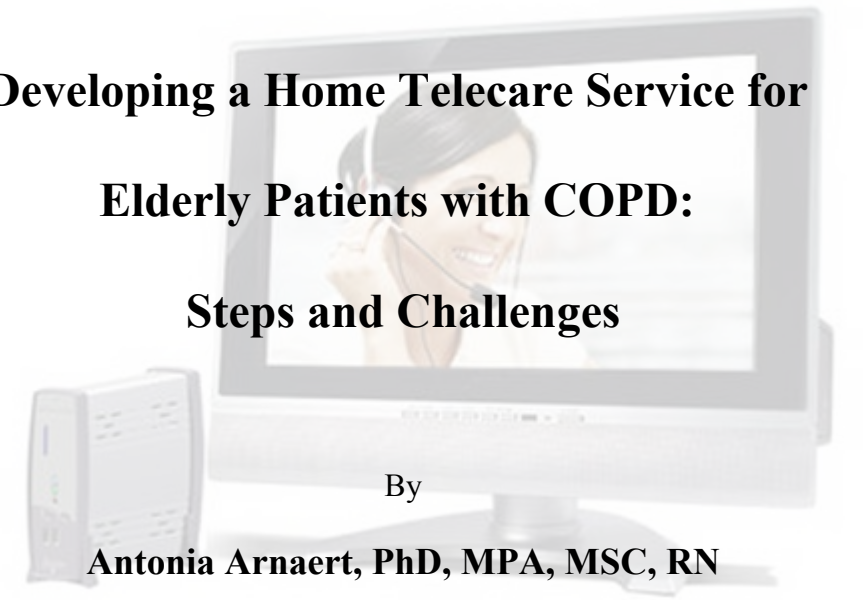

Developing a Home Telecare Service for Elderly Patients with COPD: Steps and Challenges

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ABSTRACT

Home telecare (HTC), including remote monitoring and interactive video, is increasingly seen as a promising avenue for the timely provision of nursing interventions from a distance to patients at home. While empirical evidence are published regarding satisfaction, costs, suitable patient-populations and clinical outcomes, only three articles outlined the challenges that must be anticipated and taken into consideration to take into account before planning a new HTC service. This type of initial information is crucial for understanding the steps involved, and the challenges that need to be overcome in developing such a service. This article describes the process our team went through in designing a feasibility study which involved the implementation of a HTC service for elderly patients with Chronic Obstructive Pulmonary Disease (COPD), and adds to the limited amount of procedural data currently available regarding HTC. In this paper we briefly review the literature on HTC for COPD patients, describe our research methods which include how our team members were involved and their roles, and present the steps and challenges we faced in running this service. The primary challenges included: 1) team building, 2) Tele-nurse training 3) patient recruitment and installation of the HTC technology, and 4) dealing with technology-related issues. The discussion focuses on three main areas discovered to need improvement prior to conducting future studies: 1) building nurse and patient-training, 2) defining clear roles and responsibilities for the clinical team, and 3) utilizing more user-friendly technology.

Introduction

Home Telecare (HTC) is the use of remote monitoring devices and interactive video-conferencing technology over the Internet. It is increasingly seen as a promising avenue for the timely provision of nursing interventions from a distance to patients at home (Celler, Lovell, & Chan, 1999). While empirical evidence is published regarding satisfaction, cost-effectiveness, suitable patient-populations and clinical and health-related quality of life outcomes for patients and their family caregivers (Bowles & Baugh, 2007), only three articles indicated anticipated challenges to be considerations to take into account before planning a new HTC service (Kinsella, 2003; Krause, 2004; Walsh & Coleman, 2005). However, this kind of data is key for understanding what steps are involved and what challenges need to be overcome when developing such a service. Researchers, clinicians, and healthcare administrators may be encouraged by research findings however they are at a loss when having to consider such important questions as: "H*ow much and what kind of training do nurses need to deliver HTC?" "How soon after hospital discharge can patients realistically start using HTC?" "What are the technological glitches?"*

This article describes the processes our clinical team went through in designing a study and implementing a HTC service for elderly patients with Chronic Obstructive Pulmonary Disease (COPD) and thereby contributes to the limited amount of methodological data currently available regarding HTC. Although two remote monitoring studies for patients with COPD and Congestive Heart Failure (CHF) are up and running in Québec, Canada (Canada Health Infoway, 2007), this study is the first in the province to implement remote monitoring, coupled with interactive video between the patient and the nurse. This paper begins by reviewing the HTC literature for COPD patients, followed by a description of the research methods which includes all team members and

their roles. The process section describes the steps and challenges we faced in the beginning of this three-month feasibility study. In the discussion we address some of the areas in need of improvement in more depth and make recommendations for stakeholders involved in the realization of HTC technologies and services.

Background: COPD and Home Telecare

COPD is a slowly progressive lung disorder with a steadily increasing prevalence and mortality, particularly in older people (Nazir, Al-Hamed, & Erbland, 2007). For patients 65 years and older COPD accounts for 20% of the total hospitalizations (Lee, Lee, Iris, Mackenzie, & Ho, 2002; Mannino, 2002), mainly due to acute exacerbations (O'Reilly, Williams, Holt, & Rice, 2006). Beyond the financial impact that this chronic disease has on the healthcare system (Miravitlles, Murio, & Guerrero, 2002), COPD also affects patients and their families' quality of life. It has been shown that feelings of isolation, depression and associated loss of physical capacity contribute to hospital readmissions for COPD patients (Harris, 2007).

