MOBILE PHONE-BASED TELEMONITORING AS AN AID FOR HOME CARE NURSES: A FOCUS ON DESIGN AND IMPLEMENTATION

by

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A thesis submitted in conformity with the requirements for the degree of Master of Health Science in Clinical Engineering

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Abstract

The intent of this project was to integrate an existing mobile phone-based telemonitoring system into a home care nursing environment. Analyses were conducted to examine nursing workflows and home care constraints. User-centric design, development, and testing were used to modify the current telemonitoring system for a home care pilot study with heart failure clients. Interim results show technology acceptance by home care nurses and improved self-awareness in clients; the telehomecare system offers its greatest value as an opportunity for client education following clinical alerts. The pilot study will continue with a focus on increased client recruitment and selectivity towards those most in need of chronic disease management. It is expected that the system will result in an improvement in health outcomes and more efficient delivery of home care visits. The results from this study will provide insight into the impact of a new service delivery model for home care nurses.
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List of Abbreviations

CHF Congestive Heart Failure
UHN University Health Network
US United States (of America)
ED Emergency Department
WHARF Weight Monitoring in Heart Failure
HHH Home or Hospital in Heart Failure
TIM-HF Telemedical Interventional Monitoring in Heart Failure
LVEF Left Ventricular Ejection Fraction
REB Research Ethics Board
(CE)CCAC (Central East) Community Care Access Centre
LHIN Local Health Integration Network
TAM Technology Acceptance Model
ID Identification
MRN Medical Record Number
PHI Patient Health Information
OS Operating System
UAT User Acceptance testing
PHCP Primary Health Care Provider
GP General Practitioner
RN Registered Nurse
RPN Registered Practical Nurse
HOBIC Health Outcomes for Better Information and Care
SCHFI Self Care of Heart Failure Index
MLHFQ Minnesota Living with Heart Failure Questionnaire
FAQs Frequently Asked Questions
Chapter 1: Introduction

1.1 Background

Congestive heart failure (CHF) is a "chronic, progressive condition in which the heart muscle is unable to pump enough blood through to meet the body's needs for blood and oxygen" [1]. It is a prevalent condition responsible for significant health system costs and loss of life. There are an estimated 500,000 people living with CHF in Canada [2], and almost 6 million in the US [3]. These numbers are expected to grow as the population ages and treatment improves, increasing the number of patients living with heart failure as a chronic condition [4]. As with most chronic conditions the cost of managing CHF is considerable. In 2005/06 there were 54,000 hospitalizations for congestive heart failure in Canada accounting for over 2% of all hospital admissions [5]. In 2010, the average cost of hospitalization for heart failure was $23,000 [6] and the total direct and indirect costs of CHF was $39.2 billion in the US [3].

Currently, around half of those who develop heart failure die within 5 years of diagnosis [7]. This high mortality rate and the high costs associated with CHF can be attributed to inadequate disease management. In 2004, the hospital readmission rate for Canadians with heart failure was found to be 23.6% after one year [8]. Similarly, a Canadian study in 2013 found that 26% of enrolled CHF patients returned to the ED and 25% were rehospitalized within 6 months after initial hospitalization [9]. CHF patients require close monitoring in order to detect when their condition is worsening. This is where telemonitoring presents its greatest potential benefit. Telemonitoring is when parameters such as a patient’s weight, heart rate, and blood pressure are measured at home. These measurements can be sent to the patient’s health care providers who, with the help of computer algorithms, are able to detect the earliest sign of worsening conditions. They can then act immediately to prevent further deterioration of the patient; for example, making medication adjustments, recommending dietary changes, or instructing the patient to seek emergency medical attention.

It has been suggested that as many as 50% of CHF hospitalizations are preventable with adequate discharge planning, follow-up, social support, compliance with medications and diet, and seeking medical attention when symptoms recur [10]. Post-discharge, home care nurses are often the clinicians most involved in chronic care. In this way, home care nurses are
instrumental in preventing rehospitalization and promoting disease management in patients (referred to as 'clients' in home care and hereafter). However, between scheduled home nursing visits, clients perform minimal or no self-monitoring and can deteriorate rapidly; there is no way of tracking a client's condition once the nurse's visit ends. Visits to each client are scheduled in advance according to a set treatment plan, often overlooking the client's immediate condition. This can result in clients experiencing a clinical event unknown to care givers until it is too late. Telemonitoring could be used to avert further deterioration of a client's condition and to reduce costs through more efficient home care delivery. With the predicted nursing shortage of 60,000 nurses in Canada by 2022 [11], optimizing home nursing visits and especially the time spent travelling to patient homes is of the utmost importance.

1.2 Project Objective

Home care nursing and telemonitoring are potential tools towards helping clients manage their CHF, reduce complications, and minimize overall expenditures. However, the optimal design and implementation of such a telehomecare system is unknown. The purpose of this research was to determine this optimal design and adapt an existing UHN-developed telemonitoring system for heart failure to a home care nursing application. This telemonitoring system, which has undergone a successful randomized controlled trial out of the Toronto General Hospital Heart Function Clinic [12], was integrated with a home care company's care and service systems to enable enhanced client visit triaging and information access at the point-of-care. The effectiveness of this telehomecare system in improving heart failure management and care delivery using a home care nursing paradigm was then determined.

1.3 Thesis Statement

A clinic-based heart failure telemonitoring system can be successfully redesigned and integrated into home care nursing systems and workflows. This will lead to improved heart failure management and more efficient delivery of home care nursing. Home care clients should see an improvement in self care, health outcomes, and quality of life indices. Nurses should experience improved clinical management with access to additional telemonitoring data as well as an increase in the number of remote (telephone) visits performed. Nurses should feel confident in reducing the frequency of home visits and increasing telephone visits in the future if they had access to the telemonitoring system.
1.4 Project Summary

The home care nursing setting is very distinct from an in-clinic environment and presents unique challenges for integration. These differences make for a unique study that may reveal new information about telemonitoring in a home care nursing setting. The focus of this paper will be on the design and implementation of the UHN system leading up to a pilot study.

1.4.1 Chapter 2: Literature Review

A literature review was performed to understand the current work being performed with CHF telemonitoring with extra attention on home care nursing. Journals related to telemonitoring, such as Telemedicine and e-Health and the Journal of Telemedicine and Telecare, were heavily utilized. Another objective of this review was to examine a theoretical model involved with the prediction of the acceptability of new technology systems (the Technology Acceptance Model).

1.4.2 Chapter 3: Existing UHN and ParaMed-CellTrak Systems

This chapter describes the existing mobile phone-based telemonitoring system that was developed at UHN for managing CHF. It also introduces ParaMed Home Health Care (the home care company) and the software systems that they use, which are developed by CellTrak Technologies.

1.4.3 Chapter 4: Workflow Analysis and Identifying Constraints

A detailed analysis was performed on the workflows of home care nurses and support staff. Through multiple iterations with home care representatives, 4 workflow cases were created to model the current home care processes and 9 workflow cases were created to model the proposed processes after system integration. From these workflows, a list of design constraints was established to shape the direction of development.

1.4.4 Chapter 5: Defining Study Protocol and Redesign of Existing Systems

The constraints established in Chapter 4 were examined and addressed individually. These constraints and proposed workflows determined how to redesign the existing UHN and ParaMed-CellTrak systems and defined the study protocol.

1.4.5 Chapter 6: Validation and Usability Testing

The redesigned systems and study protocol defined in Chapter 5 were taken through a walkthrough and validation process with home care representatives. Following validation, the
new systems and protocols underwent usability testing with home care staff and heart failure patients.

1.4.6 Chapter 7: User Acceptance Testing and Staff Training

The redesigned software systems and study protocols were taken through two sessions of user acceptance testing. This was to ensure that the final production versions of the new software met expected requirements before deploying to real clients. The home care staff involved with the study, including nurses and office support staff, underwent training sessions in preparation for the pilot study.

1.4.7 Chapter 8: Experimental Evaluation

The integrated telehomecare system was put through a mixed-methods pilot study out of the Oshawa ParaMed branch. Clients were recruited from a local cardiologist and used the system for several months. Nurses provided care to clients in the form of remote visits and home visits with the aid of the telehomecare alerts and data. The interim results and feedback were collected from nurses and clients and examined.

1.4.8 Chapter 9: Conclusion and Recommendations

The major challenges faced during the design and implementation process were reviewed. Recommendations were made towards the next phase of this study and towards any related studies involving telemonitoring in the home care space.
Chapter 2: Literature Review

2.1 Telemonitoring and Heart Failure

Telemonitoring involves patients taking daily physiological measurements at home. This data can be used to automatically generate alerts, help monitor their condition, aid in treatment, and help people with CHF take better care of themselves. Several large-scale randomized controlled trials using telemonitoring for CHF patients have found that it can reduce mortality, hospital readmissions, lengths of hospital stays, improve health outcomes, and improve quality of life [13]–[16]. Other studies and systematic reviews similarly support considerable improvements in heart failure patient outcomes with telemonitoring [17]–[20]. A meta-analysis by Clark et al. in 2007 on studies of telemonitoring for patients with heart failure found that they reduced the rates of hospitalization by 21% and all-cause mortality by 20% [21].

A systematic review by Seto in 2008 examined 10 different heart failure telemonitoring systems and found cost reductions between 1.6% and 68.3% compared to usual care [22]. The cost reductions were mainly attributed to reduced hospitalization expenditures. The review also noted a reduction in nursing home visits as another significant area of cost savings with telemonitoring. Similarly, Myers et al. found savings of $190 per client during their 2-month study from reduced home visits, based on $110 per home visit [23] and Noel et al. found that reduced home visits by nurses from the telemonitoring intervention saved $983 per heart failure client during their 6-month study, based on $93 per visit [28].

The Weight Monitoring in Heart Failure (WHARF) trial is a well-recognized study by Goldberg et al. In this randomized controlled trial, 280 heart failure clients either received a telemonitoring solution or standard care. This telemonitoring solution consisted of nurses using the AlereNet System to monitor clients [14]. A workflow of the system is seen in Appendix A. The WHARF trial showed a 56.2% reduction in mortality and improvements in quality of life, but no difference in rehospitalization rates. The success of this workflow presented useful prior knowledge for designing the workflows used in this study.

However, not all research regarding telemonitoring for heart failure demonstrates positive results. Several large-scale studies have shown little to no change in health or cost outcomes
The well-known Tele-HF study by Chaudhry et al. in 2010 is especially notable due to its large enrolment (1653 participants) and extensive reach (33 cardiology practices across the US) [24]. From the study, no significant differences were found between the telemonitoring group and the usual care group in regards to: rehospitalization for any reason or death from any cause within 180 days, hospitalization for heart failure, number of days in the hospital, or number of hospitalizations. A possible explanation for this lack of differences was the nature of the patient-to-intervention interaction; clinician contact was driven solely by the assessment of patient status or "variances". More regular communication between clinician and patient might have been more effective, and automated feedback or instructions from the system may have helped in supporting patients in self-care. An additional explanation was the relatively low adherence in the intervention group; only 55% were still using the system at least 3 times/week by the final week. This lack of satisfaction on the part of the users likely contributed to the lack of differences.

Another large randomized controlled trial was the 2009 Home or Hospital in Heart Failure (HHH) study by Mortara et al. [25]. This European study enrolled 461 heart failure patients in one of three telemonitoring strategies. The HHH study showed that their telemonitoring strategies had no significant effect on reducing mortality, hospitalization, or number of days in the hospital. A likely explanation for this was the intermittent nature of the telemonitoring interventions. Even their most comprehensive telemonitoring strategy consisted only of weekly vital signs reporting over telephone, monthly regular telephone contact, and monthly recording of cardiorespiratory activity. These strategies involved performing self-measurement at a far lower frequency than delivered in successful interventions (daily) [13]–[15]. In addition, the study investigators stated that the nurses were not provided any rules or guidelines to follow when measurement ranges were exceeded; they were to use their own discretion or reference external guidelines. This lack of heart failure-specific protocol for the monitoring nurses was likely another limitation.

The Telemedical Interventional Monitoring in Heart Failure (TIM-HF) trial was another randomized controlled trial that did not show positive results initially [26]. This 2011 German study by Koehler et al. placed 710 CHF patients under either physician-led telemonitoring or usual care. Compared with usual care the telemonitoring intervention had no significant effect on all-cause mortality, cardiovascular death, or CHF hospitalization. A possible explanation for
these results is the limited support offered by the telemonitoring intervention. It was clear that patients had access to a 24-hour call in service; however, if not self-initiated by the patient, it was unclear what kind of feedback or frequency of feedback they received from the clinicians or the system. It should be noted that in a later subgroup analysis, significant reductions in total mortality, cardiovascular mortality, and number of days in the hospital were found specifically for those individuals with a previous CHF hospitalization, LVEF >25% and low depression.

On the other side, a report by Schneider described a telemonitoring program successfully implemented by a home care company for over 3 years and provides a valuable model for this study [27]. This telemonitoring program was able to reduce their 30-day hospital readmission rate for CHF from 38% to 6%. They attributed this to having the same group of highly skilled cardiac nurses visiting CHF clients. Schneider reported that telemonitoring made their clients more compliant with their medical regimens; by seeing their vital signs and weight daily, clients could recognize the consequences of not following their diet or taking diuretics. They also noted the importance of client education towards learning the CHF disease process and when to call the home care nurses versus calling their doctor or 911. In the same light, Scherr et al. [28] and Gonseth et al. [29] suggest that client education towards recognizing the warning signs of cardiac decompensation was a key component of telemonitoring success. There is ample evidence that improved client self-care leads to fewer required home nurse visits and clinic visits, improved health outcomes, and decreased healthcare costs [30]–[32].

Juretic et al. performed a study in 2012 looking at the predictors of attrition in users of a telemonitoring program [33]. They found that enrolment in the program via telephone (rather than in-person) was the largest predictor of premature dropout. The second factor was system use and experience within the first 30 days of enrolment. They suggested that it was essential to engage participants in-person and encourage active use of the home telehealth device within the first 30 days to ensure sustained utilization. Rogove et al. in 2012 examined the barriers to telemedicine on the clinician-side and found that reimbursement was a significant barrier to adoption [34].

When examining usual care versus care supported with telemonitoring, Cleland et al. found that telephone assessments were more effective with access to telemonitoring data [15]. Benatar et al. found that telephone assessments with telemonitoring data could be performed more
frequently than home nursing visits and would lead to fewer CHF readmissions and shorter length of stay [13]. Similarly, Pekmezaris et al. in 2012 found that telemonitoring in home care with robust CHF management protocols were relatively equivalent to live home visits when it came to managing CHF [35]. They postulated that telemonitoring has the potential to allow for efficient monitoring of a large population more cost-effectively than live visits in home care. Dansky et al. estimated that telehomecare technology could provide telephone support for 15 to 25 clients a day while, on average, a driving visiting nurse can only see 5.2 patients per day [36]. Telemonitoring reduces nurse travel time and allows a nurse to quickly check on clients and triage those that require immediate action.

Many of the studies reviewed operated out of a physician-led model; in these studies, when client measurements went outside pre-set ranges nurses alerted a physician immediately [13–15], [17], [37]. These studies also implemented expensive commercial-grade telemonitoring [13–15] and employed cardiac or heart failure specialist nurses to provide care for clients [13–15], [27]. Furthermore, most of the discussed studies were situated in Europe or the US. This study will be unique in that it is an Ontario-based project led by general home care nurses using a low-cost mobile phone-based telemonitoring system.

2.2 Technology Acceptance Model

The Technology Acceptance Model (TAM) is a theoretical model used in information systems to predict how users come to accept and use new technology. It was developed by Davis [38] with the purpose of predicting acceptability and identifying modifications that must be brought into a technology system to make it acceptable to users. The model suggests that the acceptability and use of a new technology is determined by two major factors: perceived usefulness and perceived ease of use. Perceived usefulness was defined by Davis as "the degree to which a person believes that using a particular system would enhance his or her job performance" and perceived ease of use as "the degree to which a person believes that using a particular system would be free of effort" [39]. These influence a user's attitude towards using a system, which in turn affect their intention to use, leading to actual system use (Figure 1).
From Figure 1, an individual's intention to use a system is determined by both their attitude towards it and the impact it may have on his/her performance (perceived usefulness). In other words even if a user does not welcome the technology, he/she may still use it if they perceive that the system will improve their performance. Another aspect of the TAM is the direct link between perceived ease of use and perceived usefulness. It was recognized by Dillan and Morris that if presented with two systems offering the same features, a user will find a system more useful if it is the easier one to use [40]. Perceived ease of use also influences the attitude of a user. This occurs through self-efficacy: the easier a system is to use, the greater the user’s sense of efficacy [41]. However, in his original research Davis demonstrated that the link between perceived usefulness and intention to use is stronger than the link between perceived ease of use and intention to use [38]. This suggests that the most influential factor in the acceptance of technology is its perceived usefulness.

In health care the TAM is applicable to both clinician- and patient-facing technology. In 2011, Orruno et al. showed that perceived usefulness and ease of use were significant predictors in clinicians' intention to use a new telehealth technology [42]. Similarly, Wade et al. demonstrated in 2012 that usefulness and ease of use were tied to acceptance and compliance with elderly patients using home telehealth technology [43]. Additionally, Gagnon et al. determined that to improve the acceptance of telemonitoring, it was essential to provide adequate training to health care professionals and provide the required technical assistance to all users [44]. The TAM is especially relevant to this study given that a technology platform, the UHN telemonitoring system, was introduced to a new user population: home care nurses and their clients. The success of its implementation depended heavily on both nurse and client acceptance; this acceptance consequently depended on its perceived usefulness and ease of use.
Focussing on these two factors dictated how the UHN telehomecare system was redesigned and developed.
Chapter 3: Existing UHN and ParaMed-CellTrak Systems

3.1 Introduction

This project involves bringing together different technology systems from academia (UHN) and industry (ParaMed-CellTrak), and integrating them together. ParaMed Home Health Care is Canada's largest private sector provider of home healthcare and nursing. They serve over 80,000 clients across Ontario and Alberta [45]. ParaMed utilizes multiple technology systems developed by CellTrak Technologies including CellTrak Portal, Calipso, and eOBC that are described in this chapter.

3.2 UHN Mobile Phone-Based Telemonitoring System

A telemonitoring system for chronic disease management was developed at the Centre for Global eHealth Innovation, University Health Network (UHN). The system was designed as a cost-effective tool to enhance patient self-care and clinical management, and has been informed through extensive clinical and patient feedback [46]. The efficacy of the telemonitoring system has been evaluated through randomized controlled trials in clinics [12], but its application for use by home care nurses has not been explored. It makes use of a commodity mobile phone (BlackBerry) to lower the cost compared to traditional commercial remote monitoring systems (typically $3000-$10,000 per patient [47]). The mobile phone transmits physiological data and acts as an interface for alerts, data entry, and data review.

Patients take their physiological measures (blood pressure, heart rate, and weight) with the system’s commercially-available home medical devices (i.e. a blood pressure monitor and weight scale). These wireless devices automatically send this data via Bluetooth to the BlackBerry. The BlackBerry then sends the information to the servers at the Centre for Global eHealth Innovation, UHN, through cellular data networks.

Alerts can be generated from this data based on pre-set thresholds, and then sent to patients along with an appropriate message or instruction. The alerts can also be forwarded to clinicians. This automated alerting acts as a means of providing immediate feedback of the patient’s condition to both patients and clinicians. Clinicians are able to access their patients' physiological measurements through a password-protected website. Patients are able to access
their own data on the provided BlackBerry mobile phone. Automated adherence reminders (audio messages) are sent out at 10 AM if a patient does not record their daily measurements. See Figure 2 for a graphical representation of the system.

![Figure 2 - Architecture of the UHN mobile phone-based telemonitoring system (modified from [48])](image)

3.3 CellTrak Portal

CellTrak Portal is a software platform used by ParaMed support staff to monitor the progress of upcoming and completed home visits by the nurses. To do this, CellTrak Portal collects information from nurse BlackBerry phones in the field. In particular it collects data regarding visit times, attendance, mileage records, travel time, and care plans. CellTrak Portal uses this information to generate alerts to notify the staff of visit issues. Alerts are triggered under many conditions including a delayed start to a visit, a visit performed outside the geographical area of a client's home, a short visit, a missed visit, etc. CellTrak Portal is monitored by full-time Portal administrators (admins) within the ParaMed offices. After detecting an alert, the Portal admin will contact the nurse on duty to address the alert.

3.4 Calipso

Calipso is the software that ParaMed uses to manage their scheduling needs. It handles and organizes upcoming client visits and client information. It is also where new clients are entered into the system when they are brought onto home care service.
3.5 eOBC

eOBC is the platform that ParaMed nurses use to record routine clinical assessments of their clients. These assessments occur at admission, during monthly reassessments, and at discharge. eOBC runs on the BlackBerry mobile phones provided by ParaMed to their nurses.
Chapter 4: Workflow Analysis and Identifying Constraints

4.1 Introduction

Home care nursing companies operate much differently from the physician-run clinics and hospital clinics where the UHN telemonitoring system was previously trialed. Home care providers have different responsibilities, capabilities, and methods of care delivery; they also function under different compensation models. It was also clear that an in-depth analysis had to be completed to properly map out the workflow of nurses and other support staff of this home care service provider. As per the Technology Acceptance Model, careful planning to maximize utility and ease of access at different points of care would lead to increased acceptance [38]. A proper integration that minimized additional workload on home care nurses and staff, avoided interruption of their normal processes, and limited the number of new processes that had to be learned would be met with greater success and uptake. The goal of this phase was to identify constraints and map out the best method of integration between the UHN and ParaMed-CellTrak platforms.

4.2 Methods

To properly integrate the UHN and ParaMed-CellTrak systems, it was necessary for the research team to fully understand the home care model and the systems they use. This required extensive collaboration with ParaMed and CellTrak to determine the system requirements and prospective methods of integration between the systems. Representatives from the three groups held meetings to introduce the current software applications, which gave all parties and their development teams a high-level understanding of the components involved.

To gain first hand experience with the daily nursing workflow, a home care nurse was shadowed as she made home visits to her clients. Detailed notes were taken of all procedures and clinical actions taken before, during, and after providing care to clients. With the knowledge gained from these initial meetings and shadowing, the research team were able to identify and draw out the core workflow cases that were relevant to the current system of operations in the home care organization.
These current nursing workflows and other system limitations discovered during group meetings were used to identify the constraints that would shape the design of the telehomecare system. With these constraints identified, the research team was able to propose new study workflows and the method of integrating the telemonitoring system into the current home care systems. These workflows and method of integration were subject to detailed review by the ParaMed representatives before being finalized.

4.3 Results and Discussion

4.3.1 ParaMed Home Care Staff

There are several different home care staff that are responsible for delivering care to clients and would be involved during the study. Their primary roles and responsibilities in day-to-day operations are described below.

Home Care Nurse

The nurse is the primary clinician involved in home care. These nurses include both registered nurses (RNs) and registered practical nurses (RPNs). The primary means through which home care nurses deliver care is by the home visit. This is where a nurse physically drives to a client's home and provides care to the client in their home. As such, home care nurses are often on the road and depend heavily on their BlackBerry mobile phones for communication and information updates from the main office. Nurses are usually responsible for a certain geographic area in a city where most of their clients are located, which minimizes the distance they have to drive. Nurses can also provide care to clients in the form of remote visits, which occur over the telephone; however, these occur much less frequently.

Portal Administrator

The Portal administrator (or admin) is responsible for monitoring CellTrak Portal in the main office. They ensure that the alerts appearing in CellTrak Portal regarding visit status and completion are properly acknowledged and addressed. The Portal admin often communicates directly with home care nurses and assignment coordinators by phone or secure email.
Assignment Coordinator

The assignment coordinator is responsible for coordinating client information and communication between the office and nurses. They manage new client referrals, assigning clients to nurses, input and scheduling visits into Calipso, and fielding client calls to the office. They are responsible for knowing which nurses are working and caring for each client. The assignment coordinator communicates frequently with nurses in the field by secure email.

Nursing Supervisor

The nursing supervisor is in charge of overseeing day-to-day nurse operations within the office. They are responsible for making clinical decisions on client care and can also fill in for when a primary or covering nurse is not available.

Care and Services Manager

The care and services manager is responsible for all clinical services performed by ParaMed staff belonging to the branch. They ensure that ParaMed clinical policies and protocols are being followed and that a standard of care is being maintained. They are also responsible for directing nurse education and training.

