University of Alberta

ASSESSING THE IMPACT OF PORTABLE COMPUTERS ON THE MANAGEMENT OF LOWER LEG ULCERS IN A HOME CARE SETTING

By

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Abstract

Portable computers, including handheld computers and laptop computers, are being implemented in home care as a means to deliver high quality, cost effective care. However, limited evidence exists to support assertions regarding the impact of portable computers on health system outcomes. The purpose of this retrospective chart review was to assess the impact of portable computers on the use of evidence based practice, client outcomes, and on the cost of care when use by home care nurses to manage clients with lower leg venous ulcers. A comparison of paper based documentation collected at Location 1(paper) with electronic documentation collected at Location 2(EMR) indicated that use of the technology may improve the use of evidence based practice and may reduce the cost of care. The use of a conceptual framework proposed by Powell-Cope, Nelson and Patterson (2008) to guide the implementation of portable technology in a health care setting is recommended.

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Chapter 1

Introduction

Portable computers, including handheld computers and laptop computers, are changing the way health care providers collect and use health care information. Tweed (2003) noted that these devices are poised to improve the efficiency and effectiveness of health care interventions. Indeed, current evidence suggests that when used by health care providers, portable computers can optimize scheduling, billing, patient tracking, electronic prescribing, decision making at the point of care, education, and research (Bates & Gawande, 2003; Doran, 2009; Farrell & Rose, 2008; Hardwick, Pulido & Adelson, 2007; Kreb, 2007; Lu, Xiao, Sears, & Jacko, 2005; Tate, Gardner, & Scherting, 1995). While these applications are being used to promote the implementation of portable computers in health care, researchers have noted that limited evidence exists to support assertions regarding the ability of portable computers to improve clinical outcomes (Dykes et al., 2007; Fisher, Stewart, Mehta, Wax, & Lapinsky, 2003; Gururajan, 2010, Lu et al.; Prgomet, Georgiou, & Westbrook, 2009; Wu & Straus, 2006). In addition, there is limited evidence indicating that improved access to evidence based resources results in improved client care and improvements in the cost effectiveness of care (Baumgart, 2005).

In four separate systematic reviews of the literature designed to assess the contribution of portable computers on the delivery of health care services, Fischer et al. (2003), Lu et al. (2005), Wu and Straus (2006), and Prgomet et al. (2009) concluded that additional quantitative research is needed to build on qualitative assertions regarding the ability of portable computers to improve healthcare. Further, Dykes et al. (2007) and

Prgomet et al. noted that additional research is needed to evaluate potential improvements in client outcomes that may be achieved when the technology is implemented in multiple clinical settings.

When evaluating the use of electronic health information systems in home care, Stolee, Steeves, Glenny, and Filsinger (2010) indicated that the technology holds considerable promise, but noted that the implementation of electronic health systems in home care has not been well researched. The authors further identified that the majority of the literature available is opinion-based or discussion papers with few containing any type of empirical data.

Purpose

The purpose of this study was to increase knowledge about the impact of portable computers, including handheld devices and laptops on health system outcomes.

Research Questions

Research Questions:

The following three research questions were investigated:

1 Is there a difference in **adherence to clinical practice guidelines** when home care nurses use portable computers with integrated evidence based guidelines and decision support to provide wound care services to homecare clients with lower leg venous ulcers, and home care nurses who use an evidence based paper documentation system.

2 Is there a difference in **clinical outcomes** for homecare clients with lower leg venous ulcers who receive wound care from nurses using portable computers with integrated evidence based guidelines and decision support, and clients who receive wound care from nurses who use an evidence based paper documentation system?

3 Is there a difference in the **cost of wound care services** when home care nurses use portable computers with integrated evidence based practice guidelines and decision support, and the cost of providing care when home care nurses use an evidence based paper documentation system to manage home care clients with lower leg