In the trajectory of a chronic illness, patients must constantly learn new skilled behaviors to help them self-manage their disease (Bourbeau & Nault, 2007). It has been shown that education, regular follow-up and support from a homecare nurse can help COPD patients and their families cope better and in some cases reduce hospital admissions (Barnett, 2006; Piette, Weinberger, Kraemer, & McPhee, 2001; Weingarten et al., 2002). As statistics indicate that 80% of elderly people who live at home manage one or more chronic diseases (Health Canada, 2002) and require frequent nursing follow-up visits (Finkelstein, Stuart, Demiris, Veen, & Lundgren, 2004), new modes of service delivery, complementary to traditional homecare services, are needed.

HTC, enables a healthcare provider at the clinical site to communicate and to provide care and support to patients at home, and is therefore considered a technical innovation capable of meeting the demand for quality homecare while remaining cost-effective and efficient in the context of nursing shortages (Dittmar, Axisa, Delhomme, & Gehin, 2004; Hebert, Korabek, & Scott, 2006; Herzog, & Lind, 2003). Some American studies have reported that, although initial care delivery costs increased due to the equipment costs, overall costs of care were reduced due to decreased hospital charges and travel costs (Benatar, Bondmass, Ghitelman, & Avital, 2003; Bowles et al., 2007; Johnston, Wheeler, Deuser, & Sousa, 2000).

Furthermore, there are potential cost savings in manpower, as estimates of the number of traditional homecare visits that could be enhanced or replaced with HTC range from 12% (Black, Andersen, Loane, & Wootton, 2001) to 86% (Scott, 2002). HTC for the elderly has shown that the delivery of nursing care improved a number of outcomes, including patients' health, level of autonomy, and quality of life (Arnaert & Delesie, 2005; 2007). Even though some elderly people may harbor negative attitudes towards technology (Demiris et al., 2004), most studies report that they are receptive to and satisfied with HTC (Arnaert, Klooster, & Chow, 2007; Mass M Johnson-Mekota et al., 2001). Studies have shown that HTC can be used for health assessment, managing symptoms and teaching the elderly to manage their chronic illness (Barlow, Singh, Bayer, & Curry, 2007), including COPD and CHF (Kobb, Hoffman, Lodge, & Kline, 2003; Louis, Turner, Gretton, Baksh, & Cleland, 2003; Meyer, Kobb, & Ryan, 2002). Currently the existing literature on HTC is dominated by studies of people with diabetes (31%), and CHF (29%), but COPD accounts for only 3% of the research on HTC (Barlow et al., 2007).

Feasibility Study

Home Telecare Service

The goals of this study, presently running with three COPD patients (See Table 1), were to test the HTC technology, become familiar with the COPD patient population and their needs, uncover the challenges involved in implementing HTC from both the patient and nurse perspective, and test the appropriateness of various measurements, inclusion/exclusion criteria and interview guides in anticipation of a future, larger study. For three months, on every weekday between 9:00 am and 11:00 am, each patient had a scheduled HTC visit free of charge for up to 30 minutes with one of the three participating tele-homecare nurses. We chose to have daily HTC visits in order to explore the possibility of patients needing different levels of nursing interventions over time following discharge from the hospital. The Living Well with COPD™ action plan, a tool for teaching COPD self-management and developed by Bourbeau et al. (2003), guided the nurses' care plans. The tele-nurse's role is to reinforce and support what the patients had already learned about their action plan during their hospitalization so that they could better interpret and manage their symptoms at home. All three study patients received homecare services from community health centers for nursing and specialized respiratory care as part of their discharge plan from the hospital. HTC was thus offered as an additional service and did not affect their usual care from these community health centers.

In addition to the data gathered on patients' subjective and health-related quality of life and their satisfaction with HTC based upon both human and technical factors, the tele-nurses completed the electronic nursing log, developed by the principal investigator (first author), after each HTC visit. This log was installed on a separate desktop computer because to have installation it on the

same terminal as the HTC software would have required additional technical configuration. The purpose of the log was to gather data on the types of nursing interventions performed during visits, document interventions carried out after visits and the patient's use of health services, capture information on the technical aspects including picture and sound quality, and nurse's satisfaction with the HTC visit.

Home Telecare: A Team Effort

The HTC study was a joint effort among all team members: the homecare nurses (tele-nurses), and the president of the private homecare company *Health Access Santé* (HAS), the COPD network case manager from the hospital that referred the participants (the referring hospital), the technology provider, the principal investigator and the Nursing research coordinator (second author) from Nursing. We referred to this team as the 'clinical team' since they managed the day to day operation of the service.

Private Homecare Company

Health Access Santé delivers homecare services to about 130-150 clients in Montréal. Currently, the company employs approximately 65 nursing aides and two part-time homecare nurses, who perform the initial patient-assessments and design the care plans, which they communicate with the nursing aides. The participation of HAS in this service was born out of the president's keen interest in HTC as a tool for providing nursing services aimed at maintaining patients' autonomy and fostering their ability to manage their health at home for as long as possible. Her contribution has been both infrastructural and financial. The nurse HTC terminal is set up at the

company's office and all costs related to the purchase of HTC technology, HTC software leasing, e nurse remuneration for training and conducting HTC visits, and Internet bill payment for the study participants when necessary, were absorbed by the company.