4.3.2 Mapping of Current Workflow

It was determined that there are 4 major cases in the current workflow that are relevant to the study and would need to be mapped. These 4 cases were outlined in flowchart format (Appendix B) and described here.

- Case 1: Portal alert - The Portal admin monitors upcoming and completed home visits. The CellTrak Portal can generate alerts to notify the staff of visit issues. After detecting an alert, the Portal admin contacts the nurse or the assignment coordinator, who then contacts the appropriate nurse regarding the alert.

- Case 2: Client calls centre - Any clients receiving care from ParaMed may call in to the ParaMed office with concerns. The assignment coordinator interacts with the client and determines if they need clinical action. If clinical action is required, the assignment coordinator contacts the nurse on duty, who assesses the client on the telephone. If changes are required to the client's care plan (e.g. an extra home visit), the nurse contacts
the *CCAC care coordinator for approval, documents any changes, and notifies the assignment coordinator to make the changes in Calipso.

- *Case 3: CCAC change - The CCAC may notify ParaMed of changes regarding their clients. The CCAC will notify the assignment coordinator via telephone or fax. The assignment coordinator contacts the appropriate nurse if required; if the nurse is unable to accommodate the change, a fill-in nurse is assigned. The assignment coordinator makes any changes in Calipso.

  *no longer applicable without CCAC involvement*

- Case 4: Nurse home visit - A nurse typically calls their client before a visit to remind the client that they are coming. When the nurse arrives, they open CellTrak on their BlackBerry to document their arrival and review their care tasks. If this is a client's first visit, the nurse proceeds to conduct an initial admission assessment with the client; this is documented through eOBC on their BlackBerry. The nurse then proceeds with their care tasks and documents this in the client's in-home health care record. The nurse also documents this care task completion and completes the visit in CellTrak.

4.3.3 Identification of Constraints

Through an in-depth analysis process, a number of constraints were identified that defined how the telehomecare system would be designed and integrated. These constraints have been divided into 3 categories and listed below.

A. Clinical

1. Care and service policies - The research study must align with all home care service provider (ParaMed) policies. This includes following protocols concerning documentation, clinical communication, redundancies, clinical guidelines, and visit approval.

2. Nurse mandate - Compared to a physician-centric model, nurses have less authority over patient care and changes. As a result, some of the responsibilities from the previous clinic-based model have to be scaled back in fit within the mandate of home care nurses.
B. Logistical

1. CCAC not a partner in the study - The Central East CCAC decided not to participate in this research study because of other active initiatives and a lack of resources to devote towards this project. As a result, we are unable to recruit any individuals who are currently receiving any CCAC services and we cannot reimburse nurse costs through the CCAC.

2. Home visit compensation model - Home care nurses at this service provider are only compensated for home visits. Even though they are performed, remote (telephone) visits are not reimbursed.

3. Tracking if primary nurse is working - ParaMed does not have an automatic method for identifying whether a patient’s primary nurse is working and/or who is covering for them. The assignment coordinator is responsible for knowing who is working at any given time.

4. Off-hours staff - Outside of regular working hours, the off-hours staff take over from the core daytime staff. This separately managed group handles all operations and clinical concerns during the night and weekend hours.

5. Remote study participants - The patient participants in this study are located distant from the research team, creating challenges for recruitment, training, and distribution of equipment.

C. Technical

1. No computer access in the field - Home care nurses do not have access to any kind of computer (laptop, desktop, or tablet) while working. However, they are required to carry BlackBerry mobile phones at all times.

2. Limited network connectivity in the field - Depending on where they are in the region, nurses get varying levels of reception on their BlackBerry phones. In some locations, they are not able to access the network at all.

3. Limited resources for technology vendor development - The study budget is allocated towards clinical and research activities. As a result, there is limited time and resources to dedicate towards any new development by the technology vendor (CellTrak) for this study.

4. Outdated BlackBerry platform - The existing UHN telemonitoring system is deployed on the BlackBerry Pearl 8130, which is running BlackBerry OS 4.5.
This platform is no longer supported by the BlackBerry software development environment. Thus, if the BlackBerry Pearl 8130 is used in the study, no updates to the original telemonitoring application will be possible.

4.3.4 Proposed Method of Integration

A proposed method of integration, focusing on the backend technology, was created with the development teams from UHN and CellTrak. The model produced by CellTrak, seen in Figure 3, shows the high-level technical architecture of the UHN and ParaMed-CellTrak platforms combining to form the telehomecare system. This model was used by the development teams to coordinate development on the interface between the two systems.

![Figure 3 - Proposed technical architecture of telehomecare system](image)

4.3.5 Mapping of Proposed Workflow

Through detailed discussions with the home care representatives, the proposed study workflows were created. It was determined that there are 11 cases that would need to be mapped to cover the new procedures introduced during the study. However, two were removed due to the lack of CCAC involvement. The remaining 9 workflow cases were put through multiple iterations of feedback and changes with the home care representatives to align with ParaMed care and
service policies. Without being part of the home care organization, the research team had some difficulty navigating the details and nuances of these home care policies. Over 15 versions of the workflows were produced before being finalized (Appendix C).

4.4 Summary

The workflow analysis resulted in:

- The identification of home care staff that would be involved in the study and a description of their current roles and responsibilities
- The mapping of current nursing workflows
- The identification of core, system-shaping constraints broken into clinical, logistical, and technical categories
- The creation of a technical architecture showing the integration between UHN and ParaMed-CellTrak systems
- The creation of proposed nursing workflows to be implemented during the study

The workflow analysis showed:

- The constraints placed on the telehomecare system dictated that additional redesign and development would be required
- The UHN and ParaMed-CellTrak systems could be integrated in a low cost, time-efficient manner as dictated by the project limitations
- The organization of home care is complex and difficult to navigate without inside knowledge
Chapter 5: Defining Study Protocol and Redesign of Existing Systems

5.1 Introduction

From the constraints identified in Chapter 4, it was clear that new protocols had to be defined for the study. Along with these new protocols, the existing UHN and ParaMed-CellTrak systems would have to be redesigned and developed accordingly.

5.2 Methods

5.2.1 Defining Study Protocol

The constraints identified in the workflow analysis were examined by the study team. The effects that these constraints would have on the study protocol or design were determined and described. Each constraint was addressed in detail and approved by the ParaMed representatives for development.

5.2.2 Redesign and Development

The defined constraints indicated that a large amount of development was required to adapt the UHN telemonitoring system to home care. Development work was needed on both CellTrak's and UHN's components in order to meet the system requirements. Each component requiring redesign was drafted by the research team and presented to the ParaMed representatives for approval before development.

5.3 Results and Discussion

5.3.1 Defining Study Protocol

Clinical

A.1 Care and service policies - The research study must align with all home care service provider (ParaMed) policies. This includes following protocols concerning documentation, clinical communication, redundancies, clinical guidelines, and visit approval.

- To align with ParaMed service protocols, the identification of clients on the telehomecare website was accomplished by ParaMed client ID instead of MRN (Medical Record Number) used in the previous trial [12]. Also, the "remember me" functionality of the website, which would allow users to stay logged in for long periods of time, was
removed. This would require clinicians to login every time when accessing the website as per usual privacy and security practice with ParaMed's other digital systems.

- All clinical communication between ParaMed staff and the research team was performed over the phone (e.g. for changing weight range targets - Appendix C: Case 10). Any email communication outside of ParaMed's controlled email network (e.g. from nurse to study coordinator) was considered too unsecure to contain any PHI.

- A layer of redundancy was included in the alerting process for nurses so that potentially serious alerts are not missed. As seen in the workflows (Appendix C: Case 1), nurses were instructed to respond to any alert emails within 15 minutes to acknowledge that they had received them. If the assignment coordinator received no response within 15 minutes, they were to follow-up to ensure delivery and receipt of alerts.

- A layer of oversight was required before a nurse could perform additional remote or home visits, or increase the frequency of regularly scheduled home visits. Because the CCAC was not involved in this study, the nursing supervisor and care and services manager were responsible for authorizing additional reimbursed visits (Appendix C: Cases 1, 2, and 11).

- To align with ParaMed care protocols, all clinical activities needed to be documented. This was done either through existing ParaMed systems (CellTrak, Portal, Calipso, eOBC, or a client's in-home health records) or through new study forms. The Telephone Advice Form (Appendix D) was modified from an existing ParaMed form; this form tracks the reason and outcomes of telephone visits, and captures valuable information immediately following a telephone visit relating to the usefulness of having access to telehomecare data. With telephone visits being reimbursed in this study, this form was made mandatory. The Home Visit Log (Appendix E) is a newly created form for nurses that captures the reason for each home visit and the usefulness of having access to telehomecare data.

- To align with ParaMed care and service policies, clinical guidelines and study procedures were distributed to all staff members. Since specialist nurses were not available in this project as in other studies [13]–[15], a guide or set of standardized questions had to be provided as in [17], [23], [50] to help general home care nurses assess heart failure status. The CHF Telehomecare Assessment guide (Appendix F) was created; it includes a checklist to help nurses assess their clients' heart failure. The
checklist was created using the CHF action plans distributed by Aurora Health Care [51], Health Net Federal Services [52], and Merck [53] as reference. In addition, the Telephone Assessment and Home Visit Guideline (Appendix G) is a step-by-step guide for nurses about how to perform a telephone assessment or home visit during the study. Separate instruction booklets were also provided to all staff members, which covered in detail all study procedures.

A.2 Nurse mandate - Compared to a physician-centric model, nurses have less authority over patient care and changes. As a result, some of the responsibilities from the previous clinic-based model have to be scaled back in fit within the mandate of home care nurses.

- Alert/instruction messages that were sent to clients were modified (Table 2). Alerts #4 and #7 no longer tell clients to take extra lasix (water pills). This is because this is strictly a physician order and is specific to each patient - something that a nurse is not responsible for affecting.

- The capability to modify client target weight ranges was removed from the website. This is because nurses do not have the authority to change a client's target weight range; this responsibility lies with the client's GP or cardiologist. A workflow and guideline were created to facilitate the process of contacting a physician to request a change in weight range (Appendix C: Case 10, Appendix G). After a nurse has contacted the physician and received a new weight range target, the nurse should inform the study coordinator over phone, who will make the change.

Logistical

B.1 CCAC not a partner in the study - The Central East CCAC decided not to participate in this research study because of other active initiatives and a lack of resources to devote towards this project. As a result, we are unable to recruit any individuals who are currently receiving any CCAC services and we cannot reimburse nurse costs through the CCAC.

- Without CCAC involvement in this research, several changes were made to the study protocol. The patient recruitment process was changed such that potential participants were identified by Oshawa family physicians and cardiologists, instead of being referred by the CCAC. The inclusion criteria were updated to include the stipulation that patients must not be currently receiving any CCAC services including home care. Potential
participants were asked by their physician if they were willing to speak with the study coordinator to further discuss the study. After speaking to the study coordinator and consenting, participants were referred to ParaMed as a new non-CCAC (private) client and assigned a primary nurse. See Appendix C: Case 5 for the complete recruitment workflow of new clients. Without CCAC involvement, all expenses related to delivering care to the study clients were paid for by the project fund.

**B.2 Home visit compensation model** - Home care nurses at this service provider are only compensated for home visits. Even though they are performed, remote (telephone) visits are not reimbursed.

- The present home care compensation model is not optimized for a telemonitoring solution. ParaMed nurses are only reimbursed for the home visits that they perform; remote (telephone) visits are not reimbursed and as such are not performed very often. When they are performed, compliance to the Telephone Advice Forms for documentation is low due to lack of reimbursement. To examine the feasibility of a new home care nursing delivery model, it was necessary to have proper nurse buy-in to fully utilize the telehomecare data and perform remote visits. As a result, the study team established a new bill rate for remote visits at $29.86/visit, or exactly half the bill rate of a regular home visit.

**B.3 Tracking if primary nurse is working** - ParaMed does not have an automatic method for identifying whether a patient's primary nurse is working and/or who is covering for them. The assignment coordinator is responsible for knowing who is working at any given time.

- In previous studies with this telemonitoring system [12], a single physician was responsible for receiving and responding to all patient alerts regardless of time or day. In the home care model there are numerous clinicians working limited days and hours. Every home care client is assigned a primary nurse; however, it can be difficult to establish when this nurse is not working and who the covering nurse is during vacations, afterhours, weekends, etc. Within ParaMed there is no automated way of determining this; instead, the assignment coordinator is responsible for doing this. This lack of automation prevented direct emailing between the alerting system and the appropriate clinician as in previous studies. There were also limited resources that inhibited CellTrak from developing this automation. The solution was a manual process: alerts
would be forwarded from UHN servers to CellTrak and displayed in CellTrak Portal; the Portal admin would detect alerts then copy and paste the alert contents into an email to the assignment coordinator; the assignment coordinator would then forward the alert email to the appropriate nurse. See Appendix C: Case 1 for a complete workflow of the proposed 'alerting chain' that occurs when a telehomecare alert is received in CellTrak Portal.

B.4 Off-hours staff - Outside of regular working hours, the off-hours staff take over from the core daytime staff. This separately managed group handles all operations and clinical concerns during the night and weekend hours.

- The original intentions of the research team were to train a core group at ParaMed responsible for all study tasks, as done in other models [27]. However, this would go against ParaMed service protocols where the assignment process is typically performed randomly. Another issue was the need to provide 24-hour, 7-days a week coverage in case a study client triggers an alert in the off-hours. Off-hours staff or covering nurses are equally responsible for clients when the daytime staff or primary nurses are not working. As a result, it was deemed necessary by the study team to train all nurses and staff, daytime and off-hours, operating out of the Oshawa branch to ensure complete coverage and adequate care by study-informed staff.

- As mentioned in B.3, there is no automatic way of determining whether a client's primary nurse is working and/or who is covering for them, especially during the off-hours. Consequently, on the telehomecare website it was necessary to automatically assign all clients to all nurses (i.e. all nurses had access to every study client in case they were covering for another nurse). To prevent misuse, all access to the website was tracked and audited, and clinicians were required to agree to only access clients that they provide care for before gaining entry to the website (Figure 8); a persistent notice of this was also posted across the top of the client selection screen.

B.5 Remote study participants - The patient participants in this study are located distant from the research team, creating challenges for recruitment, training, and distribution of equipment.

- The ParaMed Oshawa branch was selected as the clinical study centre (see Chapter 8: Experimental Evaluation for reasoning) and the study participants came from the
surrounding Oshawa area. The research team was located in Toronto which meant that any interaction with the study participants had to occur remotely. This included recruiting and consenting clients over the telephone, which according to Juretic et al., would be a predictor for attrition [33]. Any pre- and post-study interviews would also be performed over the telephone.

- Distributing the telehomecare equipment to consenting clients' homes became an issue. It was agreed upon that the research team would package and mail the telehomecare equipment to clients shortly after consent. The package would be mailed express to reach the clients before their first nurse home visit; in addition to the equipment, it would contain all instruction manuals, questionnaires, and a consent form. It would be packaged in a large, reusable box along with a return label to allow for the equipment to be mailed back.

- Another issue was determining how to train remote clients to use the telehomecare equipment. In the past, patient training involved watching a research member demonstrate the proper procedure with the equipment to maximize knowledge transfer [46]. It was decided that the nurses would perform the training during the first home visit of a study client similar to in the nurse-led model described by Schneider [27]. Consequently, all nurses had to be well-trained themselves in the use of the telehomecare equipment.

**Technical**

**C.1 No computer access in the field** - Home care nurses do not have access to any kind of computer (laptop, desktop, or tablet) while working. However, they are required to carry BlackBerry mobile phones at all times.

- One of the proposed benefits of bringing telemonitoring to home care was providing access to clients' daily physiological measurements. In line with the Technology Acceptance Model, when, where, and how nurses were able to access this new telehomecare data in a useful manner was paramount for system acceptance [38]. To home care nurses, this information would be most useful at the point of care. Without computer access in the field, they would have to retrieve this information through their BlackBerry mobile phones. To accommodate for the BlackBerry's smaller screen, a
mobile-optimized version of the website had to be designed and developed to maintain usability (Figure 10).

C.2 Limited network connectivity in the field - Depending on where they are in the region, nurses get varying levels of reception on their BlackBerry phones. In some locations, they are not able to access the network at all.

- This was a concern for the study because the pathway to access a client's daily measurements is through a website. Without internet connectivity, nurses would not have reliable access to their clients' measurements in the field. It was determined that a portion of the client's past measurements would be included directly in the alert message that they receive (Figure 12). The appropriate period to include was determined to be the client's last two weeks of measurements, determined through validation and usability testing with clinicians (Chapter 6). An apparent limitation with this setup is that alerts are sent to nurses via email, which also requires network connectivity. However, the BlackBerry emailing system is quite robust and emails are downloaded to the phone whenever a connection is available. These alert emails, with two weeks of measurements, would then be readily available to the nurse even with limited network connectivity.

C.3 Limited resources for technology vendor development - The study budget is allocated towards clinical and research activities. As a result, there is limited time and resources to dedicate towards any new development by the technology vendor (CellTrak) for this study.

- With limited resources for the study, CellTrak was unable to complete any large scale development. A simple strategy to integrate the UHN and ParaMed-CellTrak systems was implemented. CellTrak would receive HTML-formatted alerts from the UHN servers and display them through the existing CellTrak Portal under a new "Telehomecare Alerts" tab (Figure 11). The Portal admin would periodically check the "Telehomecare Alerts" tab for new alerts. The contents of any alert message would have to be manually copied and pasted into an email to the assignment coordinator, who would then forward the email to the appropriate nurse.

C.4 Outdated BlackBerry platform - The existing UHN telemonitoring system is deployed on the BlackBerry Pearl 8130, which is running BlackBerry OS 4.5. This platform is no longer
supported by the BlackBerry software development environment. Thus, if the BlackBerry Pearl 8130 is used in the study, no updates to the original telemonitoring application will be possible.

- To facilitate any required updates to the original telemonitoring application, it was necessary to upgrade the mobile phone to a more recent BlackBerry. ParaMed was able to provide a collection of BlackBerry Curve 8530's running BlackBerry OS 5. As a result, the original BlackBerry 8130 application had to be repurposed and deployed to the BlackBerry 8530. Thorough testing was needed to ensure a successful migration before putting the system in the hands of study clients (Chapter 6: Validation and Usability Testing).

5.3.2 Redesign and Development

Alert/Patient Feedback Messages

The various messages that clients receive when using the system had to be modified to better fit a home care setting. Clients receive textual messages in the form of instructions or suggestions of what to do through the telehomecare application on their mobile phones when their measurements trigger an alert. All messages are relatively short in length, which serves to make the instructions clear and to the point for clients, and also to fit into the limited screen space available on the mobile phone while still remaining legible.

The original messages used in the UHN system can be seen in Table 1; these were updated to the home care-specific messages seen in Table 2. In alerts #4-7, any instance of "Heart Function/HF Clinic" or "family doctor/Dr." have been replaced with "ParaMed" to direct any clinical contact or support towards the home care nurses instead of physicians. The other major change seen in alerts #4 and #7 is that the option to take extra lasix (water pills) has been completely removed. As mentioned in A.1, this is because the decision to allow patients to take extra lasix lies with the physician; nurses do not have the ability to make this decision themselves. Alert #8 was reworded based on the advice of one of the study's clinical advisors - cardiologist Dr. Heather Ross. Her reasoning was that if an individual is in serious enough condition to trigger a '911 critical' alert, that person should not waste time trying to arrange transportation to the hospital; they should just call 911. Based on initial nurse feedback, the phrase "if you feel you should" in alerts #4-7 was placed before the rest of the message instructions to emphasize that a client can always call the ParaMed office if they feel poorly. The ParaMed clinicians wanted to make sure that a client was never sitting at home waiting for
a phone call from the nurse while they were deteriorating rapidly. All updated alert messages were vetted through Dr. Ross and representatives from ParaMed.

<table>
<thead>
<tr>
<th>Alert number</th>
<th>Patient message</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&quot;Your measurements are fine today&quot;</td>
</tr>
<tr>
<td>2-3</td>
<td>&quot;If you feel worse later today, use the system to take symptoms&quot;</td>
</tr>
<tr>
<td>4</td>
<td>&quot;Restrict salt &amp; fluids. If you feel you should, call ParaMed or go to Emerg Dept&quot;</td>
</tr>
<tr>
<td>5</td>
<td>&quot;If you feel you should, call ParaMed&quot;</td>
</tr>
<tr>
<td>6</td>
<td>&quot;If you feel you should, call ParaMed or go to Emerg Dept&quot;</td>
</tr>
<tr>
<td>7</td>
<td>&quot;If you feel you should, call ParaMed or go to Emerg Dept&quot;</td>
</tr>
<tr>
<td>8</td>
<td>&quot;Call 911 now&quot;</td>
</tr>
</tbody>
</table>

Table 1 - Previous alert/instruction messages sent to patients [54]

In addition to textual instructions, clients using the telehomecare system receive recorded audio messages sent to their home telephone (Table 3). These messages are sent for adherence purposes when a client forgets to take one or more daily measurements, and if a client triggers a 'critical 911' alert. Adherence reminders are important for the success of a telemonitoring implementation [14] [18]. The adherence message reminds the client to take their measurements now or tomorrow; the 'critical 911' message informs clients that they should go to the emergency department and to call 911 now.

<table>
<thead>
<tr>
<th>Case</th>
<th>Recorded Audio Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Adherence</td>
<td>&quot;This is a message from the Telehomecare System. We have not received your scheduled [insert adherence-type(s)] measurements. If you have not yet taken your measurements, and have not eaten or drank anything today, please take your measurements now. Otherwise, please remember to take your weight, symptoms, and blood pressure measurements first thing&quot;</td>
</tr>
</tbody>
</table>
tomorrow morning. If you are having any problems with the equipment, call 416-340-5312. Good-bye for now."

Adherence-types:
"Weight"
"Blood pressure"
"Symptoms"

2. Emergency Call (Critical 911 Alert) "This is a message from the Telehomecare System. Your symptoms and measurements show that you need to go to your local Emergency Department. Call 911 now. Good-bye for now."

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Threshold/Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight target</td>
<td>Set by GP/cardiologist</td>
</tr>
<tr>
<td>Weight range</td>
<td>Weight target ± 4 lbs</td>
</tr>
<tr>
<td>Weight change</td>
<td>± 3 lbs / day</td>
</tr>
<tr>
<td>Systolic blood pressure (min - max)</td>
<td>80 - 180 mmHg</td>
</tr>
<tr>
<td>Diastolic blood pressure (min - max)</td>
<td>60 - 100 mmHg</td>
</tr>
<tr>
<td>Pulse (min - max)</td>
<td>50 - 150 bpm</td>
</tr>
<tr>
<td>Symptoms</td>
<td>Any reported symptoms</td>
</tr>
</tbody>
</table>

Table 4 - Default alert thresholds

Alert Email
As mentioned in B.3, alerts triggered by study clients were sent to the appropriate nurses by email. As mentioned in C.2, a portion of the client's past measurements would be included directly in these alert emails. The format of these alert emails was designed and developed at UHN. An initial design by the UHN Human Factors team is shown in Figure 4.
At the top of the email is a header containing identification information of the client who triggered the alert is given. Below this is the body of the alert email, with past measurement entries. Any measurement that triggered an alert is displayed in red font. Each entry contains:

- The date & time
- Alert message sent to the client (if any)
- Abnormal condition/measurement that generated an alert
- Client's weight with variation and target range
- Client's blood pressure with variation and target range
- Client's pulse with variation and target range

![Initial alert email format](image)

Figure 4 - Initial alert email format

Through internal feedback from the research team, several changes were made to the initial design and can be seen in Figure 5:

- The header should contain the client # and home address to help identify the client
• The header should contain one phone number to simplify where the client is reached at and where recorded telephone messages are sent to

• The header does not need to contain the client's heart failure cause or date of birth as this information may not be available

• The body should contain a hyperlink to the client's profile on the telehomecare website so the nurse can see the client's complete history of measurements

• The body should contain a tentative 7 days of previous measurements (later changed to 14 days)

• Each entry should contain any symptoms that the client reported (or "None")

• Any measurement or symptom that triggered an alert should be more strongly highlighted (bolded, underlined, and red) to stand out more, especially if the red colouring does not carry over to the alert emails

• Each entry does not need to explicitly state the "Abnormal conditions generating alert" as these will already be highlighted
Telehomecare Website

The telehomecare website served as the access point for clinicians and the study team to manage clients and view their complete measurement histories. The website used in this study leveraged much of the website framework used in previous studies [12] with the addition and removal of some select features:

- Removing the "remember me" login functionality of the website
- Referring to study participants by ParaMed Client ID # instead of Patient MRN (Medical Record Number)
- Removing the "ECG" tab because ECG daily measurement was not utilized in this study (interpretation of ECG signals requires specialist knowledge)
• Removing the "Clinical Phone Actions" tab because documentation was to occur following existing ParaMed procedure and on provided study forms
• Removing the "Parameters" tab, which removed the ability from nurses to modify client alert thresholds
• Automatic assigning of all clients to all nurses
• Auditing and tracking all access to the website
• Adding an agreement screen for clinicians to only access clients that they provide care to (Figure 8)

For the reasoning behind these changes, see constraints A.1, A.2, and B.4. See Figure 6 for a snapshot of the previous website layout with all the original tabs present.