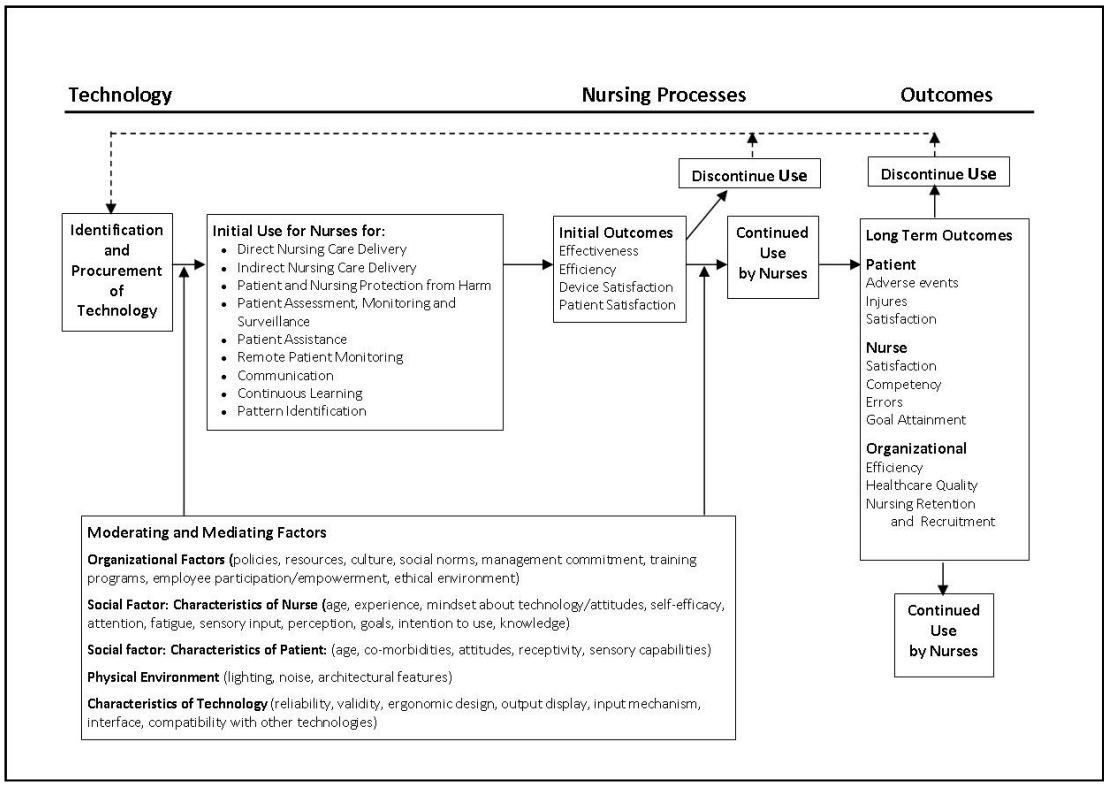
venous ulcers.

Conceptual Framework

A conceptual framework developed by Powell-Cope, Nelson, and Patterson (2008) (Figure 1) guided the development and implementation of this study. Building on a model designed by Fuhrer, Jatai, Scherer, and Deruyter (2003), the framework provides an approach to examining the impact of technology on nurses and organizations. In addition, the model identifies factors that affect the successful implementation and continued use of technology in health care. According to the framework, if the implementation of technology does not improve the effectiveness of care and efficiencies in the workplace, the integration of portable computers will be compromised (Powell-Cope, et al.). Therefore, the model establishes the need to evaluate the ability of portable computers to increase compliance with evidence based practice, optimize client outcomes, and to evaluate the cost effectiveness of care, as these criteria will ultimately influence the nurses' and the organization's decision to accept or reject the technology.

Since the conceptual framework was proposed by Powell- Cope, et al. in 2008, only one reference to the model has been cited in the literature. Tapper, Quinn, Kerry, and Grant-Brown (2012) used the model as an approach to developing an administrative and staff survey designed to assess the effectiveness of implementing portable computers in home care. Narrative feedback provided by administrators and frontline nurses suggested that the model is inclusive of all issues impacting the implementation of portable computers in home care. No additional research has been identified establishing the construct validity of the tool.

Figure 1. Conceptual Model for Technology, Nursing, and Patient Safety



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Significance

This study will provide further insight regarding the value of integrating portable computers in home care. If the results of this study support assertions that portable computers can improve the use of evidence based practice, clinical outcomes, and reduce the cost of providing care, the findings could lend additional support for a system wide integration of the technology. A system wide reduction in health care costs could be realized. Further, access to electronic data could allow nurses to identify the contribution that nursing care provides to the health care system and to home care clients. The

technology could also allow nurses to define a body of knowledge specific to the profession, inform the development of quality improvement initiatives, assist in the advancement of evidence based practice, and inform the development of research initiatives.

Foundational knowledge obtained from the study regarding the number of clients needed to identify a reduction in health care costs and overall improvements in health care outcomes could be established. Challenges associated with implementing this study could also be used to inform the feasibility of a large-scale study to establish a cause and effect relationship between portable computers, the use of evidence based practice, clinical outcomes, and the costs of providing care.

