

An Evaluation of the Wexford Telehealth Pilot Project



Waterford Institute of Technology
INSTITIÚID TEICNEOLAÍOCHTA PHORT LÁIRGE



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An Evaluation of the Wexford Telehealth Pilot Project

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Background to the Pilot Study

The implication of an ageing population is marked with an increased prevalence of chronic diseases with such diseases being major causes of morbidity and mortality. In 2020, it was estimated that 1.3 million people in Ireland were living with one of the major chronic diseases: cardio-vascular disease, chronic obstructive pulmonary disease, asthma or diabetes. The impact of chronic diseases on health service utilisation is particularly evident in the acute hospital sector, with chronic diseases accounting for 40% of admissions and 75% of bed days (Department of Health 2016). The Department of Health and Children (2008) highlighted that 80% of general practitioners' visits were attributed to a chronic disease.

The call for the use of digital technologies in healthcare lies at the heart of national and international policies for future health provision and is in line with Slaintecare and the Integrated Care Programme for Chronic Disease Prevention and Management priorities. The Covid 19 pandemic has seen increased technology use in healthcare, born out of necessity. Telehealth refers to the use of electronic and telecommunication technologies to support healthcare at a distance from the patient. Telehealth can be used to support older adults to self manage their health conditions within their own homes, and international research has demonstrated the many benefits of such remote monitoring, including cost savings.

A telehealth pilot project was undertaken in County Wexford in 2021, overseen by a multi-agency Stakeholder Group (Age Friendly Ireland, Integrated Care Programme in the HSE; Wexford General Hospital (including Consultant Geriatrician and Clinical Nurse Specialists), Tunstall Emergency Response, Wexford County Council-Age Friendly Programme including the Wexford Older Peoples Council). The pilot project set out to provide a 12 week telehealth intervention to 50 patients with a chronic illness. The project was independently evaluated by Waterford Institute of Technology.

Telehealth Project Objectives

The objectives of the pilot project were to establish a proof of concept for the provision of a telehealth service for three identified chronic conditions (Chronic Health Failure, Diabetes and Chronic Obstructive Pulmonary Disease) in County Wexford, with a potential to scale up nationally.

The research aimed to evaluate the pilot telehealth intervention, considering:

- the impacts of the intervention on the patient's clinical condition and wellbeing;
- in-person use of health services ascertaining patient and clinician perceptions of the intervention and technology and;
- an analysis of the cost effectiveness of the intervention.

The research design used a mixed methods approach, with a range of qualitative and quantitative data collection tools. Data was collected from patients using the telehealth technology. Patients were asked to take part in semi structured interviews at three stages during the 12 week intervention (prior to the intervention starting, during week 6 (mid-point) and within two weeks of completing the intervention). All patient interviews were conducted remotely via telephone due to Covid 19 public health measures in place at the time. Semi-structured interviews were also undertaken with referring clinicians.

Telehealth Equipment

Tunstall telehealth equipment was provided to the patients for a 12 week duration. This duration was set due to Covid 19 limitations on the project and funding restrictions. The technologies used were the 'My Mobile' patient app and 'Clinical Triage Manager'.

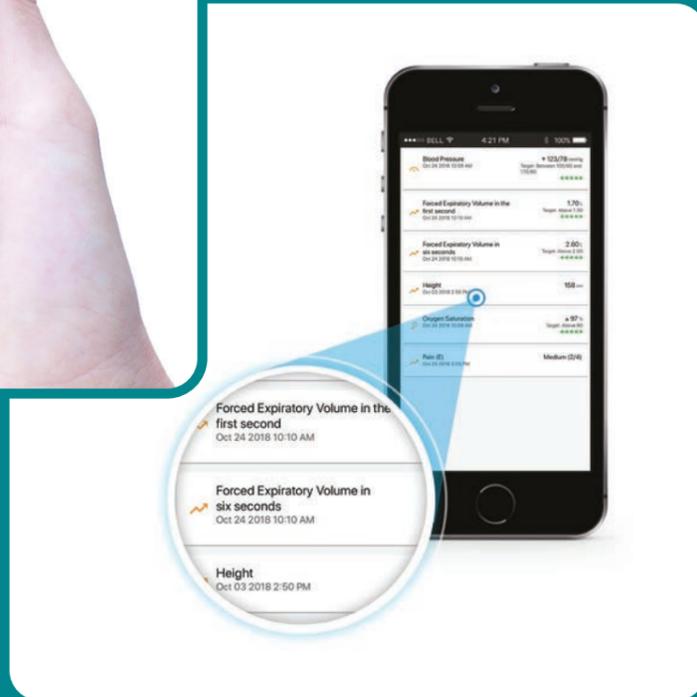
The 'My Mobile' is a patient app which enables self-management and monitoring. The app collects data from monitoring devices on vital signals such as pulse, oxygen levels and blood pressure. It provides: automatically updated readings via Bluetooth-connected devices and the ability for manual entry of readings; automated alerts and activity reminders, as part of a health management plan; condition specific health questionnaires built into the system to capture clinical information; two-way messaging for interactive patient communication; and patient view of monitoring of results to enable better self-management.

'Clinical Triage Manager' is a clinical management software platform which enables clinical and service teams to monitor patients remotely. The system enables: remote monitoring of a patient by clinicians; automated prioritisation tools which helps triage urgent investigation; utilises a traffic light system to provide visual alerts to critical patient needs; contains Customisable Health Interview templates to create structured patient engagement; provides trend graphs for comparison of historic results and data-driven clinical decision-making; provides summary reports for clinical management, auditing and regulatory reporting; and can tailor monitoring plans according to the patient's lifestyle and condition.

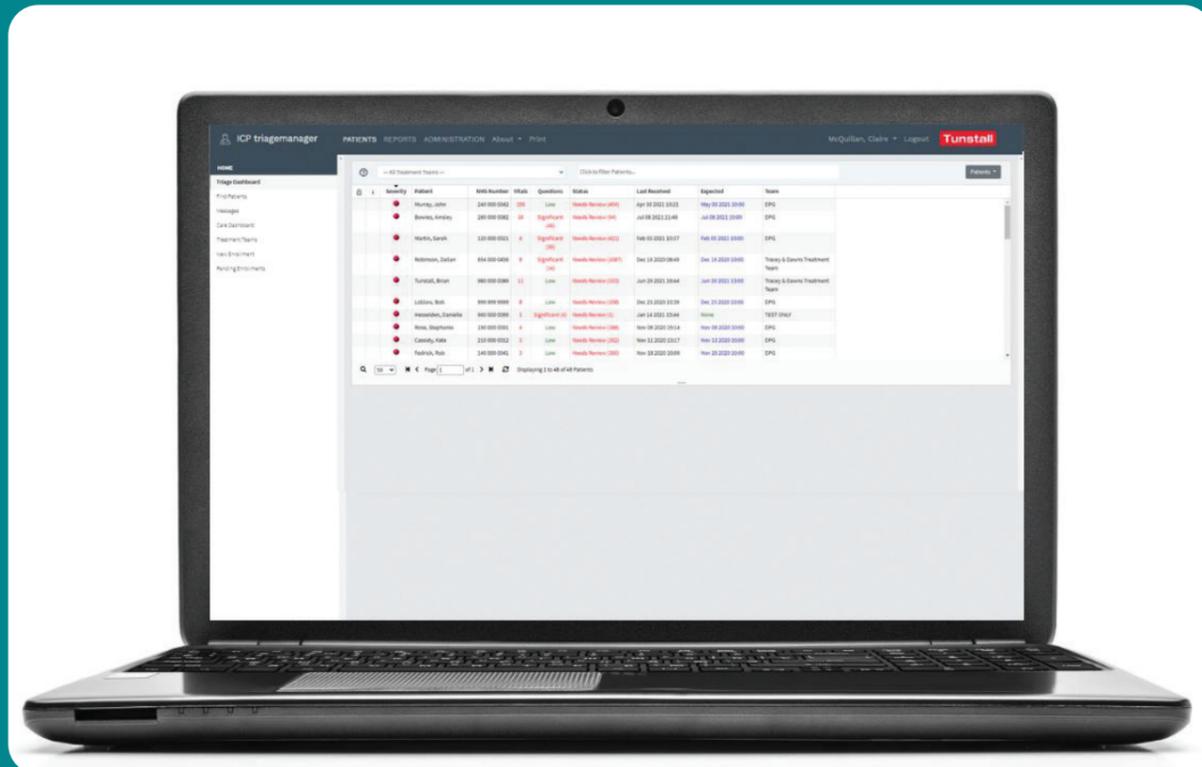
Depending on the clinical condition being monitored, patients were provided with specific equipment. The patients with COPD were asked to use a blood pressure monitor, pulse oximeter and thermometer. Those with CHF used the blood pressure monitor, pulse oximeter and scales, while the patients with diabetes recorded their blood pressure, weight and could also if they wished manually input their blood glucose readings. The patient readings and responses were transferred to participating clinicians, with a readings alarm system in place.



My Mobile Patient App



Clinical Triage Manager



Summary of Findings

Recruitment to the Intervention

A consultant medical doctor (Geriatrician) and two clinical nurse specialists agreed to recruit and monitor patients receiving the telehealth intervention.

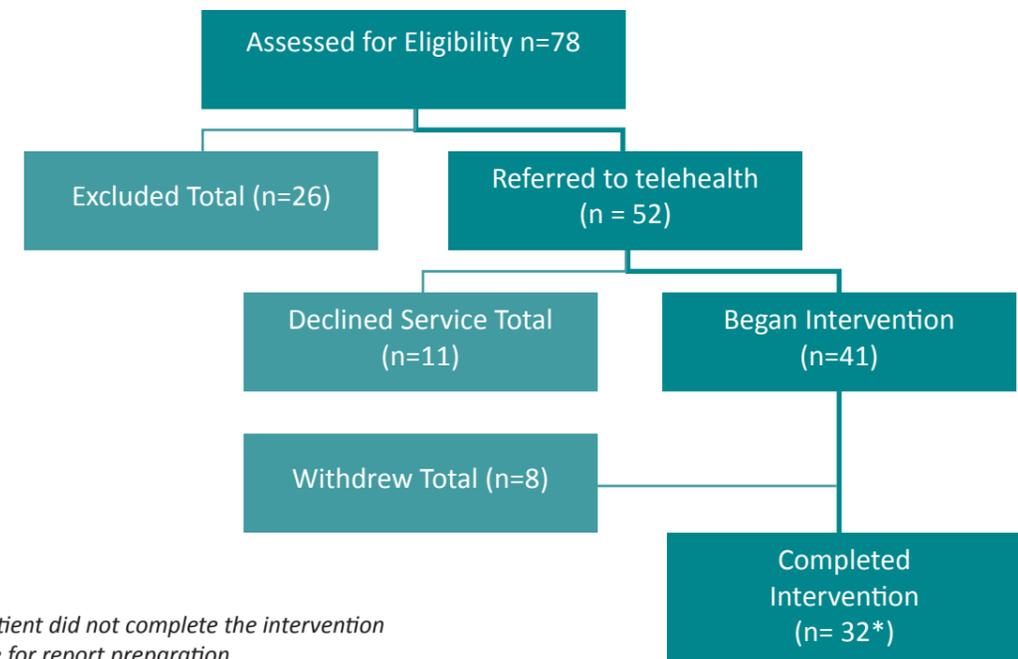
The patient inclusion criteria were:

1. patient diagnosed with one or more of the predefined conditions (with the clinician determining which was to be regarded as the primary disease condition);
2. ability to use or have support available to use the technology; mobile signal; literacy assessed by the referrer with a reading age 11 needed for intended use;
3. over the age of 55 years.

For the pilot study, clinicians went through their patient case list and contacted those who met the inclusion criteria. They excluded those who they knew were illiterate and had no support, had no English or who they considered would not be able to participate fully due to cognitive impairment, either dementia or intellectual disability.

Fifty-two patients were recruited to the intervention. However, nineteen did not take part or complete fully. Reasons for this non-participation included death of participants (RIP), change of mind, feeling too unwell or stressed, unable or no support to use technology. One patient was very delayed starting the intervention due to prolonged hospitalisation. See Figure 1 for recruitment flowchart.

Figure 1. Flow chart of Recruitment



*one patient did not complete the intervention in time for report preparation.

Sense of security

'It's nice to know you are being kept an eye on so it gives confidence.' [TWP19]

Confidence in Illness management

'I think because when I know my oxygen levels were good, it gave me more confidence to go through the day you know that this is good, my oxygen levels are good so I can do more.' [TWP02]

Use of Health Services

'Well, I suppose I have been in the health service, and I think the change for users is that you can get a check from home without having to constantly go back and forth to the hospital.' [TWP43]

'It's not easy to be getting in and out of hospital for the most part and these things would help lower the footfall in hospitals and in doctor surgeries.' [TWP43]

View of the technology

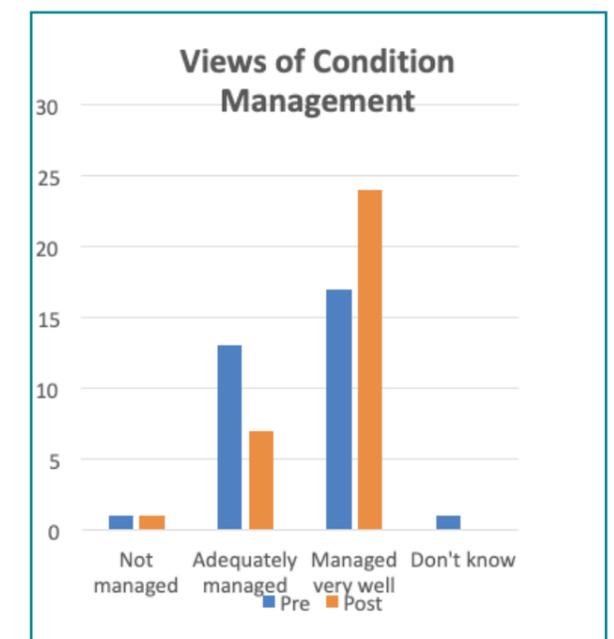
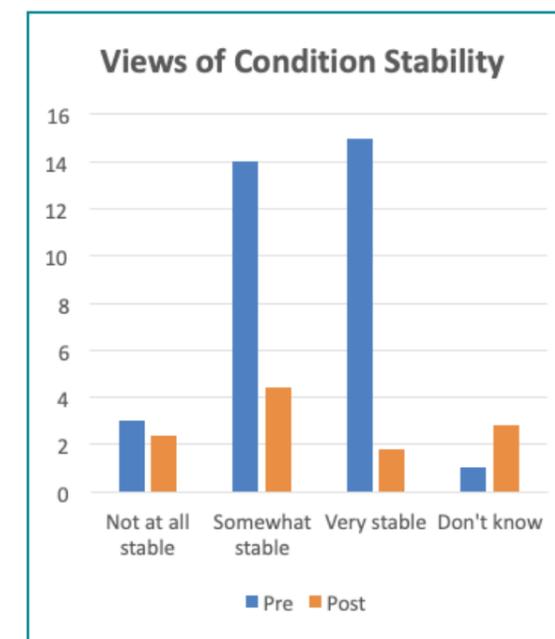
'I'm very happy to use the Tunstall device, I'm very capable to use it.' [TWP16]

Participant Characteristics

Thirty-two participants completed the 12 week intervention. Most of those participating were male (85%), and married (57%), with ages ranging from 51 to 96 years (mean 71 years) and only 18% had private health insurance. The majority owned their own home (79%) and almost a third lived alone (30%). Over 70% had lived in their current house for over 5 years and only 2 participants (6%) were considering moving house. Over 80% had more than one medical diagnosis.

Participants were asked to rate their illness stability and management prior to, during and on completion of the intervention. Most participants (n=28) viewed their illness as either very or somewhat stable at all time points and the number of those who felt they managed their illness very well increased from time point 1 to time point 3 (52%-to 73%).

Regarding health service utilisation, only 6% had not attended a general practitioner (GP) within the 6 months prior to the intervention, with almost 50% attending 1-2 times. Other health services used included hospital clinics, where again almost 50% had attended on 1-2 occasions within the 6 month timeframe. Just over a quarter had been admitted to hospital in the six months prior to the intervention, with a mean duration of stay being 6.5 days (standard deviation 10 days). During the 12 week intervention, again over 50% attended the GP 1-2 times while two patients were admitted to hospital, mean duration of stay 2 days. Participants highlighted however how Covid had impacted on their use of health services, and that cocooning had, for many of them, resulted in less 'flare-ups' from their diagnosed condition in previous times.





Pulse Oximeter

Participants' Use of Telehealth Devices

Patient engagement with the device was very high - only 2.6% of daily readings were missed. There was, however, follow up of participants by Tunstall staff when a reading was not recorded, which probably accounts for the very high percentage of readings inputted.

Looking at the readings submitted, and alerts raised, **all patients raised at least one daily alert**. With this monitoring system alerts could be raised from more than one of the readings, for example, there could be an alert for pulse and blood pressure on the same day. The number of alerts raised by individual patients ranged from 1 alert to 108 alerts. The number of days where alerts were raised by individual patients ranged from 1 day to 59 days, out of total of 60 days. The condition specific health interview was completed each day by patients. Many patients (19, 57%) noted no symptom changes in the health interviews over the 12 weeks.

Participants' Views of Technology

Pre-intervention, over half the participants were happy to use technology, and almost all, nearly 90% rated their ability to use technology as good or very good. Almost 30% felt they would still need support to use technology. Seventeen of the participants used a computer regularly and almost three quarters (70%) used a smartphone. Reasons for technology use varied, and mainly related to communication and social purposes. For those reporting limited engagement with technology, there appeared a level of discomfort. Reasons for this included lack of interest and a perception of low personal capability.

At time 2, participants were asked regarding their use of technology and if their opinion of technology had changed. It seemed using the Tunstall devices had changed the opinion and improved the use of technology for some (almost 40%) but not all participants. The key changes reported included increasing confidence when using technology and using more technology. **Almost all (97%) were very happy to use the device and the majority (over 80%) found that the technology provided help in managing their illness.**

At time 3, post the intervention, again almost all participants (97%) reported that they would still be happy to use the devices and almost 80% reported that they had found the devices very helpful in managing their illness. When asked about problems using the device that they had experienced, these included when the measurement devices (weighing scales/ blood pressure and thermometer) did not work, but the main issue seemed to be connectivity. However, all the participants said that the support from Tunstall was very good to resolve the problems promptly.

Participants' Perceptions of the Telehealth Intervention

Overall, **participants expressed positive views of the intervention** during the interviews at the mid-point and post completion interviews. Many participants perceived the telehealth intervention to have a positive impact on monitoring and managing their chronic disease and improving self-confidence in this regard. A limited number of participants did not perceive the telehealth technology as having an impact on their condition. For many participants, the fact that their condition was being monitored daily was reassuring and gave them a sense of security. This sense of security originated in the participants' belief that should their condition deteriorate, that some type of medical intervention would occur. It also seemed that the daily health-related readings helped some participants become more aware and take control of their conditions. For some, seeing that their condition was stable provoked a sense of confidence regarding their health and ability to manage their illness.