Figure 6 - Previous website layout with all original tabs
Figure 7 shows the newly designed website layout with tabs removed. Figure 8 shows the agreement that nurses must consent to before accessing the website.

Figure 7 - Website layout with tabs removed

Figure 8 - Clinician agreement to access website

Mobile Version of Telehomecare Website
As mentioned in C.1, a mobile-optimized version of the website had to be designed and developed. The main challenge was making all the information readable and usable on the much smaller BlackBerry screen without requiring excessive scrolling. The nurses would be using ParaMed-issued BlackBerry Curve 9300's and 9360's with screen resolutions of 320x240 and 480x360, respectively. The research team with the help of the Human Factors team at UHN came up with the responsive design seen in Figure 9. It was decided that only the "Summary" and "Contact Info" tabs would be visible on the mobile version because the Summary tab contains all of the client's physiological information in one location and would minimize website navigation. Also, the measurement tabs on the full website (2 Week Trend, Weight, Blood Pressure, and Pulse) contain large interactive graphs, which would not scale or display correctly inside a mobile web browser. In the Summary tab, the date and time of each entry would be listed at the top of the header. To maximize space, the client's measurements would be stacked in a column under "Morning Readings"; symptoms would appear in the middle column, and any alert messages would appear in the right column. To remain consistent with the full website and alert emails, any measurement or symptom that triggered an alert would be highlighted (bolded, underlined, and red). The mobile version of the website can be seen in Figure 10.

![Mobile Website Table](image)

**Date:** Mon February 20, 2012; 8:42 AM

<table>
<thead>
<tr>
<th>Morning Readings</th>
<th>Symptoms</th>
<th>Alert Message to Client</th>
</tr>
</thead>
</table>
| Weight: **192.0** | • Fainted  
• Night breathing worse  
• Short of breath  
• Swollen ankles  
• Unusual heart beat  
• Light-headed  
• 4 Pillows  
• Reduced activities  
• ICD Fired  
• More chest pain  
• More tired  
• Short of breath  
• Unusual heart beat  
• Light-headed  
• 3 Pillows | "If you feel you should, call ParaMed or go to Emerg Dept" |
| Blood pressure: **110/90** | | |
| Pulse: **103** | | |
CellTrak Portal
As mentioned in C.3, CellTrak had to add a new "Telehomecare Alerts" tab to their Portal to receive and display telehomecare alerts forwarded from UHN (Figure 11). This new tab would leverage the existing Portal infrastructure for columns and alert acknowledgement, and would be limited in release to just the Oshawa branch. This tab would have four columns for content: Patient ID, Patient Name, Alert Content, and Alert Time. The bulk of the alert message, as seen in Figure 5, would appear under the "Alert Content" column. This content would be forwarded from UHN servers with HTML formatting and displayed here.
5.4 Summary

This phase resulted in the study protocol being defined, using the identified constraints, for:

- Alerting clinicians (‘alerting chain’) and the format for alerts (alert emails)
- Responding to alerts (telephone/home visits) and documenting clinical actions (Telephone Advice Form and Home Visit Log)
- Recruiting and training clients
- Managing complete client coverage including off-hours
- Nurse compensation for performing clinical interventions
- Initializing and adjusting alert target ranges
Modifications were made to components of the UHN telemonitoring system:

- Alert/feedback messages to clients
- Default alert thresholds and audio messages
- Format of alert emails
- Telehomecare website: full and mobile versions
- CellTrak Portal: "Telehomecare Alerts" tab
Chapter 6: Validation and Usability Testing

6.1 Introduction

The new study protocols and software systems developed in Chapter 5 would have to undergo validation by ParaMed representatives to ensure satisfaction and alignment with their home care policies. By the Technology Acceptance Model, any perceived improvement in job performance or sense of self-efficacy should improve their attitude towards using the system [38]. In addition, a user will find a system that is easier to use more useful [40]. Thus, the new study protocols and software systems would also undergo usability testing to confirm ease of use with all end users.

6.2 Methods

6.2.1 Walkthrough and Validation

Many new workflows, protocols, and responsibilities would be placed on the home care nurses in this study. As such, it was necessary to validate these new protocols at an early stage before development was finished and before usability testing occurred. This was done with two managerial-level ParaMed nurses: the care and services manager and a corporate clinical consultant. Both nurses were taken individually through the following steps:

1. The nurse was informed that they were free to make comments at any time about any of the material presented and that the session was recorded for later review.
2. A video [55] about the heart failure telemonitoring system developed at UHN was viewed. The video introduces the system and follows a patient using it and describing the benefits.
3. Key workflows that will occur during the study were walked through: Case 1 - Telehomecare alert in CellTrak Portal, Case 7 - Initial admission assessment of study participants, and Case 8 - Regularly scheduled home visit of participant (Appendix C). Nurses were encouraged to give any feedback (e.g. if they thought a step was unnecessary, if they thought their colleagues would be averse to a particular procedure, or if any process conflicted with ParaMed policy).
4. It was explained how alerts were triggered and the different alert thresholds were walked through (Table 4). Nurses were asked if they had any clinical concerns about the default alert thresholds or triggering process.

5. It was explained how different alerts are triggered based on different conditions. Nurses were asked if they have any clinical or service policy concerns about the alert messages that would be sent to clients.

6. An early-stage alert email was walked through (Figure 4). Nurses were asked if the information in the alert email was clear and what additional information they wanted to see or not see in the email.

7. The telehomecare website was introduced and nurses were provided a test login to explore the different features and tabs. The blueprint of the mobile version of the website was described (Figure 9). Nurses were asked to give feedback regarding layout and access to clinical information on both website versions to aid in its design.

6.2.2 In-House Testing

With the migration of the telemonitoring application from a BlackBerry Pearl 8130 to a BlackBerry Curve 8530 (constraint C.4), extensive in-house testing was performed on the new platform. Testing was also performed with the server backend to make sure the alerting algorithm was functioning properly and correctly outputting to the telehomecare website and CellTrak Portal. The testing procedure involved simulating different test cases of physiological measurements (Appendix I) and confirming whether the expected alert message was generated and forwarded to the appropriate systems.

6.2.3 Usability Testing

Usability testing was performed with both patients and clinicians to inform the development and integration of the telemonitoring system with nursing care and service systems. The objective was to identify design improvements that could be made to the system to increase usability and patient safety as well as user satisfaction. Ethics approval to perform usability testing was received from the UHN REB (# 12-0363-AE) on June 18, 2012. Usability testing was performed before the CECCAC decision to not be involved, thus certain tested aspects and results pertaining to CCAC contribution are no longer applicable.

Participant Eligibility and Recruitment
Usability testing of the telehomecare system was conducted with two user groups: CHF patients and clinicians (nurses and other home care staff). Testing sessions with patient participants were estimated to take approximately 20-30 minutes to complete. Testing sessions with clinicians took approximately 1 hour to complete.

Volunteer CHF patients were recruited from the Toronto General Hospital Heart Failure Clinic. Eligible participants were English-speaking individuals who have been diagnosed with heart failure and who are outpatients. Patients who are younger than 18 years of age, deemed unable to comply with home monitoring (e.g. due to vision problems, significantly impaired physical dexterity, suffering from anxiety or depression, etc.), awaiting heart transplantation, or not expected to survive over a year, were excluded. It was estimated that approximately 5 patients would be sufficient to reach information saturation [56], [57]. Patients that met the inclusion criteria were asked by their CHF physician for permission for the study coordinator to approach them regarding the study.

For the clinicians, the care and services manager from ParaMed identified staff who were likely to be involved in the actual pilot study and who were available during the scheduled testing period. It was estimated that approximately 5 nurses and 2 additional staff members would be required to reach information saturation [56], [57].

**Testing Protocol**
For usability testing, these representative end users operated and reviewed the telehomecare system in order to assess the appropriateness and ease of use of the system prior to its introduction into practice. Usability testing involved the following:

1. Orientation - The purpose and objectives of the evaluation were explained to each participant by the study coordinator. Participants were asked to think aloud while working through the scenarios and while reviewing new clinical material. They were assured that they were not being tested and any negative impressions or problems they encounter with the system were not a reflection of their skills, but rather an indication that the system requires improvement. Participants were informed that the session would be recorded. Consent forms were reviewed with the study coordinator and signed
by both the participant and the study coordinator. Patient participants completed a brief pre-study questionnaire (Appendix J).

2. Demonstration - Prior to usability testing, each participant was given a demonstration of the telehomecare equipment including the blood pressure monitor, weight scale, and a BlackBerry smartphone. The purpose of the demonstration was to expose the participant to the general functionality of the monitoring equipment. The demonstration was not intended to be comprehensive so that learnability and intuitiveness could be assessed as part of the evaluation.

3. Test Performance & Review - Participants performed a series of representative tasks and reviewed new clinical documentation while commenting on what they saw and thought (a process referred to as the “think aloud method”). Tasks for both groups of participants are discussed in the following section. Interaction between the study coordinator and the participant was minimized in order to gain insights into the participant thought processes and actual behaviours. If a participant became stuck or confused they were asked to verbalize their thoughts in order to pinpoint the reason for the problem. Participants were audiotaped while they used the system to capture any challenges faced by the users and overall thoughts, feelings, and perceptions of the system.

4. Participant debriefing - After patient participants completed all the tasks, he/she completed a brief questionnaire (Appendix K) pertaining to their perceptions of usability and overall satisfaction with the system. Clinician participants were asked verbally to comment on their perceptions of the system and any specific issues or areas for improvement.

5. Compensation - Patients were compensated $24 to cover parking costs for participating in the usability testing session. Nurses were compensated at the same hourly rate that they receive when attending mandatory training sessions. The usability session occurred during regular working hours; thus, the other home care staff were not compensated on top of their regular wage.
Test Performance Tasks - Patients

During the usability test, patients were asked to do the following:

1. Measure and record blood pressure of the study coordinator (instead of taking their own blood pressure). If they receive an error or alert message on the BlackBerry, they may be prompted to measure blood pressure again. If the patient is unable to measure blood pressure after three attempts, he/she will be assisted by the study coordinator.

2. Measure and record the body weight of the study coordinator (instead of taking their own weight). If they receive an error or alert message on the BlackBerry, they may be prompted to measure weight again.

3. Enter and record a simulated symptoms entry. If they receive an error or alert message on the BlackBerry, they may be prompted to enter their symptoms again.

4. Find and view a history of the information just recorded on the BlackBerry.

Test Performance Tasks - Clinicians

Different home care staff went through different material based on their projected study responsibilities as outlined in Appendix L. In addition to working with the telehomecare system, staff were asked to review new clinical documentation that they would be using and referencing during the study. Clinicians were encouraged to give any feedback regarding usability, content, or any concerns relating to ParaMed's care and service protocols (e.g. did any of the steps seem unnecessary, would your colleagues be averse to any of the new procedures, did any of the processes conflict with current ParaMed policy, etc.).

6.3 Results and Discussion

6.3.1 Walkthrough and Validation

Feedback was received from the managerial nurses on a variety of the material. This feedback consisted mainly of protocol and workflow changes to improve nurse efficiency including distributing a 1-page study guide for nurses to reference and ensuring telehomecare equipment had arrived at a client's home before making a home visit. This feedback, broken into themes and any resulting changes, are summarized in Table 5.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Feedback</th>
<th>Resulting Action/Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protocol</td>
<td>Provide nurses with a 1-page protocol summary sheet</td>
<td>Created a Quick Reference for nurses</td>
</tr>
<tr>
<td>1-pager could be laminated</td>
<td>Assignment coordinator protocol updated: remember to not report the same alert twice</td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Avoid duplicate reporting: client calls in about an alert AND nurse receives the alert</td>
<td>*CCAC approval for visits can take upwards of 30 minutes to an hour</td>
<td></td>
</tr>
<tr>
<td>Workflows</td>
<td>ParaMed staff previously referred to as &quot;area coordinator&quot; is actually an &quot;assignment coordinator&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The previously referred to &quot;initial assessment&quot; is actually an &quot;initial admission assessment&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Currently, nurses respond most frequently to call-ins regarding IV pumps/therapy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>*Currently, nurses do not seek CCAC authorization for remote visits; if they are reimbursed for remote visits in the study, they will have to seek CCAC authorization</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Avoid nurses making the initial home visit before the telehomecare system has arrived</td>
<td></td>
</tr>
<tr>
<td>Workflows (Appendix C: Cases 5 and 7) updated to ensure equipment has arrived before the nurse proceeds with the initial home visit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Default alert thresholds</td>
<td>The GP/cardiologist may need to adjust the weight target many times before the client is stable</td>
<td></td>
</tr>
<tr>
<td></td>
<td>*Existing/long-term CCAC clients with CHF will likely be stable and it will be straightforward to get their weight target</td>
<td></td>
</tr>
<tr>
<td></td>
<td>*It may be possible to get clients' weight targets on the initial referral from CCAC</td>
<td></td>
</tr>
<tr>
<td>Alert messages</td>
<td>ParaMed Client ID #’s consist of 6 numbers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Avoid duplicate reporting: client calls in about an alert AND nurse receives the alert</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Can the alert message instructions be more descriptive to avoid the client going to the ED unnecessarily, e.g. wait X minutes or if you feel lightheaded</td>
<td></td>
</tr>
<tr>
<td></td>
<td>This is too prescriptive to be used commonly across all clients. Also, the alert message has to be short to fit on the BlackBerry screen. Thus, alert messages will remain as is.</td>
<td></td>
</tr>
<tr>
<td>Training nurses &amp; staff for the study</td>
<td>Training should be done using PowerPoint</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Provide a training video for those who cannot attend</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A training video will be produced</td>
<td></td>
</tr>
</tbody>
</table>
6.3.2 In-House Testing

In-house testing involved simulating different physiological measurements and confirming whether the expected alert message was generated and displayed properly in different cases (Appendix I). The major issues that were found and the resulting fixes are summarized in Table 6. The majority of changes were to the layout and accommodating for the new BlackBerry screen.

<table>
<thead>
<tr>
<th><strong>Issue Description</strong></th>
<th><strong>Fix/Solution</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Alert messages to the client are being truncated to one line on the Summary screen of the application</td>
<td>• Summary screen layout changed to allow two-line messages</td>
</tr>
<tr>
<td></td>
<td>• Font size of longer messages reduced</td>
</tr>
<tr>
<td>• Various alert algorithm bugs (incorrect alert message generated)</td>
<td>• Alerting algorithm logic and syntax rectified to match expected alert generation</td>
</tr>
<tr>
<td>• When the BlackBerry does not have network connection (in the basement/remote area or connection turned off), the application fails to properly cache (store) and resend measurements when network connection is re-established</td>
<td>• Issue in the caching and resending procedure corrected</td>
</tr>
<tr>
<td>• After erasing the history of all measurements on the BlackBerry, the old measurements persist when the application is restarted</td>
<td>• Error in the &quot;Erase All History Data&quot; function code corrected</td>
</tr>
<tr>
<td>• Alert messages to the client are being truncated to one line on the Summary screen of the application</td>
<td>• Summary screen layout changed to allow two-line messages</td>
</tr>
</tbody>
</table>

Table 6 - Issues from in-house testing

6.3.3 Usability Testing

**Patient Results**

Patient usability testing was performed at the Toronto General Hospital Heart Failure Clinic. Usability testing was stopped after three patients when information saturation was reached. This earlier than expected saturation of information was because the UHN telemonitoring system has previously undergone multiple iterations of comprehensive usability testing [46]. The interface and navigation of the current application remains unchanged, except that it is now on the
BlackBerry Curve 8530. The Curve has a larger screen and slightly different keyboard than the original BlackBerry Pearl 8130, but otherwise operates the same. In addition, testing was completed with patients from the same heart failure clinic as in previous usability trials, so information saturation was reached quickly.

From the pre-study questionnaires (Appendix J), it was found that patients were in the 25-64 year range. Two reported never using a blood pressure monitor at home. All reported weighing themselves at home, though only one kept a log of his/her weight readings (on paper). All reported using a cell phone frequently (greater than once a week); two reported that it was easy to use their own cell phone (ease of use: 5 out of 5), though one reported some difficulty (ease of use: 3 out of 5).

From the Technology Acceptance Model, perceived ease of use and utility are just as important in patients as they are in clinicians towards encouraging technology acceptance and compliance [43]. Following usage with the telehomecare equipment, patients filled out the post-study questionnaire (Appendix K). All patients responded positively to the equipment with an overall average rating of 4.87 out of 5 based on satisfaction and ease of use. Despite never using a blood pressure monitor at home, the same two patients reported being "very satisfied" (5 out of 5) with the blood pressure monitoring component. The patient who reported difficulty using his/her own cell phone, found that the telehomecare cell phone was "very easy" to use (5 out of 5).

One aspect that patients were not completely satisfied with were the cell phone keyboard buttons; two patients reported slight difficulty pressing button keys that were beside each other (e.g. the "1" button and "2" button). In users with larger fingers or reduced dexterity, this could lead to accidental presses that would be especially unsafe when answering symptoms questions ("1" for "No" and "2" for "Yes"). Accidental presses were suspected to be the culprit behind incorrect symptoms reporting in a previous study [12]. To remedy the possibility of accidental key presses during symptom reporting, the button for "Yes" was changed to the "0" button, which is located at the bottom of the keyboard; "No" was remained bound to the "1" button, which is located at the top left of the keyboard.
Other feedback comments revolved around adding additional features to the telehomecare system. One suggestion was to include blood sugar in the daily measurements; it should be noted that the telemonitoring application supports glucometry but this feature was turned off for this study to focus on CHF. Another suggestion was to include a way of indicating the progression of symptoms instead of simply listing each day's symptoms as "Normal" or "Abnormal". This would involve the symptoms history log to display a report on individual symptoms (chest pain, tiredness, etc.). To add this functionality would require further development outside the scope of the current study; thus, this feedback was passed on to the development team as a possible feature for the next iteration of the telemonitoring system.

**Clinician Results**

Clinician usability testing was performed at the ParaMed Oshawa office. From ParaMed, a corporate clinical consultant and an applications support supervisor were present throughout all testing. Testing was broken up into four 1 to 1.5 hour sessions. The first session was with the Portal admin; the second with the assignment coordinator. Due to time and availability constraints, the nurses were combined into group sessions. The third session involved two nurses and the nursing supervisor; the fourth session involved two other nurses. A variety of feedback was received from the clinicians on the material presented. This feedback, broken into themes and any resulting changes, are summarized in Table 7.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Feedback</th>
<th>Resulting Action/Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CellTrak Portal</td>
<td>Is it possible to get notification when a new telehomecare alert comes through (e.g. notification sound, popup icon, colour change) so that they are not overlooked</td>
<td>CellTrak does not have time or resources for this additional development</td>
</tr>
<tr>
<td></td>
<td>Is it possible to get a button that automatically copies contents of alert message in Portal to clipboard (so that Portal admin doesn't miss copying some of the contents)</td>
<td>CellTrak does not have time or resources for this additional development</td>
</tr>
<tr>
<td></td>
<td>Change tab label from &quot;UHN Alert&quot; to &quot;Telehomecare Alert&quot;</td>
<td>All instances corrected</td>
</tr>
<tr>
<td>UHN Telehomecare System</td>
<td>Need to include client name in alert email sent to nurses/ParaMed to improve client identification</td>
<td>Client name added to alert email (Figure 12)</td>
</tr>
<tr>
<td></td>
<td>Alert email should contain 14 days of previous measurements instead of 7</td>
<td>Alert email updated to include 14 days of measurements (Figure 12)</td>
</tr>
<tr>
<td>Days</td>
<td>49</td>
<td>2023-10-18</td>
</tr>
</tbody>
</table>

| Training nurses & staff for the study | In off-hours, one person covers both Portal and coordination | These individuals will be trained on the new responsibilities for both the Portal admin and assignment coordinator |

| Recruitment of CHF study participants | *Need information sheet that nurses can give to clients prior to recruitment | *Assignment coordinator recruitment script should have simpler language and include positives/benefits to the study (originally, assignment coordinators were to make first contact with clients regarding the study) |

| Protocol | CellTrak Portal does not get monitored very frequently during the evening and weekends | Ensure off-hours supervisors remind staff to check Portal periodically; Portal admin protocol updated |

| | Need to define an alert email subject line such that nurses will recognize it and open it promptly | Alert email subject line will be, "Telehomecare Alert"; Portal admin protocol updated |

| | Nurses/nursing supervisor comment that they acquire a lot more information seeing the client in-person during a home visit versus on the telephone (e.g. complexion, posture, mobility, composure, living conditions) | |
*CHF clients are usually only on CCAC service for 4-6 weeks (versus expected study minimum of 4 months); this will reduce any effect on self-care, QOL, HOBIC indices, mortality, hospitalization, etc.

Increase study emphasis on nurse/client perceptions of the telehomecare system and its value (survey data from nurse forms, interviews, client questionnaires)

**Workflows**

Assignment coordinator wants nurses to communicate back (call or email) that they have received the alert email within 30 minutes

Instructions added to alert email for nurses to acknowledge receipt: "Please reply to assignment coordinator that you have received this alert message email" (Figure 12); nurse protocol and workflow (Appendix C: Case 1) updated

When client calls in because of alert, assignment coordinator should estimate how long before nurse will respond to client and/or fallback on usual process if client is feeling worse (e.g. call family doctor, go to ED)

**CCAC**

*Usual practice with CHF clients discharged from hospital: CCAC authorize only 1 home visit for nurse to assess client's visit needs for next 2 weeks; after 2 weeks, reassess need

*When calling CCAC for authorization, might not get through to a person; difficulty getting quick authorization for phone or home visit after an alert

*Nurses and nursing supervisor do not believe CCAC will authorize both a telephone visit and a home visit

*Hard to get CCAC authorization for 'monitoring' visits

*Possible compromises with CCAC: reduce regularly scheduled visits, automatic visit authorization for alerts

*Updated terminology for "CCAC Case Manager" is "CCAC Care Coordinator"

**Table 7 - Clinician feedback from usability testing**

*no longer applicable without CCAC involvement*

The majority of feedback received was targeted towards improving the utility and recognisability of content within the new tools. For instance, the alert email sent to nurses were modified to contain the client's name for identification (permitted because ParaMed's internal email system is secure), 14 days of previous measurements instead of 7 days (because the
interval between regularly scheduled visits is two weeks), and instructions for nurses to acknowledge receipt of the alert to the assignment coordinator. All of these points of feedback were implemented to improve the perceived usefulness and ease of use of the system by nurses; thus, improving clinician intention to use technology [42]. The updated alert email is seen in Figure 12.

![Alert email format v2.2](image)

**Figure 12 - Alert email format v2.2**

6.4 Summary

This phase resulted in the new study protocols and software systems being validated by ParaMed representatives to ensure alignment with their home care policies and overall system utility. The updated UHN telemonitoring system was also tested thoroughly in-house. All systems and study protocols underwent usability testing to confirm ease of use with all end users. Through this validation and testing:
• Numerous changes were made to the workflows, study protocol, and study documents to best align with ParaMed policies

• Several bugs were found and resolved after updating the telemonitoring application from the BlackBerry 8130 to the 8530

• The telemonitoring system was well-received by patients during usability testing with an average overall rating of 4.87/5 based on satisfaction and ease of use

• The buttons for "Yes" and "No" on the BlackBerry 8530 were moved further apart after usability testing revealed a risk of accidental button presses

• Minor changes were made to the workflows, study protocol, and study documents after usability testing with the ParaMed staff; the alert email was modified to contain more pertinent information (client's name, 14 days of measurements, and instructions to acknowledge receipt of the alert)
Chapter 7: User Acceptance Testing and Staff Training

7.1 Introduction

The integration of a telemonitoring system into home care necessitated the introduction of new software and new processes to ParaMed clinicians and staff. As such, User Acceptance Testing (UAT) of the new software and processes was required before moving to production and starting the study. UAT involves verifying that a new system meets the agreed-upon requirements and expectations. The software systems to be tested were: the client BlackBerry telemonitoring application (for capturing and transmitting measurements), the UHN servers (for alert triggering and forwarding), the updated CellTrak Portal (for receiving and displaying alerts), and the telehomecare website (running in a BlackBerry mobile web browser).