Once the study is complete, the findings will be reconnected to the conceptual framework proposed by Powell-Cope et al. (2008). These authors indicated that for technology to be accepted by nurses and integrated within health care organizations, the technology must demonstrate improvements in efficiencies and in the effectiveness of care (Figure 1). If this study identifies improvements in the use of evidence based practice, clinical outcomes, and the cost of providing care when portable computers are used in home care, nurses and organizations would be justified in advocating for further research. The study would also inform nurses and health care organizations in their decision to advocate for the use of portable technology in home care.

If this study does not identify improvements in the use of evidence based practice, improvements in clinical outcomes, or reductions in health care expenditures, health care stakeholders would be directed to carefully consider current assertions regarding the added value obtained from the implementation of portable computers in home care. A re-

examination of existing computer-user interfaces currently being used by health care providers, factors that might limit the full utilization of the technology, and the amount and type of decision making support that needs to be embedded in the device to achieve the desired outcomes might also be required. Furthermore, a reassessment of the approach used to implement and integrate portable could in a clinical practice setting would be indicated (Powell-Cope et al., 2008).

Definition of Terms

Portable Computers: Haller, Haller, Courvoisier, and Lovis (2009) defined "portable computers" as an inclusive term that refers to both handheld devices and laptop computers. To be considered portable, the devise must be convenient for use at a patients' bedside or in home care, equipped with a miniature keyboard or an easy touch input on a display screen, and capable of accessing a wireless network.

Clinical Outcomes: The result of efforts by healthcare providers to optimize patient care that can be evaluated based on the appropriateness of the services provided, and the ability of the service to achieve the desired results. Such results can include partial or complete restoration of functions, a reduction in physiological anomalies, or improvements in the psychosocial wellbeing of clients (Hoxie, 1996).

Computer User Interface: The part of the computer system with which a user interacts in order to undertake his or her tasks and achieve his or her goals. Therefore, these components include the hardware, the device itself, and the software (Stone, Jarrett, Woodroffe & Minocha, 2005)**.**

Cost effectiveness: Defined using an incremental cost effectiveness ratio determined through a comparison of a new intervention against current practice (Donaldson, Currie, & Mitton, 2002)

Evidence Based Practice: The conscientious, explicit, and judicious use of current best evidence in making decisions about client care (Lorimer, Harrision, Graham, Friedberg, & Davies, 2003).

Health System Outcomes: For the purpose of this study, health system outcomes are defined as the end result of implementing a particular healthcare practice or intervention. In this study, the intervention will be the use of portable computers in home care, while the health system outcomes under investigation will include potential improvements in the use of evidence based practice, clinical outcomes, and a reduction in the cost of providing care.

Assumptions

1. The level of nursing education and years of experience of the home care nurses will be similar at each research location.

2. The rate of nursing turnover is similar at each research location.

3. The chart auditor and data entry clerk will remain blinded to the purpose of the study.

4. The convenience samples selected at both sites are representative of patients usually cared for by visiting home care nurses at each location.

5. The sample of patients collected at Location 1 is similar to the sample of clients selected at Location 2.

6. The power of the study will be sufficient to observe an effect size if one is present.

7. The quality of the documentation will be optimal and suitable for comparison.

Limitations

1. A cause and effect relationship cannot be established using a retrospective design.

2. The sample size will be limited to two health care regions located in central Canada.

3. The sample size may be insufficient to identify an effect size

4. The socioeconomic status of clients in each region may be different and could impact the outcomes of the study.

5. The prevalence of obesity cannot be assessed.

6. Conclusion obtained from the study could be compromised due to inaccuracies in charting or limited charting.

Chapter 2

Literature Review

The purpose of this literature review is to assess the use of portable computers in health care. As defined by Haller, et al. (2009) the term "portable computer" is an inclusive term that refers to both handheld devices and laptop computers. To be considered portable, the devise must be convenient for use at a patients' bedside or in home care, equipped with a miniature keyboard or an easy touch input on a display screen, and capable of accessing a wireless network.

Specific focus will be placed on the application of the technology in home care and the impact of the technology on the delivery, quality, and cost effectiveness of providing wound care services for clients with lower leg venous ulcers. In addition, factors that may affect the adoption and the sustainable integration of the technology in a health care environment will be explored.