The majority of participants expressed that telehealth was an acceptable way of receiving health care. Perceived positive outcomes include **a reduction in unnecessary appointments, time spent in waiting rooms and time spent travelling**. It seemed some participants were fearful of in-person health care due to the risk of infection and the reassurance provided by the device reduced the need for contacting health care professionals unnecessarily.

The participants' perceived **the training provided to use the telehealth intervention as thorough**. However, it seemed that the training provided to the patients did not cover all the capabilities of the device. One of the main criticisms expressed was that feedback on the reading inputted, either from the device or health professional was not received back to the patients.

Clinicians' Views of Intervention

Prior to taking part in the pilot study all clinicians were in favour of telehealth, were aware of how it could be used and thus were interested in taking part. As they had been asked to recruit patients and to do so in as timely fashion as possible, the clinicians' **rationale for including patients in the pilot study was based purely on the inclusion criteria** and not on other criteria which they felt could have been useful.

The issue of which clinical teams and which patient groups would benefit most from the intervention was discussed in depth. It seemed that the shared view held was that such a service would **fit well with the acute hospital condition specific clinical teams**. All three clinicians suggested that there needed to be more flexibility regarding duration of intervention and the need to tailor the intervention to the patient need. It was felt by all that the **telehealth intervention needed to be integrated within a self care management plan** for the patient.

All clinicians involved felt the telemonitoring technology used in the pilot study worked well, both the triage manager system and the monitoring devices / system provided to the patients. The referral system to Telehealth intervention generally worked well. The alert system worked well, however, checking for individual alerts was time consuming as the number of patients involved increased. Hence, the clinicians agreed with Tunstall that Tunstall would send a daily email to the clinician notifying of the alerts raised that day and the clinician then checked the system and followed up with the patients concerned if needed. One clinician said they got a lot of notifications of alerts, and did not necessarily follow up with the patient on all alerts but instead watched to see trends and then intervened as necessary. A view expressed by the clinicians was that the full capability of the technology was not utilised in this pilot study. The issue was also raised that during the cyber attack on HSE systems they were unable to access the system to monitor alerts for a time and also did not monitor when on leave from work.

As viewed by the clinicians, the ability of the participants to use the technology varied. It seemed, based on the feedback the patients gave to the clinicians regarding the technology, that they found the technology worked well.

The clinicians expressed that all patients stated that they liked being remote monitored. One clinician said some patients however became more anxious about the readings and sought more clinical appointments than normal.

Two external factors which the clinicians perceived as impacting on the intervention were the Covid 19 pandemic and the HSE cyber-attack. The pandemic slowed recruitment and the cyber attack caused challenges accessing the clinical triage system.

Conclusion

The extent to which the pilot project objectives were met are as follows:

To assess the impact of the remote patient monitoring service intervention on disease management, health and wellbeing.

Participants engaged very well with the monitoring system with very low rates of missing daily readings. The findings indicated a high level of medication adherence, with 96% of patients recording that they had taken all medication as prescribed. The monitoring system generated alerts, mainly arising from readings from devices rather than the symptoms reported in the health interviews. Alerts are based on the vital sign parameters determined by the responsible clinician. Default parameters were agreed and set at pilot implementation with a view that these would be tailored appropriately,



by the clinicians, for each individual patient. Had this be done the alert rate may have been reduced and been more appropriate. In some instances, when alerts were followed up with clinicians bringing patients back for review, there were no issues identified. However, in two cases, quite significant issues were identified and could then be managed.

The participants' chronic conditions affected their overall functioning and quality of life, with most participants having more than one condition. Their conditions, combined with living through Covid-19, meant some participants expressed distress about their illnesses and its impact on their lives. The majority of participants perceived that the intervention **helped them manage their condition by giving them reassurance that there was clinical oversight and confidence in their ability to manage**. For some participants, the **intervention gave them confidence to exercise more and a feeling that they could manage their illness more effectively** and were able to identify when they needed to take health related actions.

The participant results for mental wellbeing showed no evident changes in wellbeing scores between the three time points. Few of the participants met the cut-off for 'high' mental wellbeing, and this finding was reflected in the interviews where participants spoke of the impact of their illness on their mental and physical health and the impact of living during the pandemic.

To explore the patients' experiences and views of using the remote patient monitoring service intervention on their health service utilisation and housing.

The extent to which the intervention impacted on health service utilisation could not be determined. The six month period prior to the intervention and the 12 weeks of the intervention were during the pandemic when the patients were cocooning for most of this time and where normal health service utilisation, for example, attendance at clinics as usual was affected. Most patients commented, however, **that they felt less need to consult a doctor/ nurse as they knew they were being monitored**.

When asked about their housing, few of the participants had considered moving and most owned their own home but almost one third lived alone. The extent to which telehealth could assist them to remain living in their own homes was not evident to the participants, although some participants expressed a fear of their condition deteriorating and how they would manage.

To explore the clinicians' views of the intervention and the impacts of the intervention including the selection of patients.

The pilot study set out to recruit 50 patients. While 52 patients were referred for the intervention by clinicians, only 32 patients completed the 12 weeks of intervention. The reasons for patients declining

to take part having been recruited or withdrawing from intervention were varied, but included, in many instances, a fear or a reluctance to use technology. This was not the case for those who completed the intervention, who in the main, were happy to use technology.

Overall, the **clinicians were supportive of telehealth** and were of the view that the patients had been positive regarding the intervention. However, they were of the view that for future telehealth projects, **there must be very clear criteria on which clinical teams and health professions would get best use from accessing the intervention, which patient groups would benefit from the intervention, flexibility in determining the duration of the intervention depending on patient needs and preparation of the clinicians to use the intervention to its full capability.**

It should be acknowledged that, as this was a pilot study during the Covid 19 pandemic, there were some limitations, for example the training of patients was limited as the Tunstall technicians installing the devices could not spend time with the patients. Likewise, the pressure on clinicians during the pandemic meant that the full capabilities of the monitoring system were not utilised to full effect. Readings coming in not being monitored for a time due the HSE cyber attack and not being monitored when the clinician was on leave were also identified as issues by the clinicians.

To conduct a financial evaluation of the intervention in terms of costs and savings;

This considered the cost to deliver the telehealth intervention including both the Tunstall and clinician costs. The costing was based on 34 patients. This was calculated on those who completed the 12 weeks intervention and also takes into account the usage of the intervention by those who commenced but did not complete the 12 weeks.

Tunstall costs include installation (€100 per patient), maintenance (€5.77 per patient/ week), triage (€85 per day) and equipment (€1250 per patient).

Clinician costs included recruitment time and daily checks of system for alert, and clinical follow up identified by clinical judgement from alert readings. Clinician estimation of time for recruitment was 1.5 hours per patient (€35 per hour). Time was also required on a daily basis and this time was used for checking the Clinical Triage Manager system and follow up phone calls with patients. The costs for this time have been based on the Clinical Nurse Specialist pay scale- midpoint. The cost of review in hospital clinics was included as €172 per visit.

The estimated cost for an individual patient taking part in this pilot telehealth intervention was therefore **€ 2,155.**

Recommendations from Pilot Study

The findings from the evaluation of the Telehealth Pilot Project for Chronic Disease Management have informed a number of recommendations. The recommendations for telehealth interventions in the management of chronic disease, are made in consideration of six quality domains: safe, timely, equitable, efficient, effective, patient centered care (Schwamm et al 2017).

Recommendation 1

Telehealth needs to be integrated with telecare to offer a comprehensive solution which addresses patients' specific needs and enables both a reactive and proactive approach to management of their health and overall wellbeing. Telehealth can provide a safety net for persons with specific chronic conditions through frequent monitoring. Monitoring of chronic condition physiological parameters should result in the reduction of risk and potential harm through early identification and intervention.

Recommendation 2

Alert systems exist to support the clinician in the provision of safe, efficient and timely interventions for patients whereby urgent issues are clearly identified and prioritised over non-urgent data. To utilise the technology to best effectiveness, clinical parameters set for alerts should be patient and condition specific. This use by clinicians would improve the telehealth system efficiency and safety as the alert system would enable the clinician to clearly identify urgent versus non-urgent clinical data.

Recommendation 3

Telehealth provision should be patient centered. The telehealth system used is fully flexible and can be tailored to individual patient needs. This evaluation demonstrated that patients have unique needs based on the combination and severity of their chronic conditions and co-morbidities. The telehealth service should reflect this, providing patient specific interventions and short or longer term monitoring based on patient needs and values.

Recommendation 4

Patient training and support with technology use should be considered carefully from implementation through follow up, dependent on patient need. Consideration should be given to supports, such as peer support schemes, which may encourage hesitant patients to consider taking part. Patient training to use the devices should be easier to achieve in a non COVID environment where more time could be spent with the patients by the technicians installing the devices on the technology use, capabilities and requirements.

Recommendation 5

Adequate preparation and training of clinicians in telehealth provision is of paramount importance in implementing new ways of working, within an integrated care system, in a safe, effective and efficient manner. Clinician training and support in the pilot study was impacted by the COVID-19 restrictions. Early clinician engagement to help design and shape the telehealth service is recommended. Clinicians working with telehealth within the integrated system of care should have the knowledge, skills and competence to utilise the telehealth technology to its' full effectiveness. Clinical nurse specialists would be ideally placed for the provision of telehealth interventions as part of an integrated specialist service. Consideration must also be given to ensuring that there is always a clinician overseeing the readings being received from patients.

Recommendation 6

The findings indicate that the goal of improving patient self-management could not be fully realised due to limited feedback from the devices to patients and that the intervention was not incorporated into an individualised self care management plan. The telehealth system has the capability to provide patients with instant feedback regarding their condition but this feature was not utilised as part of the pilot. Effectiveness of the telehealth intervention in promoting patient self-management could be improved through the provision of timely, actionable, clear and concise feedback to the patients from the device.

Recommendation 7

Telehealth provision for monitoring and managing chronic disease should be planned and implemented to meet specific patient needs within target groups. Goals include improvement of disease self-management skills through patient specific education; monitoring of chronic condition parameters to identify early deterioration; provision of timely and appropriate interventions to reduce risk and limit hospital admissions. Patient groups may include: patients newly diagnosed with a chronic disease; patients with an unstable chronic disease prone to multiple hospital admissions and recently discharged patients following admission of acute illness relative to their chronic disease.

Recommendation 8

Based on the above, a key recommendation is to move to Phase 2 to roll out a broader trial with a wider number of patients across CHO Area 5 with a key focus on health and wellbeing and clinical outcomes. The Covid 19 pandemic presented limitations and impacted on Phase 1. Therefore, in order to produce more robust outcomes and measures, it is clear that Phase 2 will enable this further evidence.



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This report describes the independent evaluation of a pilot telehealth initiative in County Wexford for older adults living in their own homes with chronic diseases. The report is structured as follows. Chapter 1 provides the background and rationale for the pilot study. Chapter 2 outlines the evaluation methodology and methods. The study results are captured in two chapters, with Chapter 3 presenting the quantitative results on the participants while Chapter 4 details the qualitative results from interviews with the participants and clinicians. Finally, the evaluation results are discussed in Chapter 5 and recommendations arising from the pilot study outlined.

1.1 Ageing Population and Technology

The World Health Organisation (WHO, 2017) report that population ageing is both one of humanity's greatest triumphs and one of the greatest challenges for society and economies. In the 2016 Census, the population aged 65 years and over increased by 102,174 to 637,567 (19.1%) from the 2011 census (Central Statistics Office, 2018). The projected number of people aged 65+ is expected to double to almost 1.6 million in ROI by 2051 (Central Statistics Office 2019) with the greatest increases expected in the over 80 year's age group, where numbers are predicted to increase four-fold from 110,000 in 2006 to 440,000 in 2041.

Life expectancy at age 65 is an important measure of an ageing population. In Ireland, a woman aged 65 in 2017 had a remaining life expectancy of 21.4 years while a 65-year-old man could expect to live another 19.0 years (Eurostat, 2020). Increased longevity is not, however, the only important measure, as the number of those extra years spent in good health is crucial to both quality of life and service provision.

Disability-free life expectancy is a measure used to assess this, where, in line with the Eurostat definition, Disability-Free Life Expectancy (DFLE) is the number of years a person is expected to live in a healthy condition free of limitations to functioning/disability. In Ireland, disability-free life expectancy at age 65 has been increasing, standing at 13.4 years for women and at 12.5 years for men in 2017 (Eurostat, 2020). These figures are higher than the European Union average of 10.2 years for women and 9.8 years for men, but lower than the best-performing country, Sweden, where disability-free life expectancy at age 65 is 15.8 years for women and 15.4 years for men.

Irish government policy supports the concept of older people remaining and being cared for in their own homes, for as long as possible (Department of Housing, Planning and Local Government and the Department of Health 2019) and technological advances can facilitate and prolong independent living (World Health Organization, 2017).

There is increased political interest and investment in the use of assistive technologies to support health nationally and internationally. The continued economic pressure on the health care budget demonstrates a pressing need to find innovative and cost-effective delivery models that will provide

more efficient care and there is a need to harness the potential of technology, including telehealth, to support people to manage themselves in their own homes. eHealth is widely seen as one of the core tools for addressing some of the financial constraints imposed by demand-led growth with a RAND report noting that very small percentage increases in efficiency as a result of eHealth can have significant knock on to overall healthcare spending (Hillestad et al 2005).

Under the 'Housing Options of Our Ageing Population' policy document (Department of Health and Department of Housing Planning & Local Government, February 2019), one of the six overarching principles relates to the use of assistive technologies being a critical intervention in supporting older people to remain at home. Age Friendly Ireland are a supporting partner on the Implementation Group for this policy.

The 'An ehealth Strategy for Ireland' document (eHealth Ireland, 2013), Health Service Executive, and Department of Health, provided a useful overview for the strategy for the implementation of ehealth into Irish healthcare systems. This strategy document viewed ehealth, in line with the World Health Organisation view, as being 'the combined use of electronic communication and information technology in the health sector'. E Health is now a fundamental component of best-practice, high performing health systems.

The 'Knowledge and Information Strategy- Delivering the Benefit of eHealth for Ireland (HSE, 2015) identified that technology allows better access to accurate information, quick and efficient sharing of patient information which releases more time to treat patients and allows individuals to better manage their own health and become active participants in planning for their own needs. In short, as stated by Dr. Áine Carroll, National Director Clinical Strategy and Programmes in the report 'connected health is better health.' It is accepted that the Covid 19 pandemic has acted as a catalyst towards greater use of technology in healthcare in Ireland and internationally.

1.2 Chronic Disease in Ireland

The implication of an ageing population is marked with an increased prevalence of both chronic and long-term illnesses, with chronic diseases being a major cause of morbidity and mortality (Sheehan and O'Sullivan, 2020). In 2020, it was estimated that 1.3 million people in Ireland were living with a major chronic disease. Three diseases which are particularly prevalent in older adults are diabetes, chronic heart failure (CHF) and COPD.

Diabetes prevalence increases with age, to being present in over 11% of the population aged 75+ (McNicholas & Laird, 2018). CHF is also one of the major chronic diseases in Ireland. Current data suggest a 2% prevalence of symptomatic CHF in the Irish population (rising to 10% in those > 75 years). Because it is primarily a condition of older adults, mortality and morbidity remain high with CHF, despite advances in diagnosis and therapy. CHF is reported to account for 5% of all emergency medical admissions, of which 80% are patients > 65 years of age. TILDA data indicates 13% of people aged 56+ in ROI have a respiratory condition (Department of Health, 2019). Around 110,000 people

in ROI have been diagnosed with COPD but it is thought there are up to 380,000 people living with the disease who have not been diagnosed. It is more common in areas of high social deprivation. COPD causes over 1,600 deaths a year in ROI and a high number of hospitalisations. Prevalence increases with age with around one in five of medical card holders aged 75+ on COPD-related medication (Irish Thoracic Society, 2018).

1.3 Chronic Disease and Quality of Life

The World Health Organization (WHO) defines health as not merely the absence of disease or infirmity, but a state of complete physical, mental and social wellbeing. Quality of life is the feeling of overall life satisfaction (Meeberg, 1993), and as it relates to health, becomes the value assigned to duration of life as modified by an ailment (Patrick & Erickson, 1993).

Past research has hypothesised that chronic disease development is the preliminary adjustment from functional independence to disability (Crimmins, 2004). The most consistent outcomes linked to chronic diseases have been found to be the incremental increase in risk of mobility loss and functional dependence (Wolff et al., 2005; Kriegsman et al., 2004). Additionally, the prevalence of functional disabilities has been found to be higher in hospital-based studies than in community-based studies (Incalzi et al., 1997) supporting that case that poor health status impairs functional ability.

Research has identified that the probability of suffering a mental illness increases significantly in those diagnosed with a chronic disease (Bisschop et al., 2004). It is also apparent that pervasiveness and severity of mental illness is more prevalent in the older population. This could be linked to the higher probability of multimorbidity which exists in this population as the number of chronic diseases diagnosed in an individual is associated with the likelihood of mental illness. Serido, Almeida, and Wethington (2004) have speculated that the negative effect on an individual's mental health could be a result of significant and unremitting adjustments to an individual's lifestyle. Constantly dealing with a perceived threats (Carpenter, 2005) and warnings about their vulnerability could also be perceived as a contributing factor (Weiss and Hutchinson, 2000). Other factors which could be attributed to the link between mental wellbeing and chronic disease is the potential for disability or pain, where pain can have an adverse effect on sleeping patterns amplifying emotional distress (Von Korff, & Simon, 1996).

The two primary mental illnesses that have been linked to chronic diseases are anxiety and depression. Ali and colleagues (2006) noted that major depression is 3 times more prevalent in individuals with chronic conditions when compared similar age and gender-matched individuals. Anxiety has also been found to be associated with chronic disease (Sareen et al., 2006). Furthermore, the severity of the chronic disease has been demonstrated to be positively correlated to the severity of the mental illness (Wulsin, Vaillant, & Wells, 1999). The development of mental illness such as anxiety and depression could also have implications on the chronic condition contributing to poor lifestyle behaviours, a delay in seeking supports and non-compliance to treatment (Prince et al., 2007).

Chronic diseases can therefore be debilitating physically and psychologically. Health related quality of life is frequently impaired in people with chronic diseases, and it is important to recognise that chronic disease does not just impact the life expectancy of those effected but the quality of life which remains. Therefore, health systems and health care practitioners need to ensure that the care provided seeks to address not just illness management but promote quality of life.

1.4 Chronic Disease and the Healthcare System

Increased longevity has costs, as the healthcare system was primarily designed for acute medical care and adapts poorly to long terms needs of people living with chronic disease and disability among the population. The impact of chronic diseases on health service utilisation is particularly evident in the acute sector with chronic diseases accounting for 40% of admissions and 75% of bed days (Department of Health, 2016). The Department of Health and Children (2008) highlighted that 80% of general practitioners' visits was attributed to a chronic disease. In 2011 it was estimated that major chronic diseases accounted for 12.5% (1.68 billion) of healthcare spending.