7.2 Methods

7.2.1 User Acceptance Testing #1

A series of test scenarios emulating real-world cases were created (Appendix M) to be performed with the end-users (ParaMed staff). The expected result was listed for each step and any deviations were recorded. The first scenario involved the clinician activating their account on the telehomecare website on their BlackBerry. The remaining scenarios worked through all the possibilities outlined in Workflow Case 1 - Telehomecare alert in CellTrak Portal (Appendix C). This involved the entire 'alerting chain' starting from a client triggering an alert in their home and finishing with a nurse completing a Home Visit Log because of the alert. It was necessary to ensure the alerts were being received and displayed properly in CellTrak Portal, that formatting was preserved when copy and pasting the alert into an email, and that the mobile website functions and displays properly on the nurses' BlackBerry phones.

The UHN servers, telehomecare website, and CellTrak Portal were hosted on their respective staging (testing) servers for the UAT. The ParaMed staff that were present included a Portal admin, an assignment coordinator, a nurse, a nursing supervisor, the care and services manager, and an applications support supervisor. Each staff member focused on the scenarios that pertained to them and the responsibilities that they would take on during the study; each scenario was colour-coded corresponding to the different staff roles (Appendix M).
7.2.2 User Acceptance Testing #2

The first session of User Acceptance Testing was performed on the new software systems introduced by the study. However, all testing was completed while these systems were being hosted on their respective staging (testing) servers. As such, before starting the study it was necessary to test the systems again on the final production servers.

For this second UAT, only the Portal admin and applications support supervisor were required to be present. An end-to-end test scenario was created to test all aspects of the system and to ensure the correct flow of data passing between the various systems. A new test client was created in Calipso and assigned a new client ID, and then alert-generating measurements were taken with the monitoring equipment. In the expected outcome, these measurements would generate an alert that passes through to the CellTrak Portal.

7.2.3 Training

The proper integration and acceptance of a telemonitoring system into a home care nursing ecosystem required adequate training of the clinical team [44]. For the study duration, staff members would have to take on many new responsibilities and learn new protocols. As defined in constraints B.3 and B.4, all staff would be trained to prevent lapses in coverage, especially during the night and weekend off-hours.

The staff required to attend training consisted of Portal admins, assignment coordinators, nursing supervisors, off-hours supervisors, and nurses (approximately 50+ RN's and RPN's). It was decided that a unified training presentation containing information for all staff members would be used instead of having separate presentations for each role. This was to ensure that all staff knew each other's roles and the entire scope of the study. It was estimated that 6 training sessions over 3 days were required to accommodate for varying staff availability.

The training sessions were held in the ParaMed Oshawa office. Comprehensive training packages were prepared, specific to each of the 3 key study roles (Portal admin, assignment coordinator, and nurse). The sessions took the form of a PowerPoint presentation followed by a period for questions, and lasted approximately one hour. Nurses were compensated at the same hourly rate that they receive when attending mandatory training sessions. The sessions occurred
during regular working hours; thus, the other home care staff were not compensated on top of their regular wage.

7.3 Results and Discussion

7.3.1 User Acceptance Testing #1

Through each step of the UAT, the expected results were attained. The only deviation occurred when copying an alert message from the CellTrak Portal into a new email in Outlook; the red font colour used to highlight alerts was not preserved. Fortunately, the bolding and underlining were preserved the alert was still well highlighted. Because of this, it was deemed acceptable that the red font colour did not persist.

While testing different scenarios, the ParaMed staff also had some additional feedback on the study protocol and software layout (Appendix N). The main change was to the summary page of the telehomecare website; it was updated so that alert ranges are shown in brackets underneath each measurement to be uniform with how alert ranges appear in CellTrak Portal. Both the full (Figure 12) and mobile (Figure 13) versions of the website were affected.

![Figure 13 - Telehomecare website after UAT changes](image-url)
User Acceptance Testing #2

UAT was performed with both an existing test client and a newly created test client. The new test client was successfully added to Calipso and to the telehomecare website. There were no difficulties transmitting measurements and generating alerts to the UHN telehomecare website. However, no alerts were being properly received and displayed in the CellTrak Portal. It was discovered that the issue originated from the client IDs. The client IDs used in the production version of CellTrak Portal are 11-digits long; this consists of a 5-digit location identifier for the ParaMed branch, followed by the usual 6-digit ParaMed ID. To accommodate for this, UHN's servers were modified to append the Oshawa branch identifier to each ParaMed client ID before it was sent to CellTrak. This change was deployed and complete testing was redone on the new and existing test clients; expected results were achieved during this second iteration.

Training

The first two training sessions were video recorded. This footage was edited and used to create a training video [58] and a frequently asked questions document (Appendix O). The video,
FAQs document, and training slides were posted online, password-protected, and shared with any staff members who could not attend a training session. To train the off-hours staff, who operate out of St. Catharines, off-hours supervisors were brought in to attend a session. Upon returning to St. Catharines, the supervisors trained the off-hours staff themselves, making use of the training material and online video.

The feedback from the ParaMed staff after the training sessions was mixed. The primary reaction was that the telehomecare system was a good idea and would be useful, but there were concerns about the additional workload being placed on the nurses. In response, the nurses were reminded that most of the study workflow was similar to their usual operations except that they will be asked to fill out extra forms and will have access to more client data.

The other major concern was regarding system malfunctions and liability. Following the model laid out by Schneider [27], it was reiterated that this is not a live monitoring system. The system has built-in redundancies and caching to help prevent failure events, but nurses should remind clients to always fallback on their usual practice when in doubt or facing difficulties and seek medical attention if they feel they need it. In emergencies clients should contact their doctor, go to the emergency department, or call 911.

One aspect of the study that received a positive response was the information that nurses would be compensated for performing telephone assessments. Normally nurses are not paid for performing this service; as such, telephone visits are not frequently performed. With the study emphasis on performing these remote visits and accessing client data in the field, nurses felt it was appropriate to receive compensation for these additional responsibilities outside their usual routine.

7.4 Summary

Findings from the UAT and training sessions showed:

- When copying an alert message from the CellTrak Portal into a new email in Outlook; the red highlighting font colour was not preserved. The bolding and underlining are preserved when copied over and the alert was still well highlighted
- The website (mobile and full version) format of displaying alert ranges and triggering information was modified to better match the appearance in CellTrak Portal
• The new software and processes met system requirements and produced the expected results.

• The client IDs used in the production version of CellTrak Portal are 11-digits long and include a 5-digit branch ID and the regular 6-digit ParaMed ID.

• All ParaMed staff required for the study were trained in-person or via the recorded training video.

• Nurse response to the study was mixed: they were concerned about the additional workload being placed on them in the study, but believed the additional telehomecare data would be useful, and were satisfied with the reimbursement for telephone visits.

• This perceived usefulness and positive attitude regarding visit compensation should predict high intention to use the system despite unwelcome additional workload [38].
Chapter 8: Experimental Evaluation

8.1 Introduction

The ultimate objective of this project was to evaluate the feasibility and efficacy of a telemonitoring system on CHF management in a home care nursing setting. A pilot study was implemented with the purpose of examining the practicality of deploying such a care delivery system on a smaller scale before possibly proceeding with a larger future deployment.

8.2 Methods

8.2.1 Study Design Overview

A pilot study using the telehomecare system was run out of the Oshawa office of ParaMed Home Health Care. The goal was to recruit a convenience sample of approximately 10-15 CHF clients, provide them with the telemonitoring equipment, and enroll them in telehomecare for 3-4 months. The Oshawa location was chosen for a few reasons: upon initial review, Oshawa had one of the higher numbers of CHF clients; the ParaMed corporate director in charge of the study had a good relationship with the Oshawa care and services manager; the Oshawa branch had previous experience with research studies; and the Oshawa office had a strong relationship with the local CCAC (Central East). This last point aligned closely with the original intention of partnering with the CCAC for client referral. However, by the time the study team received confirmation that the CCAC would not be involved with the study, enough coordination and setup had already been completed to warrant continuation with the Oshawa location. Without CCAC partnership, study participants were brought onto ParaMed home care service as private clients and any visits performed by the nurses would be paid for by the study budget. The new bill rate for telephone visits at half the rate for home visits (constraint B.2) was also paid for by the study.

8.2.2 Physician Recruitment

Physician involvement was a required component of the study for patient recruitment, setting and adjusting weight ranges, and for clinical decision-making when requested by the nurses. Physicians in the Oshawa area were identified by cardiologists at UHN and by the ParaMed care and services manager. The secretaries of the physicians were called and an introduction letter to the study was faxed or emailed to the physicians along with a document containing study
responsibilities (Appendix H). Interested physicians were asked to respond to the study coordinator by phone or email.

8.2.3 Study Participant Eligibility and Recruitment

Potential study participants were identified by the involved physicians and forwarded to the study coordinator. The inclusion criteria for eligible participants was the following: English-speaking individuals with a diagnosis of congestive heart failure; New York Heart Association (NYHA) Class II or higher; over 18 years of age; not already on home care services or any other CCAC services; residing in the Oshawa area; and able to perform self-measurement tasks (e.g. use a weight scale, blood pressure monitor, and mobile phone). Clients who were younger than 18 years of age or deemed unable to comply with remote monitoring (e.g. due to vision problems, unable to read English, lack of manual dexterity to accurately press the buttons on a mobile phone, or decreased cognitive function such as advanced memory loss) were excluded.

As many participants as possible were recruited over the first two months of the study. However, this number was limited by the number of interested physicians and the size of the client population meeting the inclusion criteria. The clients that met the inclusion criteria were asked by their physician if they would be willing to speak to the study coordinator to further discuss the study. If the client agreed, they were contacted over telephone by the study coordinator.

Consent was obtained verbally over the telephone. Following consent, the clients underwent a short pre-study interview with questions regarding their current heart failure condition and how it is managed (Appendix P). Consenting participants were brought onto home care as private clients and assigned to a home care nurse. A detailed workflow on the recruitment of a new study client is shown in Appendix C: Case 5.

8.2.4 Study Protocol

Current Standard of Care

The current standard of care for CHF clients of ParaMed is to receive home nursing visits once every two weeks, depending on the client's condition and the nurse's discretion. During a visit, the nurse plays a more supportive role involving teaching and reinforcing that the client is managing their own disease. The nurse will check various vital signs including blood pressure,
chest auscultation, and assessing for peripheral edema. Nurses will also assess the client's nutritional status, ask them about any symptoms (e.g. swelling, shortness of breath), how they are managing their activities of daily living, and adherence to medications, diet, and exercise.

**Intervention**

**Admission into the Study**

Study participants were provided with regular scheduled home visits from a nurse once every two weeks and telephone assessments as needed. Clients received the telehomecare equipment in the mail prior to their first visit along with instructional documents. A consent form and pre-study questionnaire were also mailed to the client but in a separate package to prevent any undue coercion if the consent form and equipment were packaged together.

During their first home visit, clients were provided with an individual training session from their nurse on how to use the equipment. The nurses also performed an initial admission assessment of the client to confirm their suitability for the study. The initial admission assessment and follow-up monthly reassessments are standard ParaMed procedures that involve asking the client questions about their functional status, activities of daily living, symptoms, etc. These questions are part of the HOBIC measures (Health Outcomes for Better Information and Care) developed by the Ontario Ministry of Health and Long-Term Care. Nurses enter the client's answers into eOBC on their BlackBerry phones. A detailed workflow on the initial admission assessment of a new study client is shown in Appendix C: Case 7.

**During the Study**

During the study, clients could view their own measurements on the provided mobile phone and home care nurses could view their clients' measurements through the secure telehomecare website. Both clients and clinicians were alerted if the client’s measurements were outside their target range. Clients received a feedback message on their mobile phone that corresponded to the different alert types (Table 2). If it was a 911 critical alert, they also received an automated telephone call informing them to call 911. Clients were also sent an automated adherence phone call if they do not take their daily measurements. If nurses determined that a client was gaining or losing natural weight not related to their CHF, they made a request to the client's PHCP (family doctor, cardiologist, nurse practitioner, etc.) for a weight range adjustment (Appendix C: Case 10).
Receiving Alerts
Clinicians received alerts by email; these alert emails contained the client's identifying information, the last 14 days of measurements along with any alerts, and a link to the telehomecare website to view the client's entire history of measurements (Figure 12). The procedure to follow when nurses received an alert is outlined in Appendix C: Case 1. After receiving an alert, often a telephone assessment was performed, which had to be authorized by the nursing supervisor first. After a telephone visit was completed, a Telephone Advice Form (Appendix D) was filled out to track clinical outcomes. If an extra home visit was deemed required, this was also authorized by the nursing supervisor. After any home visit, a Home Visit Log was completed (Appendix E) to track the purpose of the visit. This procedure and workflow was modelled off the successful home care telemonitoring implementation described by Schneider [27].

End of the Study
At the end of the study period, all client participants will be asked to mail back the telehomecare equipment and will be discharged from ParaMed home care. As part of this process, nurses must arrange a discharge plan for their clients ahead of time; they must also conduct a discharge assessment of the client looking at the same HOBIC measures as during the initial admission assessment. The workflow for study discharge is described in Appendix C: Case 9. Following discharge, clients will be asked to complete a post-study questionnaire (Appendix S) and both clients and ParaMed staff will be contacted for an interview regarding their use and opinions of the telehomecare system (Appendix Q).

8.2.5 Evaluation
As this is more of a feasibility study than a clinical trial, a mixed-methods research strategy was taken and the outcome measures to be examined are varied. After the study, data will be collected from questionnaires, log forms, and post-study interviews. An evaluation matrix was produced to summarize all outcome measures of the pilot study (Appendix T).

Outcome Assessment: Client-End
Each consenting participant was mailed a pre-questionnaire to fill out at the time of enrolment into the study (Appendix R). This questionnaire was modelled closely off that used in a
previous study [46] and consisted of demographic and heart failure questions, initial thoughts on home monitoring, and questions from two established heart failure metrics: the Self-Care of Heart Failure Index (SCHFI) and the Minnesota Living with Heart Failure Questionnaire (MLHFQ). The SCHFI is a validated [59] self-report measure comprised of 22 items rated on a 4-point response scale and divided into 3 subscales (self-care maintenance, self-care management, and self-care confidence). It focuses on indicators of self-care (best represented by maintenance and management) and the effect that this self-care has on outcomes (represented by confidence) [60]. The MLHFQ is a validated [61] self-report measure consisting of 21 questions rated on a 5-point response scale. The MLHFQ focuses on the effect of heart failure on the physical, emotional, social and mental dimensions of quality of life [62] and has been used in several heart failure telemonitoring trials [13][14]. At the end of the study, participants will be mailed a post-study questionnaire (Appendix S) that is similar to the questionnaire given at the time of enrolment, and will include the SCHFI, the MLFHQ, and their thoughts on the telehomecare system. The results from the SCHFI and the MLFHQ will be compared between pre-study and post-study, focusing on any changes in these self-care and quality of life indices.

Clients in the study will undergo monthly assessments incorporating the HOBIC measures for home care. The HOBIC initiative was developed by the Ontario Ministry of Health and Long-Term Care to provide high-quality, standardized measures of the impact that professionals such as nurses have on health outcomes [63]. For data analysis purposes, changes will be examined between the initial admission assessment and the discharge assessment.

Consenting participants were also subject to a short pre-study interview with questions regarding their current heart failure condition and how it is managed (Appendix P). At the end of the study, participants will be interviewed again to determine their experiences regarding quality of life, degree of self-management, ease of use of the system, the need for home visits versus telephone visits, and whether they would feel comfortable reducing the number of home visits in favour of more telephone visits (Appendix Q). Participants will also be asked to self-report any hospital visits to determine any differences in hospital readmission rates, length of hospital stay, and number of ED visits. Additional participants will be interviewed until saturation of information or all clients have been approached. Both pre- and post-study interviews will be audio recorded. The interview data and transcripts will be reviewed for
emerging themes using the qualitative data analysis software NVivo, focusing on pre- and post-study differences.

As a final point of data collection, a historical chart review of past ParaMed clients will be performed to determine statistics surrounding discharge, mortality, and home care visits as a point of comparison for data collected during the study. The chart audit will include clients as similar to those in the study as possible: i.e. CHF-diagnosed clients, serviced by the Oshawa ParaMed nurses, during the same time period one year prior (May 2012 - November 2012). Measured parameters (weight and blood pressure) will also be examined pre- and post-study, and then compared to past clients from the chart audit.

All quantitative data, including questionnaire (SCHFI/MLFHQ) results, self-reported hospital records, measured parameters (weight and blood pressure), assessment (HOBIC) outcomes, and chart audit figures around mortality and service delivery will be analyzed using the statistical analysis software SPSS.

Outcome Assessment: Clinician-End
Qualitative data will be collected throughout the study from home care nurses. Their use of and experience with the telehomecare system will be evaluated as they deliver care to their clients through telephone and home visits. The modified Telephone Advice Form (Appendix D) captures valuable information immediately following a telephone visit relating to the usefulness of having access to telehomecare data in the field and whether it helped eliminate the need for a home nursing visit. The Home Visit Log (Appendix E) captures the reason for each home visit, the usefulness of having telehomecare data when seeing a client, and whether the home visit could have been replaced with a telephone assessment. From both log forms, nurse perceptions surrounding the value of home visits versus telephone visits with telemonitoring data will be explored.

Additionally, the home care nurses who used the telehomecare system will be interviewed to determine their experiences. This will include questions (Appendix Q) regarding the utility and general impressions of the system, the need for home visits versus telephone visits, and whether they would feel comfortable reducing the number of home visits in favour of more telephone
visits. These interviews will be audio recorded and reviewed along with feedback from the log forms for emerging themes using the qualitative data analysis software NVivo.

8.3 Results and Discussion

Ethics approval was received from the UHN REB to proceed with this pilot study (# 12-0525-AE) on October 22, 2012. An amendment to the original application was also approved by the UHN REB on February 23, 2013 for the changes described in constraint B.1 resulting from the CCAC no longer being involved in the study.

Physician Recruitment
Effort was made in recruiting both Oshawa family physicians and cardiologists. Local family physicians were contacted by the ParaMed care and services manager and were faxed introduction letters to the study. Similarly, a shortened introduction letter was faxed by UHN cardiologist, Dr. Ross, to some of her Oshawa-based colleagues. Interested physicians were asked to RSVP to the study coordinator by phone or email.

Ultimately, there was little response from the faxed physicians even after follow-up by the care and services manager. Fortunately, one Oshawa-based cardiologist did express great interest in being involved with the study after being referred directly to the research team by another UHN cardiologist. There may be several causes for low physician interest in the study. It is reasoned that had the initial point of contact and introduction to the study been more direct, the response rate may have been much higher. This may have taken the form of personal emails or phone calls to specific physicians with an identified interest in research. Similarly, it may have been more effective to target a small group of physicians versus sending out a mass invitation. Learning from the successful recruitment case of the Oshawa cardiologist, an effective course of recruitment involves a physician being directly referred by a colleague (in this case over email), proceeded by an enthusiastic, knowledgeable follow-up call from one of the research team members.

Client Recruitment and Attrition
Study participants were recruited through the Oshawa cardiologist from his/her existing patient list. After finding a suitable patient and asking the potential participant if they wanted to speak to the study coordinator, the Oshawa cardiologist passed any interested patients’ contact
information to the study team. The study coordinator then followed up with the patients to provide further study information and to obtain verbal consent. All patients that were forwarded by the Oshawa cardiologist were successfully consented and recruited into the study. At the maximum, there were six study clients simultaneously using the telehomecare system and receiving home care from ParaMed nurses. Due to delays in software development, recruitment, and other unforeseen changes, study clients did not begin using the system until late May 2013. Consequently, the study team decided to extend the length of the study period to November 2013 in order to obtain more meaningful results and to reach client recruitment goal (10-15). Interim data would be examined in August with a second phase of recruitment occurring in September. Unfortunately, three of the recruited clients have since dropped out of the study. The probable factors contributing to these clients leaving the study are summarized in Table 8.

<table>
<thead>
<tr>
<th>Client's Duration of Participation</th>
<th>Contributing Factors for Leaving the Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 24 - July 9 (16 days)</td>
<td>Is currently in his/her 40's and working full-time from 6AM to 6PM (commuting to Toronto); too tired after work to want a home visit from a nurse</td>
</tr>
<tr>
<td></td>
<td>Client's spouse is a nurse, so the client already feels like he/she is in good hands at home</td>
</tr>
<tr>
<td></td>
<td>Stated that it was too hard to get a hold of the nurse: had to call the ParaMed office, which then emailed the nurse, then he/she had to wait for the nurse to return their call</td>
</tr>
<tr>
<td></td>
<td>Did not pick up calls from the nurse because the phone number was listed as &quot;private&quot; on their caller display</td>
</tr>
<tr>
<td></td>
<td>Received two 'Critical 911' alerts (including automated phone messages) within the first week by mistake; these automated phone messages advising the client to call 911 were concerning to both client and spouse, especially since he/she felt fine. These mistaken alerts occurred because an incorrect weight range target was provided by the physician and this client's blood pressure is always low (high weight with low blood pressure triggers a critical 911 alert).</td>
</tr>
<tr>
<td></td>
<td>Had minor Bluetooth connectivity issues with the blood pressure monitor occasionally failing to send results to the provided mobile phone</td>
</tr>
<tr>
<td></td>
<td>Wants to enjoy the summer without having home visits and taking measurements</td>
</tr>
<tr>
<td>June 19 - July 24 (36 days)</td>
<td>Client's physician notes that he/she has psychological/coping issues: recently diagnosed with end-stage heart disease; is young (in 30's) with a young child and significant other</td>
</tr>
<tr>
<td></td>
<td>Client has his/her own business and is working full-time</td>
</tr>
<tr>
<td></td>
<td>Has consistently high weight but does not want to adjust diet, despite nurse advice and education. Physician does not want to adjust weight range target because the client is overweight (fluid overload); thus, client...</td>
</tr>
</tbody>
</table>
and nurse were both receiving alerts everyday.
There is confusion among the covering/off-hours staff: they are not familiar with this client and don't know that the client triggers alert everyday; consequently, they are calling the client repeatedly. Ordinarily, the core daytime staff will triage the alerts accordingly.

Does not answer phone calls directly: always lets phone calls go to voicemail. Client rarely returns phone messages; as a result, the client receives many phone messages from the nurses requesting a reply. From the nurses' perspective, they do not know whether the client is choosing not to respond or has fainted (or worse); thus, the lack of communication is very unsettling for the nurses.

Prior to leaving the study, this client was adhering closely to the prescribed protocol: taking measurements every morning.

Prior to the client leaving the study, the primary nurse was in the process of attempting to increase regular home visits to once per week (from once every two weeks) to better care for the client.

Client cites that he/she was not able to keep up with the frequent nursing visits, and felt a little overwhelmed by all the phone messages. Client's physician believes that he/she is having a difficult time accepting their illness, and the visitation from the nurses is a constant reminder of their disease.

May require care and services beyond that available in home care: was referred by the cardiologist to a psychiatrist to help manage the psychological aspect of heart failure. Moving forward, this client will receive specialist palliative care from the psychiatrist and specialist clinical care from the cardiologist.

Client was in the hospital for over a week, for undisclosed reasons, prior to leaving the study. Upon returning home, client felt like they were too weak to continue doing the measurements in the morning.

Has had negative experiences with other home care nurses prior to the study: cultural differences - nurses refusing to remove their shoes before entering the house; when that happened, the client asked the nurse to leave.

Client is in his/her 60's and has a large family living in the same house: sons, daughters, and possibly grandchildren. Nurse home visits/telephone calls may have been intrusive or disruptive for the other members of the household. Client asked nurse not to call before 10AM because it was waking up his/her family members.