When completing this literature review, a professional librarian was consulted and a search of Medline, CINAHL, and Proquest databases was conducted. Due to the rapid evolution of portable technology, the search was limited to articles published between 1990 and 2011. All articles were reviewed for relevance**.** Once selected, the reference lists of sentinel articles were reviewed to identify additional research studies not previously located, a review of grey literature was conducted, and leading researchers investigating the use of handheld computers in health care were consulted. After a cross reference of all information sources failed to identify additional research appropriate for inclusion, the literature review was considered complete.

Portable Computers in Health Care

Since 2003, two separate literature reviews have been published documenting the potential utility and the added value that portable technology could contribute to health care settings. In an initial systematic review of the literature, Fischer et al. (2003) identified 119 articles published between 1998 and 2002. Of these, approximately half described the application of portable computers (Fischer et al). The researchers noted that during this time period, health care providers used their devices to access medical literature and drug information data-bases (Chiswell & Parchman, 2002; Greiver, 2001; Kelly, 2000) and to increase adherence with clinical practice guidelines (Lobach & Hammomd, 1997; Shiffman, Freudigman, Brandt, Liaw, & Navedo, 2000). Devices were also used to track patient data (Embi, 2001), optimize business and office management (Bourne, Sibbald, Doig, Lee, Adolph, & Robertson, 2001; Nelson, 1999; Parker, 1999; Shiffman et al.), and to prescribe medications (Rothschild, Lee, Bae, & Bates, 2002).

Based on their findings, Fischer et al. (2003) proposed that portable computers have the potential to improve medical practice. However, the authors cautioned "most publications consist of reports of clinical experience with the use of personal data assistance (PDAs) or innovative uses without significant substantiating data" (Fischer et al., p. 148). The authors recommended additional studies to validate the benefits of portable computers in terms of cost and patient outcomes.

In 2005, Lu et al. completed a second review of the literature. The authors expanded on the literature review conducted by Fischer et al. (2003) by including non-empirical data from all health care professionals published between 1998 and 2004. Of the 200 articles indexed, 95 were assessed as relevant to the literature review (Lu et al.,

2005). Common applications included the use of portable devices to improve access to decision making support, improving administrative efficiencies, documenting care, completing professional activities, accessing research, and providing education (Table 1).

Table 1.

Common Applications of Portable Computers Associated with Improved Efficiencies

Classification	**Identified Improvement in Efficiency**
Decision Making Support	• Access to information, medical calculations, medical reference, electronic textbooks, clinical computational programs, real-time information access, diagnostic data management, laboratory result retrieval, access to Internet resources.
Administrative Support	• Scheduling, billing, charge capturing and tracking, reimbursement, data collection and tracking, analyzing services, communicating.
Documentation	• Note generation, dictation, charting, printing.
Professional Activities	• Personal information management, professional monitoring and reporting, implementation of guidelines, laboratory test ordering, communication, patient data tracking, electronic prescribing, drug delivery management, recording and retrieving data and information at the point of care.
Education and Research	• Education and research support, providing access to evidence-based medicine and medical research.

Consistent with Fischer et al. (2003), Lu et al. (2005) also concluded that the use of portable computers in health care could improve efficiencies within the health care system, but added that wide spread adoption of mobile computers could remain limited until the true impact of the devices on client outcomes is established.

Since 2005, additional studies have supported the utilization of portable computers in health care (Doran, 2009; Dykes et al., 2007; Lau, Yang, Pereira, Daeninck, & Aherne, 2006; Quinn, 2011) and have expanded on the potential utility of the technology. In a summary report outlining the of the potential benefits of portable computers in

developing countries, the Mhealth Alliance (2011) noted the technology may improve tracking and response times when managing disease outbreaks and malnutrition, supply chain management resulting in improved access to health care supplies, and access to education of pregnant women living in areas where maternal care is limited. Further, Killeen, Chan, Buono, Griswold, & Lenert (2006) identified that wireless devices may improve assess to care when used by first responders to manage mass casualty incidents.

Given the broad range of applications for portable technology across all facets of health care, use of the technology in home care may have a significant impact on the delivery, quality, and the cost of providing care.

The Application of Portable Computers in Home Care

Research to support the added value that portable computers could have in a home care setting remains largely descriptive, opinion based, and lacks empirical data (Stolee, et al., 2010). However, there is evidence to suggest the technology may improve both organizational efficiencies and the quality of care.