This impact of chronic diseases also effects the working conditions of healthcare professionals and quality of the care which can be provided. It was the perception of the majority hospital-based consultants that medical card holders with chronic diseases often experience long waiting times and have difficulty getting specialist diagnostic tests (Darker et al., 2014). After diagnosis, most hospital-based consultants surveyed found that 80% of these patients often or sometimes experience long waiting times to receive treatment. Darker et al. observed barriers such as a lack of appropriate funding, poor communication, increased workload and a lack of ongoing access to specialists.

In addition, there is a recognised shortage of health care professionals at all levels, from consultants to nurses and health care assistants (Irish Medical Organisation, 2020, Irish Nursing and Midwifery Organisation, 2019). The Health Service Capacity Review 2018 (Government of Ireland, 2018) forecast that between 2016 to 2031, the number of long-term care beds required is estimated to increase by over 10,000 and this additional demand will give rise to demand for increased staffing levels.

Telehealth offers potential to lessen the impact of such healthcare pressures and staff shortages. A review undertaken by Snoswell et al., (2020) found that if in-person consultations are substituted for alternate consultation modalities, which would include telehealth monitoring, productivity is often increased, as more patients are able to be managed simultaneously. Telehealth also has the potential to increase health system productivity, including reducing travel and consultation time.

Sláintecare is a Government of Ireland funded initiative which aims to improve patient and service user experience, improve clinician experience, lower costs and achieve better outcomes. Sláintecare Implementation Strategy 2018: Strategic Action 10 of the Sláintecare Implementation Plan seeks to 'put in place a modern eHealth infrastructure and improve data, research and evaluation capabilities' (Government of Ireland, 2018). With Sláintecare, care is to be focussed primarily in the community.

The COVID-19 pandemic has placed an increasing emphasis on this need for community based care and supporting individuals to be cared for in their own homes utilising available technologies. The call for the use of digital technologies and integrated information systems across social and healthcare contexts lies at the heart of national and international policies for future health provision (HSE & Department of Health 2013; Government of Ireland, 2017; Deloitte 2017; European Commission 2018).

1.5 Chronic Disease Management Strategies

It is advised by the World Health Organisation that the Chronic Care Model is adopted to provide direction to healthcare system reform (Oprea et al., 2010). The Chronic Care Model is an evidence-based theoretical model that identifies essential healthcare system components to encourage a transition from a reactive to a proactive healthcare system in which the patient plays an active role (Wagner et al., 2001; Hung et al., 2008). The assumption of this model is that the proactive management of chronic diseases caused by the empowerment of healthcare professionals and the patients will result in improved healthcare, improved clinical outcomes and quality of life and reduce the need to access the health care system.

Self-management support is critical to this model, this is the active involvement of patients in the management of their condition in a meaningful capacity (Darker et al., 2014). Self-management—whereby individuals take on tasks to deal with medical management, role management, or emotional aspects of their condition is also increasingly recognized as important for effective management of long-term conditions. Certain strategies can aid in accomplishing this such as individual assessment, defining problems through collaboration, agreeing upon priorities, goals and treatment plans, providing information and support, enabling access to resources and the continuity of patient involvement. Outcomes of successful implementation include improved health, quality of life and condition management and a reduction in health care costs (Schillinger et al., 2009). However, despite the outcomes observed and the importance of self-management support in the Chronic Care Model, self management support can be challenging to implement.

The ‘National Framework for the Integrated Prevention and Management of Chronic Disease in Ireland’ presents a clear vision for the delivery of integrated care, focused on the prevention and management of chronic diseases in Ireland, 2020-2025 (HSE, 2020). Within this framework, self-management is one of the foundations for the prevention and management of chronic diseases. The Framework further identifies that self-management support services should be prioritised and technological solutions for self-management developed.

1.6 Telehealth for Chronic Disease Management

Telehealth refers to the use of electronic and telecommunication technologies to support healthcare at a distance from the patient. In a publication by the World Health Organisation in 1998, telemedicine was described as ‘the delivery of healthcare services, where distance is a critical factor, by all healthcare

professionals using information and communication technologies’. This evolved into the domestic setting in the form of telemonitoring in which technology monitored and educated patients. Where a combination of the telemedicine and telemonitoring was used for health prevention rather than curative purposes, this application was coined ‘telehealth’.

A telehealth system requires a patient to be provided a device which enables the patient to collect medical data which is to be transferred to a medical professional (Adeogun et al., 2011), with the aim being to proactively manage healthcare and avoid costly hospitalisations. Various technology devices such as blood pressure monitors, glucometers, can be deployed to the remote setting and regular measurements made using the devices deployed. The data is transmitted back to a monitoring base (typically a hospital) where decision support systems featuring pre-set alarms, alerts and management care flows, assist health care planning and management for the patient. Telehealth shows significant potential for the proactive management of chronic diseases.

However, a key point made in the ‘An ehealth Strategy for Ireland’ document (E Health Ireland, 2013) is the need to ‘Deploy in Times’, i.e., using a timed approach to implementation based on national priorities and building up to scale making more sense than larger ‘big bang’ deployments.

The increasing interest in using telehealth in chronic disease management comes from a recognition that, as the population ages, the needs of the increasing number of people with chronic diseases are likely to overwhelm the capacity of conventional healthcare services designed around scheduled one-to-one and face-to-face appointments between patients and doctors (Salisbury et al., 2015). By connecting patients and clinicians, telehealth enables more proactive, preventative and person-centred care, reducing costs, improving outcomes and enhancing the patient experience.

Patient education is a key element of the healthcare services becoming proactive and preventative. Telehealth is an educational resource for patients as the act of self-monitoring can help teach patients to manage their chronic diseases (Kobb et al, 2003). In community and clinical settings, remote patient monitoring and data capture abilities help to provide efficient of resources, high quality care, mitigate adverse events and maximise clinical capacity by making more efficient use of limited resources.

In addition, by shifting the locus of control, through better access to information and development of illness self-management skills, people can become experts in their own care. The Telemedicine Industry Benchmark Survey highlighted that telehealth has the capacity to improve patient satisfaction and increase patient engagements which in turn improves overall patient experience (Klingler, 2018). Expediency is one element of telehealth which benefit patients and doctors equally. Patients avoid travelling to see a doctors or spending time in the waiting rooms by accessing health care via telehealth resulting more time for the doctors and a reduced healthcare cost for the patient (Dorsey & Topol, 2016). Jhaveri et al (2015) assert that telemedicine is reliable and accepted mode of assessment and treatment in geriatric medicine.

Research has shown a reduction in hospitalization resulting directly from the use of remote monitoring compared with patients who were not monitored remotely (Celler et al., 2016, Steventon et al., 2012,

Woods et al., 2013). Steventon et al. (2012) confirmed this in relation to chronic diseases at three trial sites using a variety of remote monitoring technologies, such as pulse oximeters, glucometers, and weighing scales. In Celler et al's (2016) study, clinicians were able to predict and avoid 53% of admissions by using remote monitoring and conducting a low-cost intervention in a timely manner. Remote monitoring has been shown to reduce not only a patient's presentation to the hospital but also their length of stay once admitted. This may be due to the confidence remote monitoring gives clinicians, that when they discharge a patient, the patient is still under observation should any acute needs arise (Snoswell et al., 2020).

1.7 Telehealth and Older Adults

The success of implementation of telehealth is dependent on the ability and willingness of older adults to engage with such services. Similar to other age groups, the way older adults use technology is changing. Historically, older adults have been considered slower to use new technology than their younger compatriots. O'Hanlon et al. (2010) assert that a common misconception is that, as consumers, older adults have either no interest in the use of technology or cannot use technology.

In the Irish context, over half of Irish people aged between 65 and 74 have never used the internet, and the most common reason given for this is a lack of skills to use it (Central Statistics Office, 2018). Combining best available figures from the above Eurostat data, Census 2016 statistics and the National Digital Strategy 2013, Age Action (2020) estimated that only 3% of people aged 75 and over use the internet, and that just over 488,000 older people in Ireland had never been online. This represented just over 70% of the total population over 65. Digital literacy is important when considering the utilisation of telehealth in health care for older adults and there is a need to evaluate the views and experiences of this older population regarding such telehealth technology.

The COVID-19 pandemic rapidly and dramatically changed how people interact, moving work and social communication online. Use of the internet to stay connected, socialise, shop and conduct business expanded due to the introduction of measures to curtail the spread of COVID-19. Researchers from The Irish Longitudinal Study on Ageing (TILDA) released a new report: *'Internet access and use among adults aged 50 and over in Ireland: Results from Wave 5 of The Irish Longitudinal Study on Ageing'* that delves into the internet habits and behaviours of adults aged 50 and over in Ireland (Doody et al., 2020). However, it was seen that only 38% of those aged 80 and over have home internet access, compared to 86% aged 50-69 years, and 66% aged 70-79 years.

With more and more financial and commercial institutions utilising the internet and allied technologies to interact with customers, this leaves a significant number of citizens marginalised and disenfranchised. It is incumbent on Government and other organisations to ensure that all citizens can engage fully with organisations and with innovations including telehealth.

A report undertaken by the Economic and Social Research Institute (Walsh et al 2021) which included a chapter on telemedicine recommended that supporting digital health literacy and capability among

older people, those in rural areas, and those in lower socioeconomic groups is essential.

Therefore, particular consideration and efforts must be made when utilizing telehealth to support patients with chronic diseases, as much of this group will consist of older adult, who may in rural areas and lower socio-economic groups. Many may find it difficult to adjust to advancing technological world or may be sceptical of technology systems impacting the success of telehealth in health systems (Bakalar, 2016).

1.8 Implementing the Telehealth Pilot Project

The Wexford Telehealth Pilot Project emerged from the identified need to consider how older adults living with chronic diseases could be supported with telehealth to remain living in their own homes and manage their condition. The pilot project was instigated by Age Friendly Ireland, Wexford County Council (Wexford Age Friendly Programme including the Wexford Older Peoples Council), the Integrated Care Programme (ICPOP) in the HSE and Tunstall Emergency Response in July 2020. The proposed objectives of the pilot project were to establish a proof of concept for the provision of remote patient monitoring services (telehealth) for three identified chronic conditions (CHF, COPD and diabetes) in county Wexford, with a potential to scale up nationally. The pilot project set out to measure a number of outputs including:

- older people's adaptability to remote technologies (telehealth & service user engagement);
- how assistive technologies can support older people to remain at home and thus potentially reduce the need for repeat hospital admissions or unnecessary admission to acute or long-term care;
- self-management of chronic diseases including patient behaviour, medication compliance, attendance at medical appointments and other health services.

A multi-agency Stakeholder Group was established to develop the pilot study. This group included representation from Age Friendly Ireland, Wexford Older Person's Council, Wexford County Council- Wexford Age Friendly Programme including the Wexford Older Peoples Council, Tunstall Emergency Response and the HSE Integrated Care Programme Wexford General Hospital (including Consultant Geriatrician and Clinical Nurse Specialists). See Appendix 1 for Stakeholder Group membership. The role of Wexford County Council's Age Friendly Programme included:

- playing a co-ordination role between the agencies involved;
- administration of and organising meetings of both the operational and steering groups;
- ensuring collaborative working between all agencies involved and ongoing liaison with all contacts involved;
- ensuring that the voice of the Older Persons Council was central to the roll out of the pilot.

Waterford Institute of Technology were contracted to undertake an independent evaluation of the pilot project.

The pilot project was timely, in the context of the Covid-19 pandemic, where national restrictions had been introduced. Due to the risk of Covid-19 for older adults, and particularly those with chronic health conditions, older adults were cocooning at the time of project commencement and attendance at health services in person was challenging. Telehealth provides an alternative monitoring and reduce need for face to face health care consultations and hence may reduce the risk of picking up Covid-19, or indeed other infections. A consultant medical doctor and two clinical nurse specialists agreed to take part in the project and to recruit and monitor patients receiving the telehealth intervention.

1.8.1 The Telehealth Technology Utilised

The telehealth technology utilised in the pilot study was provided by Tunstall Healthcare. For over 60 years, Tunstall Healthcare has pioneered the use of technology to support those requiring care and health intervention to live independently in their chosen home setting. Their solutions and services enable independent living, by defining new models of care and creating connected global healthcare solutions which support more than five million people daily. The technology being used in the pilot intervention has been used extensively elsewhere, but it was the first time being used in the Irish healthcare context.

The two technologies used in this study were the ‘My mobile patient app’ and ‘Triage manager’.

The ‘my Mobile’ is a patient app which enables self-management and monitoring. The app collects data from monitoring devices on vital signals such as pulse, oxygen levels and blood pressure. It provides:

- Automatically updated readings via Bluetooth-connected devices and the ability for Manual Entry of readings;
- Automated Alerts and activity reminders, as part of a health management plan;
- Health Questionnaires built into the system to capture clinical information;
- Two-way messaging for interactive patient communication;
- Patient view of Monitoring of Results to enable better self-management;

Clinical Triage manager is a clinical management software platform which enables clinical and service teams to monitor patients remotely. The system:

- Enables Remote Monitoring of patient by Clinical and Service teams;
- Includes Automated Prioritisation Tools which helps triage urgent investigation;
- Utilises a Traffic Light system to provide visual alerts to critical patient needs;
- Contains Customisable Health Interview templates creates structured patient engagement;
- Provide Trend Graphs for comparison of historic results and data-driven clinical decision-making;
- Provides Summary Reports for clinical management, auditing and regulatory reporting;
- Tailors monitoring plans according to the patient’s lifestyle and condition;

1.8.2 Clinical Monitoring Equipment

Depending on the clinical condition being monitored patients were provided with specific equipment. The patients with COPD were asked to use a blood pressure monitor, pulse oximeter and thermometer. Those with CHF used the blood pressure monitor, pulse oximeter and scales, while the patients with diabetes recorded their blood pressure, weight and could also, if they wished, input their blood glucose readings.

1.8.3 Patient Participation and Monitoring of Inputted Information

Patients in this study monitored their medical conditions through the inputting of their vital sign measurements every weekday which were then displayed on the Triage manager for the clinician to review.

There was an alert system in place whereby if a reading was outside the measurement parameters set by the clinician, this displayed on the Triage manager. In addition, it was agreed that Tunstall who could also see these alerts, would email the clinicians daily making them aware that there had been alerts.

Patients also noted their medication adherence daily and completed a Warwick-Edinburgh Mental Wellbeing Scale 3 times over the 12 week intervention period.

Along with the above measurements, patient also completed a health interview which was specific to their condition and the responses to this were also shared with the clinician via the Triage manager system.

1.8.4 Patient Recruitment

The clinicians involved in the project agreed to recruit a target of 50 patients who met the inclusion / exclusion criteria.

Recruitment to the project began in January 2021. This time coincided with the escalation of national restrictions due to the Covid- 19 pandemic. This meant that older adults were asked to protect themselves and ‘cocoon’, isolate themselves in their own homes. The recruitment to the study was therefore somewhat slowed down and ran from January to June 2021, with the final patients recruited completing the 12 week intervention in September 2021.

1.9 Conclusion

With the increasing aging population and the rising prevalence of chronic diseases, the Irish health care system needs to utilise available technologies to support older adults to self manage their health conditions within their own homes. This is in line with Slaintecare and the Integrated Care Programme

for Chronic Disease Prevention and Management of Chronic Disease priorities. A telehealth pilot project was undertaken in County Wexford in 2021 overseen by a multi-agency stakeholder group (Age Friendly Ireland, HSE, Tunstall Emergency Response, Wexford County Council's Age Friendly Programme including the Wexford Older Peoples Council) and a smaller operational group. Tunstall telehealth equipment was provided to patients with three chronic conditions (CHF, COPD and Diabetes). The participating patients collected medical readings and answered a condition specific health interview daily. The patient readings and responses were transferred to participating clinicians, with a readings alarm system in place. This report details the evaluation undertaken of this pilot study with the aim of making recommendations to inform the future roll out of a telehealth intervention for older adults living with chronic health conditions.

Chapter 2 Evaluation Methodology

2.1 Introduction

This chapter provides an overview of the methodology used to undertake this evaluation study. The study aims and objectives are outlined, in addition to an overview of the research design. Data collection and analysis methods are detailed and ethical considerations are discussed.

2.2 Research Aim and Objectives

The research study aimed to evaluate the pilot telehealth intervention, considering the impacts of the intervention on the patients' clinical condition and wellbeing, in-person use of health services, patient perceptions of using the intervention and technology and an analysis of the cost effectiveness of the intervention.

The research evaluation objectives were to:

1. To assess the impact of the remote patient monitoring service intervention on disease management;
2. To explore the patients experiences and views of using the remote patient monitoring service intervention on their health service utilisation, housing, health and wellbeing;
3. To explore the clinicians' views of the intervention and the impacts of the intervention including the selection of patients;
4. To conduct a financial evaluation of the intervention in terms of costs and savings;
5. To make recommendations for future implementation of remote patient monitoring services with older adults.