Prior to leaving the study, this client was adhering closely to the prescribed protocol: taking measurements every morning and triggered almost no alerts.

**Table 8 - Factors contributing to client attrition**

When examining the factors described in Table 8, there are some commonalities between the clients who chose to leave the study:

- Two of three clients are still working full-time

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• These clients are relatively young: in their 30's, 40's, and 60's
• Three of three clients are living with their family (3 or more members)
• Three of three clients had troubles early on (e.g. false critical 911 alerts, issues returning phone messages, or prior conflict with home care nurses)

These commonalities become even more apparent when comparing to the clients who are still in the study (Table 9). The factors that seem to strongly influence client attrition in the study are employment status, age, size of household, and early experiences with the home care nurses and the telehomecare system.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Clients who withdrew (total: 3)</th>
<th>Clients remaining (total: 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment Status</td>
<td>• Working full-time (2/3)</td>
<td>• Retired/not working (2/3)</td>
</tr>
<tr>
<td>Age</td>
<td>• Younger (30's, 40's, and 60's)</td>
<td>• Older (50's, 70's, and 80's)</td>
</tr>
<tr>
<td>Size of Household</td>
<td>• 3 or more family members (3/3)</td>
<td>• 2 or less family members (2/3)</td>
</tr>
<tr>
<td>Early Experiences</td>
<td>• Various issues (3/3)</td>
<td>• No issues (3/3)</td>
</tr>
</tbody>
</table>

Table 9 - Common factors for attrition

Moving forward with a second phase of recruitment, it would be pragmatic for the study team to take these factors into consideration when screening potential study participants. Despite meeting the core inclusion criteria, those individuals who are younger, still working, and have a family appear to be "too busy" to properly benefit from the telehomecare system. It should be noted that with the core inclusion criteria, all of the recruited clients were not on any CCAC services when they entered the study and were referred by their cardiologist. This indicates that these individuals are already quite independent (not requiring home care services) and being clinically managed by a heart failure specialist. The clients that would benefit most from the daily self-measurement, home nursing visits, and telephone calls of the telehomecare system would be those with heart failure who are not as independent or properly managed. This would include individuals that do not have a cardiologist (or even a family physician), have been recently hospitalized for heart failure, did not qualify for home care, and are at the highest risk for readmission.

Interim Feedback
As mentioned previously, the study duration for this pilot was extended to November 2013 and at the time of this writing is still ongoing. As such, any feedback gathered thus far from nurses and clients using the telehomecare system was gathered informally. However, these interim comments will prove valuable in determining whether any changes need to be made moving forward and as an indication of what to expect in the final results. This feedback is described in Table 10. It can be seen that half of the clients have experienced appreciable weight loss during the study. One client reported seeing reduced edema in his/her legs and began wearing shorts again because he/she was no longer embarrassed of swollen legs. Overall, the clients had varying responses to the clinical education provided by the nurse with some taking the advice to heart and applying it immediately, with others ignoring it outright. Similar to previous study findings [27], one benefit that all clients appeared to take away from the study was being able see directly the effect their lifestyle choices had on their physiology. For example, multiple clients recognized the effect of eating takeout food or skipping diuretics on the following day's measurements according to client self-report and nurse feedback.

From the nurses' perspective, the telehomecare system provided a means of catching clinical events before they occurred, in the form of alerts. Even more than this, it provided a means of identifying instances of improper behaviour by the clients and the opportunity for immediate clinical education and reinforcement as evidenced in Table 10. However, nurses did run into a few difficulties with the system. Some nurses had clients that alerted everyday; it was clear that telehomecare was not suitable for all clients. For example, the default alert ranges did not work in some participants: clients who had constant low blood pressure triggered alerts everyday, and heavier clients easily fluctuated more than 3 pounds from day to day. Nurses also reported that it became difficult to address alerts properly when they were unable to reach some of the clients. The delivery of care did not work for those younger individuals who worked full-time. Any telephone or home visits during the day failed with clients who had already left for work. To receive regularly scheduled home visits, working clients would have to take a day off or schedule the visit during the night - an undesirable situation for both client and nurse. To address these issues, either the intervention needs to be tailored to specific individuals' needs or, more feasibly, there needs to be greater discretion when selecting study participants. As mentioned previously in Client Recruitment and Attrition, additional screening when recruiting clients into the study appears to be an important step towards preventing attrition and promoting compliance.
Another restriction pointed out by nurses was having only one physician contact. With the cardiologist having limited office hours and no answering machine, often the nurses were unable to obtain clinical instructions, especially on the weekends. Their best alternative was to fax the physician clinical update forms and follow-up for a response. The ParaMed nurses felt that it was unsafe for service to occur without a physician available for stretches of time. In the next phase of recruitment, it would make sense for a second physician (the client's family physician) to be involved with the study and informed about setting weight range targets. Family physicians could become the primary points of contact for nurses as they have longer office hours and better coverage.

### Nurse/Client (enrolment status) Feedback / User Stories

<table>
<thead>
<tr>
<th>Nurse/Client (enrolment status)</th>
<th>Feedback / User Stories</th>
</tr>
</thead>
</table>
| **Client (still in study)**     | • Has been following nurse's advice: drinking less sugared drinks, spouse is looking for reduced sodium soup, popcorn, and nuts, is raising his/her legs after playing golf  
• Triggered a low blood pressure alert - nurse advises that this is likely because he/she took a water pill and drank no water the previous day; nurse educates that this is dangerous because it could cause him/her to faint  
• Has lost weight and greatly stabilized weight since coming on to the study: was fluctuating between 174-180 lbs initially and is now stable at 171-172 lbs  
• Used to not wear shorts while golfing because he/she was embarrassed about his swollen legs; nurse reports that he/she is now wearing shorts  
• Has had Bluetooth connectivity problems between blood pressure monitor and provided mobile phone (technical support performed over phone by study coordinator)  
• Has had minor issues with navigating the mobile application and correctly taking readings (re-education performed over phone by study coordinator) |
| **Client (still in study)**     | • Has been relatively stable since the start of the study; triggers very few alerts  
• Occasional high weight alerts: after nurse follow-up, every alert was because client was having guests over or travelling so did not take a water pill because he/she did not want to urinate frequently; weight spiked the next day. Client saw the immediate, direct effects of not taking a water pill - nurse advises client to adhere to prescribed frequency and not skip water pills. |
<p>| <strong>Client (still in study)</strong>     | • Has lost a significant amount of weight since starting the study: initially around 269-272 lbs, has reduced to 253-256 lbs recently. Weight loss attributable mainly to the client returning to work (outside) and sweating |</p>
<table>
<thead>
<tr>
<th><strong>Client (dropped out of study)</strong></th>
<th>• Lost weight through the study: initially around 188-190 lbs, reduced to 182-183 lbs upon leaving the study</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nurse</strong></td>
<td>• Is frustrated that one client (who has since left the study) does not answer phone calls, always lets calls go to voicemail, and rarely returns phone messages. Nurses do not know whether the client is choosing not to respond or has fainted at home (or worse)</td>
</tr>
<tr>
<td></td>
<td>• Is discouraged that same client triggers weight alert every day and is unresponsive to clinical advice; physician will not adjust the weight range because the client is in fluid overload/overweight</td>
</tr>
<tr>
<td></td>
<td>• Because of everyday alerts, the primary nurse put a note for the office staff to ignore the client's alerts when she is on vacation. Client then triggered a critical 911 alert (fainting), caught by the study coordinator who informed the care and services manager who removed the note to ignore alerts; the critical 911 alert was a false alarm</td>
</tr>
<tr>
<td></td>
<td>• Client had a critical event that caused him/her to stop driving and pull over - the client ate lots of takeout food the previous night and weight spiked 8 lbs. This &quot;wake-up call&quot; persuaded the client to be more receptive to the nurse during the next home visit and was educated on salt intake and physiology. After being informed, the physician wants him/her to stop taking &gt;80 mg lasix water pills/day</td>
</tr>
<tr>
<td></td>
<td>• After the critical event and prior to this client leaving the study, the primary nurse took a more positive approach: nurse was going to call the client whenever he/she lost weight for encouragement and increase the regularly scheduled visits to once a week</td>
</tr>
<tr>
<td></td>
<td>• Has a client (who has since left the study) with a blood pressure that is regularly low, below the preset blood pressure ranges; with the study protocol, these blood pressure ranges cannot be changed. Thus, this client triggers blood pressure alerts almost everyday.</td>
</tr>
<tr>
<td></td>
<td>• Client is difficult to reach and schedule home visits because he/she is working full-time</td>
</tr>
<tr>
<td></td>
<td>• Nurse comments that he/she is getting alerts everyday for 2 of her clients; it is disruptive because the nurse has to stop what he/she is doing (e.g. driving), check the alerts, call the alerted client immediately and fill out the forms, which delays his/her whole day of scheduled clients</td>
</tr>
<tr>
<td></td>
<td>• Nurse comments that the reimbursement received for telephone visits may not be sufficient for the amount of time he/she spends addressing alerts</td>
</tr>
<tr>
<td></td>
<td>• Nurses comment that it is very difficult to get hold of the PHCP; the physician does not have an answering machine and has limited office hours (3 days/week); some nurses have resorted to faxing clinical update forms</td>
</tr>
<tr>
<td></td>
<td>• Nurses comment that the off-hours staff do not manage alerts as well; their response to alerts may be delayed or they may even miss alerts</td>
</tr>
</tbody>
</table>

Table 10 - Informal feedback from nurses and clients
Interim Results

To explore any interim results of the study, all Home Visit Logs (Appendix E) and Telephone Advice Forms (Appendix D) that were completed up to August 13 were collected from the nurses and examined. A summary of the nurses’ responses to the system and some of the study questions are shown in Table 11 and Table 12. On the Home Visit Logs, nurses rated the telehomecare data as useful during every visit; the only exceptions were during initial home visits when there was no data available. Nurses reported checking the telehomecare data more often during than before a visit. In one case, a nurse described that a home visit could have been replaced by looking at the telehomecare data alone; in the nurse's clinical notes, she commented that the client was stable and did not require the regularly scheduled home visit. In all other cases, the nurses reported that the home visit was necessary. It was also noted that there was a large discrepancy in the number of billed home visits (25) and the number of Home Visit Logs (16) that were filled during the examined time period. This indicates an area that needs reinforcing during nurse education to ensure comprehensive data collection: nurses are required to complete a Home Visit Log after every home nursing visit performed.

<table>
<thead>
<tr>
<th>Feature/Question</th>
<th>Nurse Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>This home visit could have been replaced by a:</td>
<td>• 0% (0/16) - Telephone assessment with telehomecare data</td>
</tr>
<tr>
<td></td>
<td>• 0% (0/16) - Telephone assessment alone</td>
</tr>
<tr>
<td></td>
<td>• 6% (1/16) - Telehomecare data alone</td>
</tr>
<tr>
<td></td>
<td>• 94% (15/16) - This home visit was necessary</td>
</tr>
<tr>
<td>I looked at the telehomecare data:</td>
<td>• 25% (4/16) - Before the visit</td>
</tr>
<tr>
<td></td>
<td>• 44% (7/16) - During the visit</td>
</tr>
<tr>
<td></td>
<td>• 19% (3/16) - Both before and during</td>
</tr>
<tr>
<td></td>
<td>• 13% (2/16) - Neither (did not use) - both cases because of initial visit</td>
</tr>
<tr>
<td>The telehomecare data was:</td>
<td>• 81% (13/16) - Useful</td>
</tr>
<tr>
<td></td>
<td>• 0% (0/16) - Not useful</td>
</tr>
<tr>
<td></td>
<td>• 19% (3/16) - Neither (did not use)/No response - all 3 cases because no data was available yet</td>
</tr>
</tbody>
</table>

Table 11 - Interim results from Home Visit Logs
With the Telephone Advice Forms, 33 forms were received from the nurses. In all cases, the nurses made the telephone assessment as a result of an alert (23-0) and they felt that the telehomecare data was useful in assessing the client over the phone (23-0). In all but one case, the nurses believed the telehomecare data helped eliminate the need for a home nursing visit (20-1). It was also noted that on several forms the study questions were left unanswered; from examining the clinical notes, this occurred primarily when the nurse was unable to reach the client and thus did not assess the client over the phone.

<table>
<thead>
<tr>
<th>Telephone Advice Forms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total # filled out: 33</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Feature/Question</th>
<th>Nurse Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was this telephone assessment a result of a telehomecare alert?</td>
<td>23 - Yes</td>
</tr>
<tr>
<td></td>
<td>0 - No</td>
</tr>
<tr>
<td>Was the telehomecare data useful in assessing the client over the phone?</td>
<td>23 - Yes</td>
</tr>
<tr>
<td></td>
<td>0 - No</td>
</tr>
<tr>
<td>Do you think the telehomecare data helped eliminate the need for a home nursing visit?</td>
<td>20 - Yes</td>
</tr>
<tr>
<td></td>
<td>1 - No</td>
</tr>
</tbody>
</table>

Table 12 - Interim results from Telephone Advice Forms

8.4 Limitations

Manual Processes

The processes surrounding receiving and acknowledging alerts in this study were very manual and error-prone. For instance, to get telehomecare alerts from the client in their home to the nurse in the field, alerts had to pass through two electronic systems (UHN and CellTrak Portal) and two different people (the Portal admin and assignment coordinator) before finally arriving at the nurse. Without the time to develop automatic forwarding, this 'alerting chain' was necessary; however, as a manual process it was found to introduce user errors and delays at multiple points. Any larger scale implementation would require the development of software systems to automate the forwarding processes currently handled by staff members.

Participant Numbers

One of the main limitations in this study is the low participant numbers. The number of CHF clients referred to home care is quite low and it is unknown whether the target convenience sample of 10-15 individuals will be reached. These low participant numbers reduce the statistical significance of any findings and remove the possibility of a control group, as there
simply are not enough participants to support dividing the study group in half. The lack of a control group limits comparisons to pre- and post-study and current study values to data from a historical chart audit. Expanding the study area to the surrounding Durham region to increase the population pool would be a logical next step.

**Varied Study Duration**

Related to low participant numbers is the varied duration that some of the participants have been using the system. Because of the wide recruitment window to achieve at least 10-15 participants, some patients may be on the system for up to 6 months whereas some will be on for as little as 3 months. It would make sense to normalize any collected data to a fixed time period and/or discharge clients from the study after a set time period.

**Participant Training**

The distance between the research team (Toronto) and the study location (Oshawa) made the training of participants challenging. In previous studies with the UHN telemonitoring system [46], training was performed in-person between the participant and research staff to maximize knowledge transfer and study engagement. In the current project, the remote nature of participants necessitated that training was performed by the nurses during a home visit. This proved to be problematic as the nurses only received minimal training themselves (one training session/video) due to the sheer quantity of nurses requiring training. It was noticeable during the study that there were lapses in training with several participants forgetting to take symptoms daily or forgetting how to complete other measurement procedures. If nurses are to be performing participant training and advocating the use of the system, they need to be better trained and motivated. A small, specialized clinical team with more comprehensive training should be targeted in continuing and future studies.

8.5 **Summary**

Interim findings from the experimental evaluation showed:

- There is difficulty recruiting physicians to be involved with the study without existing buy-in. For future recruiting, it makes sense to target a smaller group of physicians in a personalized manner and/or have physicians referred to the study by colleagues
- Study participant recruitment has been low. Additional physicians and/or sources of eligible participants need to be pursued
• Study participant attrition has been high. Some of the factors that appear to influence client drop out are employment status, age, size of household, and early experiences with the home care nurses and telehomecare system

• Overall response to the telehomecare system from both nurses and clients has been encouraging: several clients are seeing positive effects (weight loss, self-management); nurses report using the system as a tool for detecting clinical events and opportunities for re-education

• Nurses report using the telehomecare data consistently and that it is useful in almost all cases; the primary nurse criticism has been the difficulty they are having reaching certain clients and contacting the primary physician

• There are several limitations intrinsic to this study including error-prone manual processes, low participant numbers, varied study enrolment duration, and participant training
Chapter 9: Conclusions and Recommendations

There exist clear challenges in designing and implementing a telemonitoring system into home care. The nature of home care organizations is complex; their internal regulation and governing protocols form intricate constraints. To integrate the telemonitoring system, the research team was required to learn and understand these protocols in detail. Despite the obstacles faced in designing and implementing a telehomecare system, the interim results from this study do show promising outcomes. Several of the study clients have lost weight or stabilized. From client and nurse feedback, clients are becoming more self-aware of the effect that their actions and diet have on their body and physiological measurements. By becoming more involved in managing their disease process, they should be more knowledgeable and better able to manage their disease following discharge from home care [27]. From the study log forms, nurses are showing an overall positive response to telehomecare. The system allows them to identify clinical events quickly and provides the opportunity for immediate education following the event, which is in line with findings from the WHARF trial [14]. A study by Wootton et al. predicted that up to 45% of home nursing visits could be done by telemedicine [64]. Thus far, nurses have also reported one case where the telehomecare data could have replaced a full home nursing visit. Most of these positive effects were displayed by the cohort of clients that remain in the study, while those that chose to leave the study did not produce the same effects. The benefits of telehomecare are promising but they are dependent on finding the right users that will benefit the most from the system.

The Technology Acceptance Model can be used to explain the acceptance and use of the telehomecare system by the home care nurses thus far. The home care nurses consistently rated the telehomecare data as useful after both telephone and home visits but were reluctant about additional workload. According to Davis' original model, an individual's intention to use a system is determined by both their attitude towards it and the impact it may have on his/her performance (perceived usefulness) [38]. Therefore, even though the nurses did not welcome the additional workload of the telehomecare system, they still used it because they perceived that it was useful and would improve their performance at work.

Future Work
With the continuation of this study, several of the issues encountered so far will be addressed. The challenge that the nurses are having reaching the clients’ cardiologist for clinical action will be reduced by introducing clients’ family physicians into the study. Often in telemonitoring systems, introducing a second physician is a required component of providing adequate coverage, especially on weekends and holidays [14]. These GP’s will become the primary points of contact for nurses as they have longer office hours and better coverage. To increase study enrolment and to target individuals who would most benefit from telehomecare, the study area will be expanded to the entire Durham region. Flyers will be posted in physician offices and other common areas including pharmacies and community centres to allow eligible individuals to self-identify. The team will also redouble efforts towards recruiting other family physicians and cardiologists in the area. Recruiting physicians to be involved with this study or any study where physicians are not the central clinicians has shown to be challenging. More success was seen in this study when targeting a small group of physicians with a pre-identified interest in research versus distributing a mass invitation to all physicians in the area. Furthermore, it is advisable for the first point of contact to be a personalized email, phone call, or referral from a colleague with adequate follow-up. Previous studies have shown success with clients referred from inpatient wards or intensive care units following acute hospitalization [18]. Thus, the emergency departments of regional hospitals including Rouge Valley and Lakeridge Health will also be approached for potential collaboration.

**Recommendations**

The interim results from this research have implications on any studies looking to implement telemonitoring technologies into home care. As described in the TIM-HF trial, telemonitoring and home care may not be appropriate for all HF patients [65]. This study has shown that employment status, age, and size of household influence telehomecare compliance. As in the study by Juretic et al. [33], negative early experiences with the system or home care intervention also predicted attrition. Improved participant response could be attained with additional screening or adjusted inclusion criteria that considers functional independence and employment status.

At the core of any home care implementation are the nurses; the need for nurse and staff buy-in for successful implementation of technology cannot be overlooked [44]. Accordingly, it makes more sense to engage a smaller group of home care staff for a study as in Schneider's
implementation [27] versus trying to involve all employees. A small, dedicated study team can be better trained and motivated, and will avoid the logistical issues seen in this study when engaging an entire branch of 60+ staff members. It would be even more beneficial if this team were specially trained in cardiac care to better recognize the signs and symptoms that lead to CHF exacerbation [13]–[15], [27]. Utilizing untrained staff and nurses leads to an inefficient layering of clinicians who lack the experience or mandate to make clinical decisions; in a telehomecare model it is crucial to avoid using nurses as simply an intermediary for reporting patient symptoms and alerts to a physician. As in Cleland et al. [15], specialized nurses are able to take an active role in client heart failure care: giving short-term advice and changes in therapy, or working through a patient’s physician for long-term therapeutic changes when needed. Furthermore, from the comments that arose during this study, financial compensation remains a strong motivator for home care staff to take on new responsibilities or learn new procedures. With a small, specialized study team, this would also be more manageable. Additionally, the need for compensation may not even be necessary if the new technology elicits a sense of pride in the individuals chosen to be part of the study team [27].

As a recommendation for future work in this area, the successful, efficient integration of trial systems into home care necessitates close communication between the research team and the clinical home care team. Ideally, the clinical team should dedicate at least one member to the project to provide direct feedback and inside knowledge of the home care organization. This greatly assists the research team, if they are coming from an academic or hospital-based background, in understanding an otherwise unfamiliar domain.

Systemic Issues – Ontario Health Care

The difficulties encountered in this study with implementing a telemonitoring solution into home care were primarily a result of systemic health care issues rather than problems with the technology itself. As the health care system is set up now, regional CCACs do not actually stand to benefit from the advantages of telemonitoring, including improved health outcomes and reduced hospitalizations [19]–[22]. Ontario CCACs are siloed from other entities within each LHIN, including from hospitals; the costs saved from reductions in hospital use would not impact a CCAC's measured performance or allocated budget. Thus, many CCACs have no immediate incentive to pursue telehomecare strategies; they may prefer instead to focus on fee-for-service treatments such as wound care and IV therapy.
By extension, home care organizations and their nurses also have little motivation to use telemonitoring systems, beyond altruism. It could be reasoned that telehomecare would improve the efficiency and number of clients that home care organizations could service [64]. However, as mentioned in constraint B.2, the home care compensation model is such that nurses are only compensated for the number of home visits that they perform. This fee-for-service payment model does not cover telephone or remote visits; in fact, a new bill rate had to be created in this study specifically for these types of visits. In addition, by operating under this home visit compensation model for some time, nurses may fear a reduction in the number of home visits and thus reduced pay when performing telehomecare. Moreover, CCACs do not sanction so-called ‘monitoring’ home visits where a client with a chronic condition receives recurring visits or follow-up over a long duration. Instead, the typical duration of home care services for a heart failure client is only around 4-6 weeks. As such, without the study budget to reimburse nurses for visits, this study would not have been possible; both the nature and extent of visits required by a telemonitoring solution to be effective would not have been covered by a CCAC. This coupled with the fear of being replaced or some services rendered obsolete by the telehomecare system, home care organizations and CCACs have little reason to actually adopt and implement such a system in the current or near future.

For such a telemonitoring solution to be viable in Ontario, significant reforms in health policy would have to occur at the community, regional, and provincial levels. The Ontario Ministry of Health and Long-Term Care and the regional LHINs along with their CCACs and hospitals need to look at spending as a whole. They must investigate and emphasize strategies that reduce overall spending and reward these solutions. This may involve establishing official bill rates in home care for remote visits, or perhaps something more drastic such as moving towards a bundled payment or capitation health care model. In a bundled payment model, a single payment would cover all services delivered in a single episode of care or over a specific period of time, such as the follow-up of a heart failure patient post-discharge. In a capitation model, care providers would be allocated a set amount of funding for each patient assigned to them regardless of service use. Both the bundled payment and capitation models could offer reimbursement for telemonitoring solutions but in such a way that limits excessive use and promotes efficiency. Either of these payment models or merely reimbursing remote visits would
better incentivize community care entities to utilize effective technologies, like telemonitoring, which reduce hospitalization and overall health system costs [22].