Achieving Operational Efficiencies

Software vendors are currently leveraging the added value that portable devices could have on the delivery of home care services. Companies are designing and marketing "software solutions" for home care organizations that are accessible using a variety of mobile computers (alorahealth.com; goprocura.com). Once integrated, the software can streamline client referrals by forwarding referrals to the nurses' mobile devices. All health care providers are able to access the referral on their device and can accept or reject the referral by selecting the appropriate response. When a care provider accepts an electronic referral using her device, the appointment time and the client's

address are automatically inserted into an electronic calendar located in the provider's device. GPS technology embedded in the computer decreases mileage costs by providing the care provider with the most direct route to the client's home (goprocura.com). Home care agencies monitoring the GPS signal can confirm the time that the care provider arrived at the client's home, the duration of the visit, and time of departure (alorahealth.com). The information is automatically converted into an electronic time sheet, travel expenses are calculated, and the information forwarded to the payroll using a wireless Internet connection (goprocura.com).

Further, electronic smart forms can be used to record the client's demographic data, health care information, and billing information. Once the information is documented, clinical information can be forwarded directly to members of the health care team, and billing information can be forwarded to accounts receivable (alorahealth.com; goprocura.com). The electronic data can also be reorganized into electronic reports needed by funding agencies or uploaded to an electronic database (alorahelath.com). The suggested efficiencies may result in a reduction in the number of administrative staff needed to coordinate care, improved utilization of nursing staff, and a reduction in the cost of providing care.

Optimizing Client Care

Two areas where portable technology may have a significant impact on client outcomes include chronic disease management and the provision of wound care. A review of the evidence suggests that improvements in client outcome may be associated with improved access to information.

Chronic disease management.

Cavoukian (2009) identified the added value of using handheld computers and computer software applications to assist patients in the management of chronic illness. Marketed as "Healthanywhere for BlackBerry®", the product was designed to assist patients in the management of hypertension while at home (Cavoukian). Clients using the service were given a blood pressure monitoring device that used a wireless connection known as Bluetooth to connect with the client's portable computer. Once the client completed a blood pressure reading, the reading was transmitted wirelessly to the handheld device and forwarded to an electronic data based using a cellular network. Home care organizations with access to the electronic data base were able to monitor the client's blood pressure reading and determine if an intervention was required. If required, the home care organization could communicate with the client through the client's handheld device. If warranted, more urgent interventions could also be arranged (Cavoukian).

Additional software applications designed for portable computers are also available that could assist home care organizations in the management of chronic disease. Weight scales and glucose meters that connect to handheld computers via Bluetooth are currently available (www.ihealth99.com). The technology could be used by home care organizations to monitor the health status of clients with congestive health failure or diabetes, and could alert nurses to changes in the client's health status. For example, early identification of rapid weight gain in clients with congestive health failure could result in changes to the client's medication, and life style modification that could prevent destabilization, hospitalization, and death. Further, remote monitoring and trending of a

client's blood sugar could facilitate early identification of hyperglycemia or hypoglycemia and ensure that corrective actions is taken to prevent a life threatening event. In the future, it is possible that mobile applications and Bluetooth enabled hardware will expand to include the monitoring of additional chronic illnesses including atrial fibrillation and chronic obstructive pulmonary disease.

Wound care.

Software programs for portable computers have also expanded to the management of wound care. These applications leverage many features embedded within a device including a camera, keyboard, and Internet access. For example, a recent application developed by Dr. John Semple, allows clients to take a picture of their wound, input text, and email the information to the care provider using wireless technology embedded in the device (Priest, 2012). The technology has been used to improve access to wound care services, and has received positive feedback from clients and care providers (Priest).

Additional wound care software is also available. Pixalere, an Internet based software program, allows home care nurses to take a digital picture of a wound using a smart phone, tablet or laptop, and upload the data to a secure website using a cellular network. The system was designed to expedite referrals to wound care specialists who can then provide treatment recommendations to home care nurses (Case & Simkus, 2003).

In select regions of Ontario, Canada, home care nurses are using a combination of national wound care best practice guidelines (CPGs) published by Sibbald, Orsted, Coutts, and Keast (2006), and wound care management program guidelines published by the Central West Community Care Access Center (CCAC) in 2009 to care for clients with wounds. Best practice recommendations for the care and management of these clients

have been converted into electronic smart forms, and have been integrated in C5 and F5 Motion Tablet computers, Panasonic computer tablets, and into Levono S103T Idea Pads (Appendix A). Home care nurses are using the devices and the software to chart client assessments, care plans, and to evaluate outcomes. When providing care, nurses record the client's demographic data, history and physical exam, risk factors, and co-morbidities. Nurses also assess and document wounds as healable, non-healable, or maintainable, and determine if wounds are acute or chronic. Wounds are classified as "acute" if they have been present for less than three weeks (CCAC, 2009). To be identified as "chronic", a wound must be present for greater than three weeks and not progressing through the expected stages of healing (CCAC).