2.3 Research Design

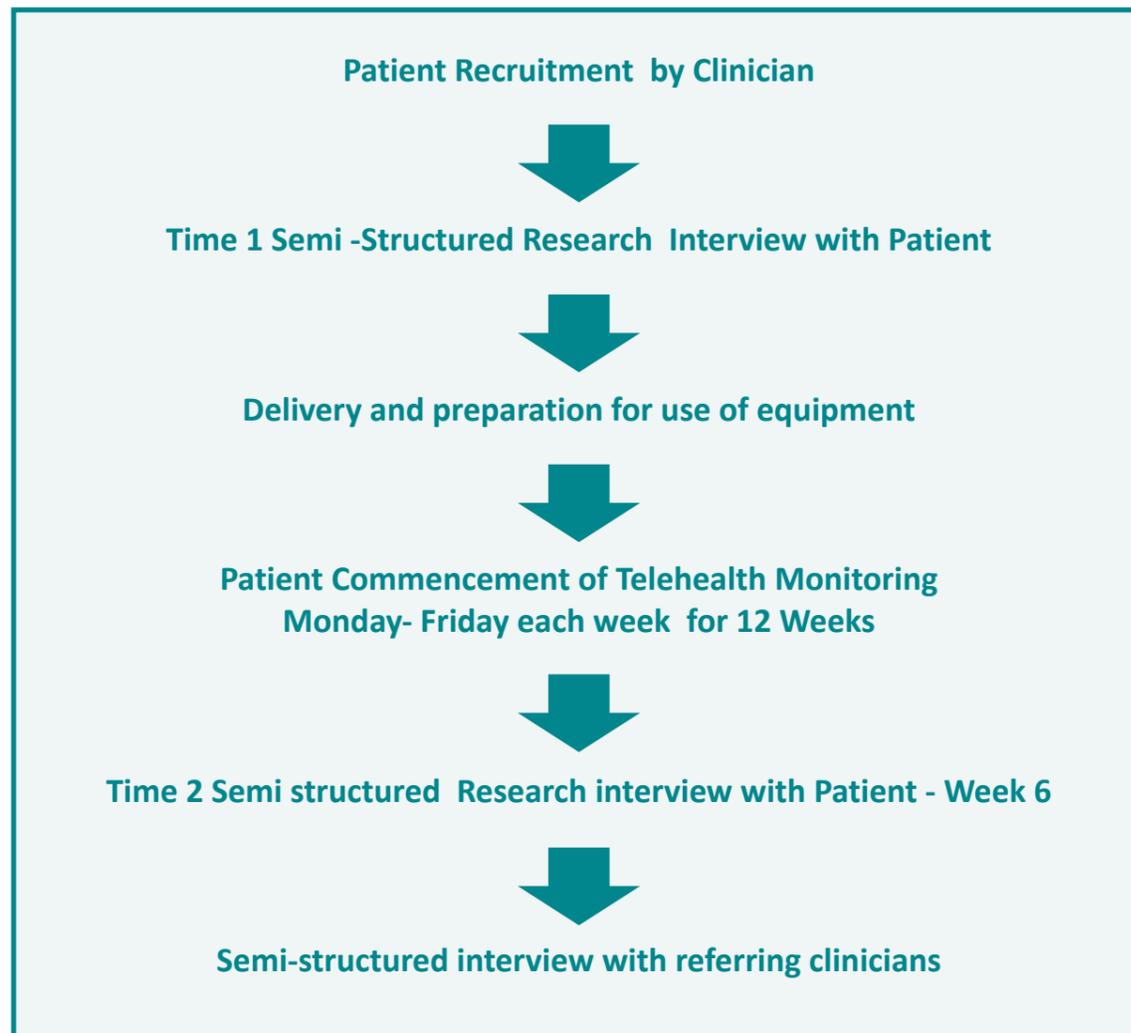
The research design used a mixed methods approach, with a range of qualitative and quantitative data collection tools used, including data collected from patients using the telehealth technology and semi-structured interviews with patients, clinicians and telehealth providers

The research design and data collection can be seen in Figure 2.

2.4 Research Sample

The research sample included the patients referred for the telehealth intervention by the participating clinicians and the clinicians. Box 1 details the inclusion and exclusion criteria for the patient participants. There were no inclusion or exclusion criteria for the referring clinicians, other than they had to have referred at least one patient to the intervention.

Figure 2. Flow chart of Research Design



Box 1. Patient Inclusion and Exclusion Criteria

Inclusion criteria include:

- Diagnosed with one or more of the predefined conditions (with the clinician determining which is to be regarded as the primary disease condition);
- Patient must have the ability to use or have support available to use the technology;
- Must have Mobile signal;
- Literacy and digital literacy will be assessed by the referrer (reading age 11 needed for intended use).

Exclusion criteria include:

- Lack of English/ Lack of Cognitive capacity (as determined by the Clinician);
- Lack of technology literacy capacity or support for this;
- Lack Access to mobile signal.

2.5 Data Collection Methods

Data was collected using a range of data collection tools including: the referral information on patients from clinicians; the data inputted by the patients on the ' My Mobile ' patient app every weekday over the 12 weeks of the intervention; interview data from patients prior to, during and post the intervention period; interview data from referring clinicians.

Quantitative Data from Patients

Patients used the telehealth remote monitoring equipment as described in section 1.8. The data provided from this included their daily measurement readings (Monday- Friday). They were asked to complete a condition specific health interview and note their medication adherence daily as to whether they had taken all their medication as prescribed. Each week, they were asked to rate on a Likert scale their condition management ranging from managing very well, managing adequately to not managing well.

Patients were also asked to complete the Warwick-Edinburgh Mental Wellbeing scale (Tennant et al., 2007) three times over the 12 week intervention period. The Warwick-Edinburgh Mental Wellbeing Scale was developed to enable the measuring of mental wellbeing in the general population. The items are all worded positively and cover both feeling and functioning aspects of mental wellbeing. The scale has been widely used nationally and internationally for monitoring, evaluating projects and programmes. The 14-item scale has 5 response categories, summed to provide a single score. The scoring range for each item is from 1 – 5 and the total score is from 14-70. Scores of 45-59 represent average mental wellbeing and scores of 60 or more for high mental wellbeing (Warwick University 2021).

Qualitative Data from Patients

Patients were asked take part in semi structured research interviews at three stages during the 12 week intervention (prior to the intervention starting, during week 6 and following the intervention- within two weeks of ceasing intervention). Patient interviews were conducted remotely via telephone.

At time 1, the interviews explored health service utilisation for the 6 months prior to the interview, Assessing current housing, challenges with same, likelihood of remaining in the property, extent to which assistive technology may help remain in own home, future housing need: what technology they currently use, capacity in using this, support for using technology, satisfaction and willingness to use/re-use .

At time 2, the interviews explored health and health service utilisation during the first 6 week of the intervention. The participants perception of the service was assessed, in term of use, usability and user experience. As it was apparent from the time 1 interviews that the pandemic had impacted the patients' use of healthcare services, this was assessed further in terms of use, access and experience.

At time 3, interviews, in addition to the reassessing health, health service utilisation and perceptions of the service, the overall experience of the intervention was assessed. This included expectations, service provided, views on future use and impact of the intervention on health and healthcare usage.

The final element of patient data collected was information on the alerts raised on the ICP Triage app, from the readings from the equipment.

Referring Clinician Data

Referring clinicians were asked to input demographic and clinical details onto the Tunstall system. Clinicians were also asked to complete a data sheet containing anonymised information about patients considered but not referred for the intervention and outlining reasons they were not included. In addition, referring clinician participants were asked to take part in research interviews. Interviews were conducted via video conferencing.

Telehealth Cost Analysis Data

This considered the cost to deliver the telehealth intervention including both the Tunstall and clinician costs. The costing was based on 34 patients. This was calculated on those who completed the 12 weeks intervention and also takes into account the usage of the intervention by those who commenced but did not complete the 12 weeks.

Tunstall costs include installation (€100 per patient), maintenance (€5.77 per patient/ week), triage (€85 per day) and equipment (€1250 per patient).

Clinician costs included recruitment time and daily checks of system for alert, and clinical follow up identified by clinical judgement from alert readings. Clinician estimation of time for recruitment was 1.5 hours per patient (€35 per hour). Time was also required on a daily basis and this time was used for checking the Clinical Triage Manager system and follow up phone calls with patients. The costs for this time have been based on the Clinical Nurse Specialist pay scale- midpoint. The cost of review in hospital clinics was included as €172 per visit.

The estimated cost for an individual patient taking part in this pilot telehealth intervention was therefore **€ 2,155**.

2.6 Data Analysis

Quantitative data was inputted into IBM SPSS v.25 and was analysed using descriptive statistics.

Qualitative data was managed using data analysis software (NVivo). Data was subject to thematic analysis (Braun and Clarke, 2006) to explore issues emerging from the semi- structured interviews with patients, referring clinicians and Tunstall staff.

2.7 Ethical Considerations

Ethical approval for the evaluation was sought and obtained from the Regional Research Ethics Committee of the HSE, and Waterford Institute of Technology. All data gathered by Tunstall in their delivery of the interventions, patient monitoring and shared with the research team, in addition to interview data gathered by the WIT research team, were subject to ethical considerations in relation to data collection and data management. In this regard, the process of data collection (e.g., consent and anonymity), storage (data transfer and security) and use (analysis, GDPR compliance), in addition to considerations of participant safety were prioritised and considered extensively.

At the point of patient assessment by the clinician, patients, if deemed suitable, were informed of the opportunity to engage with telehealth pilot project/ research evaluation. Participants were provided with the Telehealth and Research Information Sheets. Following this, patients were asked to provide informed consent by completing the Informed Consent Forms. No data was shared with WIT until the consent form had been received. Participants were informed of their right to withdraw from the study at any time should they wish to do so, at which point telemonitoring equipment was removed from their home and they had access to their usual health care.

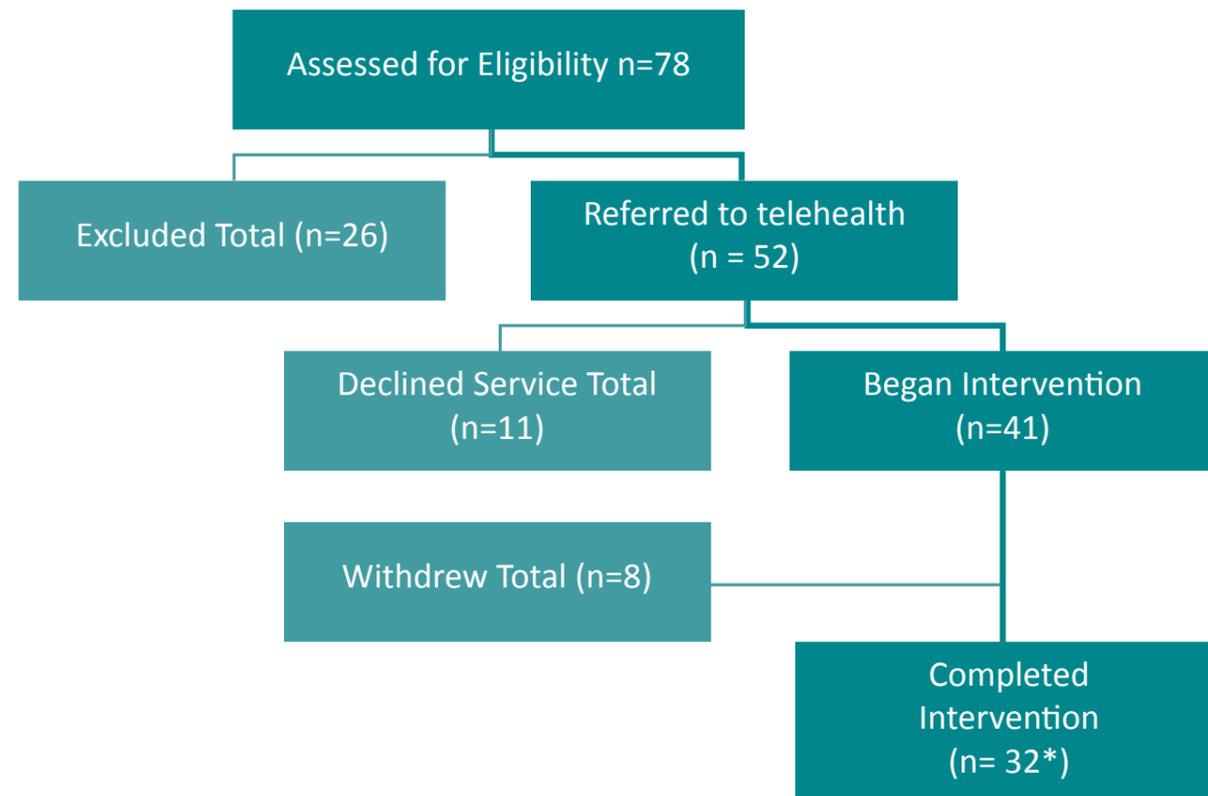
Patients' demographic and clinical details along with the data from the monitoring system were shared with the research team. Tunstall coded all information received from participants and removed all personally identifiable information from the forms before sharing them with the research team via a secure cloud system. The code was provided separate to the cloud system to ensure safety of patient data.

3. Introduction

Chapter 1 detailed the background and implementation of the telehealth pilot project. Chapter 2 detailed the methodology used to evaluate the pilot project. This chapter explores the quantitative findings from the evaluation of the project.

The results are presented as follows. Section 3.1 provides an overview of the recruitment of patients to the intervention and consideration of those who were considered eligible but not included in the study. The socio demographic and clinical characteristics of those who completed the 12 weeks of the intervention are detailed in Section 3.2. Section 3.3 examines the findings emerging from the ‘My Mobile’ app information from the participants over the 12 weeks of the intervention. Findings related to participants’ wellbeing and their views on their illness stability and management prior to during and on completion of the intervention is detailed in section 3.4. Section 3.5 considers the participants’ use and views on technology prior to, during and on completion of the intervention

Figure 3. Flow chart of Recruitment



*one patient was not completed intervention in time for report preparation.

3.1 Recruitment of patients

This section considers the recruitment, attrition and retention of patients and also examines those patients who were considered by clinicians but who were not recruited to the intervention.

3.1.1 Recruitment and Retention

The recruitment for this pilot study began in December 2020, with the first patient commencing the intervention early January 2021. Between December 2020 and May 2021, the three referring clinicians referred 52 patients to the intervention.

Of the 52 patients referred, nineteen did not take part or complete fully. Three patients who commenced the intervention died during the intervention period (RIP). One patient took part in intervention but is not included in results due to a hospitalization during intervention.

Eleven patients withdrew before starting the equipment was installed. No reason was provided for five withdrawals. Reasons provided by other patients included changed mind (1 patient), too unwell (2 patients), believed it would be too stressful to monitor (1 patient), unable to fit into their day (1 patient) or unable to use the equipment (1 patient).

Four patients began monitoring but did not continue. Reasons were given for ceasing included that they have thought trial was 1 week only and weren’t able to commit to 12 weeks as would be relying on a neighbour for technical support. Two stopped monitoring due to illness at days 1 and 31. No reason for given for the patient who stopped at day 11. One patient was not completed intervention in time for report preparation and hence is not included in the results.

Therefore, thirty-two patients completed the full 12 weeks of the intervention in time for inclusion in report and their interviews at the three time points and data are included in the results.

Table 1 captures the profile of those nineteen patients who were referred for the intervention but who did not take part.

Table 1. Profile of Referred Non Participants

Variable	Detail	Number of participants (%)
Age	>65	3 (16)
	65-70 years	1(5)
	71-75 years	7 (37)
	76-80 years	3 (16)
	81-85 years	4 (21)
	<86 years	1 (5)
	Range Mean	51-89 years 73.4 years
Gender	Male	9 (47)
	Female	10 (53)
Conditions referred	Heart failure	7 (37)
	COPD	10 (53)
	Diabetes	2 (10)
Declined prior to installation: 11 Patients	No reason given	5 (26)
	Changed mind	1 (5)
	Too unwell	2 (10)
	Unable for technology	1 (5)
	Unable in include in day	1 (5)
	Too stressful to partake	1 (5)
Deceased: 3 Patients		
Withdrew: 4 Patients	No reason given	1
	Illness	2
	No tech support	1

3.1.2 Non Participating Patients

Clinicians were asked to keep a record of patients they had considered for the intervention but who did not take part either because the clinician deemed them unsuitable or the patient declined referral. Forms were returned by clinicians for 26 patients. Table 2 provides a summary of these forms. Some participants were not referred by clinicians due to illness/ disability considerations, while others were considered suitable by clinicians declined to take part, in main due to technology concerns. All participants for whom this non participation form was returned had heart failure along with other medical conditions. Clinicians were also asked to rate their perception of the patient’s illness stability and patient’s ability to manage their illness.

Table 2. Profile of Non- referred Patients

Age	Range, 67-93 years	Mean 75.4 years	Number of patients (%)
Gender	Male		14 (54)
	Female		12 (46%)
Medical Conditions	Chronic Heart Failure		26 (100)
	Hypertension		8 (31)
	COPD		4 (15)
	Type 2 Diabetes		7 (27)
	Left Ventricular failure		4 (15)
	Ischaemic Heart Disease		14 (54)
	Arthritis		3 (12)
Stability of illness	Very stable		2 (8)
	Relatively stable		15 (58)
	Somewhat stable		5 (19)
	Not stable		4 (15)
Illness management	Manages very well		1 (4)
	Manages well		4 (15)
	Manages adequately		12 (46)
	Does not manage well		9 (35)
Reasons for not referral: illness/ disability related	Blind		1 (4)
	No capacity to consent (ID/ Dementia)		2 (8)
	Illness too unstable		4 (15)
	No English language		2 (8)
	Non adherent to medical plan		3 (12)
	Poor mobility- unsafe to use scales		1 (4)
Reasons for refusal: technology related *	Not competent in technology		9
	Not interested in technology		11
	Fearful of technology		4
	No support to use technology		8

*could select more than one answer

3.2 Patients Socio- Demographic Characteristics

This section details the participating patients' socio-demographic and clinical characteristics gathered from the clinician inputted information to Tunstall and interview with patients.

Table 3 presents these findings. The majority of those participating were male (85%), married (57%), ages ranged from 51 to 96 years (mean 71 years) and only 18% had private health insurance.

Table 3. Participants' Socio Demographic Characteristics

Variable		Number (%)
Age	>65 years	3 (9)
	65-70 years	9 (27)
	71-75 years	9 (27)
	76-80 years	8 (24)
	81-85 years	1 (3)
	<86 years	2 (6)
Gender	Male	28 (85)
	Female	5 (15)
Marital Status	Single	7 (21)
	Married	17 (52)
	Widowed	3 (9)
	Divorced	1 (3)
	Separated	3 (9)
	Other	1 (3)
Education	Primary	10 (30)
	Secondary	12 (36)
	Third Level	6 (18)
	Trade	4 (12)
Health Cover	Medical Card	22 (67)
	Private Health Insurance	6 (18)
	Both	2 (6)
	Neither	2 (6)

Participants were asked about their housing and living arrangements and this data can be seen in Table 4. The majority owned their own home (79%) and almost a third lived alone (30%). Over 70% had lived in their current house for over 5 years and only 2 participants (6%) were considering moving house.

Table 4. Participants' Housing and Living Arrangements

Variable	Detail	Number (%)
Housing	Own home	26 (79)
	Renting	4 (12)
	Social Housing	1 (3)
	Other	1 (3)
Living Arrangements	Alone	10 (30)
	Spouse/Partner	21 (64)
	Family	1 (3)
Length at Current Housing	>1 year	1 (3)
	1-3 years	3 (9)
	4-5 years	4 (12)
	< 5years	24 (72)
Planning to Move	Yes	2 (6)
	No	30 (91)

3.3 Participants Clinical Profile and Health Service Utilisation

This section presents an overview of the clinical conditions of the participants, their views on their illness stability and ability to manage their condition and their health service utilization prior to and during the telehealth intervention.

Table 5. Participants' Clinical characteristics

Variable	Detail	Number (%)
Referred Condition	COPD	12 (38)
	Heart Failure	17 (53)
	Diabetes	3 (9)
Length since Diagnosis	>1 year	2 (6)
	1-5 years	11 (34)
	6-10 years	7 (22)
	< 10 years	8 (25)
	Missing	4 (13)
Other Health Conditions	Yes	26 (81)
	No	6 (19)

Along with the condition for which they were taking part in the intervention, other medical conditions reported by patients included asthma, high blood pressure, pancreatic cyst, glaucoma and scoliosis. Where patients were being referred for monitoring for one condition by their clinician, they may also have had one or both of the other conditions.

