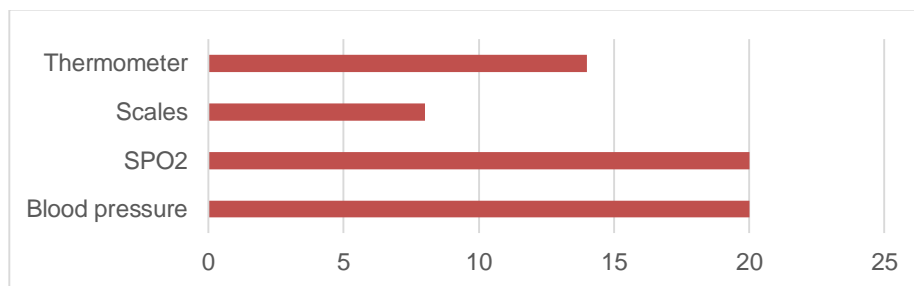
Figure 17: Biometric equipment installed for participants

Participants chose a time of day to take their daily measurements. They were given a range from 8.00 am till 1.00 pm for appointments with the telehealth nurse and were required to do their measurements before this appointment. Some had appointments every day, while others had appointments on certain days of the week or weekly, depending on their need.

The results that follow reflect the questionnaires that were completed by clients before and after use of the telehealthcare service.

Participants' approaches and views about their health and care

Views about their health

Participants were asked about their views on their own health.

Overall, the people who participated in the research had a low sense of health competence that improved towards the end of the programme. The graphs that follow compare the before and after answers to the questions.

As expected, no-one rated their health as excellent before (Figure 20). This was primarily because the people selected for the research project were selected because of their health issues and could benefit from telehealthcare. There were two people who rated their health as 'very poor' and no-one rated their health as 'excellent'. The telehealthcare service aimed to manage and reduce risk and therefore did not include people at high risk of becoming 'very poor' during their participation in the project. It appears from Figure 18: Rate your health, before and after that there is a general shift by one level of improvement from very poor. Two participants reported that they now had excellent health. This pattern appears in all the questions about health perceptions.

Figure 18: Rate your health, before and after

In Figure 19: How physical health problems affect activity, before and after it appears that two people feel unaffected by their health (they may be the two who indicated that they are in 'very good' health above). The balance of the participants fit the profile of candidates who could benefit from telemonitoring, i.e. that their health affects their ability to do physical activities. It is interesting to note that the five participants who could not do physical activities before has been reduced to one person after the service. Two people were not

affected by their health issues before, and after participating in the service eight responded to feel unaffected by their health issues.
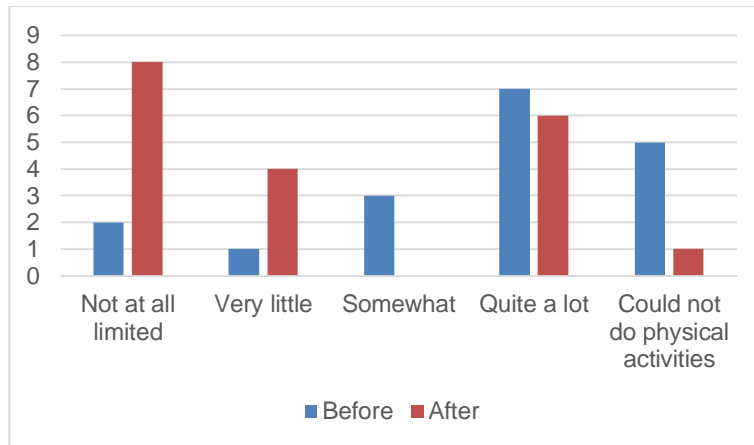
Figure 19: How physical health problems affect activity, before and after

The ability to do daily work (Figure 20: How physical health affects daily work, before and after) is similar to the effects of their health issues on physical activity (Figure 19: How physical health problems affect activity, before and after). Although most of the participants were retired, and we did not ask them if they were working, they answered this question as if their daily activities were a form of daily work. Similarly as to the effects of their health on physical activities we see a shift from six participants saying they could not do daily work, to one participant at the end of the service answering that she/he could not do daily work.
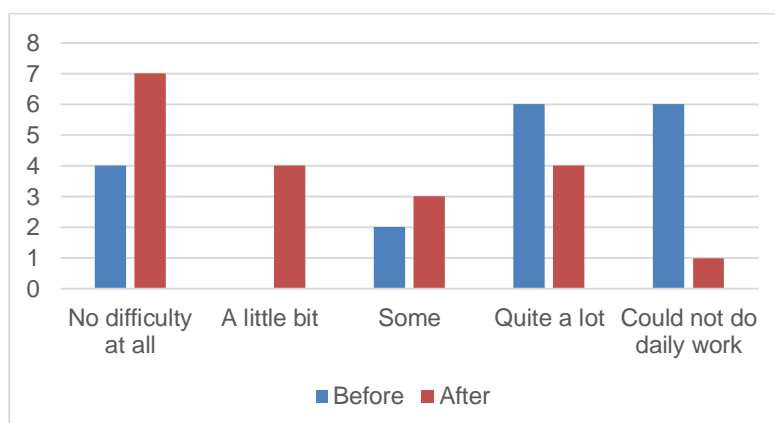
Figure 20: How physical health affects daily work, before and after

Seven respondents (as per Figure 21: Differences in bodily pain) had severe to very severe pain. This remained unchanged after the service was used, although the graph does not show if the 'before' persons were the same participants as the 'after' persons. The interviews revealed one person on Morphine who required assistance to adjust the dose and therefore the effectiveness of the medication. It is interesting to note that moderate pain was reduced and four participants shifted to a pain free state.
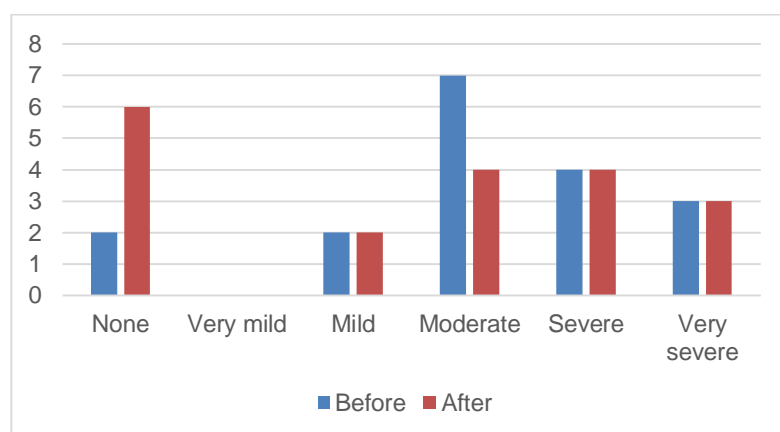
Figure 21: Differences in bodily pain