Both of the part-time nurses (Nurse N1, Nurse N2) performed the HTC visits in addition to their regular caseload from Monday to Thursday. A third nurse (Nurse N3) was hired to deliver HTC on Fridays. Although a third nurse was initially considered not necessary, it was judged important to have a third nurse trained and experienced in HTC, in case one of the others could not participate in the study. The age of these female nurses ranged from 34-58 years and their years of nursing practice in homecare varied: Nurse N1 had five years of experience; Nurse N2 had more than two years and Nurse N3 had more than three years. Their previous experience with HTC also varied. Prior to this study, Nurse N1 completed a distance-learning HTC training course which involved roughly 50 hours of coursework, assignments and examinations; and Nurse N3 participated in a HTC study as a tele-nurse for six months duration in another Canadian province during which time she followed 10 patients. Only Nurse N2 had no previous experience with HTC.

COPD Network Case Manager

The COPD network case manager employed by the referring hospital, and was an invaluable resource person throughout this study due to his expertise with COPD clientele. He carried out two main roles within this study: 1) training of the tele-nurses in COPD and the Living Well with COPD™ action plan (as described in the following section), and 2) recruiting eligible study participants. The inclusion criteria were: 1) COPD diagnosis, 2) hospital admission with a primary diagnosis of COPD or pneumonia, 3) at least one hospitalization in the past 12 months, 4) discharged directly to home, 5) live in Montréal, 6) age of 60 years of age and over, 7) live alone, 8) have a poor social support network, 9) speak French or English, 10) be capable of giving informed

consent, and 11) a sufficient level of cognitive, visual and auditory function to permit self-operation of a HTC terminal. The study's aim was to recruit at least one eligible patient per week.

In terms of recruitment, the COPD network case manager first reviewed the patients' charts and identified eligible patients who matched the inclusion/exclusion criteria. In a second step, he narrowed the list of eligible patients in order to select one patient who he considered could potentially benefit significantly from this service. The network case manager spent approximately 30 minutes to an hour introducing the study to the selected patient and explained how he/she could benefit from the service. If the patient agreed, the research coordinator then met with the patient on the ward to futher explain the study and to obtain consent.

Technology Provider

The HTC software used in this study was a prototype web-based application that combined remote monitoring and video-conferencing, and runs on a standard desktop computer for the patients and laptop computer for the nurses. The nurse activated the connection with the patient's terminal at previously agreed-upon times, and controlled most aspects of the system, including most of the medical devices for remote monitoring, such as the pulse oxymeter, blood pressure cuff, scale, and stethoscope. These devices were connected to each patient terminal via USB or through wireless interfaces. Image and sound could be controlled by the patient to maintain privacy. The technology provider was responsible for the installation of the patient and nurse terminals and provided them with continuous training and technical support.

Process: Steps and Challenges

Throughout the study the research coordinator kept track of the steps we took and the challenges the team faced in planning, designing and implementing the HTC service. The field

notes kept included a timeline and notes from various in-person, telephone and email correspondence with members of our clinical team, both from one-on-one interactions and as a group. Four categories of challenges emerged, as encountered during the initial portion of the study: 1) team building, 2) tele-nurse training, 3) patient recruitment with subsequent installation of the HTC technology, and 4) dealing with technology-related issues.

Team Building

Nearly one year prior to the realization of this HTC study, the HAS president and the principal investigator began to exchange ideas about the use of HTC. The president explored the various options in HTC technology, while the principal investigator explored research funding opportunities and developed a partnership with the referring hospital's respirologist and COPD specialist. The respirologist involved both his research group and clinical team in this study, particularly the COPD network case manager, in this study. The authors held two separate meetings (one with the president of HAS and the other with the respirologist) in order to discuss research methods, training of the nurses about COPD, the use of the action plan, patient recruitment procedure, and the coordination of HTC with patients' other homecare services. This last point pertaining to coordination was particularly important. Not only was there a need to foster strong ties within the clinical team but also amongst the tele-nurses and the other homecare nurses who cared for the patients.

Coordinating this diverse team was complex but effective communication and collaboration was exceptionally fruitful and essential for the success of this type of service (Anagnostopoulos & Bamidis, 2003). Bi-monthly conference phone calls with the clinical team were found to be very helpful. In these conference calls, team discussion included technical and installation issues,

recruitment, patients' well-being and the participating nurses' perspectives in order to make joint-decisions regarding future directions. Occasionally, patients' other homecare nurses or COPD nurse have joined-in on these valuable conference calls.

Training of the Tele-Nurses

The tele-nurses were not initially specialized in COPD or in the use of the action plan. Although two of the three nurses had experience with HTC in the past, the technology system used in this study was new to all three. Therefore, they received three stages of training: 1) an introduction to the concept of HTC, the research components and the electronic nursing log, 2) a training day on COPD and the Action Plan at the referring hospital, and 3) training on the use of the HTC software and its devices.