Participants were asked regarding their use of a range of health services within the 6 months prior to the intervention at the first interview and were also asked at the interviews mid- way and at end of the intervention about their use of health services. Table 6 captures this usage. It can be seen that only 6% had not attended a general practitioner (GP) within the 6 months prior to the intervention, with almost 50% attending 1-2 times. Other health services used included hospital clinics, where again almost 50% had attended on 1-2 occasions within the 6-month timeframe. Just over a quarter had been admitted to hospital in the six months prior to the intervention, with a mean duration of stay being 6.5 days (standard deviation 10 days). During the 12-week intervention, again over 50% attended the (GP) while two patients were admitted to hospital, mean duration of stay 2 days. It should be noted however that the participants in the interview highlighted how Covid had impacted on their use of health services, and that cocooning had been an illness reducer for many of them, resulting in less 'flare-ups' than usual.

Table 6. Participants' Health Service Utilisation

Variable	Detail	Health visits during 6 months prior to Intervention n (%)	Health visits Time 2 during Intervention n (%)	Visits Time 3 during Intervention n (%)
General Practitioner	Never	6 (18)	16 (50)	14 (42)
	1-2 times	16 (49)	16 (50)	17 (55)
	3-4 times	7 (21)		1 (3)
	5-6 times	2 (6)		
	<6 times	1 (3)		
Public Health Nurse	Never	29 (91)	32 (100)	31 (100)
	1-2 times	3 (9)		
Hospital Clinic Appointment	Never	14 (44)	25 (78)	28 (88)
	1-2 times	15 (47)	7 (22)	4 (12)
	3-4 times	2 (6)		
	<6 times	1 (3)		
Private Consultant Appointment	Never	28 (88)	32 (100)	32 (100)
	1-2 times	3 (9)		
	3-4 times	1 (3)		
Emergency Hospital Visit	Never	25 (78)	30 (94)	30 (94)
	1-2 times	7 (22)	2 (6)	2 (6)
Physiotherapist	Never	26 (81)	31 (100)	30 (94)
	1-2 times	4 (12.5)		1 (3)
	< 6times	2 (6)		1(3)
Other Hospital Appointments	Yes	13 (40)	8 (25)	23 (71)
	No	19 (60)	24 (75)	9 (29)
Hospital Admission	Yes	8 (26)	2 (6)	2 (6)
	No	23 (74)	30 (94)	30 (94)
	Duration of stay	Mean 6.5 days (SD 10)	2 days	6 days

3.4 Participants' Wellbeing and Illness Management

Participants mental wellbeing was assessed using the Warwick – Edinburgh Mental Wellbeing Scale at three timepoints, end of week 1, week 6 and week 12. Scores of 45-59 represent average mental wellbeing and scores of 60 or more represent high mental wellbeing. Table 7 details these results. It can be seen that there was no evident change in wellbeing scores between the three time points and that there was a substantial number of missing readings. The readings were to be recorded via the 'my mobile' app but were frequently forgotten to be recorded by participants.

Table 7. Participants' Warwick Wellbeing Scores

Warwick	Time 1	Time 2	Time 3
Mean (SD)	57 (7)	56 (9)	56 (10)
Range	40-67	41-68	45-70
Average wellbeing n (%)	14 (43)	11 (33)	11 (33)
High wellbeing n (%)	11 (33)	9 (27)	8 (24)
Missing	7 (24)	13 (40)	14 (43)

Participants were asked to record every day if they had taken their medications as prescribed and the findings indicated a high level of adherence, with 96% of patients recording that they had taken all medication as prescribed.

Participants were also asked to rate their views of how stable their illness is and how well they feel they are managing their illness prior to, during and on completion of the intervention. As can be seen in Table 8 most participants viewed their illness as either very or somewhat stable at all time points and the number of those who felt they managed their illness very well had increased from time point 1 to time point 3 (52%-to 73%).

Table 8. Participants' Views of Illness Stability and Management

	Level	Prior to intervention n (%)	During intervention n (%)	Post intervention n (%)
Views on Illness Stability	Very stable	15 (47))	17 (53)	16 (49)
	Somewhat stable	13 (41)	11 (33)	12 (39)
	Not stable	3 (9)	2 (6)	4 (12)
	Unsure	1 (3)	2 (6)	
Views on Illness Management	Very well managed	17 (52)	23 (72)	24 (73)
	Somewhat well managed	14 (44)	8 (25)	8 (24)
	Not well managed	1 (3)	1 (3)	1 (3)
	Unsure			

3.5 'My Mobile' Patient App Findings

As explained in section 1.8, the 'My mobile' app captured the data from the monitoring devices and from the health interview.

Patient engagement with using the device was very high- only 2.6% of daily readings were missed. There was however follow up by Tunstall staff when a reading wasn't recorded which probably accounts for the very high percentage of readings inputted.

Table 9 details the monitoring system usage, missed and extra reading and alerts raised. All patients raised at least one alert. With this monitoring system, alerts could be raised from more than one of the readings, for example there could be an alert for pulse and blood pressure on the same day. The number of alerts raised by individual patients ranged from 1 alert to 108 alerts. The number of days where alert were raised by individual patients ranged from 1 day to 59 days.

The health interview was completed each day by patients. Many patients (19, 57%) noted no symptom changes in the health interviews over the 12 weeks.

Table 9. Monitoring System Usage and Alerts

Extra Readings	Number of patients taking extra readings	11
	Total number of extra readings	17
Missed Daily Readings	Number of patients who missed readings	11
	Number of readings missed	53
	Range of readings missed	0-10
	Overall percentage of readings missed	2.6
Alerts Raised	Total days alerts raised	569
	Total number of alerts raised	932
	Number of patients with alerts	33 (100%)
	Alerts per patient (mean, range and SD)	33 (1 – 108, 31)
	Alerts	
	Weeks 1-4 (mean, range and SD)	12 (0-43, 11)
Weeks 5-8 (mean, range and SD)	10 (0-42, 10)	
Weeks 9-12 (mean, range and SD)	10 (0-42, 12)	
Symptoms from Health Interview	Patients noting changed symptoms	
	Yes	19
	No	
	Total days changed symptoms noted	28
Total number of changed symptoms noted	32	

3.6 Participants' Views of Technology

Participants' views of technology were ascertained prior to, during and on completion of the intervention.

As can be seen in Table 10, at time 1, over half the participants were happy to use technology, and almost all, nearly 90% rated their ability to use technology as good or very good but almost 30% felt they would still need support to use technology. As this was prior to the intervention, the participants had not yet received the Tunstall equipment, but over three quarters of participants were of the view the devices would help them manage their condition. Information on the devices had been provided by the clinicians during the recruitment process.

Table 10. Participants' Views of Technology Time 1

		n%
Happy to Use Technology	Not happy	3 (9)
	Somewhat happy	12 (36)
	Very happy	17 (52)
Ability to use Technology	Very good	12 (38)
	Good	16 (50)
	Not good	4 (12)
Would like support with technology	Yes	9 (28)
	No	22 (69)
	Don't know	1 (3)
Technology helpful to manage condition	Not helpful	1 (3)
	Somewhat helpful	2 (6)
	Very helpful	25 (76)
	Unsure	4 (12)

The participants use of technology in everyday life was explored at time point 1 and this can be seen in Table 11. Over half of participants used a computer regularly (at least once a week), and almost three quarters (70%) used a smartphone.

Table 11. Participants' Use of Technology

		n%
Computer Use	Yes	17 (54)
	No	15 (46)
Smartphone	Yes	23 (70)
	No	9 (27)
iPad	Yes	16 (57)
	No	11 (39)
Smart TV	Yes	2 (6)
	No	30 (91)
Internet	Yes	27 (76)
	No	5 (21)
Video Calling	Yes	17 (52)
	No	15 (46)
Whatsapp	Yes	14 (42)
	No	18 (55)
WiFi	Yes	19 (58)
	No	13 (39)
Other Technology	Yes	4 (15)
	No	28 (85)

At time 2, participants were asked regarding their use of technology and if their opinion of technology had changed. As detailed in Table 12, using the Tunstall devices changed the opinion and improved the use of technology for some (almost 40%) but not all participants. Almost all (97%) were very happy to use the device and the majority (over 80%) found that the technology provided help in managing their illness.

Table 12. Participants' Views of Technology Time 2

		n%
Happy to use the Tunstall devices	Very Happy	31(97)
	Not happy	1 (3)
Using Tunstall improved ability to use other technology	Yes	12 (38)
	No	20 (62)
Now using more technology	Yes	1 (3)
	No	31 (97)
Helpfulness of technology to help manage illness	Not helpful	4 (12)
	Somewhat helpful	2 (6)
	Very helpful	25 (78)
	Unsure	1 (3)

At time 3, post the intervention, almost all participants (97%) reported that they would still be happy to use the devices and almost 80% reported that they had found the devices very helpful in managing their illness. See Table 13 for detail on views of technology at time point 3. When asked about problems using the device that they had experienced, these included when the measurement devices (weighing scales/ blood pressure and thermometer) did not work, but the main issue seemed to be connectivity. However, when problems were explored further, all these participants said that the support from Tunstall was very good to resolve the problems promptly.

Using the device had changed the opinion of technology for over 40% of participants and the key changes reported included increasing confidence when using technology and using more technology.

Table 13. Participants' Views of Technology Time 3

		n%
Ability to use Tunstall device	Somewhat able	2 (6)
	Very able	30 (94)
Changed opinion on technology	Yes	14 (42)
	No	18 (58)
Helpfulness of device to manage illness	Not helpful	4 (12)
	Somewhat helpful	3 (9)
	Very helpful	25 (79)
Experienced problem with device	Yes	14 (45)
	No	18 (55)
	Blood pressure monitor	5 participants
	Thermometer	3 participants
	Connectivity between devices	10 participants

4. Introduction

As detailed in chapter 2, quantitative data was collected during the study to address the study aims and objectives and these quantitative findings can be seen in Chapter 2. Qualitative data was also gathered from the participants. As detailed in section 2.5 interviews were undertaken with all participants (n = 32 patients) at three time points, prior to, during and on completion of the intervention and also interviews with the three clinicians. The findings emerging from these interviews are presented in this chapter. Section 4.1 outlines the findings from the interview prior to the intervention with section 4.2 providing the findings emerging during the intervention. Section 4.3 provides the findings from the interview with participants on completion of the intervention. Referring clinicians (n = 3) were also interviewed as part of the study, and findings from these interviews can be seen in section 4.4.

4.1 Participants' Interviews Prior to Intervention

Questions posed during this interview related to the participants medical conditions, stability of conditions, quality of life, health service utilization and technology use. This data indicated the emergence of four main themes: Health and Illness; Health Service Utilisation; Technology Use and availability; and Assistive Telehealth Technology

4.1.1 Health and Illness

Participants described a range of illnesses that affected their respiratory, cardiac, metabolic and autoimmune function; comorbidities were common finding throughout the sample. Respiratory conditions included Chronic Obstructive Pulmonary Disease (COPD), pleural plaques and one participant had previously had a pneumonectomy. In relation to cardiac disease, this included previous myocardial infarctions, Chronic Cardiac Failure (CCF) and atrial fibrillation. Metabolically, diabetes was diagnosed for some participants and from an autoimmune perspective, several participants suffered with arthritis. Responses within this theme relate to *condition stability and quality of life*.

Condition Stability

Despite several participants suffering from symptoms relating to their chronic disease and comorbidities, many described their illness to be quite stable in the previous 6 months and had managed this well.

'It appears to be very stable now, I'm working every day and I know I'm slowing down a bit, cutting back a bit on the amount of work that I have to do less stock, we're farming here... I'm able to most things I want to do I'm able to do it now, I have a pace maker now as well or a defibrillator... I'm delighted with that now... I always take my medication.' [TWP27]

'The treatment and the resulting treatment with the cardiac nurses brought me back to almost normal except that I couldn't do heavy work anymore and then in December last year, I had a pacemaker defibrillator implanted' [TWP19]

'unbelievably good...I don't cough as much usually at all now, its breathing more than anything ... the other thing is if I see a hill, I lose my breath, now that's the way it is, I just not able to do inclines, I can walk on the flat but I gasp on incline.' [TWP02]

Exercise appeared to have a positive impact on condition stability for some participants.

'Doing exercises with the pulmonary rehab and since I'm doing that, I feel a lot better, I think exercise helps.' [TWP02]

'I've been doing three of four miles a day, always done it, I love doing it, and now all I get is far is the hotel on the promenade, the riverside.' [TWP09]

However, a number of participants reported the stability of their condition to be precarious in the previous 6 months whereby symptoms varied from day to day.

'You know I have good days and bad days. It's hard to condense it into one sentence.' [TWP06]

For participants who had health difficulties in the previous 6 months, this was attributed to several factors that included their chronic disease and additional health issues related to co-morbidities and seasonal illnesses. For some, symptoms affected their mental health, along with the impact of the Covid – 19 pandemic as they were 'cocooning' as required under national public health guidelines at the time.

'Breathlessness obviously, but again that's only minor....I'm very depressed, the same as half the country I suppose, not been able to get out and meet some people, you know, I haven't been the best but what can you do?' [TWP06]

'...the arthritis in my knee and then I had a blood clot right in the very same leg and then COPD... I know this COPD is up there...but its the secondary thing to me at the moment.' [TWP09]

'...I got a terrible flu, worse flu I ever had in my life...and then recently I developed vertigo.' [TWP13]

Quality of Life

Health difficulties have had a significant impact on many participants' overall wellbeing, with COVID restrictions also being a contributory factor for some. Quality of life appeared to be affected by both disease related symptoms and isolation. For many levels of independence were reduced as they relied on others for assistance with daily activities.

'I went into isolation for 12 weeks, I have shopping delivered, my shopping is delivered every Thursday evening and ordered on Wednesday.' [TWP03]

'It has obviously affected the independence you know, quite a bit. You know, there are a lot of things that I can't do that I used to do and yes yes so it does effect it.' [TWP04]

'I can't make my bed at all. I don't shower on my own. I have a carer who comes in four days a week, an hour? each time. Getting up the stairs takes me a while; I just have to take my time and do one step at a time.' [TWP06]

'I wouldn't be able to do a full day's work, I need my hubby here, he does most of it.' [TWP02]

Decreased levels of physical activity were common to many. Condition related breathlessness and fatigue were also reported as common symptoms affecting quality of life.

'Not great, in a sense that I can't walk very far, I'm not able to stand for long periods of time. Andt kind of my appetite not really interested in cooking, which I always was and if I do a basic dinner every day.' [TWP12]

'I'm getting very, very breathless in the morning.' [TWP15]

'Very tired and sometimes go to bed after dinner, after midday, go lay down for a few hours and sleep for a few hours. So along with symptoms, heart failure, circulation problems and swelling of the feet and the swelling of the legs and the feet and the circulation is bad, you know, very bad circulation.' [TWP17]

4.1.2 Health Service Utilisation

In terms of health service utilization, there was an awareness amongst the participants of who to phone if there is any deterioration such as reporting to the GP, the respiratory department and the cardiac specialist services. Other routine services that participants engaged with included physiotherapy, occupational therapy and the diabetic clinic. Participants perceived COVID restrictions had impacted negatively on routine health service utilization and access to care.

'They've all been, I've had quite a few that I should go to, but they've all been cancelled yet because of the COVID' [TWP04]

Several participants found it difficult to get an appointment with their GP.

I couldn't get, can't get, an appointment with her (GP) even on the phone or anything in the last 6 months I have had two phone calls, that's all it's very hard to get in the door [TWP13]

Where there was a significant health deterioration, some participants were hospitalized for treatment.

4.1.3 Technology Use and Availability

The third main theme resulting from the Time1 interview data concerned technology use and availability. Participants were asked about their experience and use of technology prior to engaging in the study. Responses ranged from limited experience and/or interest and use, to high interest and engagement with a variety of technologies that included lap tops; tablets; smart phones; and in some instances previous monitoring devices. Reasons for use varied, however mainly related to communication and social purposes. Comments relating to technology use and availability are reported as *limited experience and engagement; confidence and support; and reasons for use.*

Limited Experience and engagement

For those reporting limited engagement with technology there appeared a level of discomfort. Reasons included lack of interest, a perception of low personal capability, and for one participant a fear of using the internet for risk of 'on-line scams'.

'I'm probably a bit low on that there now.... I find it difficult.' [TWP24]

One participant described his lack of interest in technology and appeared content with using an old phone.

'I just haven't got the interest in that end of things..... It is an old phone, with big buttons which I can see and press them with my finger.' [TWP13]

Others reported a lack of interest as a result of not perceiving a need to use technology.

'I'm not into it (technology), so it doesn't affect me in any way.' [TWP09]

Confidence and Support

Some participants expressed confidence in their ability to use technology, 'I'm fairly up with the technology' P23, or at the very least, confidence in accessing support when needed. The majority of participants reported that they had 'help' with technology from family, when they 'got stuck'. Daughters, sons and spouses were often referred to when difficulties arose.

'He has always helped with computers and he has always worked with them.' [TWP12]

'I ring my daughter.' [TWP16]

'If I really get stuck now I have my granddaughter here and she is, you know young people today experts in technology.' [TWP15]

Reasons for Use

Participants' used technology for a number of purposes, although the main reason appeared to be to remain connected with friends and family which was deemed even more important during COVID restrictions. Applications such as Zoom, Facebook and WhatsApp were referred to in this regard. Others reported the use on on-line gaming platforms such as bridge for entertainment and social purposes. On-line banking and exercise classes were also reasons given by participants for technology use.

'Yeah, I can use the video calls because I have two sons living up in Newbridge in county Kildare, I can use that but I don't use WhatsApp but I would use Facebook.' [TWP15]

'I play bridge twice a week online, so you know I use it a good bit, the what do you call it, the iPad.' [TWP02]

'Household records we keep on spreadsheets on the computer. We use emails regularly, Facebook and messaging we use a lot.' [TWP19]

4.1.4 Assistive Telehealth

For the final section of time 1 interview questions participants were asked about their understanding of assistive telehealth technology, their thoughts on how useful they think it would be in helping managing their condition and why they decided to participate in the telehealth intervention. Responses were varied however most were very positive towards the intervention with many anticipating the benefits of being monitored. A couple of participants had experienced telehealth prior to the study. However, for the majority, the Tunstall project was their first experience of telehealth. Participant comments relating to assistive telehealth technology related to *benefits anticipation; and willingness to engage.*

Benefits Anticipation

The reassurance of being monitored on a daily basis and the anticipated potential of the intervention to be 'helpful' was perceived by many of the participants. This was described in terms of a 'safety net' of others watching, 'experts looking after you'[TWP15] in addition to the ability of patients to self-monitor their own condition.

'It's going to be very helpful. I'll have people on my case every day now instead of every three weeks.' [TWP14]

'I suppose I'd like to see if it works which I hope it does, that, well obviously I'll know how my health is going for a start on a day-to-day basis.' [TWP1]

'I think it'd be very reassuring for me anyway that I know somebody can see what's going on and if there is a problem, they will be able to sort it or get me to sort it.' [TWP13]

'At least I'd have a little more confidence in myself to be able, how'd you say, manage my own symptoms and manage my own health.' [TWP2]

Willingness to engage

Even though some participants were less sure of the potential benefits there was a general willingness to engage with the intervention.