The energy profile (Figure 23: Social limitations due to health problems, before and after) appears to fit with the pain profile in Figure 21: Differences in bodily pain, and the ability to get on with work and daily physical activities (Figure 20: How physical health affects daily work, before and after). These graphs appear to be building a profile of respondents who were mostly not well (11 perceived their health to be less than 'good'), are limited in daily physical activity, and whose health affects their ability to get on with daily work.
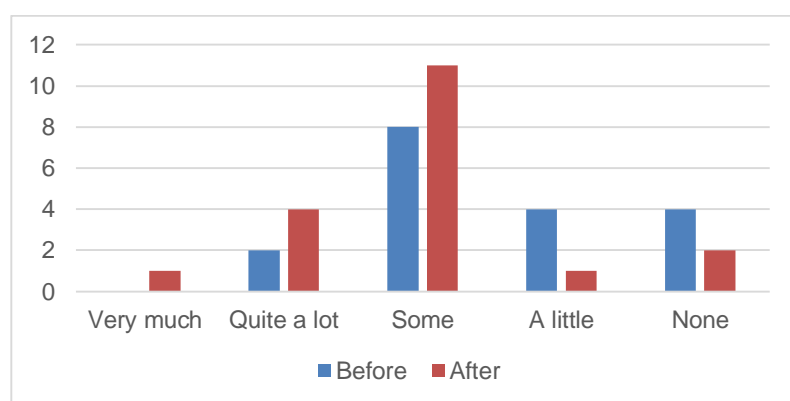
Figure 22: Energy levels before and after

In response to the question, 'How much did your physical health or emotional problems limit your usual social activities with family or friends?' participants indicated a reduced effect on their social activities, i.e. an ability to participate more socially. This aligns with the shift in their energy (Figure 22: Energy levels before and after) and the positive shift in confidence in their health (Figure 18: Rate your health, before and after).
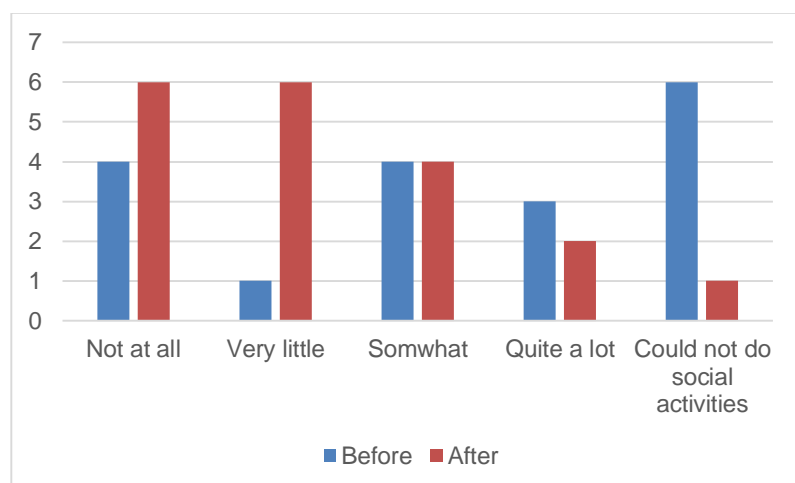
Figure 23: Social limitations due to health problems, before and after

In contrast, Figure 24: Bothered by emotional problems, before and after shows an inverse response to these limitations – 13 people were not significantly bothered by their emotional limitations and this number of persons who were not significantly bothered grew to 18 after using the telehealthcare service. The interviews revealed that one participant was so bothered in the beginning that 'I was hiding' and was pleased that she had been able to become more socially active. Another interviewee did not seem bothered at the outset, and remained unbothered, indicating that his wife would sort out any issues, e.g. knew when to take him to hospital.
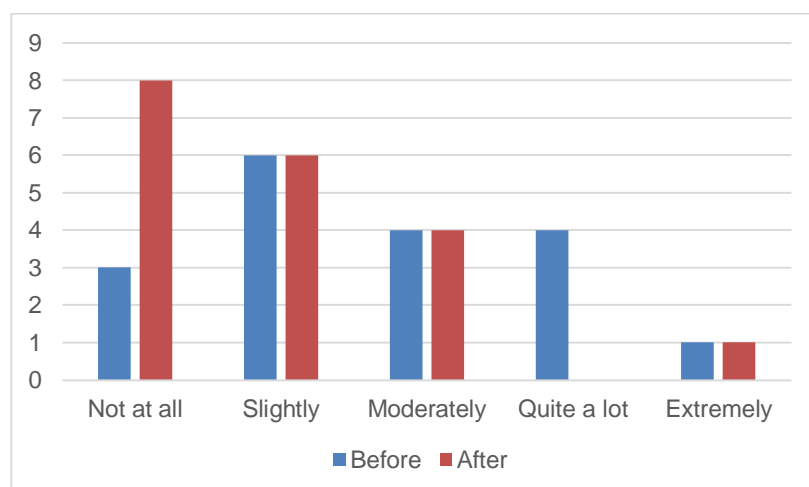
Figure 24: Bothered by emotional problems, before and after