Introduction to the Research

The principle investigator initially gave a presentation at HAS which lasted approximately 90 minutes so that participating nurses clearly understood their role in the study from both a research and clinical point of view. It included a description of the study purpose, its objectives, the data collection procedure and an overview of research in the area of HTC for elderly people with chronic illnesses. The feedback from the nurses on all aspects of this study was very useful in developing a more patient-centered HTC service. The participants were also introduced to the electronic nursing log, which was followed up with a more detailed training at a later date that lasted for two hours.

COPD and the Action Plan

A one-day training session for the participating nurses was provided at the referring hospital. It was led by the COPD network case manager and the respirologist's research assistant, which included presentations by the network case manager, the social worker and a COPD nurse from the pulmonary rehabilitation clinic of the referring hospital. The HAS president, principal investigator and research coordinator were also present for this session. The nurses received training and materials at that time on: COPD symptomatology, etiology and epidemiology, medications, types of inhalation techniques, psycho-social issues faced by COPD patients and family caregivers, the HTC action plan, and other medical and social services available to patients in the community.

Technology Training

A technology specialist offered the third level of training which related to using the HTC software and hardware. In light of a previous study's findings (Mair et al., 2002) that insufficient training of nurses can become an obstacle to implementation, our study began the staff HTC training one month prior to the recruitment of the first eligible patient. This involved five areas of training that occurred in this sequence: 1) group training, 2) one-on-one training, 3) remote HTC sessions between the HTC technician located at their office and the nurses located at HAS, 4) HTC sessions with both patient and nurse terminals installed in the office, and 5) HTC sessions with a patient terminal set up in the home of Nurse N2 and the nurse terminal at HAS's office. The first two types of HTC training involved in-person teaching and orientation for the software and interface with the HTC technician. The other kinds of training were considered 'play-time', whereby nurses practiced using the system, either with the HTC technician or another tele-nurse

acting as a patient. In these initial sessions, they would practice initiating a visit and using all the medical devices. The nurses received an average of 11.5 hours of HTC training prior to the implementation of the service (See Table 2). Nurse N3 was not as available for certain meetings or some training sessions due to her other job responsibilities.

Patient Recruitment and Installation of the Home Telecare Technology

Choosing appropriate patients for HTC is challenging yet extremely important for ensuring that the service truly benefits patients (Kinsella, 2003). The network case manager found the study's inclusion criteria for 'being over 60 years of age' and 'lives alone' problematic. For instance, during the third recruitment week he was unable to find an eligible participant who met the 'lives alone' criteria, despite the fact that 19 of the 25 patients hospitalized had a primary diagnosis of COPD. Hence, our team decided to be flexible in this feasibility study for these two criteria, seeing that it would not influence the validity of the results to do so. Patient P1 was 83 years old but lived with a companion. Patient P2 lived alone but was 56, and patient P3 was 75 years old but rented rooms in her home. The study wanted to target patients who lived alone because the principal investigator's prior study identified this group as more likely to need increased nursing contact because of their limited social support (Arnaert et al., 2007). However, the study determined that co-habitation did not necessarily mean that patients were well supported in terms of living well with their illness. It was also decided that patients with MRSE (Methicilin-Resistant Straphylococcus Epidermidis) be excluded from this study. However, we have since identified safe sanitizing options for the HTC equipment and will consider including this population in future studies.

During meetings with the respirologist and his team prior to the implementation of the HTC service, it was suggested that patients should have the computer terminals installed and functioning in their homes within 48-72 hours following hospital discharge because patients particularly need of support when first returning home from the hospital. Unfortunately, commencing HTC visits within 48-72 hours proved to be impossible.

As can be seen in Table 3, it took between five to eight days to finally install and initiate the HTC service. Many factors contributed to this installation delay. First of all, most patients were discharged at the end of the week which meant that the earliest the installation in every case was at the beginning of the next week, such as on a Monday, due to the availability of the tele-nurses and the HTC technicians. Furthermore, the research coordinator had to meet with patients in their home prior to the start of the service in order to gather data about his/her perceptions, attitudes and expectations about HTC. Due to privacy issues, this home-based interview could not be done while the patient was still in-hospital. However, the biggest issue was having the Internet connections set up. Only one patient (P2) had a high speed Internet connection. For the other two patients (P1, P3), the process of setting up an Internet connection was started while the patient was still in the hospital as soon as the research coordinator obtained informed consent. However, organizing a quick set-up for P1 and P3 was not as straightforward as we had expected.

Setting up a computer Internet connection required a service provider to do two things: activate the Internet connection and install a modem. For the sake of simplicity we decided to do business with the telephone company with whom the patient already had an account. We were assured by the company of the patient P1 that they could have Internet functioning within two days. In order to speed the process up we asked that the modem be sent to HAS so it could be installed by a HTC technician instead of by the Internet provider's technician. Despite our best efforts, the

modem for patient P1 did not arrive on the anticipated date and the HTC installation had to be postponed. Moreover, at the time of the HTC installation it was found that the Internet connection had not been activated as it should have been. In addition to the Internet issue, the HTC technician discovered that the room where the patient wanted to install the HTC terminal did not have a phone jack and so a long Ethernet cable was required to complete the installation. Furthermore, despite being assured by the Internet provider that all associated costs would be sent to HAS, the billing the fee for the modem and account set-up was mistakenly sent to the patient. The bills for the monthly service fees were sent to HAS as planned.