'They were obviously looking for guinea pigs to try it out on so I said I might as well do it if it helps.' [TWP06]

'I'll have a go ... there is no reason for me not to try it.' [TWP17]

Some people were willing to engage in the study for altruistic reasons; they did not anticipate benefits of the intervention for self but were participating in the research in case it could help others.

'Thought I could do something to help.... it's not going to benefit me if not linked up permanently' [TWP19]

'Well, it mightn't be any help to me you know, but it might be help down the years to somebody else like would be my thinking of it.' [TWP24]

4.2 Participants' Interviews During Intervention

Qualitative data from interviews conducted at time 2 of the study, that is at the mid-point of the intervention, indicated the emergence of two main themes: Health, Illness and Health Service Utilisation and Telehealth Technology Use.

4.2.1 Health, Illness & Health Service Utilization

Most participants reported the perception of their health to be unchanged since the time 1 interview. Those that experienced any deterioration had attended or had been reviewed by their GP with interventions including COVID testing and changes to medication. Issues relating to health, illness and health service utilization identified by participants included the experience of COVID isolation and the associated impact on mental health; anticipatory worry; access to health care providers; and exercise.

COVID Isolation and Mental Health

Although physical health conditions were reported to be stable by the majority, a few participants described a deterioration in their mental health due to social isolation as a result of the pandemic.

'COVID stress more than anything...I can't see my family...that kind of stresses me.' [TWP02]

'The doctor gave me the depression tablets but I sort of cut down on those..... It has an effect I am here on my own ...you get lonely...fed up...no one to talk to ..' [TWP04]

'I don't go near crowds...on the mental health, you'd be a bit funny...' [TWP17]

'I haven't got my appointment for the vaccine yet' ...yes, well on your mental health really, the weather was terrible, you couldn't get out, I would find fresh air very soothing and not being able to do that was a penance really...but I'd be terrified to go into company and I wouldn't go anywhere without my mask'... [TWP15]

Anticipatory Worry

There was also some anticipatory worry evident in terms of potential physical health deterioration related to their chronic disease.

'My worry is when I get sick I panic, I worry if I am going to end up with the oxygen tank on my back.' [TWP03]

Access to Health Care Providers

Some participants had their hospital appointments cancelled, whilst others still attended these and/or utilized specialist clinics support remotely.

'I was due to see the consultant last April..... now its February....I have not met this man yet with what's going on . I had appointments on the phone.' [TWP3]

'My biggest reassurance has been the cardiac unit, they have been fantastic. If I phone them, they will come back to me. If I'm not feeling well, I can call...' [TWP25]

One participant was hesitant to visit the GP when they thought they were getting a chest infection and started taking antibiotics they 'had in reserve'...stating:

'I just can't afford to get COVID.' [TWP04]

Exercise

Exercise was perceived positively in terms of mental health. Several participants reported walking to be their main outlet, whilst others engaged in Zoom classes.

'We do exercise twice a week COPD Irelandon zoom... they're brilliant.' [TWP2]

'Mentally I think it helps you... you do see people...neighbours when I go down the road.' [TWP7]

4.2.2 Telehealth Technology Use

Overall, the majority of participants had very positive experiences and attitudes towards the telehealth intervention with benefits to their care and wellbeing perceived by many. Very few participants felt the intervention was of no benefit. Issues relating to telehealth technology use raised by participants included reassurance and peace of mind afforded; ease of technology use; suggestions for telehealth monitoring improvements; and telehealth impact on disease management.

Reassurance

The feeling of reassurance and peace of mind that the telehealth monitoring provided was evident from many participants. In some instances, this related to participants being able to manage their own condition through self-monitoring but for most it was the reassurance that their condition was being monitored by others.

'It's very good to know that my oxygen levels are good... I'm not one for going to the doctor..... it reassures me.....contact with somebody.' [TWP2]

'You feel a little bit safer you know that somebody knows what's going on....I think it's a brilliant idea that you are being monitored.' [TWP8]

'It's nice to know you are being kept an eye on so it gives confidence.' [TWP19]

Ease of use

Participants found the technology easy to use in the main with many describing the inclusion of monitoring in their morning routine. Some participants experienced difficulties with the temperature equipment not working or poor connections yet took a problem solving approach to address any equipment challenges.

'It's easy to usenothing to it at all.' [TWP8]

'I'm very happy to use the Tunstall device, I'm very capable to use it.' [TWP16]

'We always had a problem with the thermometer.... it had to be kept warm.... if it's too cold it won't do it... I'd put it in my pocket before I used it and then it would work...' [TWP3]

'It just doesn't want to connect If it doesn't connect I switch it off and start again....' [TWP7]

Suggestions for improvement

Participants were asked about the feedback the telehealth equipment provided. Many were satisfied with the immediate reporting of their readings. However, a number of participants felt that the

feedback they received could be improved and that this would enable them to be more self-aware and consequently improve self-management of their condition.

'I would like more information on readings and if they are going well.....maybe every week or fortnight.' [TWP 1]

'What would be handy, I think maybe once a week once a fortnight to be able to see and compare the resultsthat would be a bit of a help for sure.' [TWP4]

Some participants had recommendations for improving the types and nature of the questions they were asked each day by the telehealth application. Others commented on the frequency of monitoring indicating that they could feel very different in the morning compared to the afternoon.

'With regards the questions it's all a yes or a no..... there is nowhere to put that (palpitations during the day).. I thought the question could be a little more broad spectrum.' [TWP12]

'I would like a question to know how I felt yesterday.....a question about breathing..... As the day goes on you could have a bad day..... (mornings feel well) as the day goes on you could be gasping..... I feel maybe I am not giving enough information yet I am answering the question..... ' [TWP2]

'In the morning it could be high and in the evening it could be low..... I think it would benefit people to do it twice a day.....to see the (difference) between the two readings' [TWP 10]

Impact on Disease Management

Many participants perceived the telehealth intervention to have a positive impact on monitoring and managing their chronic disease and improving self-confidence in this regard.

'It's given me confidence in myself and my condition. It has definitely helped me in managing my condition...to check myself out in the mornings is brilliant.' [TWP14]

'I'm very happy to use the Tunstall device, I'm very capable to use it...it's very helpful to manage my condition as it gives me my readings...yes, this is helping me manage better.' [TWP16]

In some instances this projected beyond themselves to others with similar conditions.

'It would certainly be helpful for people with long term illness and make them feel safe...not only do they get to look out for themselves there is someone looking out for them.' [TWP4]

'I just think that If we've got these devices we need to use them every day for our own benefit as well as the benefit for other people.' [TWP7]

Conversely, a limited number of participants did not perceive the telehealth technology as having an impact on their condition.

'It's not doing any harm but 'not doing any good. I'm not taking an injection or any pills like so I don't see how it can help me' [TWP09]

'Well, I don't know about managing my condition, all that data goes to the clinic.' [TWP17]

The positive response by participants to the Telehealth intervention was revealed in a number of ways at the second interview. Many participants were delighted to find out that they had another 6 weeks of monitoring whilst others were pleased that people were taking an interest in them and taking the time to listen to what they 'older people' had to say. All of the participants interviewed were happy to continue and engage in the final interview at 12 weeks.

4.3 Participants' Interviews Post the Intervention

Qualitative data from interviews conducted in time 3 of the study indicated the emergence of four main themes: Reassurance, Telehealth and the Health Services, Telehealth intervention - Patient interaction and Device limitations and potential.

4.3.1 Reassurance

A common theme that was present throughout these interviews was reassurance. Participants in this evaluation saw themselves as vulnerable, some expressed feelings of isolated and/or living with complicated unstable conditions. For them, reassurance is an important outcome of this project.

'People are sitting sometimes on a timebomb, with blood pressure, they wouldn't know there's no real symptoms as such, but it can be very dangerous.' [TWP14]

Reassurance can be divided further into these three sub-themes; sense of security, learning to live with the condition and communication.

Sense of Security

For the majority of the participants, the fact that their condition was being monitored daily was reassuring and gave them a sense of security. This sense of security originated in the participants' belief that should their condition deteriorate, that some type of medical intervention would occur.

'If there's somebody looking at it on a daily basis and my readings weren't great, I'm sure I would have got a call.' [TWP33]

'The way I looked at it, the way (the CNS) explained it to me, my heart nurse, she said, at least someone would be keeping an eye and if there was something going seriously wrong, I'd be contacted, so it gave me this security.' [TWP37]

'You know, it's like someone waiting in the wings with the assistance.' [TWP 14]

A few people referred to a feeling that someone would be 'keeping an eye' on them resulting in peace of mind and sense of being connected. The device helped relieve the anxiety that can occur when living a chronic health condition.

'The while I've been doing it now, it gave me a sense of comfort, comfort is not the word at all, I wasn't alone, you know.' [TWP02]

'I mean, not everybody in the streets would have this and they could be sitting on a time bomb like I was, so this was just unreal, it's just like winning the lotto for me this.' [TWP14]

'I think for day-to-day monitoring and to take that feeling of isolation away with your illness.' [TWP37]

'It does give you the feeling you're connected to the system so I'm sure it would give a lot of people extra peace of mind.' [TWP19]

Living with the Condition

It is evident in the qualitative data that some participants would rather ignore symptoms of their condition until a time where their condition becomes critical. This project has required daily health-related readings helping participants become more aware and take control of their conditions.

'While I was on this, I probably had to face up to it... I learned to face up to how I was feeling and how every time I took out that box... every morning, like I'm facing up to of what's in me so that would be a very good thing in itself.' [TWP02]

'I suppose that it would keep you on your toes more.... I suppose it makes you more aware like when you see the readings, with regards carrying on with a to b, you understand me.' [TWP27]

'You're guessing but it's very reassuring that you know exactly where you stand when you do your test on here, it's a wonderful thing to have because some people could be in trouble. I could have been in trouble, and this is a great indicator, isn't it?' [TWP14]

For others, being able to see health-related readings is a source of reassurance. For some, seeing that their condition is stable provoked a sense of confidence regarding their health and ability to manage their illness.

'I wouldn't say it has any effect on it other than maybe peace of mind when I really when I get to readings and I'm happy with them.' [TWP13]

'I think because when I know my oxygen levels were good, it gave me more confidence to go through the day you know that this is good, my oxygen levels are good so I can do more.' [TWP02]

Participants were able to educate themselves about their condition through this system. However, this was determined by the determination of the participant to find ways in which to do so. For those, the education consisted of adjusting their lifestyle to stabilise and improve their condition.

'Absolutely, I went to town one day, Wexford town, we walked along the quay around them and that showed in my readings, obviously, so you have to keep on the move, this machine is telling me all that.' [TWP14]

'Well, I did notice my blood pressure is up a bit... My blood pressure, I think, is probably what I do the night before, if I stay up too late reading or if I have a couple glasses or wine, something like that.' [TWP02]

For others, the usefulness of self-monitoring was to become familiar with the early indicators of deterioration. Many participants have multi co-morbidities, being able to attribute specific symptoms to each condition was seen by some to increase the chance of early intervention.

'When I was feeling a peculiar change, I would take it and that was for me to learn, right? If the blood pressure went down to 75, 80 or 90, I knew what was sort of happening and I know to sit down... If I'm going up the side of a mountain, and something starts to go peculiar... I can figure it out.' [TWP25]

'I mightn't be feeling that great and I'd be saying oh, I'm dropping too low or something but then I can kind of eliminate that and say well look it's only the arthritis or something else.' [TWP37]

4.3.2 Telehealth and the health services

Participants were asked their view on telehealth and subthemes which emerged were current limitations and patient benefits.

Current Limitation

The majority of participants expressed that telehealth is an acceptable way of receiving health care. For some, anything that might reduce time spent in hospitals is a step in the right direction. People were fearful of in-person health care due to the risk of infection.

'I think hospitals are an awful place... there's no healthier a place to go into then the doctors waiting room, sitting there with 20 other people for two hours and they are all coughing and spluttering.' [TWP43]

Additionally, some participants perceived the current system to be overburdened and understaffed. It was felt that the current workload could cause a serious health condition to be overlooked.

'Nowadays doctors don't have time, you could go in, and they could miss something, they wouldn't have time to do the blood pressure, do all those things.' [TWP14]

Participants recognize that the doctor's workload and time limitations can also have serious implications. The burden is on the patient relay medical information from doctor to doctor which becomes a concern when patient is not in a condition to answer questions accurately.

'I know they're only trying to get the answer, but some people are half unconscious... they don't really study the file in relation to what you've been in hospital for... they say why are you on this, or who put you on that and you have to explain yourself.' [TWP43]

Workload and time limitations are perceived to reduced access. Some participants have experienced limited local access and long waiting times to see specialists.

'If I rang to a doctor for an appointment, they'll see me in three weeks, you know that's common now like I know people that rang the doctor all day and not got through.' [TWP03]

Patient Benefits

Findings suggest what made telehealth acceptable to the participants was convenience. The concept of sending medical information from home was perceived positively by participants. Perceived positive outcomes include a reduction in unnecessary appointments, time spent in waiting rooms and time spent travelling.

'Well, I suppose I have been in the health service, and I think the change for users is that you can get a check from home without having to constantly go back and forth to the hospital.' [TWP43]

'It's picking up the pace of the information going back, you understand everything can be done on a phone, like how quickly you do things on the phone compared to going down there or wasting appointments.' [TWP03]

'People like me could go on Zoom and now talk to whoever you're supposed to see, rather than go to a hospital or whatever, I would be quite happy with that.' [TWP15]

Additionally, participants felt that telehealth did not compromise the level of health care they received, as some participants observed notable improvement in terms of experience and access.

'It was like having the resident nurse here in a way it was like having your own medic to look after you.' [TWP14]

'They listen to us more when we ring the GP... because they know I have the equipment and they know I have been doing what I'm doing. So, their more attentive to listen to me then what they were.' [TWP10-2]

Health Service Benefits

Participants felt that this device would relieve the workload of health care professionals. Telehealth

was viewed as a way of reducing in-person use of health services through the support of home monitoring.

'It's not easy to be getting in and out of hospital for the most part and these things would help lower the footfall in hospitals and in doctor surgeries.' [TWP43]

Additionally, the reassurance provided by the device could prevent people from contacting their health care professionals unnecessarily.

'I think would relieve their minds a lot and save them even running to the doctor or calling the doctor or whoever it may be.' [TWP04]

'I used to be on to (CNS) at least every month, or maybe every three weeks, I'd be worried about stuff... whereas I haven't been in contact with her now for about three months if it... (the device) was used more of the time, it would keep people away from the health service a bit more.' [TWP37]

4.3.3 The Telehealth Intervention - Patient Interaction

The qualitative data has indicated that the interactions between service users and service providers about the intervention are important. It was evident that the participants viewed this interaction in two ways, where good communication could either bolster positive perceptions of the intervention or undermine the participants' views of the intervention.

Communications

Participants noted feelings of confidence and reassurance when contacted by the telehealth support team or by a health professional concerning their readings. Many of the reported communications were about missed readings, however, it was perceived as active monitoring by the participants.

'I just say the fact that I'm contacted if I didn't do it means, I know that there is somebody there keeping an eye to things.' [TWP37]

Therefore where communication about the telehealth intervention and the how the data being inputted was perceived as good, the participant's confidence in the telehealth project was reinforced.

However, if the communication regarding the intervention and readings was perceived as poor, faith in the project seemed to falter.

'I felt at the time I felt it must feel okay or they be on to me but then when I went to the GP and he was he was concerned about it, I thought then that they should have been on to me.' [TWP13]

'Whenever I went in to (SNP), she never pulled up this information. She said that's (another SNP) whose doing that, that's upstairs in the top office, though it doesn't seem to be linkage, this information isn't

going in that (SNP) can look at over the last month' [TWP25]

Training

The participants' perceived the training provided to use the telehealth intervention as thorough. However, it was apparent that the training provided to the patients did not cover all the capabilities of the device. The capabilities which may not have been covered in training were as follows, accessing input history record, the messaging function and the star system. In terms of usability, a few participants noted that manual inputting and connection had not been part of the training.

'The only thing I think should be explained is that if you do, like, say, one day, I missed the timeline by half an hour and then when you go into it, it says you have to put it in manually and I didn't know how to do that.' [TWP37]

'I can't see the history of it on the iPad. It only it doesn't give me sort of a few weeks so I can look at blood pressure.' [TWP43]

'I can't tune it into somebody else's WIFI, I could if I worked it out on the machine, but not sure if it's something to be fiddling around with.' [TWP43]

'I realised afterwards that there is a message function on it, which I simply haven't noticed.' [TWP19]

It is possible that some of the above could have been covered in the training which was provided. Some participants acknowledged that they may simply have forgotten the information over time or the gap between their understanding of technology and the training that was provided may have caused confusion.

Feedback

One of the main criticisms of this project was that feedback either from the device or health professional wasn't received. Although some participants inferred this based on the information from their readings, it was participant determined and not provided by the device.

'The device itself asked you, well how did you manage all week, but the device doesn't tell you how you actually did get on that week.... they should be able to tell us how we did ourselves, how could we have helped ourselves better managed through their perspective.' [TWP15]

The implications of providing inadequate or inappropriate information were highlighted by the participants.

'(referring to tests) I did ask him, I said, 'how did it go? So how am I?'... he says, 'I can't really you anything', he said, 'but I did find something' and left me at that... he should have told me what it was.' [TWP15]

However the findings also suggest that some patients can experience anxiety stemming from their chronic disease contributing to the fear of knowing.

'If I have too much feedback, my head just exploded, like you can only put up with so much.' [TWP33]

Device Limitations and Potential

Participants noted some issues in the final weeks of using the service. Most of these issues relates to the speed of the device and connection issues. The speed issues discussed concerned the time taken to turn on the device or log into the application. Connection issue related to the Bluetooth connectivity and the daily readings failing to upload. Other issues experienced by participants was either usability or the failure of equipment.

'I think I could have been, switched off on it on maybe the thing hasn't rerouted itself or something? I don't know because it's not been right.' [TWP33]

'The blood pressure machine stopped transmitting to the iPad. I've been answering (device questions) them manually since which isn't a problem.' [TWP19]

'No, just sometimes the blood pressure machine doesn't work. I know it's going to work on maybe the second or third attempt.' [TWP43]

Although some technical issues were experienced, these issues were mostly considered minor and did not affect the users' experience. However, a few participants noted possible opportunities for improvements such as question style, user experience and further application. The first two relate to expanding question answers and a larger window in which the reading can be uploaded.

'Make the hours of sending the thing in a bit longer... It's just sometimes, say, I might be going for blood or something and I'd rush out, I wouldn't have time to do it before I go, and then you don't get back on time.' [TWP37]

The latter comes from the suggestion of one participant who proposed methods that could increase the device's function by adding a brief medical history and medication list. He hoped that this could benefit the patients and doctors alike by providing accurate up to date information.