In response to the question about how personal or emotional problems kept participants from doing their daily activities or work, we see the same shift to improvement as indicated in the rest of the questions (Figure 25: Personal and emotional problems and usual activities, before and after). This fits the rest of the profile in which more than half the respondents rated their health as less than 'good', they experienced moderate to severe pain, experienced difficulty with daily activities/doing work, and had low energy before the telehealthcare service. This improved after use of telehealthcare.
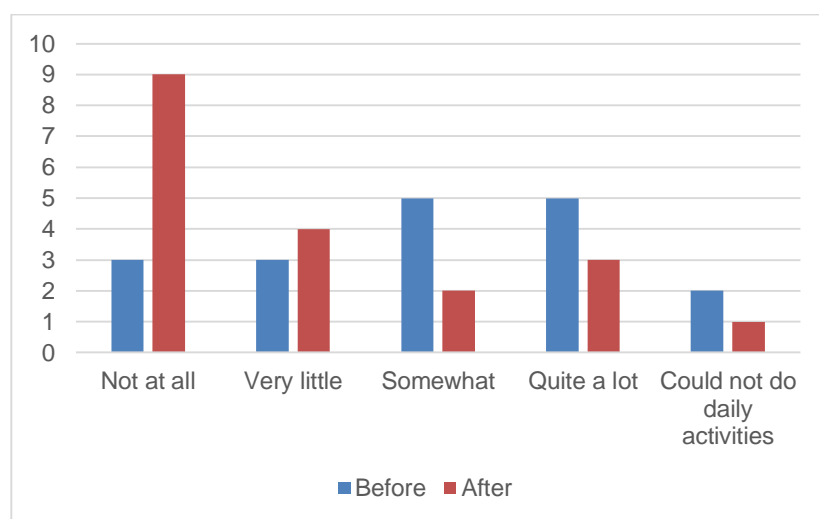
Figure 25: Personal and emotional problems and usual activities, before and after

Summary:

In summary, participants perceived their health as moderate, with some participants indicating that their health was poor and it affected their daily activities and social interactions. This improved after using the telehealthcare service.

In the next section, the results are presented about perceptions of health competence.

Perceptions of health competence

Although we had diagnoses supplied by participants' clinicians, we wanted to know how competent participants felt about their health, and if the telehealthcare service improved their perception of competence. We used the Perceived Health Competence Scale [7] for these measurements. These data show small improvements in some questions.

Due to the small number of participants in the study, statistical analysis of this questionnaire cannot be conducted. The Central Limit Theorem states that statistical analysis is best performed on studies with large numbers of participants, preferably more than 25. One can dichotomize the table to see if a stronger pattern emerges, i.e., simplify the Likert scale by collapsing the five items into three and have only 'agree', 'not sure', and 'disagree'.

By dichotomizing the scale, the results show no change except for questions 4, 5, and 8, where a small improvement was noted. However, as can be seen in Table 2: Before and after perceptions of health competence, the main shift occurred from 'agree' to 'strongly agree'. If only the 'strongly agree' and 'agree' columns are examined, then questions 1, 3, 4, and 8 show an improvement. Question 5 indicates a shift from a distribution of answers from before, becoming concentrated on 'agree' after.

Summary

It appears that participants began to feel more able to accomplish their health goals after participating in the telehealthcare service.

Table 2: Before and after perceptions of health competence

			Strongly agree	Agree	Not sure	Disagree	Strongly Disagree
1	I handle myself well with respect to my health	Before	3	13	2	0	0
		After	9	7	2	1	0
2	No matter how hard I try, my health just doesn't turn out the way I would like	Before	5	9	1	1	2
		After	6	9	0	4	0
3	It is difficult for me to find effective solutions to the health problems that come my way	Before	7	3	1	6	1
		After	3	6	2	8	0
4	I succeed in the projects I undertake to improve my health	Before	2	11	1	4	0
		After	6	10	1	2	0
5	I'm generally able to accomplish my goals with respect to my health	Before	3	7	3	4	1
		After	4	12	1	2	0
6	I find my efforts to change things I don't like about my health are ineffective	Before	3	7	2	5	1
		After	0	8	4	6	1
7	Typically, my plans for my health don't	Before	2	5	2	8	1

	work out well						
		After	2	5	3	8	1
8	I am able to do things for my health as well as most other people	Before	3	9	3	2	1
		After	6	9	2	2	0

PACIC (Patient Assessment of Chronic Illness Care) results

The PACIC questions were asked to see if participants felt a change in how their care was delivered to them (Table 3: Comparing before and after for PACIC questions). Again, the sample number is too small for statistical analysis. Therefore no conclusions can be made about significant differences.

Small improvements are noted for questions 5, 6, 7, 13, 18, 19, 22, and 25. This means that participants felt they were more satisfied with how their care was organized (Q5), were shown how their healthcare actions influenced their health (Q6), and invited to discuss their health goals (Q7). They indicated a difference in being helped to make a treatment plan to fit into their daily activities (Q13), and were referred to additional services, e.g. dietitian (Q18). Participants shifted from 'almost never' to 'almost always' in the question about being told how their visits to other doctors/specialists helped their treatment (Q19).

Table 3: Comparing before and after for PACIC questions

			Almost never	Generally not	Sometimes	Most of the time	Almost always
1	Asked for my ideas when we made a treatment plan	Before	5	3	3	2	5
		After	4	2	4	5	4
2	Given choices about treatment to think about	Before	3	4	6	1	4
		After	1	2	8	3	5
3	Asked to talk about any problems with my medicines or their effects	Before	4	3	4	2	5
		After	2	2	3	5	7
4	Given a written list of things I should do to improve my health	Before	5	4	2	5	2
		After	4	3	3	5	4
5	Satisfied that my care was well organised	Before	0	2	1	11	4
		After	0	1	1	8	9
6	Shown how what I did to take care of my health issue influenced my condition	Before	2	6	3	3	3
		After	2	2	5	6	4
7	Asked to talk about my goals in caring for my health issue	Before	3	4	5	3	3
		After	4	1	2	4	8
8	Helped to set specific goals to improve my eating or exercise	Before	6	1	2	7	2
		After	4	2	4	5	4
9	Given a copy of my treatment plan	Before	8	2	2	3	3
		After	5	3	5	2	4
10	Encouraged to go to a specific group or class to help me cope with my health issue	Before	4	3	4	3	3
		After	4	6	3	3	3
11	Asked questions, either directly or on a survey, about my health habits	Before	6	3	2	4	3
		After	3	4	3	4	5
12	Sure that my doctor or nurse thought about my values and my traditions when they recommended treatments to me	Before	2	1	5	3	7
		After	1	1	4	4	9
13	Helped to make a treatment plan that I could do in my daily life	Before	3	2	5	5	3