Patient's P2 HTC installation was far simpler because she already had high-speed Internet at home. Nevertheless, since she was discharged on a Thursday and the interview with the research coordinator could only occur over the weekend, installation occurred the following week on a Tuesday.

The third patient (P3) did not have the Internet and her phone line provider was a different company than patient P1. However, that company's set up of an Internet service was much more straightforward as the Internet connection was relayed through the same modem as the television and telephone. Therefore, the modem was already in the patient's home and the Internet was activated by a customer service representative over the telephone. The complication with this patient (P3) implementation was coordinating HAS billing for the Internet fees. The research coordinator was told that splitting the bill was impossible due to the fact that each modem could have only one associated billing address. The phone company's solution was to set up a second account and have a second modem installed to solve the billing problem. This involved new installation costs of over 100$ CAD, and extra personnel time, the registration of a new account would take 24-48 hours, the account demand had to be processed, and then it would take about 2-3

days before a technician could install the second modem. Finally, the research coordinator asked if she could simply pay for the Internet fees over the phone every month using a credit card from HAS, so that the payment would simply be deducted from the patient's total. This was possible, yet it required that the patient and research coordinator call the phone company together in order to register the research coordinator as having authorized access to the account. Hence, the research coordinator calls the company every month to pay the Internet fees before the patient (P3) paid the bill. In retrospect, these kinds of issues in a HTC study, such as this one, required creative problem-solving, negotiation and staff perseverance.

Dealing with Technology-Related Issues

On the day of the HTC installation a tele-nurse and the HTC technician showed the patient how to turn the terminal on, begin the HTC visit and use the remote devices with the help of another tele-nurse interacting with them from the HAS's office. Nurse N2 was responsible for all the initial installation visits. She introduced the patient to HAS, completed an initial assessment and performed a physical exam which included chest auscultation, blood pressure monitoring and oxygen saturation. Having a nurse present during the HTC installation, even if a technician is doing the installation, was important (Starren et al., 2005) as it was a valuable first point of contact in the process of nurse-patient relationship building.

Because all HTC visits were pre-scheduled the nurses always initiated the visit. When the nurse 'called' the patient over the system, a bell rang on the patient's terminal and a pop-up message appeared which asked the patient if she would like to accept this visit. Using the computer mouse, the patient clicked once on the square icon 'accept' and the HTC visit began within seconds.

At installation, patients were given a step-by-step instruction sheet for using the system. The nurse's interface was slightly more complex in that there were more features for documenting patient clinical data and the parameters for managing the medical devices were also under the nurse's control. Nevertheless the tele-nurses did not find learning the HTC software difficult. Not surprisingly, they were all familiar with the use of computer-technology both in their professional and private lives. However, despite the simplicity of the HTC software program, technical issues were still encountered, the majority of which pertained to the hardware (physical equipment). A few of these technical issues are described below.

The interaction between technical aspects and human factors was often the reason behind the some of the hardware issues encountered in this study. For example, although patients P1 and P2 were familiar with using a computer mouse, patient P3 was not and found it very difficult to maneuver it to the correct position in order to click 'accept'. We realized that for someone not used to manipulating a mouse, the act of eye-hand coordination to direct the cursor to the correct spot on the monitor was not straightforward. The same patient (P3) faced another technical challenge when her computer was turned off mysteriously and she was unable to turn it back on.

Also, many elderly people have limited dexterity and shakiness which can pose a problem. This dexterity issue thwarted a seemingly simple task for Patient P3, (which highlighted how important it was not to overlook human factors when installing computerized equipment). During installation the computer hard-drive processor for Patient P3 was placed on the floor because the desk was small and it would have been cramped with both the monitor and the processor on it. However, this patient (P3), like many COPD patients, experienced shortness of breath when she bends down to perform tasks, so it was not only physically difficult but also frustrating for her to bend down to attempt to turn her computer processor on. She missed out on two HTC visits before,

on the third day, she succeeded in pressing the 'on' button with the help of a tele-nurse over the telephone. Once she had successfully done so, she was advised to keep her terminal on constantly and she has continued with the service happily.

Another hardware issue encountered in the study involved the pulse oxymeter sensors. After the onset of the study's HTC service, two of the three pulse oxymeters (P1, P2) became damaged and no longer functioned properly. The oxymeter units were wireless and required that the patient plug and unplug the sensor from the wireless transmitter as required. During the act of plugging and unplugging, the metal 'pins' making the electronic connection became bent and the device could no longer provide consistent readings. Patient P2 industriously managed to fix the device herself by straightening the pins with a pair of tweezers. Patient P1 was provided with a new sensor for the study.

Study nurses and patients also struggled with using the stethoscope. During one of the conference calls the team decided to stop utilizing it, because patients found it frustrating to use and nurses expressed uneasiness with the sounds encountered. The nurses expressed that they did not feel confident that what they were hearing was 'accurate' and therefore diagnostic accuracy or values might not be valid. It is still unclear whether the 'static-like' noise reported by nurses was due to patients not holding the device correctly or whether there was some other technical fault. On one occasion a homecare nurse from another community health center was visiting patient P2, while the HTC visit was in progress. The tele-nurse asked the homecare nurse to try using the stethoscope for herself and the homecare nurse confirmed that there was a lot of interference and that she would not feel comfortable assessing a patient based on what she heard.