'If you had a communication process for doctors, were able to read all these things and see what was happening over the last two months or three months or whatever. It might help them make a diagnosis a lot quicker.' [TWP43]

4.4 Clinicians' Views of Intervention

All three referring clinicians agreed to be interviewed and these interviews took place towards the end of the telehealth intervention. At this stage 50 patients had been referred but all not patients

had completed the 12 week intervention. Two of these interviews took place via Zoom and one via telephone due to technology issues. The interviews lasted between 25- 45 minutes.

The themes emerging included: Selecting the patients for a telehealth intervention; views of the telehealth technology; patients' use of the technology; external factors impacting on the intervention; and factors to consider for a future telehealth intervention.

4.4.1 Selecting the patients for a telehealth intervention

For the pilot study, the clinicians explained that as they had been asked to recruit patients who met the inclusion criteria and to do so in as timely fashion as possible, they went through their patient case list and contacted those who met the inclusion criteria. They excluded those who they knew were illiterate and had no support, had no English or who they considered would not be able to participate fully due to cognitive impairment, either dementia or intellectual disability. One clinician said that for some patients they had concerns about patients' willingness to adhere to the intervention and that while the patient said yes initially, they subsequently withdrew, but had a history of such non adherence in past also, for example not attending clinics. Another reason for non-inclusion was those patients whose illness was deemed to be too unstable. When the clinician asked other patients who they felt met criteria, these patients said that they would not participate due to lack of interest or fear of technology.

However, the rationale for including patients in the pilot study was based purely on the inclusion criteria and not on other criteria which the clinicians felt could have been useful. Clinicians, when asked to explain what criteria they felt would be useful were uncertain on this. Suggested criteria could be to provide the intervention to patients who are not managing their illness well and to use the technology as a monitoring and patient education tool. The intervention, it was felt, could also be useful for patients newly diagnosed where their condition self-management skills were being developed. Alternatively, the remote monitoring could be used where a patient was very anxious about their condition and again combining with self-management education, the device could promote confidence in managing the condition.

An issue discussed at length by all clinicians was which clinicians/ clinical team should be involved in any future roll out of this intervention. One clinician discussed how the patients they dealt with were referred to the pilot study. This clinician was not part of the condition multi-disciplinary team as such but rather provided a specialized assessment service. They had been asked to get involved in the project by their line manager. This clinician's view was that it should be the patients acute care clinical team overseeing their diagnosed condition, including the consultant and other team members of the team who should be involved and not a peripheral team member. This clinician was of the view that the telehealth intervention would be more relevant to a condition's outreach team, or a specialized community condition team. This clinician didn't feel their patient group was the most suitable as many had multiple co-morbidities. It seemed however that the outreach teams may already have a robust monitoring system in place, albeit not technology based, and may not be interested in taking part.

One of the other clinicians involved was a medical consultant working with older adults, but not a consultant specialist in one of the specified pilot study conditions. They were supportive of telehealth as an intervention, for example, would like to see a telehealth intervention for managing older adults with dementia where patient carers would be involved and a monitoring system for dementia related parameters provided. The clinics could then only call back patients who needed to be called back based on a change in dementia related parameters, for example, getting up multiple times at night. This pilot study, with its focus on the three chronic medical conditions, was therefore not viewed as particularly relevant by this clinician to their specialty. Similar to the other clinician above, this clinician felt that the hospital-based condition specific medical team would be better placed to take part in any future telehealth intervention.

The final clinician was a clinical nurse specialist for one of the included medical conditions. This clinician felt that they were well placed to take part in the telehealth project and any future such projects, and that other hospital services who had clinical nurse specialist in the relevant conditions would be good to include in future projects. This clinician was not of the view that the intervention would work in primary care as those who require specialised care are always referred on from primary care.

4.4.2 Views of the Telehealth Technology

The clinicians interviewed said that before being invited to take part in the pilot study that they were in favour of telehealth, were aware of how it could be used and thus were interested in taking part. One was using a telehealth intervention for a different purpose. All clinicians involved felt the telemonitoring technology used in the pilot study worked well, both the Triage manager system which they access and the monitoring devices / system provided to the patients.

The referral system to Telehealth intervention generally worked well. There was some disquiet expressed regarding imputing of medications where the system reset after several medications were inputted but generally the referral system was quite intuitive. There was a concern expressed as to where the patient data was stored as to whether it was with Tunstall UK or Ireland.

The alert system worked well. Checking the individual alerts was time consuming as the number of patients involved increased. Hence, the clinicians agreed with Tunstall that Tunstall would send a daily email to the clinician notifying of the alerts raised that day and the clinician then checked the system and followed up with the patients concerned if needed. One clinician said they got a lot of notifications of alerts, didn't necessarily follow up on all alerts but instead watched to see trends and then intervened as necessary. On some occasions the clinician knew the alerts were meaningless, for example, pulse reading coming from blood pressure monitor was '0' while a normal recording a pulse on the pulse oximeter and hence ignored the '0' reading.

One clinician described how they got only a limited number of calls from patients who were concerned about readings. In this instance, the clinician reassured them and where necessary advised them to contact their GP. This clinician called a patient back to the clinic who had a trend of poor oxygen level

readings, and this ended up identifying quite a major issue when an arterial blood gas reading was done in hospital. Therefore, for this patient, the alert system was effective.

A view expressed by the clinicians was that the full capability of the system was not utilised in this pilot study. One of the clinicians, in discussing the ability of parameters to be set, spoke of the difficulty they experienced in setting parameters as they were not the patient's specialist clinician in heart, respiratory or diabetes. Hence, setting of the parameters was quite generic and not specific to the patients themselves and therefore, while this clinician may have been happy with certain readings, their specialist clinician might not have been happy with the readings. Another clinician went with the standard parameters for everyone and didn't alter parameters depending on patient as this was very time consuming and seemed to have to be done in numerous sections and so didn't use this facility.

4.4.3 Patients' Use of the Technology

As viewed by the clinicians, the ability of the participants to use the technology varied. As one clinician put it 'Some patients are very tech savvy', while other patients were not referred due to inability to use technology.

One clinician described how they demonstrated the technology to patients when recruiting them and felt that it provided some reassurance. It seemed based on the feedback the patients gave to the clinicians regarding the technology was that they found the technology worked well.

A view expressed by the clinicians was that all patients expressed that they liked being remote monitored – 'Patients liked feeling there was clinical oversight'. One clinician said some patients however became more anxious about the readings and sought more clinical appointments than normal.

Clinicians wondered regarding the ability of some patients to use the monitoring devices correctly. For example, one clinician questioned some patient's ability to record blood pressure correctly. Due to the number of blood pressure alerts, three patients were brought into the clinic because their readings were high but this wasn't the case when checked in clinic for two of the patients. However, for the third patient, a 24-hour blood pressure monitor was arranged as a result of the home monitoring readings which identified a blood pressure issue.

4.4.4 External factors impacting on the intervention

Two external factors which impacted on the intervention were the Covid 19 pandemic and the HSE cyber-attack. These factors were raised by the clinicians during the interview.

The pandemic meant that most patient consultations were virtual, which meant that the clinician was not meeting the patient in person to explain the intervention and instead was relying on explaining the study and providing information and reassurance remotely. One clinician expressed concern at

recruiting to the study during the pandemic, as the equipment would have to be delivered to the patient's home and this delivery may have caused some patients to have contacts when they should be 'cocooning' and hence the clinician did not recruit until the Covid 19 national level 5 restrictions lifted. The other clinicians expressed that they were aware that patients made arrangement for the delivery of the equipment and some patients just asked that it be left at the door as means of reducing contacts during the pandemic. This remote recruitment could perhaps have caused a challenge in terms of skill development in using the technology but the clinicians in fact found that most patients coped well with using the technology and monitoring devices. The clinicians believed that the Tunstall staff provided good support to the patients, this was commented by the patients to the clinicians.

The HSE cyber-attack which occurred during the period of the telehealth project impacted on the pilot study in that it slowed recruitment due the inability of the clinicians to access their patient information on the Triage manager system or HSE emails. Where this had a particular effect was the alert system as the clinicians did not have access to review these and could not receive the emails sent from Tunstall informing them of the alerts. Communication between the clinicians and Tunstall then utilised telephone and Tunstall provided an iPad to facilitate one of the clinicians to access which improved the situation only somewhat. The other two clinicians were able to access the Triage manager when working from home on devices approved by the HSE and the cyber-attack seemed to have less effect.

At times, separate to the cyber-attack, one of the clinicians reported that there were sometimes difficulties in getting into the Triage manager on the HSE system.

4.4.5 Factors to Consider for a Future Telehealth Intervention

In the pilot study, the duration was set at 12 weeks for all patients. All three clinicians suggested that there needed to be more flexibility regarding duration. Two clinicians suggested that the telehealth intervention could be better located for use with a specialist clinic where perhaps it would be used for longer term monitoring, identifying the individual parameters for the patients and then only calling back if there was an issue with parameters emerging.

It was felt by all three clinicians that the telehealth intervention needed to be incorporated, not as a stand alone element, but rather integrated within a self care management plan for the patient. This could take a number of forms.

An individualised self-management care protocol could be devised –*'e.g., if gain of 2kg, take extra medication.'*

Patients could be provided with the devices and self monitor daily. The clinician could then use the readings and work with the patient to develop their knowledge and awareness of their condition and how to manage it. As one clinician said *'Patients need feedback in order to learn, and then get self managing.'*

The pilot telehealth project did not involve a self-management component. As one clinician said *'only a small number said afterwards that they had learned a little about their condition.'*

All clinicians spoke about the need to involve clinicians fully. It seemed, for this pilot study, the clinicians were not fully aware of what it involved. For one clinician, it wasn't what they had expected as they weren't aware it was solely chronic disease focused. Another clinician said that clinicians need to be fully involved from the beginning- to get very familiar with the Tunstall system- and how it could work for them, including how parameters would be set and - how the alerts would work and would be monitored. By having this involvement, it was felt that clinicians would then be very clear on who they select for the intervention and how a self-management plan for the patient would link with the intervention.

5. Introduction

The previous chapters in this report provided the background, methodology and findings from the study. This chapter provides an overall summary of the findings (Section 4.1). A discussion of the findings is then provided in section 4.2. The project pilot conclusions in relation to the evaluation objectives set are outlined in Section 4.3. Finally, the recommendations arising from the study are presented in Section 4.4.

5.1 Summary of Findings

The pilot project ran from January to September 2021 with 32 patients receiving the telehealth intervention, overseen by three clinicians.

5.1.1 Recruitment to the Intervention

The patient inclusion criteria were: patient diagnosed with one or more of the predefined conditions (with the clinician determining which was to be regarded as the primary disease condition); ability to use or have support available to use the technology; mobile signal; literacy assessed by the referrer with a reading age 11 needed for independent use.

For the pilot study, clinicians went through their patient case list and contacted those who met the inclusion criteria. They excluded those who they knew were illiterate and had no support, had no English or who they considered would not be able to participate fully due to cognitive impairment, either dementia or intellectual disability.

Fifty-two patients were recruited to the intervention. However, nineteen did not take part or complete fully. Reasons for this non-participation included death of participants (RIP), change of mind, feeling too unwell or stressed, unable or no support to use technology. One patient was very delayed starting the intervention due to prolonged hospitalisation.

5.1.2 Participant Characteristics

Thirty-two participants completed the 12 week intervention. Most of those participating were male (85%), and married (57%), with ages ranging from 51 to 96 years (mean 71 years) and only 18% had private health insurance. The majority owned their own home (79%) and almost a third lived alone (30%). Over 70% had lived in their current house for over 5 years and only 2 participants (6%) were considering moving house. Over 80% has more than one medical diagnosis.

Participant were asked to rate their illness stability and management prior to, during and on completion of the intervention. Most participants (n= 28) viewed their illness as either very or somewhat stable at all time points and the number of those who felt they managed their illness very well increased from time point 1 to time point 3 (52%-to 73%).

Regarding health service utilisation, only 6% had not attended a general practitioner (GP) within the 6 months prior to the intervention, with almost 50% attending 1-2 times. Other health services used included hospital clinics, where again almost 50% had attended on 1-2 occasions within the 6 month timeframe. Just over a quarter had been admitted to hospital in the six months prior to the intervention, with a mean duration of stay being 6.5 days (standard deviation 10 days). During the 12 week intervention, again over 50% attended the (GP) 1-2 times while two patients were admitted to hospital, mean duration of stay 2 days. Participants highlighted however how Covid had impacted on their use of health services, and that cocooning had, for many of them, resulted in less 'flare-ups' from their diagnosed condition in previous times.

5.1.3 Participants' Use of Telehealth Devices

Patient engagement with the device was very high- only 2.6% of daily readings were missed. There was, however, follow up of participants by Tunstall staff when a reading wasn't recorded, which probably accounts for the very high percentage of readings inputted.

Looking at the readings submitted, and alerts raised, all patients raised at least one daily alert. With this monitoring system alerts could be raised from more than one of the readings, for example, there could be an alert for pulse and blood pressure on the same day. The number of alerts raised by individual patients ranged from 1 alert to 108 alerts. The number of days where alerts were raised by individual patients ranged from 1 day to 59 days, out of total of 60 days.

The condition specific health interview was completed each day by patients. Many patients (19, 57%) noted no symptom changes in the health interviews over the 12 weeks.

5.1.4 Participants' Views of Technology

Pre- intervention, over half the participants were happy to use technology, and almost all, nearly 90% rated their ability to use technology as good or very good. Almost 30% felt they would still

need support to use technology. Seventeen of the participants used a computer regularly and almost three quarters (70%) used a smartphone. Reasons for technology use varied, and mainly related to communication and social purposes. For those reporting limited engagement with technology, there appeared a level of discomfort. Reasons for this included lack of interest and a perception of low personal capability.

At time 2, participants were asked regarding their use of technology and if their opinion of technology had changed. It seemed using the Tunstall devices had changed the opinion and improved the use of technology for some (almost 40%) but not all participants. The key changes reported included increasing confidence when using technology and using more technology. Almost all (97%) were very happy to use the device and the majority (over 80%) found that the technology provided help in managing their illness.

At time 3, post the intervention, again almost all participants (97%) reported that they would still be happy to use the devices and almost 80% reported that they had found the devices very helpful in managing their illness. When asked about problems using the device that they had experienced, these included when the measurement devices (weighing scales/ blood pressure and thermometer) did not work, but the main issue seemed to be connectivity. However, all the participants said that the support from Tunstall was very good to resolve the problems promptly.

5.1.5 Participants' Perceptions of the Telehealth Intervention

Overall, participants expressed positive views of the intervention during the interviews at the mid-point and post completion interviews. Many participants perceived the telehealth intervention to have a positive impact on monitoring and managing their chronic disease and improving self-confidence in this regard. A limited number of participants did not perceive the telehealth technology as having an impact on their condition. For many participants, the fact that their condition was being monitored daily was reassuring and gave them a sense of security. This sense of security originated in the participants' belief that should their condition deteriorate, that some type of medical intervention would occur. It also seemed that the daily health-related readings helped some participants become more aware and take control of their conditions. For some, seeing that their condition was stable provoked a sense of confidence regarding their health and ability to manage their illness.

The majority of participants expressed that telehealth was an acceptable way of receiving health care. Perceived positive outcomes include a reduction in unnecessary appointments, time spent in waiting rooms and time spent travelling. It seemed some participants were fearful of in-person health care due to the risk of infection and the reassurance provided by the device reduced the need for contacting health care professionals unnecessarily.

The participants' perceived the training provided to use the telehealth intervention as thorough. However, it seemed that the training provided to the patients did not cover all the capabilities of the device.

One of the main criticisms expressed was that feedback on the reading inputted, either from the device or health professional wasn't received back to the patients.

5.1.6 Clinicians' Views of Intervention

Prior to taking part in the pilot study all clinicians were in favour of telehealth, were aware of how it could be used and thus were interested in taking part. As they had been asked to recruit patients and to do so in as timely fashion as possible, the clinicians' rationale for including patients in the pilot study was based purely on the inclusion criteria and not on other criteria which they felt could have been useful.

The issue of which clinical teams and which patient groups would benefit most from the intervention was discussed in depth. It seemed that the shared view held was that such a service fitted well with the acute hospital condition specific clinical teams. All three clinicians suggested that there needed to be more flexibility regarding duration of intervention and the need to tailor the intervention to the patient need. It was felt by all that the telehealth intervention needed to be integrated within a self care management plan for the patient.

All clinicians involved felt the telemonitoring technology used in the pilot study worked well, both the Triage manager system and the monitoring devices / system provided to the patients. The referral system to Telehealth intervention generally worked well. The alert system worked well, however, checking for individual alerts was time consuming as the number of patients involved increased. Hence, the clinicians agreed with Tunstall that Tunstall would send a daily email to the clinician notifying of the alerts raised that day and the clinician then checked the system and followed up with the patients concerned if needed. One clinician said they got a lot of notifications of alerts, and didn't necessarily follow up with the patient on all alerts but instead watched to see trends and then intervened as necessary. A view expressed by the clinicians was that the full capability of the system was not utilised in this pilot study.

As viewed by the clinicians, the ability of the participants to use the technology varied. It seemed based on the feedback the patients gave to the clinicians regarding the technology was that they found the technology worked well.

A view expressed by the clinicians was that all patients expressed that they liked being remote monitored. One clinician said some patients however became more anxious about the readings and sought more clinical appointments than normal.

Two external factors which the clinicians perceived as impacting on the intervention were the Covid 19 pandemic and the HSE cyber-attack. The pandemic slowed recruitment and the cyber attack caused challenges accessing the Clinical triage system.

5.2 Discussion on Findings

5.2.1 Quality of Life

The COVID-19 pandemic has had direct and indirect effects on people with chronic diseases. In addition to mortality rates being high among this population, efforts to lessen the curve of infection such as stay-at-home recommendations have disrupted lives (Nicola et al., 2020). Many of this study's participants have had the physical, psychological and social implications of their chronic diseases influenced by the COVID-19 pandemic and subsequent preventive measures. Although these implications are mostly negative, some positive impacts were experienced by participants in this evaluation.

Most participants (88%) reported that their condition was either somewhat or very stable with no real changes over the course of the intervention. However, what they perceive as stable may need to be considered as many described debilitating symptoms which they experience daily. COPD participants expressed that the random nature of their condition meant that their difficulty in breathing was debilitating and physically draining. Participants felt that this condition can be extremely limiting on daily life. The perceived limitations range from exercise type and duration to housework which could possibly have implications on future independence. CHF participants felt limited by two elements of their disease which were water retention in the external extremities and extreme fatigue. In line with previous research, functionality and subsequent loss of independence appear to have the greatest impact on quality of life in terms of physical factors (Megari, 2013).

The telehealth device provided some positive impacts for these conditions. In COPD participants, it provided the confidence to be more physically active by way of seeing their readings; in CHF participants, it enabled participants to observe increased water retention and adjust their medication accordingly. Significant physical improvements were never the goal of this intervention but relief through an improved capability to self-manage speaks to the success of the project. The positive outcomes perceived in this evaluation are contrary to a prior research study in which telemonitoring caused self-perception of physical health to deteriorate (Pecina et al., 2013).