#		Time					
		After	2	3	3	5	6
14	Helped me to plan ahead so I could take care of my health issue even in hard times	Before	5	2	3	4	3
		After	5	3	2	4	4
15	Asked how my health issue affects my life	Before	4	2	4	1	6
		After	4	2	2	3	6
16	Contacted after a visit to see how things were going	Before	7	2	2	4	2
		After	6	0	5	3	4
17	Encouraged to attend programmes in the community that could help me	Before	5	4	5	4	0
		After	1	5	6	5	2
18	Referred to a dietician, health educator, or counsellor	Before	11	3	2	1	1
		After	4	6	5	3	1
19	Told how my visits with other types of doctors, specialists, helped my treatment	Before	7	2	3	3	2
		After	4	4	4	2	5
20	Asked how my visits with other doctors were going	Before	7	4	1	1	3
		After	5	3	3	4	4
21	Asked how my work, family or social situation related to taking care of my health issue	Before	5	3	5	3	2
		After	6	3	4	4	2
22	Helped to make plans for how to get support from my friends, family or community	Before	4	3	4	5	2
		After	4	6	2	5	2
23	Told how important the things I do to take care of my health issue, (e.g. exercise) were for my health	Before	2	1	4	5	6
		After	0	5	1	9	4
24	Set a goal together with my team for what I could do to manage my condition	Before	4	4	2	3	5
		After	2	6	3	5	3
25	Given a book or monitoring log in which to record the progress I'm making	Before	3	2	7	2	4
		After	1	4	4	5	5

Participants indicated that there was more discussion on how to elicit support from family and friends (Q22), and that they were given ways to record daily measurements (Q25). Those participants diagnosed with heart failure were given log books after the service was discontinued to record their daily weights to show their doctor at the next appointment, when their telehealthcare was discontinued.

If the scale is dichotomized to 'generally not' (adding 'almost never' and generally not together), 'sometimes', and adding 'most of the time' to 'almost never' showed, the sensitivity of the shift is lost, but changes featured in the same questions as listed above. It would be useful to collect data from a larger sample in the future to see if this pattern persists.

Summary

In summary, it appears that telehealthcare could influence how people perceive the delivery of their care in terms of being able to participate in goal setting, care plan design, embedding treatments into daily living activities, being referred to additional resources, and getting guidance on how to elicit support from family and friends.
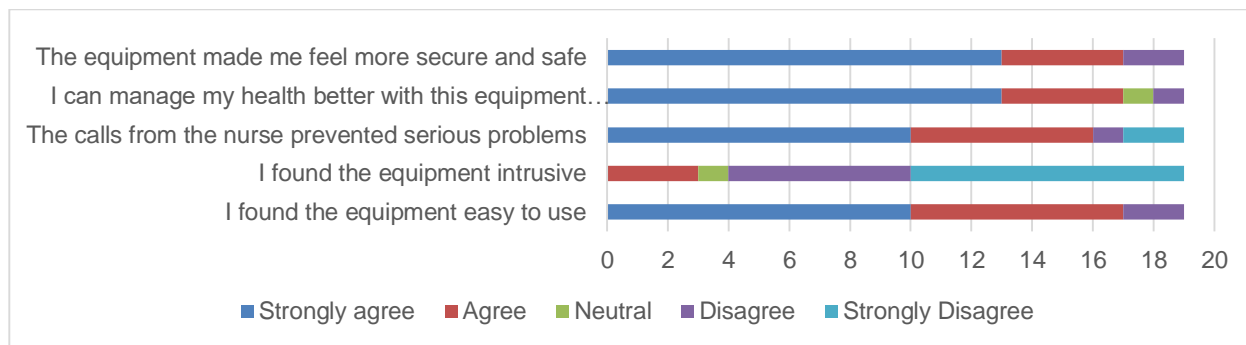
How telehealthcare worked for the participants

When participants exited the programme they completed a health-related questionnaire (same as the 'before' one) which included additional questions about how the service worked for them. As can be seen in Figure 26: How telehealth worked for the participants, participants felt strongest about how secure and safe they felt, and that they can manage their health better via the telehealthcare service.

Half the participants indicated that their regular discussions with the telehealth nurse prevented serious problems (but they did not indicate how in the interviews). It is interesting to note that the 'strongly disagree' option was chosen by two participants. It is possible that they may have felt that they were sufficiently in control of their health to not need a nurse to pick out any problems with or for them.

Three people found the equipment intrusive (strongly agree, and no 'agree'), and this may be accounted for by two participants finding it scary to use the equipment and one participant finding it stressful to use the equipment because it did not work as expected (this comes up in the interviews). Almost all the participants found the equipment easy to use as reflected in the interviews with the qualifier that they first had to get used to it.

Figure 26: How telehealth worked for the participants

Caregivers

There were two caregivers who completed the questionnaires. One was retired and the other a sickness beneficiary, aged 68 and 22 respectively. The former was the spouse of a participant and the latter a family member. During the interviews one of the participants indicated that she had a care giver who came in daily to help her (this person did not complete a questionnaire).

The caregiver questions revealed that the caregivers did not feel burdened by their role. They indicated that their care recipient was dependent on them, but that care giving did not affect their lives significantly. One care giver however felt emotionally drained and that care giving had affected their social life.

Clinicians

There were five clinicians who referred their patients to the telehealthcare service. Three responded to the questionnaire. Their responses were positive to all the questions. Since so few were included in the study, and even fewer responded to the questionnaire, we can only draw tentative conclusions.

When asked to elaborate on their responses in the free text boxes, the clinicians said that telehealthcare was a good opportunity for patients to learn more about self-care and how it impacts on their overall health, and cope better. Telehealthcare is a good opportunity for patients to learn to decide to go to a doctor early, before they become too sick and need to be admitted to hospital. Understanding their daily measurements and how they fit into parameters that are set for them, is expected to reduce anxiety about whether they need to see a doctor or not.

From a clinician's point of view, telehealthcare is good for post-discharge transition, especially for borderline patients who may have spent extra days in hospital without the service.

Telemonitoring could reduce anxiety for people who have just been discharged from hospital. They could feel safe, secure and confident. Videoconference is better than using the phone, especially when the clinician needs to do a visual assessment of their patient, e.g. wounds, subject to 'some limitations'.

The clinicians would recommend telehealthcare to their peers, subject to careful selection of patients (especially in terms of patient anxiety), and if the goal is to improve self-management.

Telehealthcare was noted to be a less costly alternative to GP visits (from the patient's cost point of view). They did not see their workload increasing, e.g. telehealthcare could be a substitute for home visits. Telehealthcare was seen as a valuable adjunct to usual care.