Despite these systemic issues and barriers to actual utilization, the results upon completion of this study will provide insight into the impact of a new service delivery model that involves telemonitoring in a home care nursing environment. Specifically, this study will determine whether presenting home care nurses and clients with their daily physiological readings improves the clinical management and self-care of their heart failure condition. It will also examine the most appropriate combination of home visits, telephone assessments, and telemonitoring to determine if any visit optimization is possible. If positive results are indicated through the pilot of this system, the implementation of the telehomecare system as an aid to home care nurses would be supported. However, further large-scale clinical studies would have to be conducted to more definitively determine the effects of the integrated UHN telehomecare system on client outcomes and cost.
References


Appendix A - The AlereNet System [14]
Appendix B - Nursing Flowcharts: Current Process

Case 1: Portal alert (e.g. delayed visit, visit outside geographic area, missed visit, short visit, etc.)
Case 2: Client calls centre

1. Client calls centre
   - Assignment Coordinator interacts with client

2. Does client require clinician action? (Yes/No)
   - No: Client change in schedule? (Yes/No)
     - Yes: Assignment Coordinator makes changes to Calipso
     - No: Assignment Coordinator handles call
   - Yes: Assignment Coordinator contacts nurse

3. Is there a visit scheduled today? (Yes/No)
   - Yes: Assignment Coordinator contacts Nurse on duty
     - Nurse assesses need by telephone
     - Are changes required to careplan? (Yes/No)
       - Yes: Nurse contacts CCAC Care Coordinator for approval of change
       - No: Nurse acts accordingly
         - Nurse documents and communicates back to Assignment Coordinator
         - Assignment Coordinator makes changes to Calipso

4. 1

Case 3: CCAC change (e.g. clinical order, schedule change, person change, level of care provided change, address change, service end date change, etc.)

[Flowchart diagram]

CCAC calls centre

Assignment Coordinator receives communication

CCAC change in schedule?

Change comes via Portal as service frequency change form

Assignment Coordinator calls Nurse(s) and address of changes

Does change include visit today?

Is primary nurse available?

Assignment Coordinator makes changes to Calipec

Assignment Coordinator assigns to fill-in Nurse

Done

Done
Case 4: Nurse home visit

1. Nurse calls client ahead (night 4 or 1 hour 64)

2. Nurse arrives at client's house

3. Nurse opens CellTrak to document arrival

4. Nurse reviews care tasks in CellTrak

5. Is this the initial visit?
   - Yes: Nurse conducts initial admission assessment, Initial assessment documented through EOBG
   - No: Is reassessment required?
     - Yes: Nurse conducts reassessment in EOBG
     - No: Nurse provides care to client

6. Nurse documents care in client's in-home healthcare record

7. Nurse documents care task completion & closes visit in CellTrak

8. Done
Appendix C - Nursing Flowcharts: Proposed Process

Case 1: Telehomecare alert in CellTrak Portal

1. CellTrak Portal Admin detects alert
2. Admin contacts Assignment Coordinator (copies & pastes alert and data into email)
3. Is the client's nurse working today?
   - Yes: Assignment Coordinator contacts the nurse (emails the alert)
   - No: Supervisor acknowledges receipt of alert (emails the alert)
4. Does client require a telephone assessment? (consider recent history)
   - Yes: Supervisor notifies Assignment Coordinator to add telephone assessment into Calipso
   - No: Supervisor conducts telephone assessment: telehomecare data in email or link in email to telehomecare website
5. Nurse calls supervisor to authorize telephone assessment (remote visit)
6. Supervisor notifies Assignment Coordinator to add telephone assessment into Calipso
7. Assignment Coordinator makes changes to Calipso
8. Supervisor documents even if unable to reach client (Telehomecare Advice Form)
9. Does client require a home visit?
   - Yes: Supervisor contacts Nurse and Assignment Coordinator about home visit
   - No: Supervisor makes changes to Calipso
10. Assignment Coordinator makes changes to Calipso
11. Done
Case 2: Client calls centre

1. Client calls centre
   - Assignment Coordinator interacts with client

2. Does client require clinician action?
   - No: Client change in schedule?
     - No: Assignment Coordinator handles call
       - Done
     - Yes: Assignment Coordinator makes changes to Calipso
   - Yes: Is this client's Nurse working today?
     - No: Assignment Coordinator contacts Nurse
       - Assignment Coordinator makes changes to Calipso
       - Supervisor documents even if unable to reach client (Telephone Advice Form)
     - Yes: Nurse calls Supervisor to authorize telephone assessment (remote visit)
       - Nurse documents even if unable to reach client (Telephone Advice Form)

3. Nurse conducts telephone assessment, access telehomecare data on website (on BB)
   - Supervisor notifies Assignment Coordinator to add telephone assessment into Calipso
     - Assignment Coordinator makes changes to Calipso

4. Does client require a home visit?
   - Yes: Supervisor contacts Nurse
     - Supervisor contacts Nurse and Assignment Coordinator about home visit
     - Assignment Coordinator makes changes to Calipso

5. No: Done
Case 3: CCAC schedule change* (e.g. clinical order, schedule change, person change, level of care provided change, address change, service end date change, etc.)
*no longer applicable without CCAC involvement
Case 4: UHN Telehomecare System

Client takes daily measurements on UHN telehomecare system

Measurements (BP, pulse, weight) and symptoms sent to UHN servers

Measurements and symptoms saved on UHN servers

Are measurements and symptoms within normal limits?

Yes

"Normal" message (alert #1) forwarded to client from UHN servers

No

Alert generated (alert number 2-8)

Alert message forwarded to client from UHN servers

Alert, measurements, and symptoms (last 14 days) forwarded to ParaMed servers

Alert, measurements, and symptoms (last 14 days) displayed in CallTrak Portal

Measurements and symptoms displayed on telehomecare website

Done
Case 5: New client recruitment*
*no longer applicable without CCAC involvement
Case 6: Existing client recruitment

Nurse reviews higher existing CHF clients for potential study participants using inclusion criteria.

Nurse notifies Assignment Coordinator of potential study participant.

Assignment Coordinator calls CHF client; notify of potential study (with script).

Client agrees to be approached by Study Coordinator?  

Yes → Assignment Coordinator immediately nominals Study Coordinator of potential study participant.

Study Coordinator immediately calls client to introduce study.

Client gives verbal consent to participate in study?  

Yes → Study Coord. obtains contact info of client's PHCP.

Study Coord. mails consent form & questionnaire and UHN telehomecare system (2 packages) to client.

No → Study Coord. notifies Assignment Coord. that client has consented to study & system mailed.

Assignment Coord. notifies Nurse that client has consented to study & system mailed.

Study Coord. takes study info (Weight Range Guideline) to clients PHCP.

Done.
Case 7: Initial admission assessment of study participants

1. Client calls PM office and informs that telehomecare equipment has arrived

   - Assignment Coordinator makes changes to CallLog

2. Nurse calls client ahead (might be 1 or 1 hour earlier)

   - Nurse confirms telehomecare equipment arrived?
     - Yes
     - Nurse proceeds with scheduled home visit, arranges at clients' house
     - Nurse opens CellTrak to document arrival
     - Nurse reviews care tasks in CellTrak
     - Nurse conducts initial admission assessment
     - Client confirmed suitable for study?
       - Yes
       - Nurse opens, educates client on telehomecare system
       - Nurse reminds client to sign consent form
     - No
       - Nurse notifies Assignment Coord. of unsuitability & client to be discharged from home care
       - Nurse notifies Study Coord. of unsuitability & telehomecare system needs pickup
       - Done
     - No
       - Nurse notifies Assignment Coord. that equipment has not arrived
       - Nurse notifies Assignment Coord. and Study Coord. of equipment not arrived

5. Nurse asks client to call PM Office (Assignment Coordinator) when equipment arrives

   - Assignment Coordinator makes changes to CallLog

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Case 8: Regularly scheduled home visit of participant

1. Nurse calls client ahead (night b4 or 1 hour b4)
   Nurse arrives at client's house
   Nurse opens CellTrak to document arrival
   Nurse reviews care tasks in CellTrak
   Nurse provides care to client
   Nurse reviews telehomecare data

   Is the weight range target still appropriate?
   Yes
   Is it time for a reassessment? (once per month)
   Yes
   Nurse conducts reassessment
   Reassessment documented through eOHCC

   No
   Nurse documents care (and changes) in client's in-home health care record and Home Visit Log
   Nurse documents care task completion & closes visit in CellTrak
   Done

   No
   Contact PHCP to change weight range target (Case 10)

3.  

4.  

5.  

99
Case 9: Discharge/end of study

1. Nurse calls client ahead (night 3rd or 1 hour 4th).
2. Nurse arrives at client's house.
5. Nurse provides care to client.
7. Assessment documented through eOBC.
8. Nurse reminds client to complete post-study questionnaire and mail back to UHN.
11. Nurse contacts Study Coordinator to arrange pickup of system/equipment.
12. Study Coordinator arranges and conducts post-study interview with client.
13. Study Coord. prints out client's telehomecare data from website and faxes to Assignment Coord. for paper record.
14. Done.
Case 10: Changing weight range target

Nurse calls client’s PHCP about a new weight range target

Nurse talks to leaves message for PHCP relaying findings from client’s CHF assessment

Nurse requests PHCP to prescribe new weight range target ASAP

Has PHCP prescribed a new weight range target after one day?

Yes

Leave message for study coordinator with new weight range target

Study Coordinator enters new weight range target into system

No

Follow Up
Case 11: Determining client care path (after initial admission assessment/reassessment)

- Nurse uses initial admission assessment/reassessment to determine client's care path.
- Nurse determines client home visit frequency for the next month (standard: one visit every 2 weeks).
- Client requires more or less home visits than once every 2 weeks?
  - Yes: Nurse has check-in with Supervisor to confirm home visit frequency.
  - No: Nurse notifies Assignment Coordinator about home visit frequency.
- Done.
Appendix D - Telephone Advice Form

TELEPHONE ADVICE FORM

DATE OF CALL: ____________________ TIME OF CALL: ____________________
CLIENT’S NAME: ____________________ ADDRESS: ____________________
NAME OF CALLER (if different than client): ____________________
RELATIONSHIP TO CLIENT: ____________________
TELEPHONE NUMBER: ____________________

CLIENT AWARE OF CALL:  □ YES  □ NO
REASON FOR CALL: ____________________

ASSESSMENT DATA: ____________________

ADVICE:
☐ Emergent – requires immediate medical attention
☐ Urgent – requires medical attention within 24 hrs
☐ Non Urgent – requires support/teaching (describe)

RECOMMENDATIONS/REFERRED TO:  □ 911  □ Go to hospital  □ Dr. within 24 hrs
☐ Telehealth / Health Link  □ Pharmacist  □ Call back if condition worsens
☐ Other: ____________________
☐ Nursing visit required:  □ Today or  □ ____________________ (Date)
CLIENT/CALLER:  □ Agrees  □ Disagrees with recommendations (list reason)

FOLLOW UP
☐ Office / Primary Nurse notified  □ Primary Health Care Practitioner notified
☐ Contractor notified (if applicable)

TELEHOMECARE STUDY
Was this telephone assessment a result of a telehomecare alert?
☐ YES  □ NO

Was the telehomecare data useful in assessing the client over the phone?
☐ YES  □ NO

Do you think the telehomecare data helped eliminate the need for a home nursing visit?
☐ YES  □ NO

Signature/status of Telephone Advisor ____________________ Date ____________________

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Revised Dec 2012 for ParaMed-UHN Telehomecare Study P10066
Appendix E - Home Visit Log

University Health Network

Telehomecare Study
Home Visit Log
(complete after each home visit)

RN: ________________
Date: ________________
ParaMed Client Identifier #: ____________ (labelled on client's phone)

HOME VISIT

1. Purpose of home visit:
   ☐ Regular scheduled home visit.
   ☐ Responding to a telehomecare alert. (Skip Question #2)
   ☐ Other: ________________

2. This home visit could have been replaced by a:
   ☐ Telephone assessment with telehomecare data
   ☐ Telephone assessment alone
   ☐ Telehomecare data alone
   ☐ This home visit was necessary

3. I looked at the telehomecare data:
   ☐ Before the visit ☐ During the visit ☐ Neither (did not use)

4. The telehomecare data was:
   ☐ Useful (e.g. for assessing the client or providing informed care)
   ☐ Not useful
   ☐ Neither (did not use)

Comments:
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Version 1.22
Version Date: January 20, 2013
Appendix F - CHF Telehomecare Assessment

University Health Network

Telehomecare Study
CHF Telehomecare Assessment

1. Verify that the client entered their symptoms into the BlackBerry correctly. Ensure they did not answer "Yes" to any symptoms questions accidentally (See 3.3.4 of Instruction Booklet).

2. (Only during Home Visits): Verify the client’s measurements (weight, blood pressure, and pulse) by taking new readings using the telemonitoring equipment.
   a. Ensure the client is using the equipment correctly (e.g., standing squarely in the centre of the weight scale, placement of the blood pressure cuff, taking weight first thing in the morning, without clothes, after urinating, before eating or drinking).
   b. Ensure the equipment is functioning correctly (i.e., weight scale and blood pressure monitor are accurately sending measurements to the BlackBerry, weight scale and blood pressure monitor are giving reasonable measurements).
   c. After taking these new measurements, the BlackBerry will ask "Was this?"; make sure to answer "During the day" by pressing 2 to denote that these measurements were taken during the day and not in the morning.

3. Perform an assessment of the client using the checklist below as a guideline.

   DATE: ____________________  □ Home visit  OR  □ Telephone assessment

   SYMPTOMS
   Weight and Water Retention
   □ No change
   □ Weight gain of 3 lbs or more in a day  □ Weight loss of 3 lbs or more in a day
   □ Weight above upper weight range  □ Weight below lower weight range
   □ Increased edema (swelling): abdomen, feet, legs, or ankles

   Heart Pain and Palpitations
   □ No change  □ Increased chest pain  □ Fast, irregular heartbeat

   Ability to do Daily Activities
   □ No change  □ Reduced activity level  □ Decreased energy level, fatigue
   □ Confusion  □ Dizziness  □ Painted  □ Fell

   Breathing
   □ No change  □ Increased dyspnea (shortness of breath)
   □ Increased wheezing  □ More coughing than usual

   Sleeping
   □ No change  □ Increased # pillows to sleep at night
   □ Needs to sit up or sit in a chair to sleep
   □ Trouble sleeping or waking up because can't breathe well

   Other
   □ No change  □ Coughed up frothy or pink saliva
   □ Reduced urine output  □ Increased side effects from medications

   DIET
   □ No change  □ Nausea, vomiting  □ Pain or bloating in stomach
   □ Recent salty meal  □ Increased fluid intake  □ Loss of appetite

   MEDICATION
   □ No change  □ Not taking correct pills  □ Incorrect quantity/frequency

Version 1.04
Version Date: Feb 7, 2013

References: CHF Action Plans by Aurora Health Care, Health Net, & Merck
Appendix G - Telephone Assessment and Home Visit Guideline

University Health Network

Telehomecare Study
Telephone Assessment and Home Visit Guideline

During the course of this study you may receive alert messages by email regarding your clients. After receiving an alert, a telephone assessment of the client may be performed. This guideline outlines the procedure during a telephone assessment to determine whether a home visit is required, the procedure during a home visit, and possible discussion points when contacting the client’s PHCP.

TELEPHONE ASSESSMENT GUIDELINE (AFTER AN ALERT)
1. Review the alert message and 14-day telehomecare data in the alert email. A client’s complete telehomecare history can be viewed by clicking the included link to the telehomecare website.
2. Decide whether the client requires a telephone assessment. Consider recent remote and home visits, alerts, symptoms, requests to PHCP to change weight range target, etc.
3. Contact the Supervisor to authorize a telephone assessment.
4. Call the client and conduct a telephone assessment. See CHF Telehomecare Assessment.
5. Follow standard telephone assessment procedure, which may include checking medication adherence, seeking immediate medical attention, client education, etc.
6. If you think the client has gained/lost weight and/or has any other clinical symptoms, schedule a home visit. Contact the Supervisor to authorize a home visit.
7. Complete a modified Telephone Advice Form. Return completed forms to the office once a month.

HOME VISIT GUIDELINE (AFTER AN ALERT)
1. Review the alert message and 14-day telehomecare data in the alert email. A client’s complete telehomecare history can be viewed by clicking the included link to the telehomecare website.
2. Conduct a complete CHF Telehomecare Assessment. See CHF Telehomecare Assessment.
3. Follow standard home care visit procedure, which may include checking medication adherence, seeking immediate medical attention, client education, contacting the PHCP, etc.
4. If your assessment suggests normal weight gain/loss not related to CHF or any other medical condition (client exhibits no symptoms), call the client’s PHCP to relay your assessment findings and discuss a new weight range target (see Possible Discussion Points with PHCP). If the PHCP is unavailable at the time, request that they call back as soon as possible. The PHCP should already be informed about the study and about adjusting weight range targets. If the PHCP does not respond after one day, follow-up. When a new weight range target is set, contact the study coordinator (416-340-5312).
5. Complete a Home Visit Log. Return completed logs to the office once a month.

SUGGESTED DISCUSSION POINTS WITH PHCP
- Relay any symptom findings from your assessment and trends from the telehomecare data
- Discuss if a change in weight range target is needed
- Review medications adherence, possible adjustment, water pills
- Review diet and exercise plan/education: possible adjustment, re-education
- Discuss any need for an appointment (for PHCP to see client in person)

Version 1.03
Version Date: Feb 7, 2013
Appendix H - Weight Range Guideline

University Health Network

Telehomecare Study
Weight Range Guideline

Dear (Primary Health Care Provider),

The Telehomecare System will allow patients to measure their daily weight, blood pressure, pulse, and symptoms, and alerts are generated if these measurements fall outside of a defined range. As such, you may be contacted during the course of the study to help determine your patient’s weight range target. The purpose of this guideline is to inform you on how to determine your patient’s weight range target.

As a guide to determining an appropriate weight range target:
- This weight range dictates where a patient's weight should be when they are healthy and properly maintaining their heart failure condition.
- A suggested weight range target is a patient’s dry weight ± 4 pounds [1]
- A patient’s dry weight is considered their “normal weight when he/she is not experiencing an acute exacerbation of congestive heart failure or any other medical condition” [2]
- Patients will be instructed to take their daily weight when they first wake up, and after they have urinated and removed their clothing.

Please be prompt in responding to the request for a weight range adjustment to ensure that accurate weight alerts are generated for your patient.

If you would like more information on heart failure management or weight range targets, please consult the American College of Cardiology Foundation/American Heart Association guidelines [3]. If you have any questions or concerns regarding this study, please contact the study coordinator: Jonathan Tomkun at (416) 340-5312.

Thank you for your efforts in this study,

Jonathan Tomkun
Study Coordinator
Centre for Global eHealth Innovation
University Health Network
Email: jtomkun@ehealthinnovation.org
Phone: (416) 340-5312
Fax: (416) 340-3595


Version 1.03
Version Date: Apr 8, 2013
### Appendix I - In-House Testing Cases

<table>
<thead>
<tr>
<th>Case</th>
<th>Parameters</th>
<th>Audio Msg</th>
<th>BB Message</th>
<th>BP Simulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ideal case: took all morning measurements, everything normal</td>
<td>time_of_day=morning, weight_tag=normal, morning_bp_tag=normal, morning_pulse_tag=normal, latest_symptom_tag=normal</td>
<td>1. Your measurements are fine today</td>
<td>pass</td>
<td>userdef1</td>
</tr>
<tr>
<td>morning: did not take bp yet</td>
<td>time_of_day=morning, weight_tag=normal, morning_bp_tag=not_reading, morning_pulse_tag=not_reading, latest_symptom_tag=normal</td>
<td>Take your blood pressure now</td>
<td>pass</td>
<td></td>
</tr>
<tr>
<td>morning: all normal except bp high, hr high</td>
<td>time_of_day=morning, weight_tag=normal, morning_bp_tag=high, morning_pulse_tag=normal, latest_symptom_tag=normal</td>
<td>2. If you feel worse later today, use the system to take symptoms</td>
<td>pass</td>
<td>userdef2</td>
</tr>
<tr>
<td>morning: abnorm symptoms, bp low, hr high</td>
<td>time_of_day=morning, weight_tag=normal, morning_bp_tag=low, morning_pulse_tag=high, latest_symptom_tag=abnorm</td>
<td>6. If you feel you should, call Paramed or go to Emerg Dept</td>
<td>pass</td>
<td>userdef3</td>
</tr>
<tr>
<td>morning: critical symptoms, weight abnormal, bp low, hr normal</td>
<td>time_of_day=morning, weight_tag=normal, morning_bp_tag=low, morning_pulse_tag=normal, latest_symptom_tag=abnorm</td>
<td>critical911.wav</td>
<td>6. If you feel you should, call Paramed or go to Emerg Dept</td>
<td>pass</td>
</tr>
<tr>
<td>morning: weight loss, bp high, hr high, no symptoms</td>
<td>time_of_day=morning, weight_tag=high, morning_bp_tag=high, morning_pulse_tag=normal, latest_symptom_tag=normal</td>
<td>4. Restrict salt &amp; fluids. If you feel you should, call Paramed or go to Emerg Dept</td>
<td>pass</td>
<td>userdef5</td>
</tr>
<tr>
<td>morning: weight loss, critical symptoms, bp normal, hr normal</td>
<td>time_of_day=morning, weight_tag=normal, morning_bp_tag=normal, morning_pulse_tag=normal, latest_symptom_tag=abnorm</td>
<td>7. If you feel you should, call Paramed or go to Emerg Dept</td>
<td>pass</td>
<td>userdef6</td>
</tr>
<tr>
<td>morning: weight gain, symptoms abnormal, bp low, hr normal</td>
<td>time_of_day=morning, weight_tag=high, morning_bp_tag=low, morning_pulse_tag=normal, latest_symptom_tag=abnorm</td>
<td>6. Call 911 now</td>
<td>pass</td>
<td>userdef4</td>
</tr>
<tr>
<td>morning: weight gain, symptoms critical, bp normal, hr normal</td>
<td>time_of_day=morning, weight_tag=high, morning_bp_tag=normal, morning_pulse_tag=normal, latest_symptom_tag=abnorm, last_abnorm=true</td>
<td>critical911.wav</td>
<td>6. Call 911 now</td>
<td>pass</td>
</tr>
<tr>
<td>morning: weight loss, critical symptoms, bp normal, hr normal</td>
<td>time_of_day=morning, weight_tag=high, morning_bp_tag=normal, morning_pulse_tag=normal, latest_symptom_tag=abnorm</td>
<td>critical911.wav</td>
<td>6. If you feel you should, call Paramed or go to Emerg Dept</td>
<td>pass</td>
</tr>
<tr>
<td>morning: weight loss, critical symptoms, bp high, hr high</td>
<td>time_of_day=morning, weight_tag=low, morning_bp_tag=high, morning_pulse_tag=normal, latest_symptom_tag=critical</td>
<td>critical911.wav</td>
<td>6. If you feel you should, call Paramed or go to Emerg Dept</td>
<td>pass</td>
</tr>
<tr>
<td>morning: weight loss, critical symptoms, bp low, hr low</td>
<td>time_of_day=morning, weight_tag=low, morning_bp_tag=low, morning_pulse_tag=low, latest_symptom_tag=crf911</td>
<td>critical911.wav</td>
<td>6. Call 911 now</td>
<td>pass</td>
</tr>
<tr>
<td>Time of Day</td>
<td>Other Morning Weight Tag</td>
<td>Low Morning Pulse Tag</td>
<td>Low Latest Symptom Tag</td>
<td>Crit 911</td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------</td>
<td>----------------------</td>
<td>-----------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Afternoon: took a bp reading that is normal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Afternoon: symptoms normal, bp low, HR low</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Afternoon: symptoms abnormal, everything else normal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Afternoon: symptoms critical, high bp, low hr</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Afternoon: critical 911 symptoms, bp high, hr high</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. If you feel you should, call Paramed or go to Emerg Dept.
Appendix J - Usability Testing: Patient Pre-Study Questionnaire

Appendix D: Questionnaires:

Pre-Study Questionnaire – Patient

Study Title: Usability Testing of a Heart Failure Remote Monitoring System as an Aid for Home Healthcare Nurses

Participant ID#: ____________________________ (to be assigned by the study coordinator)

Thank you for participating in our usability study of a prototype heart failure remote monitoring system. Please fill out the questionnaire below.

1) In what age range is your age? (check one box)
   □ < 25
   □ 25 – 34 yrs
   □ 35 – 44 yrs
   □ 45 – 54 yrs
   □ 55 – 64 yrs
   □ 65 – 74 yrs
   □ 75 – 84 yrs
   □ > 84 yrs

2) Do you use a blood pressure monitor at home?
   □ Yes, daily
   □ Yes, between 2-6 times a week
   □ Yes, about once a week
   □ Yes, but less than once a week
   □ Never → PLEASE GO TO QUESTION 8.