The psychological effects of chronic diseases became apparent throughout the interviews. Some participants experienced depression and anxiety stemming from their chronic disease(s) and the frustrations in their physical limitations. Although the physical health of conditions was reported to be stable by the majority, a few participants described a deterioration in their mental health due to social isolation caused by the pandemic. During the pandemic, telehealth became useful for the care of patients with chronic disease. A previous study on telehealth in Covid-19 identified that patients reported feeling less isolated and having lower anxiety levels (Liu et al., 2020). In this evaluation, telehealth was perceived as a 'safety net' for participants, giving them a sense that they were not alone. For others, it helped them confront fears and come to terms with the extent of their illness. This is consistent with the current literature where Walker and colleagues (2019) reported that reassurance was a prevalent positive outcome of several telehealth interventions in their recent systematic review.

5.2.2 Access to Healthcare

Many participants spoke highly of the overall healthcare they receive in terms of access and quality. Darker and colleagues (2015) observed that most people living with chronic diseases in Ireland were happy with the care they received for their illness. However, in this pilot study, a minority felt that the health services they had received had been somewhat less than ideal. In the examples given the commonality of indifference was present. Participants expressed feeling frustration when communicating the seriousness of the anomalies in their health to their GPs, whom they felt devalued their symptoms or provide prescriptions without proper examination. This is consistent with Darker and colleagues (2015) study, who noted that patients with chronic diseases are generally not consulted when developing treatment plans thus the plans do not consider their ideas or goals. Other studies also note a mistrust of healthcare providers and a perception that the doctor–patient relationship is unequal (Nimmon & Stenfors-Hayes, 2016; Green, Tung & Segal, 2018). Some participants felt that having a medical card impeded their access to both local and specialist health services. Several medical card holders reported limited access to their healthcare providers and some reported waiting times of up to 3 weeks for a consultation. One participant noted that in-person consultation in her areas were reserved for paying patients. This is concurrent with previous research, medical card holders report longer waits for access to services including hospital consultant evaluation, have greater difficulty accessing specialised diagnostic tests and longer waiting times to receive treatment after diagnosis (Darker et al 2015).

The pandemic results in changes to the healthcare service delivery in Ireland. In response to the pandemic the Irish government recruited the help of private hospitals, increased ICU beds, cancelled routine appointments, GP consultations were conducted via telephone and video link and student nurses were hired as health care assistants (Kennelly et al., 2020). The participants perceived these changes in different ways. Some observed no changes to their immediate healthcare, some experienced longer waiting times to access local and specialised services and others noted significant improvement in terms of the quality and efficiency of the services they had received. During the pandemic non urgent appointments were sometimes canceled, however, evidence suggests that there was a large-scale postponement of medical treatment and check-ups among the general population (Kennelly et al., 2020; Czeisler et al., 2020). The pandemic caused concerns about the safety of accessing health care thus reducing the ability to prevent or control chronic disease. Other studies noted decreases in health care utilization which ranged from preventive care, condition management and emergency care (Hartnett et al., 2020). A few of the participants in this current study reported forgoing medical assistance to reduce the risk of COVID-19 infection. However, the majority reported a diminished need to access healthcare services attributed to isolation related benefits to their physical health, due to less exposure to infections, along with access to this intervention.

The most utilized health service by participants was the GP. In the 6-month period before the intervention 94% of participants had attend their GP on at least one occasion. Healthcare usage is high in older adult with chronic condition. In America it was noted that people with chronic conditions are five times more likely to access their physicians than their peers. (Schneider, O'Donnell & Dean,

2009). A Canadian study reported that for each additional chronic condition. there is a 51% increase in use of the physician's services (Rapoport et al., 2004). Over the period of the intervention, only 27% of the participants reported not having a GP consultation. This is consistent with current literature, in several studies telemonitoring has significantly reduced the healthcare usage for patients with chronic diseases (Woodend et al., 2008; Gellis et al., 2012). Although, the findings demonstrate a reduction in healthcare usage, other factors needed to be considered including incomparable time periods. Additionally, as discussed earlier, the pandemic had an impact on healthcare usage due to cancellation of non-urgent medical consultation and patient reluctance. Hence the results are not comparing the intervention to 'normal' health service usage for this cohort.

However, the participants' perspectives would give credence to the reduction in healthcare usage. For most participants this novel technology was perceived as a form of healthcare from the comfort of their own homes. Several participants felt that it would reduce the need for visit in-person healthcare services. Patients perceived that the device provided similar tests to those a GP would conduct negating the need for in person 'check-ups'. The reassurance that was provided reduced anxiety which in turn increased confidence and reduced their need of the healthcare service. It is impossible to determine if the perceived impact on the healthcare services would translate to a real-world reduction in healthcare usage had the limitation and external factors not been present.

5.2.3 Self-Management

One of the purpose of such telehealth technology is to support self-management. Most participants viewed their illness as either very or somewhat stable at all time points, however, the number of those who felt they managed their illness very well had increased from 52% to 73% over the period of the intervention. Sultan and colleagues (2019) noted that self-management starts with education and learning the technical skills related to their specific conditions. Important factors in self-management include being aware of changes in symptoms and measured parameters and learning to take appropriate actions. A small number of participants noted that monitoring their condition via telehealth enabled a greater understanding of their condition. As observed in similar studies, patients believed that they would be able to identify signs of condition deterioration, take appropriate action and possibly avoid hospitalization (Rahimpour et al., 2008; Riley, Gabe & Cowie, 2013). It was evident that some participants took ownership over their condition more than others and were more comfortable making medical decisions. Monitoring appeared to empower these patients to become an equal partner in their healthcare in which they perceived a greater level respected by healthcare professionals. This is consistent with current literature as themes such as supporting self-management and shared decision-making have been observed in several studies concerning telehealth (Ure et al., 2012; Rahimpour et al., 2008; Gorst, Coates & Armitage, 2016; Fairbrother et al., 2014).

As self-management necessitates education, it is important to ensure that patients are provided with clinically validated information. For most patients, their healthcare team is a great source of information and teaching, however, the absence of feedback may cause the patient to pursue unverified sources (Sultan et al., 2019). Feedback was an evident weakness of this project and thus

the goal of supporting self-management could not be fully realised. Further development is needed incorporating a self-management programme for the patient, in line with best practice in developing self-care in chronic diseases allowing for flexibility to meet the patient needs. It is important that feedback provided should be constructive or for the safety of the patient. The information should also be simplified and concise to prevent anxiety or information overload.

5.2.4 Telehealth Uptake and Satisfaction

In this pilot study fear of technology or poor technical literacy was the most common reason for non-referral or attrition. Previous research has asserted that reluctance to partake could be attributed to reluctance to learn something new (Walker et al., 2019). In Walker's study patients reported that learning to use new technology would be a burden to them and the additional information would cause confusion triggering anxiety. As the older population may be unfamiliar with the technology it is understandable for them to be apprehensive about its adoption. It is a significant ask to request that somebody who has largely lived without the use of technology undergo the learning required to attain a level of technological literacy in which this technology would be usable. Additionally, it may place a burden on clinicians to sell technological concepts such as this to a technological inept or averse population. Among this study's sample 12% initially reported being unhappy with technology citing a lack of interest, need and ability as reasons for their dislike. This rationale is comparable with previous studies, in which, the rate of development and functional ability of the user acted as a barrier to digital technology in older adults (Pirhonen et al., 2020). It was apparent in Pirhonen's study that rapid development of technology left participants feeling like they were forever catching up or that the products are not designed with the older populations in mind.

The current study indicates a high level of interest and acceptability among participants, whereas previous research indicated that such novel technology would be of no interest to the older population (Ancker et al., 2015; Grindrod, Li & Gates, 2014). Consistent with recent research undertaken by Doody et al., (2020) the sample in this evaluation was found to have at least a good ability regarding digital technology. A significant proportion had access to the internet (76%) and owned a computer (54%) or smart phone (70%). Many participants (88%) reported having been happy to use technology and having a proficient ability in its use. Most were very happy to use the telehealth technology (97%), with 80% reporting that the device provided help in managing their illness. Furthermore, almost 40% of participants noted that participation in this intervention helped improve opinions on technology.

Those who participated in the intervention found that devices provided was simple to use. There was a short learning curve among participants, many noting becoming more adept with the device as time progressed and gained the confidence to explore the functionality of the device further. Training may have impeded some participants from experiencing the full capabilities of the device and certain aspects of the device were not clearly outlined to the participants. An example of this was the star rating system, it seemed this aspect of the device was not explained and caused confusion among participants. It should be noted that the national Covid-19 government guidelines in place at the time of this pilot study caused some participant to request no-contact equipment installation, forgoing the

in-person training that could be provided as part of installation. Furthermore, this study consisted solely of older adults and previous studies would indicate that there can be low levels of technical literacy among an older population (Kruse et al., 2020).

5.2.5 Implementation and Acceptance

Over the course of this evaluation 932 alerts were received from the telemonitoring equipment. The alerts ranged from 1 alert over the course of the evaluation to 108 alerts per patient. It must be noted that not all these alerts would have warranted the intervention of the clinician. The alert system worked well in principle. However, as the number of participants grew it was evident that it became time consuming for the clinicians. Additionally, clinicians received meaningless alerts which were perceived to be user error. Clinicians in this study noted not following up all alerts but observing trends and responding when necessary. Previous studies have identified that an influx of data and the need to respond to the alerts could be seen as a 'burden' by clinicians (Collier et al., 2015; Kozikowski et al., 2019).

This evaluation was limited in that the impact that this intervention had on clinicians' workload was not quantitatively recorded. The findings from Andersen et al.'s (2019) study would suggest that even the alerts which require no further action would require from 0:39 to 6:55 of the clinicians' time. In cases that required further action (telephone calls), the average time consumed was 17.55 minutes. These calls were mostly framed around inclusion and diagnostic work, however, coordination, education, and comfort work were also noted. It should be noted that Andersen et al. (2019) study concerns implantable electronic devices which differs greatly from the device utilized in this study and thus the time consumed by clinicians may also differ greatly. An increased workload was a common complaint among clinicians that facilitate telehealth interventions in Kruse et al.'s (2019) study but this finding was not supported in other studies (Snoswell et al., 2020).

The growing number of participants in this study necessitated the restructuring of the alerts system to relieve pressure from participating clinicians. This step was aligned with recent literature, in which the recommendations were made to differentiate urgent clinical issues from nonurgent tasks prior to alerting the clinician to avoid burnout (Kozikowski et al., 2019). It should be noted that the alert system could have been more effective if utilize to its fullest extent. The system allowed for clinicians to set the parameters for their patients, however, clinicians choose not to utilize this aspect of the service due to a lack of patient specific knowledge or because it was viewed as a time-consuming task. Although this was a drawback in the implementation of the project, there were some significant examples in which the systems identified serious issues which in the absence of the intervention may have gone unnoticed. Identifying these issues resulted in the clinicians being able to intervene before the participants condition worsened. Calvo and colleagues (2014) noted that through telemonitoring, any worsening of the symptoms of the disease (COPD) could be identified and treated, reducing the number and severity of exacerbations. In this evaluation the device has demonstrated its capability to identify deteriorating health. This was achieved even with the clinician not utilizing the adjustable parameters feature, relying solely on default generic setting of the device instead. One clinician

perceived a potentially negative effect in that patients could become more anxious about the readings and seek more clinical appointments than normal. Similar concerns were voiced in a similar study, in that potential burden of clinical surveillance provided via telehealth may cause anxiety negating any tangible benefit (MacNeill et al., 2014). However, it was noted by another participating clinician that the project only resulted in a limited number of calls from patients who were concerned about readings. The participants' perspective supports this observation, as the majority felt that telehealth would and had reduced their utilization of the health service.

5.3 Conclusion

The extent to which the pilot project objectives were met are as follows:

To assess the impact of the remote patient monitoring service intervention on disease management, health and wellbeing.

Participants engaged very well with the monitoring system with very low rates of missing daily readings. The findings indicated a high level of medication adherence, with 96% of patients recording that they had taken all medication as prescribed. The monitoring system generated alerts, mainly arising from readings from devices rather than the symptoms reported in the health interviews. In some instances, when alerts were followed up with clinicians, there were no issues identified. However, in two cases, quite significant issues were identified and could then be managed.

The participants' chronic conditions affected their overall functioning and quality of life, with most participants having more than one condition. Their conditions, combined with living through Covid-19, meant some participants expressed distress about their illnesses and its impact on their lives. The majority of participants perceived that the intervention helped them manage their condition by giving them reassurance that there was clinical oversight and confidence in their ability to manage. For some participants, the intervention gave them confidence to exercise more and a feeling that they could manage their illness more effectively and were able to identify when they needed to take health related actions.

The participant results for mental wellbeing showed no evident changes in wellbeing scores between the three time points. Few of the participants met the cut-off for 'high' mental wellbeing, and this was reflected in the interviews where participants spoke of the impact of their illness on their mental and physical health and the impact of living during the pandemic.

To explore the patients' experiences and views of using the remote patient monitoring service intervention on their health service utilisation and housing.

The extent to which the intervention impacted on health service utilisation could not be determined. The six month period prior to the intervention and the 12 weeks of the intervention were during the pandemic when the patients were cocooning for most of this time and where 'normal health

service utilisation, for example, attendance at clinics as usual was affected. Most patients commented however that they felt less need to consult a doctor/ nurse as they knew they were being monitored.

When asked about their housing, few of the participants had considered moving and most owned their own home but almost one third lived alone. The extent to which telehealth could assist them to remain living in their own homes was not evident to the participants, although some participants expressed a fear of their condition deteriorating and how they would manage.

To explore the clinicians' views of the intervention and the impacts of the intervention including the selection of patients.

The pilot study set out to recruit 50 patients. While 52 patients were referred for the intervention by clinician, only 32 patients completed the 12 weeks of intervention. The reasons for the reluctance of clinicians to recruit certain patients, patients declining to take part or withdrawing from intervention were varied, but included, in many instances, a fear or a reluctance to use technology. This was not the case for those taking part, who in the main, were happy to use technology.

Overall, the clinicians were supportive of telehealth and were of the view that the patients had been positive regarding the intervention. However, they were of the view that for future telehealth projects, there needed to be very clear criteria on which clinical teams and health professions would get best use from accessing the intervention, which patient groups would benefit from the intervention, flexibility in determining the duration of the intervention depending on patient needs and preparation of the clinicians to use the intervention to its full capability.

To conduct a financial evaluation of the intervention in terms of costs and savings;

This considered the cost to deliver the telehealth intervention including both the Tunstall and clinician costs. The costing was based on 34 patients. This was calculated on those who completed the 12 weeks intervention and also takes into account the usage of the intervention by those who commenced but did not complete the 12 weeks.

Tunstall costs include installation (€100 per patient), maintenance (€5.77 per patient/ week), triage (€85 per day) and equipment (€1250 per patient).

Clinician costs included recruitment time and daily checks of system for alert, and clinical follow up identified by clinical judgement from alert readings. Clinician estimation of time for recruitment was 1.5 hours per patient (€35 per hour). Time was also required on a daily basis and this time was used for checking the Clinical Triage Manager system and follow up phone calls with patients. The costs for this time have been based on the Clinical Nurse Specialist pay scale- midpoint. The cost of review in hospital clinics was included as €172 per visit.

The estimated cost for an individual patient taking part in this pilot telehealth intervention was therefore **€ 2,155**.

5.4 Recommendations

The findings from the evaluation of the Telehealth Pilot Project for Chronic Disease Management have informed a number of recommendations. The recommendations for telehealth interventions in the management of chronic disease, are made in consideration of six quality domains: safe, timely, equitable, efficient, effective, patient centered care (Schwamm et al 2017).

1. Telehealth needs to be integrated with telecare to offer a comprehensive solution which addresses patients' specific needs and enables both a reactive and proactive approach to management of their health and overall wellbeing. Telehealth can provide a safety net for persons with specific chronic conditions through frequent monitoring. Monitoring of chronic condition physiological parameters should result in the reduction of risk and potential harm through early identification and intervention.
2. Alert systems exist to support the clinician in the provision of safe, efficient and timely interventions for patients whereby urgent issues are clearly identified and prioritised over non-urgent data. To utilise the technology to best effectiveness, clinical parameters set for alerts should be patient and condition specific. This use by clinicians would improve the telehealth system efficiency and safety as the alert system would enable the clinician to clearly identify urgent versus non-urgent clinical data.
3. Telehealth provision should be patient centered. The telehealth system used is fully flexible and can be tailored to individual patient needs. This evaluation demonstrated that patients have unique needs based on the combination and severity of their chronic conditions and comorbidities. The telehealth service should reflect this, providing patient specific interventions and short or longer term monitoring based on patient needs and values.
4. Patient training and support with technology use should be considered carefully from implementation through follow up, dependent on patient need. Consideration should be given as supports, such as peer support schemes, which may encourage hesitant patients to consider taking part. Patient training to use the devices should be easier to achieve in a non COVID environment where more time could be spent with the patients by the technicians installing the devices on the technology use, capabilities and requirements.
5. Adequate preparation and training of clinicians in telehealth provision is of paramount importance in implementing new ways of working, within an integrated care system, in a safe, effective and efficient manner. Clinician training and support in the pilot study was impacted by the COVID-19 restrictions. Early clinician engagement to help design and shape the telehealth service is recommended. Clinicians working with telehealth within the integrated system of care should have the knowledge, skills and competence to utilise the telehealth technology to its' full effectiveness. Clinical nurse specialists would be ideally placed for the provision of telehealth interventions as part of an integrated specialist service.

Consideration must also be given to ensuring that there is always a clinician overseeing the readings being received from patients.

6. The findings indicate that the goal of improving patient self-management could not be fully realised due to limited feedback from the devices to patients and that the intervention was not incorporated into an individualised self care management plan. The telehealth system has the capability to provide patients with instant feedback regarding their condition but this feature was not utilised as part of the pilot. Effectiveness of the telehealth intervention in promoting patient self-management could be improved through the provision of timely, actionable, clear and concise feedback to the patients from the device.
7. Telehealth provision for monitoring and managing chronic disease should be planned and implemented to meet specific patient needs within target groups. Goals include improvement of disease self-management skills through patient specific education; monitoring of chronic condition parameters to identify early deterioration; provision of timely and appropriate interventions to reduce risk and limit hospital admissions. Patient groups may include: patients newly diagnosed with a chronic disease; patients with an unstable chronic disease prone to multiple hospital admissions; recently discharged patients following admission of acute illness relative to their chronic disease.
8. Based on the above, a key recommendation is to move to Phase 2 to roll out a broader trial with a wider number of patients across CHO Area 5 with a key focus on health and wellbeing and clinical outcomes. The Covid 19 pandemic presented limitations and impacted on Phase 1. Therefore, in order to produce more robust outcomes and measures, it is clear that Phase 2 will enable this further evidence.

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Appendix 1 Stakeholder Group Membership

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