Clinicians were impressed by the 'simplicity of referral; comprehensive service and timely feedback'; that patients can be monitored after discharge from hospital; and that patients can 'learn to take control of their health issues'.

Only one comment was made about improving the service: 'Keep it going'.

Participant interviews

Short interviews, averaging around 10 minutes each, were conducted with 17 participants to hear about their experiences and gain feedback on what could be improved. The person who was enrolled (self-referral) in the programme for only eight days was interviewed and some good insights were gained. The remaining three participants were not available for an interview – one was ill at the time and another one was not available during the time we conducted the interviews. One declined an interview because she did not speak English well. The interviews were conducted via the videoconference equipment that was used for telehealthcare.

The questions that were asked included:

- How has this telehealthcare helped with your health?
- How has your health changed (if it has changed)?
- Has telehealth reduced your need to see a doctor or go to hospital?
- Was it easy to use the technology and do your measurements and do the videoconference discussion with the nurse/s?

- Would you recommend this service to others, e.g. family and friends?
- Was there anything that didn't work well and how did it get sorted out?

The interview findings showed up patterns with regard to how telehealthcare influenced their health and ability to do self-management, being able to make decisions that avoided seeing a doctor or being admitted to hospital, ease of use of the technology, and recommending the programme to others.

Health changed for participants in ways that did not show definitively that they were healthier. Half the respondents who reflected on the question about telehealth helping with their health were ambivalent (saying that they had a health issue that was not curable, and would always be with them) and others said that their health had changed but not markedly.

What did change was the development of a self-awareness of what their health was doing, and how to respond appropriately to what they have found out about themselves. They learned how to decide when to go to the doctor or hospital, in discussion with the telehealth nurse. In some instances participants were able to make a direct link between their daily measuring, these discussions, and a reduction in visits to the doctor or hospital. One person indicated that she/he had learned to compare today's breathing with other times when she/he had been aware of breathing issues, and whether it was worse today or yesterday. The nurse relaying the data back to the participant, with an interpretation of that data, which gives a sense of *'if you've dropped or gone up'* and know if this change is good or not. Another participant indicated that self-management has improved.

> *"I have been able to manage a lot better the things that I never use to be able to do which was manage my fluids and my own health. So I have been able to manage that with the help of telehealthcare, of this programme. And I have learnt a lot more about myself through this programme."*

Half the participants appreciated knowing they were being watched over by the telehealth nurse, and that they are not in this alone anymore, "*If I am crook I can get a hold of you people. And I don't feel alone anymore*" (75-year-old, with no family). One person was ambivalent, and the others did not say anything about being watched over. Those who appreciated being watched over were able to discuss their data with the telehealth nurse and decide what to do next, as indicated by a participant, "*I am more aware of when I should possibly be talking to the doctor or nurse.*" In contrast, another participant needed to discuss with the telehealth nurse whether to go to the hospital or not:

> *"I've got Dropsy as well and my feet swell with fluid and she will tell me, [name], your feet and legs are swollen, you ring your doctor. Go and ring your doctor. You know. Before I was just sitting here and doing nothing. I just thought it was part of my health and I couldn't do anything about it. [The nurse] showed me since when they get really bad I am to ring my doctor and go and see him you know."*

Two participants indicated that they had already been doing self-monitoring but the telehealthcare service made them more disciplined and more aware of the meaning of the data. There was an advantage in a nurse seeing the data and helping them decide on how to act on it. One person had been self-monitoring but found that if a telehealth nurse was waiting for their results they were more likely to be more disciplined about it. One person '*could see the advantage of it because it keeps tabs on people*' but no more than that, while another just found it interesting. Another participant emphasized the advantage of their doctor knowing the detail from twice-daily blood pressure measurements for medication adjustments.

> *"I think the pull for me is a really effective tool for monitoring blood pressure problems because you can do it over a time frame and get some real valid information rather than a one off visit to the doctor or having to go back there every day then you have got the white coat syndrome. Or even just getting in a car and driving to the doctors can up your blood pressure. So you didn't have to do any of those kind of things that can impede on the outcome."*

Four participants said they felt more self-confident about their health, with one person saying that 'it puts your mind at rest' to have the telehealthcare service. Having support is important, especially "*at times when I have been very sick I've seen how useful this [telehealthcare] can be*". Participants learned new ways of deciding when to see a doctor or go to hospital.

Had the service reduced visits to doctors and/or hospitals? One participant avoided going to the doctor twice a day for blood pressure readings, as indicated above, and this person emphasized that even twice daily visits to the doctor may not have been useful. Another indicated that it was so much more convenient to have the measurements done at home, to avoid traffic and going to the doctor. Five participants indicated they had reduced hospitalisations, while one person stated that he/she had been admitted to hospital, saying that '*it's not through this programme. It's just things have gone wrong.*' One person observed that, '*I've been to hospital so many times it's not funny,*' but did not indicate if this was before or during telehealthcare. Another said he/she goes to hospital every winter but this winter had not been in hospital.

Exacerbations of health issues, starting on new treatments or different doses of the same treatment, and finding from the data unnoticed changes, raised a sense of awareness that resulted in changes in self-management. One person was noted to have a high temperature and an infection was handled earlier rather than later. A diabetic person had noted energy lows after activity and between meals, and learned how to match energy and food intake under guidance of the telehealth nurse. Someone who was struggling with adjusting to Morphine for back pain was guided by the telehealth nurse regarding tolerance of side-effects. As a consequence of monitoring and discussions with the telehealth nurse, a participant was able to discuss a problem with their doctor and change the treatment. One participant felt that having the telehealth nurse monitor her weight reduction efforts was

> *"…a bit like 'weight watchers' or any of those things that where if you know you have to report to someone once a week, it is not quite so easy to cheat."*

While two participants felt they were always engaged in self-management and did not need to do more, two others said they felt more involved and '*less of a nuisance'* and more active. While some said their relationship with their doctor was as good as usual, others said they felt more heard/listened to, and another said that his/her family was proud of how well he/she was doing, and that

> *"…a few of my family and that kept asking questions and they are quite impressed with the fact of how I am at the moment. Because before all this started, I was sort of, more or less, hid myself. So now because I am able to understand things a bit better I know what is going on better I can just share with what is actually happening and other people will know."*

Was it easy to use the technology and do the self-monitoring activities? All indicated that it was easy but stated that it took a few days to get used to the technology, the voice on the measurement machine, the touch screen tablet, initiating a videochat session with the nurse. Once the initial difficulties were overcome and a routine established, it was easy to participate in the telehealth programme and use the technology, someone saying that '*once you get the hang of it you're away laughing'*. One person did not like the technology, saying that it '*…frightens me when I have to turn it on and answer questions…'* One participant said that not being able to see made it difficult but not impossible to do the self-monitoring activities.