In addition to some of the more concrete examples of technology-related issues described above, there were also some miscellaneous inconveniences throughout the first half of the study's

service. Occasionally there are interruptions with sound and image quality, characterized by 'image freezing' and 'sound lag'. We hypothesized that these unpredictable and sporadic interruptions may be related to the Internet network traffic. For future studies, the HAS president will consider purchasing a separate high-speed Internet connection solely for HTC visits. Furthermore, just as the computer of patient P3 was turned off mysteriously, wires occasionally became unplugged or hardware failed without explanation. For example, for two days nurses were unable to hear patient P1. When the HTC technician went to the home he found nothing wrong with the patient's microphone and it spontaneously began working again. Battery and power supplies needed for the study were another issue. We found that batteries depleted much faster than expected and there were instances where a home visit by the HTC technician was needed to replace batteries with power cords. Although this problem with batteries and power cords was a minor issue in terms of complexity, it was something that caused frustration for patients and required additional home visits.

Discussion

Our experience with implementing a HTC service for elderly patients with COPD has uncovered three main areas in need of improvement before conducting another study in the future: 1) building on nurse and patient-training, 2) defining clear roles and responsibilities of the clinical team, and 3) utilizing more user-friendly technology.

Building on Nurse and Patient-Training

Training of the tele-nurses is an exceptionally important component for success. We believe our five-stage design of tele-nurse training was useful considering it was the first study of its kind

for the participating nurses, the homecare company, and the technology provider. Beyond knowing the software's features and functioning we believed tele-nurses needed to become familiar with the HTC system from the patient's perspective. We achieved this by first having the patient terminal set-up at HAS so that the nurses could practice with each other. Nurses must feel confident with a HTC system if they are to troubleshoot minor problems and encourage patients' interest in the use of the technology (Finkelstein, Speedie, Lundgren, Demiris, & Ideker, 2001; Krause, 2004). The patient terminal was then installed in one of the nurse's homes as a way of simulating a real patient's home environment. Just as Krause (2004) found it helpful to allow nurses in her agency to bring the HTC equipment home to practice, we found 'play-time' very useful as an element of their training. However, despite exploring the system through the five stages of training, nurses still had much to learn. Similar to Finkelstein et al.'s study (2004), the study nurses\ keen interest to learn of about HTC, in addition to the availability of technology provider support, were fundamental for continuous and successful training. We recognized that training was an ongoing process, as research has shown that becoming comfortable and competent with HTC could take up to six months (Kinsella, 1998).

Although formal patient-training was minimal in this study, because it was assumed that patients would learn as they go along, we would increase formal patient training component , in future studies for HTC. Starren et al.'s (2005) study also found that they had underestimated patient-training needs and concluded that training needed to be a larger component of the installation process. We, on the other hand, have come to the conclusion that installation and training for the patient should occur on separate days. We found that asking patients to participate in installation and training in the same day was too demanding on them, due to the fatigue they experience as a result of their illness. While some literature has reported installation times of 15 to

30 minutes (Smith et al., 2002), our study demonstrated thatt installation and training combined took at least two hours. Krauss's (2004) study also found that an 'overload of information' could occur when installation and training occur in the same day, and therefore it was better to have two consecutive visits. From our findings, we suggest that, for elderly COPD patients or similar patient-populations, training should be built into several of the initial HTC visits by having a second tele-nurse present with the patient.

Defining Clear Roles and Responsibilities for the Clinical Team

Open and straightforward information sharing at all stages of HTC service implementation has made this study fulfilling for all team members (Starren et al., 2005). Debate and discussion among clinical team members with such varied perspectives and professional skills during our conference calls has strengthened the study's progrtess immeasurably. In particular, the nurses' motivation and enthusiasm to deliver HTC and their willingness to partake in the research as subjects and data-gatherers has been extremely important.

As supported by Gagnon et al. (2005) and Whitten and Adams (2003), we found that nurses' participation in the design of the HTC service is a major factor for success. Furthermore, the close communication of all team members was exceptionally conducive to improving the service and dealing with unforeseen difficulties along the way. For instance, while discussing the architectural and technical issues faced during the first HTC installation during a conference call, the team decided that a pre-installation check should be done by either the HTC technician or the research coordinator in order to systematically assess power supplies, phone lines, space constraints, the Internet connection if already available and cable needs. Kinsella (2003) identified the pre-

installation check as necessary to ensure smooth installation and patient-safety. This adjustment to the installation process proved to be immensely beneficial. In the case of Patient P2, a technical issue with the configuration of her Internet modem was circumvented due to the pre-installation visit. For patient P3 the research coordinator did the pre-installation check and drew up a physical layout of the patient's home indicating furniture, power jacks, and the location of the desk where the system would be set up which assured that the HTC technician arrived with appropriate supplies. Drawing up a plan of the physical space is supported by Kinsella (2003), however she suggests it be done prior to recruitment as a way of assessing the suitability of the patient for the service. Since we recruited patients during their hospital stay, a home visit prior to discharge was not possible. However, the network case manager and the research coordinator thoroughly explored the issue of home environment suitability, in their discussions with potential study participants..