   Very Difficult  Very Easy

3) How easy is it for you to use the blood pressure monitor?  1  2  3  4  5

4) Do you keep a record of your blood pressure?
   □ Yes, I write it down on paper
   □ Yes, I enter the values onto a computer
   □ Yes, I keep track by ________________________________
   □ No → PLEASE GO TO QUESTION 6.

5) Do you tell or show your blood pressure values to your doctor or nurse?
   □ Yes
   □ No
   □ Comment: ________________________________

6) Do you weigh yourself at home?
   □ Yes, daily
   □ Yes, between 2-6 times a week
   □ Yes, about once a week
   □ Yes, but less than once a week
   □ Never → PLEASE GO TO QUESTION 10.
7) How easy is it for you to weigh yourself?

<table>
<thead>
<tr>
<th>Very Difficult</th>
<th>Very Easy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3  4  5</td>
</tr>
</tbody>
</table>

8) Do you keep a record of your weight?

- Yes, I write it down on paper
- Yes, I enter the values onto a computer
- Yes, I keep track by _____________________________
- No → PLEASE GO TO QUESTION 10.

9) Do you tell or show your weight values to your doctor or nurse?

- Yes
- No
- Comment: ________________________________

10) Do you use a cell phone?

- Yes, I use a cell phone more than once a week.
- Yes, I use a cell phone less than once a week, but more than once a month.
- Yes, I use a cell phone once a month or less.
- No, I do not use a cell phone.

11) How easy is it for you to use the cell phone?

<table>
<thead>
<tr>
<th>Very Difficult</th>
<th>Very Easy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3  4  5</td>
</tr>
</tbody>
</table>

Please provide any additional comments that you may have.

..........................................................................................................................................................................................
..........................................................................................................................................................................................
..........................................................................................................................................................................................

Page 2 of 2
### Post-Study Questionnaire – Patient

**Study Title:** Usability Testing of a Heart Failure Remote Monitoring System as an Aid for Home Healthcare Nurses

**Participant ID#:** ________________ (to be assigned by the study coordinator)

Thank you for participating in our usability study of a prototype heart failure remote monitoring system. Please fill out the questionnaire below and provide comments wherever necessary. A section for general comments is available at the end of the questionnaire.

#### CELL PHONE

<table>
<thead>
<tr>
<th></th>
<th>Very Difficult</th>
<th>Very Easy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Overall, how easy was it to use the cell phone?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Comment:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) How easy was it to enter information into the cell phone?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Comment:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Satisfied/Dissatisfied

<table>
<thead>
<tr>
<th></th>
<th>Very Dissatisfied</th>
<th>Very Satisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>3) How satisfied are you with screen readability?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>4) How satisfied are you with the scroll pad?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>5) How satisfied are you with the user buttons?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
</tbody>
</table>

#### How easy was it to find the following information on the cell phone?

<table>
<thead>
<tr>
<th></th>
<th>Very Difficult</th>
<th>Very Easy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comment:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Report</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>b. History log</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>c. Graphs</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
</tbody>
</table>
7) How easy was it to interpret the information on the following screens:
Comment:

<table>
<thead>
<tr>
<th></th>
<th>Very</th>
<th></th>
<th>Very</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Report</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>b. History log</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>c. Graphs</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

GENERAL

1) How satisfied are you with the following system components?
Comment:

<table>
<thead>
<tr>
<th></th>
<th>Very</th>
<th></th>
<th>Very</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Blood pressure monitoring</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>b. Body weight monitoring</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Please write any comments that you may have on the use of the prototype heart failure remote monitoring system.
Appendix L - Usability Testing: Clinician Test Performance Tasks

Different home care staff went through different material based on their projected study responsibilities as outlined below:

**Portal Admin**
1. Demonstration of the telehomecare equipment.
2. Overview of the flow of data from client to nurse (Figure 3).
3. Reviewing a screenshot of the CellTrak Portal showing the new "Telehomecare Alerts" tab and the alert message information appearing on this new tab (Figure 11).
4. Walkthrough of the procedures and instruction booklet for Portal admins, emphasizing specific sections:
   a) 2.1 Telehomecare Alerts - a description of the alerts, how/why they are triggered, when they will most likely be triggered (after morning readings around 10 AM)
   b) 2.2 Receiving Alerts - how to detect alerts, and what to do when an alert is triggered (Appendix C: Case 1)

**Assignment Coordinator**
1. Demonstration of the telehomecare equipment.
2. Overview of the flow of data from client to nurse (Figure 3).
3. Walkthrough of the procedures and instruction booklet for assignment coordinators, emphasizing specific sections:
   a) 2.1 Telehomecare Alerts - a description of the alerts, how/why they are triggered, when they will most likely be triggered (after morning readings around 10 AM)
   b) 2.1.1 Receiving Alerts - what to do after receiving an alert from the Portal admin (Appendix C: Case 1)
   c) Recruiting New CHF Clients* - intake process for new study clients including: referral by CCAC, calling clients to inform them of the study, and bringing them on to service after consent
   d) Recruiting Existing CHF Clients* - process of examining existing ParaMed clients as potential study participants including: calling clients to inform them of the study and bringing them into the study after consent (Appendix C: Case 6*)
   e) 2.3 Clients Calling In - what to do after a client calls in to the office, particularly if it is in regards to a telehomecare alert (Appendix C: Case 2)
   f) 2.6 Discharge or End of Study - what to do at the end of the study (Appendix C: Case 9)

*no longer applicable without CCAC involvement

**Nurses and Nursing Supervisor**
1. Demonstration of the telehomecare equipment with patient Quick Guide.
2. Overview of the flow of data from client to nurse (Figure 3).
3. Walkthrough of the procedures and instruction booklet for nurses, emphasizing specific sections:
   a) 2.1 Telehomecare Alerts - a description of the alerts, how/why they are triggered, when they will most likely be triggered (after morning readings around 10 AM)
   b) 2.1.1 Alert Parameters - a detailed description of the default alert thresholds, when they are triggered, and which thresholds can be changed (weight range)
c) Recruiting New CHF Clients* - intake process for new study clients including: referral by CCAC and assignment to a nurse after consent  
d) Recruiting Existing CHF Clients* - process of examining existing ParaMed clients as potential study participants including: matching clients to inclusion criteria and forwarded potential clients to the assignment coordinator (Appendix C: Case 6*)  
e) 2.4 Initial Study Assessment - process when visiting a study client for the first time (Appendix C: Case 7)  
f) 2.1.2 Receiving Alerts - what to do after receiving an alert from the assignment coordinator (Appendix C: Case 1), including reviewing the following new clinical documents:  
- Example Alert Email (Figure 5) - example to show the format and content of alert emails that they will be receiving from the assignment coordinator  
- Telephone Assessment and Home Visit Guideline (Appendix G) - guideline of steps when performing a telephone assessment or home visit  
- CHF Telehomecare Assessment (Appendix F) - guideline/checklist of what to look for when assessing a client’s CHF over the phone or in person  
- Telephone Advice Form (Appendix D) - form used to track all telephone assessments/visits, clinical action taken, and value of the telehomecare system; both completed visits and unsuccessful visits (attempted but failed to reach client) should be recorded  
- Home Visit Log (Appendix E) - form used to track all home visits, clinical action taken, and value of the telehomecare system  
g) 2.8 Adjusting Weight Range Target & Weight Range Guideline (Appendix C: Case 10, Appendix H) - guideline for when a weight range target should be adjusted and how to get this adjustment from the PHCP (family doctor, cardiologist, nurse practitioner, etc.)  
h) 2.9 Regularly Scheduled Visit - what to do during the regularly scheduled home visits which occur every two weeks (Appendix C: Case 8)  
i) 2.10 Discharge or End of Study - what to do at the end of the study (Appendix C: Case 9)  
4. Demonstration of Telehomecare Website - showing nurses the features of the website and how to access mock client data; also, reviewing a preliminary design of the mobile version of the website (Figure 9)
# Appendix M - User Acceptance Testing Checklist

## Telehomecare Study

**User Acceptance Testing - Checklist**

**Testing: Case 1 - Telehomecare alert in CellTrak Portal**

<table>
<thead>
<tr>
<th>Step</th>
<th>Expected Result</th>
<th>Outcome as Expected?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Clinician (Nurse/Supervisor) activating account on telehomecare website (BlackBerry/desktop computer)</td>
<td>Clinician receives registration/activation email with link</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Clicking link opens telehomecare website</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Telehomecare website asks Clinician to choose password</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Telehomecare website informs Clinician to access only their clients, and YES/NO to acknowledge they accept</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Clinician has access to all clients in study</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Alert generated using Telehomecare equipment</td>
<td>Alert message appears on client’s Telehomecare phone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. UHN forwards alert to CellTrak</td>
<td>Alert appears in CellTrak Portal under &quot;Telehomecare Alerts&quot; tab</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Alert appears with correct time and date</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Alert appears with correct values under Patient ID and Patient Name columns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Alert message appears under Alert Content column</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Alert message contains client first name, last name, address, phone #, and client #</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Alert message contains message directed towards nurse/Supervisor to reply to Assignment Coordinator</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Staff Legend**

- Nurse & Supervisor
- Portal Admin
- Assignment Coordinator
- Nurse
- Supervisor

---

*Version: 1.0*  
*Version Date: Feb 21, 2013*
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>13.</td>
<td>Alert message contains working, click able link that connects to telehomecare website</td>
</tr>
<tr>
<td>14.</td>
<td>Alert message contains last 14 days of telehomecare data</td>
</tr>
<tr>
<td>15.</td>
<td>Any values that triggered an alert is red and underlined.</td>
</tr>
<tr>
<td>16. Portal Admin selects alert message</td>
<td>Portal Admin is able to select the entire contents of the alert message including 14 days of data</td>
</tr>
<tr>
<td>17. Portal Admin copies and pastes alert message into a new email</td>
<td>Alert message formatting is preserved when pasted into a new email, including: line spacing, bolding, italics, colouring, and underlining.</td>
</tr>
<tr>
<td>18.</td>
<td>Link to telehomecare website preserved in email; clicking link opens telehomecare website</td>
</tr>
<tr>
<td>19. Portal Admin sends alert message email to Assignment Coordinator</td>
<td>Assignment Coordinator receives alert message email from Portal Admin with formatting preserved, including: line spacing, bolding, italics, colouring, and underlining.</td>
</tr>
<tr>
<td>20.</td>
<td>Link to telehomecare website preserved in email; clicking link opens telehomecare website</td>
</tr>
<tr>
<td>21. Assignment Coordinator identifies appropriate clinician</td>
<td>Assignment Coordinator able to identify client's nurse and if they are currently available/working today</td>
</tr>
</tbody>
</table>

A) Client's nurse *is* working today

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>22. Assignment Coordinator forwards alert message email to appropriate nurse</td>
<td>Nurse receives alert message email on their BlackBerry from Portal Admin with formatting preserved, including: line spacing, bolding, italics, colouring, underlining</td>
</tr>
<tr>
<td>23. Nurse replies to email to acknowledge receipt of alert message</td>
<td>Assignment Coordinator receives email reply to acknowledge nurse has received alert message</td>
</tr>
<tr>
<td>24. Nurse determines whether client requires a telephone assessment</td>
<td>Nurse able to interpret alert message on their BlackBerry: alert triggers clear, client goals clear</td>
</tr>
<tr>
<td>25.</td>
<td>Nurse able to make use of 14 days of telehomecare data on their BlackBerry: too much? (home visit frequency ~ once/14 days)</td>
</tr>
<tr>
<td>26. Using telehomecare website</td>
<td>Link to telehomecare website preserved in email; clicking link opens telehomecare website</td>
</tr>
</tbody>
</table>

Version: 1.0
Version Date: Feb 21, 2013
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>27.</td>
<td>Nurse able to log in to telehomecare website on their BlackBerry</td>
</tr>
<tr>
<td>28.</td>
<td>After logging in, nurse taken directly to client summary on telehomecare website</td>
</tr>
<tr>
<td>29.</td>
<td>Client summary displayed appropriately on BlackBerry: line spacing, column width</td>
</tr>
<tr>
<td>30.</td>
<td>Nurse able to see entire telehomecare history of client on their BlackBerry by scrolling</td>
</tr>
<tr>
<td>31.</td>
<td>Nurse able to navigate through telehomecare website on their BlackBerry (Summary, Contact Info)</td>
</tr>
<tr>
<td>32.</td>
<td>Nurse calls Supervisor to authorize telephone assessment</td>
</tr>
<tr>
<td>33.</td>
<td>Supervisor notifies Assignment Coordinator of telephone assessment</td>
</tr>
<tr>
<td>34.</td>
<td>Assignment Coordinator schedules telephone assessment (remote visit) into Calipso</td>
</tr>
<tr>
<td>35.</td>
<td>Nurse conducts telephone assessment</td>
</tr>
<tr>
<td>36.</td>
<td>Nurse makes use of telehomecare data in email/website, Telephone Assessment and Home Visit Guideline, CHP Telehomecare Assessment, additional questions on modified Telephone Advice Form are clear</td>
</tr>
<tr>
<td>37.</td>
<td>Nurse determines whether client requires a home visit</td>
</tr>
<tr>
<td>38.</td>
<td>Nurse calls Supervisor to authorize additional home visit</td>
</tr>
<tr>
<td>39.</td>
<td>Supervisor notifies Assignment Coordinator of additional home visit</td>
</tr>
</tbody>
</table>

Version: 1.0
Version Date: Feb 21, 2013
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>40. Assignment Coordinator schedules additional home visit into Calipso</td>
<td></td>
<td></td>
</tr>
<tr>
<td>41. Nurse performs home visit and completes Home Visit Log</td>
<td>Questions on <em>Home Visit Log are clear</em></td>
<td></td>
</tr>
<tr>
<td>B) Client's nurse is not working today</td>
<td></td>
<td></td>
</tr>
<tr>
<td>42. Assignment Coordinator forwards alert message email to Supervisor</td>
<td>Supervisor receives alert message email from Portal Admin with formatting preserved, including: line spacing, bolding, italics, colouring, underlining</td>
<td></td>
</tr>
<tr>
<td>43. Supervisor replies to email to acknowledge receipt of alert message</td>
<td>Supervisor receives email reply to acknowledge Supervisor has received alert message</td>
<td></td>
</tr>
<tr>
<td>44. Supervisor determines whether client requires a telephone assessment</td>
<td>Supervisor able to interpret alert message: alert triggers clear, client goals clear</td>
<td></td>
</tr>
<tr>
<td>45.</td>
<td>Supervisor able to make use of 14 days of telehomecare data: too much? (home visit frequency - once/14 days)</td>
<td></td>
</tr>
<tr>
<td>46. Using telehomecare website</td>
<td>Link to telehomecare website preserved in email: clicking link opens telehomecare website</td>
<td></td>
</tr>
<tr>
<td>47.</td>
<td>Supervisor able to log in to telehomecare website</td>
<td></td>
</tr>
<tr>
<td>48.</td>
<td>After logging in, Supervisor taken directly to client summary on telehomecare website</td>
<td></td>
</tr>
<tr>
<td>49.</td>
<td>Client summary displayed appropriately: line spacing, column width</td>
<td></td>
</tr>
<tr>
<td>50.</td>
<td>Supervisor able to see entire telehomecare history of client by scrolling</td>
<td></td>
</tr>
<tr>
<td>51.</td>
<td>Supervisor able to navigate through telehomecare website</td>
<td></td>
</tr>
<tr>
<td>52. Supervisor notifies Assignment Coordinator of telephone assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>53. Assignment Coordinator schedules telephone assessment (remote visit) into</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Version: 1.0
Version Date: Feb 21, 2013
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>54. Supervisor conducts telephone assessment</strong></td>
<td>Supervisor makes use of telehomecare data in email/website, <em>Telephone Assessment and Home Visit Guideline, CHF Telehomecare Assessment</em></td>
</tr>
<tr>
<td><strong>55. Supervisor completes modified Telephone Advice Form</strong></td>
<td>Additional questions on modified Telephone Advice Form are clear</td>
</tr>
<tr>
<td><strong>56. Supervisor determines whether client requires a home visit</strong></td>
<td></td>
</tr>
<tr>
<td><strong>57. Supervisor notifies Assignment Coordinator of additional home visit</strong></td>
<td></td>
</tr>
<tr>
<td><strong>58. Supervisor notifies nurse of additional home visit</strong></td>
<td></td>
</tr>
<tr>
<td><strong>59. Assignment Coordinator schedules additional home visit into Calipso</strong></td>
<td></td>
</tr>
</tbody>
</table>
## Appendix N - Results from UAT #1

<table>
<thead>
<tr>
<th>Feedback</th>
<th>Resulting Action/Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce the time allowed for a nurse to acknowledge that she has received an alert email from 30 min to 15 min. This is so the assignment coordinator can remember to follow-up if the nurse has not responded to the email within 15 min.</td>
<td>Assignment coordinator and nurse protocols updated: nurses should acknowledge receipt of alert emails within 15 min to the assignment coordinator.</td>
</tr>
<tr>
<td>Any new study client referrals should be faxed in with a phone call to the assignment coordinator during the day so that the primary day staff can handle admissions, etc.</td>
<td>New study client referrals will be faxed in during the day, if possible.</td>
</tr>
<tr>
<td>The 14 days of telehomecare measurements contained in the alert email is suitable. Nurses do not think it is too much or overwhelming, and the whole list can be viewed easily on the BlackBerry by scrolling downwards.</td>
<td></td>
</tr>
<tr>
<td>The display of alerts on the telehomecare website should match the format in CellTrak Portal; i.e. any measurement that triggered an alert should be bolded, underlined, and red.</td>
<td>The summary page of the telehomecare website was updated so that alert triggers are bolded, underlined, and red to be uniform with CellTrak Portal. Both full (Figure 13) and mobile (Figure 14) versions affected.</td>
</tr>
<tr>
<td>Nurses may not always remember their clients' alert thresholds/ranges. The alert thresholds/ranges for each client should be visible when the nurse is examining measurements on the telehomecare website.</td>
<td>The Summary page of the telehomecare website was updated so that alert thresholds/ranges are shown in brackets underneath each measurement to be uniform with CellTrak Portal. Both full (Figure 13) and mobile (Figure 14) versions affected.</td>
</tr>
</tbody>
</table>
| There should be a way to distinguish between a weight range alert (weight outside thresholds) and a weight change alert (gaining 3 lbs or more in a day) in the alert emails. Currently both alert types are highlighted the same (bolded, underlined, red) and there is no indication between the two. | Alert emails updated:  
- Weight range alerts will describe how far outside the range the measurement was in brackets; e.g. "169.5 lbs (+1.5 Goal 160.0 - 168.0)"
- Weight change alerts will use the word "change" to describe how large the one day change was in brackets; e.g. "165.5 lbs (-4.0 change Goal 160.0 - 168.0)" |
Appendix O - ParaMed Staff Training: Frequently Asked Questions

Telehomecare Study
Frequently Asked Questions

1. What is the ultimate goal/purpose of the telehomecare system?
2. Will study clients be assigned to specific nurses? / Why do all the nurses and staff have to be trained for this study?
3. This seems like a lot of work for the nurses.
4. How long is this study and when does it start?
5. What do I do when I get an alert?
6. Can you tell us more about the clients that will be in the study?
7. How much training do the study clients receive?
8. How many doctors are involved with the study, and how involved will they be?
9. Who is behind this project?
10. If a client is in congestive heart failure and can't send an alert, what happens?
11. What happens if the client begins exploring the BlackBerry?
12. What if the telehomecare system (server, website, or BlackBerry app) goes down?
13. Do you perform auscultation/listen to lung sounds as part of the telehomecare system?
14. What happens if a client's dog eats the BlackBerry?
15. What happens if someone else uses the client's weight scale?

1. What is the ultimate goal/purpose of the telehomecare system?

To reduce the frequency of costly, time-consuming home visits, shifting care towards compensated telephone assessments performed by nurses with access to telemonitoring data. This is expected to increase nurse efficiency while maintaining or improving client outcome.

2. Will study clients be assigned to specific nurses? / Why do all the nurses and staff have to be trained for this study?

Like with CCAC clients, study clients will be assigned at random to any nurse. All nurses are being trained in this study to address the cases where a study client's primary nurse is not working that day (sick, on vacation, etc.) and another nurse has to cover their study client. This also covers the cases where alerts are generated from study clients during the off-hours (nights and weekends). As per usual, all nurses reserve the right to refuse taking on a client.

3. This seems like a lot of work for the nurses.

Most of the workflow in this study is the same as in your usual operations. Nurses will be asked to fill out a few extra forms and will have access to more
client data. Nurses will have to authorize any extra visits as usual, except that authorization comes from the ParaMed Supervisor instead of through the CCAC; if the Supervisor is unavailable, authorization can also occur through the Care and Services Manager (Tracey Stevenson). The other major difference in this study is that nurses will be compensated for telephone assessments.

4. How long is this study and when does it start?

The study will be three months long and will start in mid-April with continuous recruitment so as to gradually ramp up the number of study clients over the first month.

5. What do I do when I get an alert?

This information is summarized in the "Nurse Quick Reference" and "Telephone Assessment and Home Visit Guideline" documents. In brief, the process after receiving an alert in your email is to: review telehomecare data → decide if telephone assessment needed → authorize telephone assessment through Supervisor → perform telephone assessment.

6. Can you tell us more about the clients that will be in the study?

The clients that will be recruited into the study will not be on any CCAC services and will have been managing their CHP condition on their own. Thus, most clients will be relatively stable. See section 2.3 of the "Instruction Booklet - Nurses" for detailed client inclusion criteria for this study.

7. How much training do the study clients receive?

The nurses will be responsible for training the clients in the use of the telehomecare system (weight scale, blood pressure monitor, and BlackBerry). This training should be performed during the initial home visit.

8. How many doctors are involved with the study, and how involved will they be?

One cardiologist and one to two GP’s will be involved with this study. They will be responsible for selecting appropriate clients for recruitment and setting the weight range targets for any clients that consent to the study.

9. Who is behind this project?

ParaMed Home Health Care, federal research/health agencies, and the University Health Network in Toronto are backing this project to try to improve efficiencies in the healthcare system.

10. If a client is in congestive heart failure and can’t send an alert, what happens?
It is important to remember that this is not a comprehensive 24-hour monitoring system. Nurses should remind clients to always fallback on their usual practice when in doubt or facing difficulties and seek medical attention if they feel they need it. For instance, in emergencies clients should do what they would normally do if not in the study including: calling family members, contacting their doctor, going to the emergency department, or calling 911.

11. What happens if the client begins exploring the BlackBerry?

We have removed as much functionality from the BlackBerry’s as possible to reduce confusion and minimize errors. Please ask the client to leave the BlackBerry within the telehomecare app at all times so that they do not miss readings or feedback messages.

12. What if the telehomecare system (server, website, or BlackBerry app) goes down?

The system should be stable during the study, especially with the expected low numbers of 10-15 study clients; however, errors can always occur. Again, it is important to remember that this is not a 24-hour monitoring system. Nurses should remind clients to always fallback on their usual practice when in doubt or facing difficulties and seek medical attention if they feel they need it. Client BlackBerry problems and troubleshooting should go through the Study Coordinator or Portal Admin. If cell service/data connection goes down to the client BlackBerry’s, the telehomecare app will automatically store any readings that are taken and re-send them to the servers when the data connection is restored.

13. Do you perform auscultation/listen to lung sounds as part of the telehomecare system?

The symptoms questions included in the telehomecare system ask the clients to assess their own respiratory issues (worsened breathing at night, shortness of breath). During home visits, you may follow your usual ParaMed protocol for clients with CHF, including performing auscultation.

14. What happens if a client’s dog eats the BlackBerry?

We will mail the client a new one. Clients are responsible for any veterinary bills incurred.

15. What happens if someone else uses the client’s weight scale?

Please remind clients not to let others use the medical equipment; all measurements go into their medical record and may trigger unintended alerts. If this occurs and the second person is of a large weight difference, you will receive an alert but should be able to recognize the abnormality in their weight
reading (e.g. losing 50 lbs over night). Use your clinical judgment. If the weight difference is not hugely significant, you should be able to discover the cause of the weight change after making a telephone assessment.

Training packages that contain all the information and forms that you need during this study are available in the Oshawa ParaMed office. Contact Tracey Stevenson (tstevenson@paramed.com) to obtain a training package. There are also copies of the different log forms used in the study in the office should you need more.