> *"Well my son thought that I would never be able to do it [Why?] Oh because I am old and my eye sight is bad and that. So ah I have proved that to him. When it won't go he reckons it is my fault it won't go. …when*

it comes up on the screen what is wrong, I can't see. I can't see what is wrong. And that annoys me a bit."

All but one of the participants indicated they would recommend the programme to others, especially older people with long term health issues, particularly a health issue similar to the one they have. One person claimed a preference to in-person interaction. One person observed that the monitoring makes '*us feel better about ourselves even when we're not feeling good*'. One person said that telehealthcare is good for older people who are not coping because they would '*cope ten times better because everything is there and they can check it themselves'.* Someone observed that people may feel worse than their vital signs say they are, and that knowing this is useful. Telehealthcare was found to help people decide whether or not to go to hospital as a reason for recommending the service.

> *"And it sort of like if you don't need to go into hospital this programme sort of puts the halters on it if you know what I mean. When they can tell you oh well you don't really need to go to hospital but what I suggest is you do this or you do that. And if you follow instructions, um you don't need to go to hospital. For me, I don't like going to hospital, period. You know what I mean. So um I rather be at home."*

Participants felt that telehealthcare gave them confidence in their self-management activities and skills, and also in their health. Being checked made them feel confident they were all right. Three stated that they felt more confident. Being able to discuss their results with a nurse gives them a sense of self-awareness and confidence that they are doing the right self-care. It also gives people an opportunity to confide in a nurse some things they wouldn't share with friend, family or spouse. Being able to talk to someone left them feeling less alone. Doing the monitoring at home would be good for those who can't get out (particularly those who are isolated), but is also good for those who want the convenience, making them confident on both levels.

What was it about the nurses that made telehealthcare work well? Although this question was not asked, the interviewees made some observations. Some said that the background of the nurse was important, that her connectedness and ability to direct them to other services with little effort was very helpful and motivated them to take action that they otherwise would not have taken, e.g. follow up about a joint replacement that was troubling them for which the prosthesis batch had been recalled in other countries. The nurses' responsiveness and experience played a role in developing trust that resulted in the ability for participants to learn from them (self-awareness) and take action (go to/avoid

hospitalization/be disciplined about self-care). Making telehealthcare fun was an important part of the nurses' relationship with participants.

Customer service regarding technology issues was referred to even though no questions were asked about it. One participant was unhappy that the oximeter batteries had gone flat and were not replaced because his/her period in the programme was coming to an end. Participants offered reasons for their technology not working such as not being able to make a video call, e.g. living in a flat that is 'built below the road and transmission doesn't get through' while another participant said that the weather was a problem, or the trains passing nearby caused problems, or that the apartment was too sound proof. The participants indicated that response time was quick and problems were solved effectively when referred by the nurse to the technicians.

Most participants indicated that they were happy with telehealthcare as a service. Some said it was 'brilliant' and another had unqualified praise for the programme saying, '*… it is just everything. It is just everything you do. I think it is a marvellous, marvellous programme.'* One participant went further and said,

> '*I couldn't put value on this, it is too valuable'.*

Summary
In summary, participants who were interviewed commented on how the telehealthcare service had affected their awareness of their health issues and how they responded to their state of health, rather than if the programme resulted in improved outcomes because they had incurable long term health issues.

As their awareness grew, so did their ability to learn how to make different decisions about seeing a doctor or going to hospital, resulting in fewer visits and/or admissions. Aspects of their condition that they had been unaware of were raised and handled, e.g. fever.

 Exacerbations and aspects of their health that were difficult to self-manage were handled under nurse supervision, e.g. dealing with a COPD exacerbation without going to hospital.

 They would recommend telehealthcare to others, saying that they are already recommending it to people like them.

They found it easy to use the technology once they had got used to it and built it into their routine.

Customer service was considered to be good in light of the responsiveness of the nurses, and the expertise and ability of the technical support team.

They stated that the nurses' abilities to solve their health problems and assist them into better health, were related to experience, background and expertise, and making self-care fun. This resulted in the ability to trust the nurses when their health took a downturn.

Discussion

We set out to establish if telehealthcare is a viable service to be offered to older people ageing in place. The two research objectives were to determine whether telehealthcare technology can

1) Assist people with long-term conditions remain at home longer and reduce avoidable acute admissions
   a) Providing and supporting more continuous targeted care of people in their homes
   b) Improving safety, independence and lowering the anxiety of people, their carers, and families
   c) Reducing social isolation
   d) Reducing carer burden.
2) Help people effectively manage their long-term condition
   a) Putting them in charge of their own health outcomes
   b) Providing early intervention and triage based on clinically determined thresholds
   c) Improving client/clinician partnership
   d) Improving client confidence through the reassurance of immediate regular feedback of relevant health indicators.

Summary and discussion of the findings

Assisting people with long-term conditions to remain at home longer and reduce avoidable acute admissions

Although the data does not show definitively that the telehealthcare service was able to achieve this goal, they revealed that aspects were achievable. Most literature on telemonitoring indicates that avoidable hospital admissions/readmissions cannot be attributed to telemonitoring, or are measured with difficulty.(13)

Providing and supporting more continuous and targeted care in people's homes

Patients could be discharged early from hospital and monitored safely from home. The daily measurements and discussions with the telehealth nurse kept the patient safe. Patient safety also related to the growing self-awareness of participants as they learned new

information and its application to their daily activities. The PACIC and interview findings revealed that people developed a clearer understanding of their care plan.

Improving safety, independence and lowering the anxiety of people, their carers, and families

Participants received guidance from the telehealthcare nurse when making a decision to see a doctor or go to hospital, which reduced unplanned hospital or doctor visits. The decision was made earlier than they had done in the past. Although the literature states that early detection is a primary purpose for telemonitoring (13) there is no examination of how patients decide that they need a visit to a doctor or hospital, other than that they wait too long.