Although the collaborative approach among all stakeholders was the founding factor of success in this study since it allowed for ongoing adjustment via collective problem solving, joint-planning and good communication, when actually facing the various challenges throughout this study we realized that at times there was disagreement or hesitation about who was responsible for what task. Krause (2004) stated that 'when the entire process [of a HTC service] is documented in a procedural format, individual accountabilities are clear to everyone involved' (p.14).

In our study, although it was clear who was responsible for what in terms of the 'normal' or 'planned' course of events, it became less clear when things did not go according to plan or when problems occurred. Generally, when a technical problem was encountered the tele-nurse communicated with the HTC technician by telephone while remaining in the HTC visit with the patient. In order for the HTC technician to understand the source of a problem that he could not see directly, he would guide the nurse by questions to the patient. For example, he might ask the nurse

to ask the patient 'Do you see two wires coming out the back', in order to uncover if a device had become unplugged. In most cases, the HTC technician was able to help nurses resolve the problem and over time nurses became more confident in troubleshooting some issues without their help. However, if the problem could not be resolved remotely, it was unclear who was responsible for taking the extra time to fix the problem by making a home visit and what constituted a reasonable time for delay when issues occurred. Patient P3 is an excellent example of delays related to computer issues . When her computer was turned off and she was unable to turn it back on, the tele-nurses were not able to have a HTC visit for two days. This brought up the issue of 'who is responsible for making the home visit' in these kinds of situations. While a technology provider is surely responsible for the functioning of its equipment, does turning 'on' a computer constitute a technological problem for which they are responsible? Or, is it the tele-nurse's responsibility to make the home visit? This of course has budgetary implications for all stakeholders. While the small size of this study made it easy to make up for this lack of clarity, in larger studies, with many more patients, this kind of issue could have hindered its success. One factor that contributed to some mis-management of Patient P3 was that she resided on the other side of the city far from the HAS offie, which meant that staff travel there and back would take a few hours. Hardware installation for studies which cover large geographic areas has been shown to be a challenge (Starren et al., 2005). What this study has shown is that city-wide HTC services can encounter travel-related issues, which is one reason why responsibilities and roles must be clearly defined at the onset, and take unforeseen time management and technological issues into consideration.

Utilizing More User Friendly Technologies

One somewhat unexpected study discovery was the frequency of the HTC technology-related issues, particularly those related to computer hardware, remote medical devices and the Internet. HTC publications have historically focused on the successes of implementation and have spent relatively little time quantifying difficulties, except anecdotally. However, our experience is not inconsistent with that reported by Dansky and Bowles (2002), who noted that one fourth of HTC connections failed because of technology-related factors.

Participants in this study were not only elderly but also severely ill with COPD. Their ability to troubleshoot technological issues and manipulate medical devices for themselves was not only limited by their inexperience with computer-technology but also by their complicated and severe health profile (Frantz, 2003). The network case manager had predicted that physical factors such as using the omputer mouse, clicking 'accept', and using the devices would be the most difficult things for patients. His prediction was accurate, as can be seen in the example of Patient P3 with difficulties using her computer mouse. Hence, our team has discussed the importance of developing a more user-friendly system that caters to a wide range of user-skills, in order to improve the relationship between patients and computers (Brownsell et al., 1999; Chou & Hsiao, 2006). The computer processors we used are black and the power buttons were very small, so we would pro-actively place brightly colored stickers on the computer power buttons and devices for the patients' convenience, which were colour coordinated to the accompanying step-by-step HTC instruction sheets. Instead of using the mouse to operate the computer, other options will be considered, such as fingerprint biometric recognition or using touch screens with icons (Allen et al., 1991). In addition, we are considering using either laptops or horizontally-oriented computer hard drive processors

upon which the monitors can be placed. These ergonomic options are interesting as they take up less space in the patient's home. However, one pitfall we can foresee with laptops for instance, is that they may be more tempting to 'move' and therefore be more likely to be damaged. Furthermore, since prices vary with features, smaller, but more powerful computers will inevitably be more expensive.

Similarly, in terms of the remote devices, currently, finding user-friendly yet affordable models at present is a challenge. Many of the devices used in this study were not easy to manipulate particularly by elderly people, such as the pulse oxymeter. While the shakiness of the patients' hands may have accelerated the damage caused to the devices, it remains clear that the device is not designed for durability or for easy use by elderly people. Changing batteries in the devices can also be a challenge for certain elderly patients. As indicated by Frantz (2001) one of the most important considerations when choosing a remote device is the compatibility of the technology with the patient's capabilities.