Any other inquiries should be directed to the Study Coordinator, Jonathan Tomkun (jtomkun@healthinnovation.org, 416-340-5312).
Appendix P - Pre-Study Client Interview Questions
The following is a list of questions for the pre-study interview for the client participants.

1. How does your heart failure condition affect your daily life?
   Probe question: Does it influence the quality and amount of sleep that you get each night?
   Probe question: Does it prevent you from participating in recreational or physical activities that you would otherwise be doing?
2. How do you currently take care of yourself with respect to your heart failure condition?
3. What do you think would help reduce the effects of heart failure on your daily life?
4. How would you describe your relationship with your heart failure physician/nurse?
Appendix Q - Post-Study Interview Questions

The following is a list of questions for the post-study interview for the client participants.

1. How does your heart failure condition affect your daily life now that you are using the remote monitoring system?
   Probe question: How has it changed compared to before you received the monitoring system, if at all?
2. How do you currently take care of yourself with respect to your heart failure condition now that you are using the remote monitoring system?
   Probe question: How has it changed compared to before you received the monitoring system, if at all?
3. Please describe your current relationship with your heart failure physician/nurse.
   Probe question: How has it changed compared to before you received the monitoring system, if at all?
   Probe question: How have home nurse visits changed compared to before you received the monitoring system, if at all?
4. How could the remote monitoring system be improved to help you take care of yourself better?
   Probe question: What did you dislike about the monitoring system, if anything?
5. What did you like about the monitoring system, if anything?
6. If given the choice, would you like to continue to use the monitoring system? Why?
   Probe question: Would you pay to use the monitoring system? If yes, how much do you think would be reasonable to charge per month?
7. Would you feel comfortable receiving a reduced number of home nurse visits while using the monitoring system?
   Probe question: Would you feel comfortable having some home nurse visits replaced with clinical telephone calls?
8. Could you think of other ways, besides the remote monitoring, that would help you take care of your heart failure condition? If yes, what are they?

The following is a list of questions for the post-study interview for the clinician participants.

1. What were your general impressions about the heart failure remote monitoring system?
2. How did home visits change compared to before using the remote monitoring system, if at all?
3. Do you think any of the remote visits you performed prevented a future unscheduled urgent/alert home visit?
4. Do you think any of the home visits you performed were unnecessary or could have been replaced by remote visits because of the monitoring system?
   Probe question: Would you feel comfortable performing a reduced number of home visits to each client while using the monitoring system?
   Probe question: Would you feel comfortable having some home visits replaced with reimbursed remote visits?
5. What were the things you liked the most about the heart failure remote monitoring system, if any?
6. What were the things you disliked the most about the heart failure remote monitoring system, if any?
   Probe question: How do you think the system could be improved?
7. If given the choice, would you like to continue to use the monitoring system? Why?
Appendix R - Pilot Study: Pre-Study Questionnaire

Questionnaire on Living with Heart Failure
Pre-Study Questionnaire

Thank you for completing the following survey. The following questions will help us evaluate how home monitoring for heart failure management might affect your quality of life and well-being.

Please indicate your responses by marking a dark, black 'X' in the appropriate box, circling the appropriate answer, or filling in the blank provided. Please try to complete the survey within 1 week of receiving it. Upon completion, return the completed booklet in the pre-stamped and self-addressed envelope provided.

Some of the questions in this survey are of a personal nature and we appreciate your willingness to complete the items. Your replies will be kept strictly confidential and only the research team will see your answers. The results from this study that are published will not refer to you by name. If you have any questions please contact Jonathan Tomkun at 416-340-5312.

IT IS IMPORTANT THAT YOU TRY TO ANSWER ALL QUESTIONS. HOWEVER, IF THERE ARE ANY QUESTIONS THAT YOU WOULD PREFER NOT TO ANSWER, YOU ARE FREE TO LEAVE THEM BLANK.

ParaMed CLIENT IDENTIFIER

# ____________________

TODAY’S DATE

Day Month Year
A. Some Facts about You

1. Sex: □ MALE
   □ FEMALE

2. Age: __________ years old

3. What is your ethnicity?
   □ Aboriginal (Inuit, Metis, North American Indian)
   □ Arab/West Asian (e.g., Armenian, Egyptian, Iranian, Lebanese, Moroccan)
   □ Black (e.g., African, Haitian, Jamaican, Somali)
   □ Chinese
   □ Filipino
   □ Japanese
   □ Korean
   □ Latin American
   □ South Asian
   □ South East Asian
   □ White (Caucasian)
   □ Other (specify): ____________________________________________

4. Were you born in Canada?
   □ Yes
   □ No. Please specify where: ______________________________________

5. What is your highest completed level of education?
   □ Less than high school
   □ High school
   □ Trade or technical training after high school
   □ College/University undergraduate
   □ Postgraduate

6. What is your current living arrangement?
   □ Living with a partner and/or family member(s)
   □ Living with friend(s) and/or roommate(s)
   □ Living alone
   □ Other (specify): ____________________________________________

7. What type of area do you live in?
   □ Urban (in a city)
   □ Suburban (in a community adjacent to a city)
   □ Rural (in a small town)
8. What is your current marital status?
   □ Never been married
   □ Married or living with a partner
   □ Separated or divorced
   □ Widowed

9. What is your work situation?
   □ Homemaker
   □ Work full time
   □ Work part time
   □ Retired for health reasons
   □ Retired for non-health reasons
   □ Unemployed
   □ Other (specify) ________________________________

10. What is your yearly income?
    □ Less than $15,000
    □ $15,000 to $29,999
    □ $30,000 to $49,999
    □ $50,000 to $74,999
    □ More than $75,000
    □ I prefer not to answer this question.
B. Questions about your heart failure condition

1. For how long have you been diagnosed with heart failure?
   ________ months   OR   ________ years

2. Over the past 6 months, were you away from work because of your heart failure condition, including going to the Heart Failure Clinic?
   □ No
   □ Yes. Please fill in the following blanks.
     a) Sick days ________ (number of days)
     b) Vacation ________ (number of days)
     c) Unpaid days away ________ (number of days). Total lost wages: $ ________

3. Over the past 6 months, was someone else away from work because of your heart failure condition, including accompanying you to Heart Failure Clinic visits?
   □ No
   □ Yes. Please fill in the following blanks.
     a) Sick days ________ (number of days)
     b) Vacation ________ (number of days)
     c) Unpaid absence ________ (number of days). Total lost wages: $ ________

4. Over the past 6 months, how much money does your heart failure condition cost you (out-of-pocket) in each of the following categories?
   a) Travel and parking costs: $_______
   b) Medication costs: $_______
   c) Other: $_______ Please specify source: ____________________________

5. In the last 6 months, how many times did you visit the Emergency Department because of your heart failure condition?
   ________ times
6. In the last 6 months, how many times were you admitted to a hospital because of your heart failure condition?  

_________________ times

7. In the last 6 months, how many nights in total did you stay in hospital because of your heart failure condition?  

_________________ nights

8. In the last 6 months, have you visited the Emergency Department and/or admitted to the hospital because of reasons OTHER THAN your heart failure condition?  

☐ No  

☐ Yes. Please specify: __________________________________________________________

9. Can you walk down a flight of steps without stopping?  

☐ No. Skip to question #12.  

☐ Yes

10. Can you carry anything up a flight of 8 steps without stopping or can you do any of the following?  

a) have sexual intercourse without stopping 

b) garden, rake, weed 

c) roller skate, dance foxtrot 

d) walk at a 4 miles (6.5 kilometers) per hour rate on level ground  

☐ No. Skip to question #14.  

☐ Yes. Go to question #11.

11. Can you carry at least 24 pounds (11 kilograms) up 8 steps or can you do any of the following?  

a) carry objects that are at least 80 pounds (36 kilograms) 

b) do outdoor work (such as shovel snow, spade soil)  

c) do recreational activities, such as skiing, basketball, touch football, squash, handball 

d) jog/walk 5 miles (8 kilometers) per hour  

☐ No. Skip to question #14.  

☐ Yes. Skip to question #14.
12. Can you shower without stopping or can you do any of the following?
   a) strip and make bed
   b) mop floors
   c) hang washed clothes
   d) clean windows
   e) walk 2.5 miles (4 kilometers) per hour
   f) bowl
   g) play golf (walk and carry clubs)
   h) push power lawn mower
      □ No. Go to question #13.
      □ Yes. Skip to question #14.

13. Can you dress without stopping because of your symptoms?
   □ No
   □ Yes

14. What other conditions do you have besides heart failure?
   □ Diabetes
   □ High blood pressure
   □ Cancer
   □ Chronic obstructive pulmonary disease
   □ Other (specify) _____________________________________________________________
C. Experiences with Heart Failure Self-Care

Think about how you have been feeling in the last 3 months as you complete these items.

SECTION A:

Listed below are common instructions given to persons with heart failure. How routinely do you do the following?

<table>
<thead>
<tr>
<th></th>
<th>Never or rarely</th>
<th>Sometimes</th>
<th>Frequently</th>
<th>Always or daily</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Weigh yourself?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. Check your ankles for swelling?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. Try to avoid getting sick (e.g., flu shot, avoid ill people)?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. Do some physical activity?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. Keep doctor or nurse appointments?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. Eat a low salt diet?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. Exercise for 30 minutes?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. Forget to take one of your medicines?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9. Ask for low salt items when eating out or visiting others?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. Use a system (pill box, reminders) to help you remember your medicines?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

SECTION B:

Many patients have symptoms due to their heart failure. Trouble breathing and ankle swelling are common symptoms of heart failure.

In the past month, have you had trouble breathing or ankle swelling? Circle one.

1) No
2) Yes

11. If you had trouble breathing or ankle swelling in the past month...

<table>
<thead>
<tr>
<th>Have not had these</th>
<th>I did not recognize it</th>
<th>Not Quickly</th>
<th>Somewhat Quickly</th>
<th>Quickly</th>
<th>Very Quickly</th>
</tr>
</thead>
<tbody>
<tr>
<td>How quickly did you recognize it as a symptom of heart failure?</td>
<td>N/A</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Listed below are remedies that people with heart failure use. If you have trouble breathing or ankle swelling, how likely are you to try one of these remedies?

(circle one number for each remedy)

<table>
<thead>
<tr>
<th></th>
<th>Not Likely</th>
<th>Somewhat Likely</th>
<th>Likely</th>
<th>Very Likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>12. Reduce the salt in your diet</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>13. Reduce your fluid intake</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>14. Take an extra water pill</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>15. Call your doctor or nurse for guidance</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

16. Think of a remedy you tried the last time you had trouble breathing or ankle swelling. (circle one number)

<table>
<thead>
<tr>
<th>I did not try anything</th>
<th>Not Sure</th>
<th>Somewhat Sure</th>
<th>Sure</th>
<th>Very Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>How sure were you that the remedy helped or did not help?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

SECTION C:

In general, how confident are you that you can:

<table>
<thead>
<tr>
<th></th>
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<th>Somewhat Confident</th>
<th>Very Confident</th>
<th>Extremely Confident</th>
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D. Living with Heart Failure

The following questions ask how much your heart failure (heart condition) affected your life during the past month (4 weeks). After each question, circle the 0, 1, 2, 3, 4 or 5 to show how much your life was affected. If a question does not apply to you, circle the 0 after that question.

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<tr>
<th>Did your heart failure prevent you from living as you wanted during the past month (4 weeks) by -</th>
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</tr>
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<td>21. making you feel depressed?</td>
<td></td>
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E. Your Thoughts on Home Monitoring

Please circle the number that best represents whether you agree or disagree with the following.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
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<th>Neither Agree nor Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
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<td>4. I feel confident that I could use a mobile phone to look up my health information if shown how to do it.</td>
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<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
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<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

6. Please provide any other comments that you would like to add.

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE
Questionnaire on Living with Heart Failure
Post-Study Questionnaire

Thank you for completing the following survey. The following questions will help us evaluate how home monitoring for heart failure management might affect your quality of life and well-being.

Please indicate your responses by marking a dark, black 'X' in the appropriate box, circling the appropriate answer, or filling in the blank provided. Please try to complete the survey within 1 week of ending the study. Upon completion, return the completed booklet in the pre-stamped and self-addressed envelope provided.

Some of the questions in this survey are of a personal nature and we appreciate your willingness to complete the items. Your replies will be kept strictly confidential and only the research team will see your answers. The results from this study that are published will not refer to you by name. If you have any questions please contact Jonathan Tinkam at 416-340-5312.

IT IS IMPORTANT THAT YOU TRY TO ANSWER ALL QUESTIONS. HOWEVER, IF THERE ARE ANY QUESTIONS THAT YOU WOULD PREFER NOT TO ANSWER, YOU ARE FREE TO LEAVE THEM BLANK.

ParaMed CLIENT IDENTIFIER
# ___________________

TODAY’S DATE
Day  Month  Year
A. Some Facts about You

1. Sex:  
   - ☐ MALE  
   - ☐ FEMALE

2. Age: ___________ years old

3. What is your current living arrangement?
   - ☐ Living with a partner and/or family member(s)  
   - ☐ Living with friend(s) and/or roommate(s)  
   - ☐ Living alone  
   - ☐ Other (specify): ________________________________

4. Over the months during the study, were YOU away from work because of your heart failure condition, including going to the Heart Failure Clinic?
   - ☐ No  
   - ☐ Yes. Please fill in the following blanks.
     a) Sick days ___________ (number of days)  
     b) Vacation ___________ (number of days)  
     c) Unpaid days away ________ (number of days). Total lost wages: $________

5. Over the months during the study, was SOMEONE ELSE away from work because of your heart failure condition, including accompanying you to Heart Failure Clinic visits?
   - ☐ No  
   - ☐ Yes. Please fill in the following blanks.
     a) Sick days ___________ (number of days)  
     b) Vacation ___________ (number of days)  
     c) Unpaid absence ________ (number of days). Total lost wages: $________

6. Over the months during the study, how much money does your heart failure condition cost you (out-of-pocket) in each of the following categories?
   a) Travel and parking costs: $________
   b) Medication costs: $________
   c) Other: $________ Please specify source: ____________________________________________
7. In the months during the study, how many times were you visited by a home health care nurse?
   ______________ times

8. In the months during the study, how many times did a home health care nurse call you when a
   visit was not scheduled for that day?
   ______________ times

9. In the months during the study, how many times did you visit the Emergency Department
   because of your heart failure condition?
   ______________ times

10. In the months during the study, how many times were you admitted to a hospital because of
    your heart failure condition?
    ______________ times

11. In the months during the study, how many nights in total did you stay in hospital because of
    your heart failure condition?
    ______________ nights

12. In the months during the study, have you visited the Emergency Department and/or admitted to
    the hospital because of reasons OTHER THAN your heart failure condition?
    □ No
    □ Yes. Please specify: ________________________________________________________
B. Experiences with Heart Failure Self-Care

Think about how you have been feeling in the last 3 months as you complete these items.

SECTION A:

Listed below are common instructions given to persons with heart failure. How routinely do you do the following?

<table>
<thead>
<tr>
<th></th>
<th>Never or rarely</th>
<th>Sometimes</th>
<th>Frequently</th>
<th>Always or daily</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Weigh yourself?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. Check your ankles for swelling?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. Try to avoid getting sick (e.g., flu shot, avoid ill people)?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. Do some physical activity?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. Keep doctor or nurse appointments?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. Eat a low salt diet?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. Exercise for 30 minutes?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. Forget to take one of your medicines?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9. Ask for low salt items when eating out or visiting others?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. Use a system (pill box, reminders) to help you remember your medicines?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

SECTION B:

Many patients have symptoms due to their heart failure. Trouble breathing and ankle swelling are common symptoms of heart failure.

In the past month, have you had trouble breathing or ankle swelling? Circle one.

   1) No
   2) Yes

11. If you had trouble breathing or ankle swelling in the past month...

<table>
<thead>
<tr>
<th>Have not had these</th>
<th>I did not recognize it</th>
<th>Not Quickly</th>
<th>Somewhat Quickly</th>
<th>Quickly</th>
<th>Very Quickly</th>
</tr>
</thead>
<tbody>
<tr>
<td>How quickly did you recognize it as a symptom of heart failure?</td>
<td>N/A</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Listed below are remedies that people with heart failure use. If you have trouble breathing or ankle swelling, how likely are you to try one of these remedies?

(circle one number for each remedy)

<table>
<thead>
<tr>
<th>remedies</th>
<th>Not Likely</th>
<th>Somewhat Likely</th>
<th>Likely</th>
<th>Very Likely</th>
</tr>
</thead>
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<tr>
<td>12. Reduce the salt in your diet</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>13. Reduce your fluid intake</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>14. Take an extra water pill</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
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<td>15. Call your doctor or nurse for guidance</td>
<td>1</td>
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<td>4</td>
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</table>

16. Think of a remedy you tried the last time you had trouble breathing or ankle swelling. (circle one number)

<table>
<thead>
<tr>
<th>remedies</th>
<th>Not Sure</th>
<th>Somewhat Sure</th>
<th>Sure</th>
<th>Very Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>I did not try anything</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How sure were you that the remedy helped or did not help?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

SECTION C:

In general, how confident are you that you can:

(circle one number)

<table>
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<th>remedies</th>
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C. Living with Heart Failure

The following questions ask how much your heart failure (heart condition) affected your life during the past month (4 weeks). After each question, circle the 0, 1, 2, 3, 4 or 5 to show how much your life was affected. If a question does not apply to you, circle the 0 after that question.

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<th>Did your heart failure prevent you from living as you wanted during the past month (4 weeks) by -</th>
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### D. Your Thoughts on Home Monitoring

Please circle the number that best represents whether you agree or disagree with the following.

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<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
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<td>2</td>
<td>3</td>
<td>4</td>
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<td>3</td>
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<td>5</td>
<td>0</td>
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<tr>
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<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
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<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>0</td>
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<tr>
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<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>0</td>
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</table>
E. Your Thoughts on the Heart Failure Monitoring System

Please circle the number that best represents whether you agree or disagree with the following.

<table>
<thead>
<tr>
<th></th>
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<th>Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>I Don't Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The monitoring system was important for managing my heart failure condition.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>Learning to operate the monitoring system was easy for me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>I found it easy to get the monitoring system to do what I wanted it to do.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>It was easy for me to become skillful at using the monitoring system.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>I found the monitoring system to be easy to use.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>I think using the monitoring system improved my health.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>Taking my blood pressure at home was easy.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8</td>
<td>Taking my weight was easy.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>I would choose to continue using the monitoring system.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td>The benefits of home monitoring outweigh my concerns about privacy.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>11</td>
<td>The mobile phone was useful to me to look up my health information.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
12. To continue using the monitoring system, I would be willing to pay up to:
   ☐ $200 or more per month
   ☐ between $100 and $199 per month
   ☐ between $50 and $99 per month
   ☐ between $25 and $49 per month
   ☐ between $10 and $24 per month
   ☐ between $1 and $9 per month
   ☐ I would not pay to use the monitoring system

13. To continue receiving home care nursing, I would be willing to pay up to:
   ☐ $200 or more per month
   ☐ between $100 and $199 per month
   ☐ between $50 and $99 per month
   ☐ between $25 and $49 per month
   ☐ between $10 and $24 per month
   ☐ between $1 and $9 per month
   ☐ I would not pay to receive home care nursing

14. Please provide any other comments that you would like to add.


THANK YOU FOR COMPLETING THIS QUESTIONNAIRE
Appendix T - Outcome Measures Evaluation Matrix

<table>
<thead>
<tr>
<th>Metric/Measureable Outcome</th>
<th>Source/Method of Collection</th>
<th>Significance/Possible Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Client Self-Care</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self care (Self Care of Heart Failure Index- SCHFI)</td>
<td>Client self-report of 6 months prior to study (pre-study questionnaire) and during study period (post-study questionnaire).</td>
<td>May see an improvement in SCHFI when comparing pre-study to post-study results.</td>
</tr>
<tr>
<td>Frequency of performance of self-care</td>
<td>Look at UHN monitoring system data/adherence alerts. Access via telemonitoring website or manually on client's study telephone.</td>
<td>For statistics purposes (nothing to compare to?). May see a high adherence to self-care. E.g. clients took their weight/BP an average of 94% of the days.</td>
</tr>
<tr>
<td>Health Outcomes for Better Information and Care (HOBIC) - Therapeutic self-care, ADL, Dyspnea</td>
<td>Home healthcare nurse performs this measure at initial assessment or reassessment (for existing clients) and at end of study (reassessment) or discharge (discharge assessment).</td>
<td>May see an improvement in the HOBIC scores when comparing results from initial assessment to end of study/discharge.</td>
</tr>
<tr>
<td><strong>Health Outcomes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood pressure, heart rate, and weight</td>
<td>Values from monitoring system at start of study and at end of study. Could also look at variability of values over study period.</td>
<td>May see an improvement in these values when comparing results from initial assessment to end of study/discharge. May see less variability; e.g. more stable maintenance of BP.</td>
</tr>
<tr>
<td>Quality of life (Minnesota Living with Heart Failure Questionnaire- MLHFQ)</td>
<td>Client self-report of 6 months prior to study (pre-study questionnaire) and during study period (post-study questionnaire).</td>
<td>May see an improvement in MLHFQ when comparing pre-study to post-study results.</td>
</tr>
<tr>
<td>Mortality</td>
<td>ParaMed manual chart review on deaths during the study and average deaths in similar HF clients during the same 6 month period, 1 year prior.</td>
<td>May see a reduction in mortality rate when comparing the study group to a similar group during the same 6 month period, 1 year prior.</td>
</tr>
<tr>
<td><strong>Home Care Delivery</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td># of scheduled nurse home (site) visits</td>
<td>ParaMed manual chart review on remote/site visits during the study and average HF visits during the same 6 month period, 1 year prior.</td>
<td>Likely no change in scheduled nurse home visits when comparing the study group to a similar group during the same 6 month period, 1 year prior.</td>
</tr>
<tr>
<td># of unscheduled/alert nurse home visits</td>
<td>Likely to see an increase in # of unscheduled/alert nurse home visits.</td>
<td></td>
</tr>
<tr>
<td># of remote visits</td>
<td>May see an increase in # of remote</td>
<td></td>
</tr>
<tr>
<td><strong>Perceptions towards reduced home visits and increased remote visits while using the monitoring system</strong></td>
<td><strong>Post-study interview of both clients and home healthcare nurses.</strong></td>
<td><strong>May see a high report of willingness towards reduced home visits and increased remote visits while using the monitoring system from both clients and home healthcare nurse.</strong></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>Perceptions on replacing some home visits with remote visits</strong></td>
<td><strong>Home visit log filled out after each site home visit, and post-study interview of home healthcare nurses.</strong></td>
<td><strong>Home healthcare nurse may report that they would feel clinically-confident in replacing some home visits with remote visits. Remote visits are far more efficient in terms of time, cost, and convenience for both client and clinician. If some home visits could be replaced with remote visits without a drop in care/health outcomes, this could drastically improve the efficiency of home care delivery.</strong></td>
</tr>
<tr>
<td><strong>Perceptions that remote visits prevented a future unscheduled alert/urgent nurse home visit</strong></td>
<td><strong>Modified telephone advice form filled out after each remote visit and post-study interview of home healthcare nurses.</strong></td>
<td><strong>Home healthcare nurses may report that they were clinically-confident that a remote visit they performed prevented a future unscheduled urgent/alert home visit.</strong></td>
</tr>
</tbody>
</table>

**Health Care System Usage**

| # of ED visits because of HF | Client self-report of 6 months prior to study (pre-study questionnaire) and during study period (post-study questionnaire). Also, chart review of similar HF clients during the same 6 month period, 1 year prior. | May see a reduction in overall hospital usage when comparing the study group pre and post; also when comparing to a similar group during the same 6 month period, 1 year prior. |
| # of hospital admissions because of HF | Billing rate of HF clients during study period and during the same 6 month period, 1 year prior. Billing rate calculated using length of stay, number/type of visits, and cost of visit. | Likely to see an increase in cost. May see a reduction if hospitalization taken into account, or if reduced home visits and increased remote visits (at a new CCAC billing rate) |
| Average length of hospital admission because of HF | | |
| Comparison of cost of HF case | | |

**User Satisfaction**

| Efficacy/ease of use of the system | Post-study interview of both clients and home healthcare nurses. Also post-study questionnaire for clients. | Both clients and home healthcare nurses may find the system useful and easy to use. They would be willing to permanently incorporate the system into their daily routine and workflow, respectively. |