Participants felt safe and cared for. They felt less anxious about their health, as shown in the Perceived Health Competence Scale, and more confident about their self-care decisions. Although the PACIC questionnaire did not reveal significant changes, it revealed some small changes that showed that participants were helped with embedding their treatment plan into their lives, they gained insight into the effect of their actions on their health, and felt more involved. These observations occur in the literature, e.g. Pecina et al (14) state that patients felt 'watched over' and therefore safe, and demonstrated a growing self-awareness.

Reducing social isolation

There are concerns about people becoming socially isolated as they age, and especially as their health declines.(15) In our findings we note that social isolation changed with respect to how confident participants felt about their health. The questionnaire relating to participants' views about their health revealed that they felt more energetic, in less pain, more active, and less bothered about their emotional and physical health.

The interviews revealed a picture in which those who were isolated because of their health issues had re-emerged ('I was hiding') socially.

Those who found it inconvenient and stressful to deal with their health issues, e.g. driving through traffic for an appointment, were able to manage their health more easily by avoiding stressful access to healthcare.

Reducing carer burden

We were unable to establish if carer burden existed because only two carers completed the carer questionnaire and didn't complete the 'after' questionnaire. Consequently, we were unable to discover if carer burden had been reduced.

Helping people effectively manage their long-term condition

We are able to conclude that the telehealthcare service helped people effectively manage their health issues. Participants learned about themselves, the meaning of their daily measurements, and how to make appropriate decisions about seeking help from their GP or hospital.

Since they were being 'watched over' some participants were more disciplined about their self-care.

As a consequence, their health improved, their pain levels dropped, they were more active and more socially involved.

In a systematic literature review by Bowles et al (16) the literature reveals mixed results about this kind of findings. In some instances self-awareness improved or made worse how people felt about their health.

More research is needed to uncover nuances and patterns about self-awareness of health issues, behavioural and psychological health changes are a result of this raised awareness. Differences in health services utilization have not been unequivocally proven in past research.(14, 16)

We also noted novel uses for telemonitoring. One use was to collect data regularly at home instead of going in to the GP twice a day. This kind of data collection can be done using portable devices and is standard practice in many specialist health services, e.g. portable ECG 24/7 monitoring. However, the supervision from the telehealth nurse assisted the GP in titrating antihypertensive medication in 'real time' over ten days, something not reported in the literature.

Another novel use for telehealthcare is in the form of step-down care from hospital. The patient in our study was able to be discharged early into the care of the GP and under the supervision of the telehealth nurse. No literature could be found to support this observation.

Putting patients in charge of their own health outcomes

The clinicians indicated that since the patient is the most important person in health care, they should be in the centre and telehealthcare appears to achieve this. Telehealthcare supports self-care in terms of greater self-awareness and ability to adjust treatment plans to match daily activities.

Participants were more confident (as stated above), and felt more competent by the time their experience with telehealthcare was over. This has been supported by findings in other telehealth research.(17)

Providing early intervention and triage based on clinically determined thresholds

The regular measurement and reporting of vital signs, plus videoconference calls in which participants discussed briefly how they were feeling, gave opportunities to talk about appropriate visits to the doctor or hospital earlier than a patient is likely to go. Conversations led to the discovery of additional issues or misunderstandings, e.g. a diabetic patient learning to match activity with food intake.

Brunton et al (18) confirm this in their literature review, with a caution that there is a fine line between independent self-care and learned dependence.

Improving client/clinician partnership

This was most obvious in the interviews when participants described their relationships with the telehealth nurses. The ease with which the nurses linked them to additional support services, helped solve their problems, and help them decide to see a doctor or go to hospital, and how they made self-care activities fun, could influence how they relate to their doctor after the service was discontinued.

The clinicians indicated that they found it easier to see if their patients were coping, especially knowing that the ones who had been discharged from hospital were being safely monitored. Also, the ease of accessing services via telehealthcare appeared to make it easier for a clinician to make good treatment decisions under difficult circumstances, e.g. the twice-a-day blood pressure monitoring to decide on the best medication dose for a patient with unpleasant treatment side effects.

It is not clear yet how telehealthcare will change or disrupt the patient-clinician relationship, but there are signs that it could improve the relationship, with a caution that the relationship will be disrupted.(19) Our study shows that the relationship is supported and trust is enhanced. A longitudinal study is needed to examine how the relationship may change over time.

Improving client confidence through the reassurance of immediate regular feedback of relevant health indicators

Participants became more confident about how they handled their health issues as they became more self-aware because of the monitoring. In the interviews they indicated that they became more disciplined about doing their measurements because it 'was like Weight Watchers….you can't cheat.' Others learned new insights as they discussed their measurements with the nurses. The person who was hiding began to discuss her health issues with her family and found them to be supportive.

Telehealth research shows that patients do become more confident, and that regular feedback on health status can improve patient engagement and empowerment.(16, 17) The extent and scope of these effects require further research.

Unexpected findings

As with any research, there were some unexpected findings.

- Telehealthcare as a step down service from hospitalization. One of the clinicians noted that a patient had been discharged early from hospital because of the availability of the telehealthcare service. He was confident that the patient was safe, and the risk of re-hospitalisation was reduced. He saw telehealthcare as an adjunct service to usual care (a common view held by clinicians (14, 16)), adding value similar to home visits but without having to make the visit. What is not in the literature is the idea that telehealthcare could be a form of step-down care to enable early discharge and assist people in the few weeks post discharge from hospital.
- Telehealthcare as a means to collect data about a patient to refine a treatment plan. In some instances the usual setting for data collection about patients (i.e. a GP practice or hospital ward) may be counter-intuitive because of the anxiety, stress, and inconvenience of getting to the service. Interviewees indicated that gathering data at home is a useful alternative that may deliver more accuracy.
- The importance of the telehealth nurse's training, background, network, and interpersonal skills is key to the success of telehealthcare. The personal nature of the service, the general skills and knowledge required for a broad range of health and social issues experienced by patients, and the interpersonal connectedness of the nurse to other clinicians and services, and the social skills of the nurses, are a mix that should be carefully considered in job description design.(20)

Conclusion and recommendations

We set out to determine if telehealthcare technologies and processes could (1) assist older people with long term health issues remain at home longer and reduce avoidable acute admissions, and (2) help older people effectively manage their long-term condition. Data was collected from a range of stakeholders (older people with long-term conditions, their clinicians and caregivers, and the telehealthcare nurses) using a suite of data collection tools (before and after questionnaires plus interviews from older people receiving the service, questionnaires from clinicians and care givers, and field notes from discussions with the telehealth nurse).