The case of the electronic stethoscope is another example. It is important to first acknowledge that, since the tele-nurses were not familiar with patients' baseline lung sounds it was hard for them to assess whether what they were hearing reflected degeneration or simply a normal state for the patient considering their advanced lung disease. Nurse N2 said that when she explained to the patient that she was not hearing much air movement in the lungs the patient said 'that's normal for me'. Furthermore, we must not overlook the importance of human factors. Auscultation is not an easy skill to perform especially for elderly patients on themselves. It may or may not be feasible for elderly patients to perform auscultation on themselves, no matter how user-friendly the technology is, which may be an indication that patients need more training. Evidently, these factors complicate our ability to pass conclusive judgment on the technology, which was successfully tested by the

technology provider in another context prior to the start of this service. Nevertheless, whether or not the failure of the stethoscope was due to human factors, faulty technology, or a combination of both, its design certainly contributed to frustrations. For example, the 'on' and 'off' buttons were small in size, as were their associated lights. Patients reported that they struggled with turning it on, and recognizing whether it was on or off. If a problem was encountered when using a device, for whatever reason, struggling to determine something as simple as whether the device is on or off is tiresome for patients and nurses alike, and magnified study frustrations. We support Moore's (2005) assertion that HTC technologies need to capitalize on older adults' strengths and minimize their weaknesses. After all, the clientele in most need of HTC in the near future will not be young, healthy, technologically savvy patients, but rather patients who are older, perhaps less familiar with technology and computers, who have complicated health profiles and physical limitations. It is certain that ease of use will be an important factor for determining the future of HTC and the achievement of its full potential (Hughes, 2001; Wakefield, Holman, Ray, Morse, & Kienzle, 2004).

Final Recommendations

Our experience demonstrates that despite great strides in technological sophistication the fundamental challenge to HTC is the same as it was in the 1990s: technology user-friendliness (Allen et al., 1991).Technology's sophistication must come to be understood not only in terms of a product's advanced features and capacities but also its compatibility with the capabilities and motivation of the users for whom the technology is intended (Frantz, 2001). We believe that users, particularly elderly users, should be involved in the development and designing of HTC technologies. Frantz (2003) stated that the best way to determine whether a remote monitoring

device is accurate, consistent, and reliable is to use and test it. In the meantime, we suggest that any HTC service team include a healthcare provider familiar with the targeted patient-population. This team member should explore the various HTC technology models available on the market alongside the technology provider in order to make the most appropriate selection based on users' needs. Hensel et al.'s (2005) review provides a useful model for thinking about the various factors affecting user-perceptions of obtrusiveness of HTC technologies, including user-friendliness.

Furthermore, Internet-providers must acknowledge that their current policies and services have to be changed if they are to contribute to this healthcare wave of the future. In the present study we found that trying to organize quick Internet set-up, organizing an appropriate billing agreements and following various policies was unnecessarily difficult and time consuming.

In terms of the research and Nursing mandate in HTC, there is a need for guidelines, policies and standardized protocols for the provision of nursing care via HTC technologies (Rice, 2006). It is also paramount that HTC's contribution to the healthcare profession and to patients be integrated into nursing education; something which has received support from nurses engaged in telehealth (Grady, Schlachta-Fairchild, & Elfrink, 2005). In order to design appropriate nurse-training, more needs assessment research is required to identify the skills and aptitudes tele-nurses must possess in order to provide quality HTC care.

Although we encountered various technology-related issues during the first portion of this study, our preliminary findings suggest that daily video-interaction by patients with nurses who exhibit positive attitudes towards nursing informatics and who are knowledgeable about COPD self-management has helped these patients gain confidence and skills in managing their chronic illness at home. At present, the response of patients to their study participation been very positive. Our analysis thus far suggests that an approach to research and implementation that values the relative

strengths and expertise of all participants, including nurses, and which prioritizes information sharing throughout all levels of project design and implementation, can buffer technical and clinical challenges and maximize patients' experiences of HTC.

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Table 1: COPD Patients (N = 3): Demographic and Medical Information

	patient P1	patient P2	patient P3
Age	83	56	75
Gender	Female	Female	Female
Domestic Situation	Lives in the home of her 86 year old companion who is legally blind	Lives alone	Lives alone but rents 2 rooms to borders
Dyspnea (difficult or labored respirations)*	Stage 5: Too short of breath to leave the house or out of breath after getting dressed	Stage 5: too short of breath to leave the house or out of breath after getting dressed	Stage 4: Stops to catch her breath after walking 100 meters on level ground
Oxygen at Home	Yes	Yes	Yes
Number of Hospitalization in Past Year	2	3	8
Computer at Home	Yes	Yes	No
Internet at Home	No	Yes	No
Type of Residence	House	Apartment	Condo

* There are five stages of dyspnea which run from stage 1 no difficulty or labored breathing to stage 5 difficult or labored breathing when performing elemental activities.

Table 2: Hours per Tele-Nurse and per Type of Home Telecare Training

HOURS OF HTC TRAINING	Nurse N1	Nurse N2	Nurse N3	TOTAL
1) Group Training	2.5	2.5	2.5	7.5
2) One-on-One Training	1.0	1.0	1.0	3.0
3) Remote practice sessions between trainer and nurses	5.0	4.5	3.0	12.5
4) Practice sessions with patient and nurse terminals at HAS	2.5	2.5	2.5	7.5
5) Practice sessions with patient terminal set up in the nurse's home and the nurse terminal at HAS	2.0	2.0	0.0	4.0
TOTAL	**13.00**	**12.5**	**9.0**	**34.5**

Table 3: Installation Delay of the Patients' Home Telecare Terminals

Participants **(N=3)**	Recruitment Date	Discharge Date	Installation Date	Installation Delay
PATIENT P1	24/01/08	26/01/08	31/01/08	5 days
PATIENT P2	30/01/08	01/02/08	06/02/08	5 days
PATIENT P3	20/02/08	20/02/08	28/02/08	8 days

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