The results show that the telehealthcare service was able to assist people remain at home and reduce avoidable acute admissions, and that older people learned to manage their long-term conditions. Unexpected findings include discovering the value of using telehealthcare as a step down service from hospital, the ability to collect data to refine long-term care plans, and the importance of the telehealth nurse's training, background, network, and interpersonal skills in the success of a telehealthcare service.

The following recommendations are noted.

- Future research should take advantage of larger numbers of participants, clinicians and care givers, subject to a power calculation of the population, to be able to draw strong conclusions about the effectiveness of the service in terms of outcomes.
- There is little research on the cost of telehealth other than to indicate that telehealth is not a cheaper model than usual care.(17) However, if the costs of this pilot study are acceptable, and the model of care is clearly defined, then the results of this research show that telehealthcare does make a difference and is worth implementing.
- Since the results show that a telehealthcare service for older adults is feasible, and the lessons learned are available, it is recommended that the enrolment and clinical processes are documented, and policies be designed to enable and support a sustainable service.
- It is recommended that a business plan is drawn up to clarify how this service is offered, how it is referred to by clinicians in primary and secondary care services. Future research about this kind of business model could be informative regarding effectiveness, accountabilities, and integration into mainstream health care.
- Since care giver burden was not measured, it would be useful to do so in the future should the opportunity appear.
- Careful selection of telehealthcare nurses is central to the success of a telehealthcare service. Some research is being done on this.(20) In summary, we set out to see if telehealthcare could be delivered as a service to older adults with long term health issues, and we showed that it could be done, and that it can make a difference in terms of keeping older people independent and out of hospital, and in control of their health.

References

1.   Wagner EH, Davis C, Schaefer J, Von Korff M, Austin B. A survey of leading chronic disease management programs: Are they consistent with the literature? Managed Care Quarterly. 1999;7(3):56-66.

2.   Cottrell E, Chambers R, O'Connell P. Using simple telehealth in primary care to reduce blood pressure: a service evaluation. BMJ Open. 2012:2:e001391.

3.   Novak M, Guest C. Application of a multidimensional caregiver burden inventory. The gerontologist. 1989;29(6):798-803.

4.   Riddell TTA, Jackson RT, Wells LSM, Broad JB, Bannink L. Assessing Maori/non-Maori differences in cardiovascular disease risk and risk management in routine primary care practice using web-based clinical decision support:(PREDICT CVD-2). 2007.

5.   Gee PM, Greenwood DA, Paterniti DA, Ward D, Miller LMS. The eHealth enhanced chronic care model: a theory derivation approach. Journal of medical Internet research. 2015;17(4).

6.   Sahama T, Liang J, Iannella R. Impact of the social networking applications for health information management for patients and physicians. Studies in Health Technology & Informatics. 2012;180:803-7.

7.   Kenealy TW, Parsons MJ, Rouse APB, Doughty RN, Sheridan NF, Hindmarsh JKH, et al. Telecare for Diabetes, CHF or COPD: Effect on Quality of Life, Hospital Use and Costs. A Randomised Controlled Trial and Qualitative Evaluation. PloS one. 2015;10(3).

8.   Richardson J, Atherton Day N, Peacock S, Iezzi A. Measurement of the Quality of Life for economic Evaluation and the Assessment of Quality of Life (AQoL) Mark 2 Instrument. The Australian Economic Review. 2004;37(1):62 - 88.

9.   Smith MS, Wallston KA, Smith CA. The development and validation of the Perceived Health Competence Scale. Health Education Research. 1995;10(1):51 - 64.

10.   Glasgow RE, Wagner EH, Schaefer J, Mahoney LD, Reid RJ, Greene SM. Development and validation of the Patient Assessment of Chronic Illness Care (PACIC). Medical Care. 2005;43(5):436 - 44.

11.   Southern Cross University. Feros Care's My Health Clinic at Home Pilot, Final Report. Australia: Southern Cross University; 2014.

12.   Statistics New Zealand. 2013 Census QuickStats about culture and identity 2014. Available from: www.stats.govt.nz

13.   Hardisty AR, Peirce SC, Preece A, Bolton CE, Conley EC, Gray WA, et al. Bridging two translation gaps: a new informatics research agenda for telemonitoring of chronic disease. International journal of medical informatics. 2011;80(10):734-44.

14.   Pecina JL, Vickers KS, Finnie DM, Hathaway JC, Hanson GJ, Takahashi PY. Telemonitoring increases patient awareness of health and prompts health-related action: Initial evaluation of the TELE-ERA study. Telemedicine and e-Health. 2011;17(6):461-6.

15.   Philip LJ. Social isolation and the perceived importance of in-person care amongst rural older adults with chronic pain: A review and emerging research agenda. Journal of Pain Management. 2014;7(1):13.

16.   Bowles KH, Dykes P, Demiris G. The use of health information technology to improve care and outcomes for older adults. Research in gerontological nursing. 2015;8(1):5-10.

17.   Kenealy TW, Parsons MJ, Rouse APB, Doughty RN, Sheridan NF, Hindmarsh JKH, et al. Telecare for diabetes, CHF or COPD: effect on quality of life, hospital use and costs. A randomised controlled trial and qualitative evaluation. PloS one. 2015;10(3):e0116188.

18.   Brunton L, Bower P, Sanders C. The Contradictions of Telehealth User Experience in Chronic Obstructive Pulmonary Disease (COPD): A Qualitative Meta-Synthesis. PloS one. 2015;10(10):e0139561.

19.   Dedding C, van Doorn R, Winkler L, Reis R. How will e-health affect patient participation in the clinic? A review of e-health studies and the current evidence for changes in the relationship between medical professionals and patients. Social science & medicine. 2011;72(1):49-53.

20.   van Houwelingen CT, Moerman AH, Ettema RG, Kort HS, ten Cate O. Competencies required for nursing telehealth activities: A Delphi-study. Nurse Education Today. 2016;39:50-62.