Reminders built into the electronic forms facilitate improvements in the nurses access to evidence based practice and encourages them to reflect on established best practice standards. For example, when managing a lower leg venous stasis ulcer, nurses are reminded to assess the need for, or the results of a client's lower limb vascular assessment, and the need for wound compression. According to the CCAC's (2009) wound management guidelines, healable wounds should achieve 30% closure within four weeks, and should not require more than three dressing changes per week after four weeks. If the client's wound has not achieved 30% wound closure within four weeks, consultation with a wound care expert is advised. Failure to achieve 30% wound closure during this time decreases the likelihood that the wound will be completely closed at 100 days (CCAC).

During the initial and subsequent visits, nurses also assess nurse sensitive outcomes as defined by the Canadian Health Outcomes for Better Information and Care Initiative.

These outcome indicators include functional status, ability to complete therapeutic self-care, safety, quality of life, pain, nausea, and level of fatigue (Hannah, White, Nagel, & Pringle, 2009). Lack of improvement or a decline in any one of the nursing sensitive outcomes, or failure to meet any of the wound care milestones, necessitates that nurses reassess and revise their care plan (H. Quinn, personal communication, September 29, 2011).

To further support nurses in optimizing the delivery of wound care services, portable devices are equipped with Email and Internet access using WiFi and 3G. One touch quick reference sources embedded in the electronic documentation provides nurses with immediate access to additional information. Nurses can also access documents provided by the client's primary care provider. These documents may include a referral letter, lab results, and the results of diagnostic procedures.

After the client's electronic file has been completed by a home care nurse, the device is synchronized with a secure computer server using a Wifi or a 3G network connection. The synchronization process ensures the information collected by visiting nurses is electronically transferred from the nurse's device to a computer server, and then "pushed" from the computer server to the devices used by other care providers. The process ensures that all health care providers participating in the care of the client receives the most up to date information.

Wound care: An Environmental Assessment

The CCAC (2009) identified that wound care is the fastest growing expenditure in home care. Further, Sen et al. (2009) indicated that venous leg ulcers account for up to 90% of all lower leg ulcers. This section will focus on the prevalence of lower leg ulcers, the impact of lifestyle and chronic disease on wound development and healing, and the cost of lower leg venous ulcers on society. The potential impact of using best practice to management lower leg venous ulcer will also be addressed.

The Prevalence of Lower Leg Venous Ulcers

In a Canadian best practice guideline for the prevention and treatment of venous leg ulcers, Burrows, Miller, Townsend, MacKean, Orsted, and Keast (2006), noted the prevalence of lower leg venous ulcers in Canada ranges between 0.12 and 0.32 per cent in the general population. The prevalence rate reported by Burrows et al. is highly consistent with international data published by Woo et al. (2007), and in a prevalence study conducted in Ontario, Canada (Shannon, 2007). However, Woo et al. noted the prevalence of lower leg venous ulcers rises to 3.6% of those over the age of 65, and further increases to 12.6% of individuals over the age of 70. Of these, reoccurrence rates could be as high as 76% (Lorimer et al., 2003). The increase in prevalence with age suggests that the provision of care can be complex in terms of health problems and care challenges (Burrows et al., 2006.)

Factors Affecting the Development and Management of Lower Leg Venous Ulcers

A review of the pathophysiology associated with the development of lower leg venous leg ulcers, and factors affecting wound healing suggests that lifestyle, the presence of chronic disease, and the client's family history must be assessed. Simon, Dix,

and McCollum (2004) noted that venous hypertension is the primary cause of venous ulcerations and classified the causes of venous hypertension into three distinct categories. These categories include venous disease, factors contributing to impaired calf muscle pump function, and the presence of congestive heart failure. The list of venous disease included varicose veins, while factors contributing to impaired calf muscle pump function included immobility, joint disease, paralysis, and obesity. Of the three categories listed, Simon et al. noted that congestive heart failure was the only chronic illness identified as impacting the development of venous leg ulcers. However, Venencia, Falabella, Kirsner, and Eaglstein (2001) indicated that obesity was a significant predisposing factor.

The link between lifestyle, chronic disease, and the development of lower leg venous ulcer, has significant implications for health care organizations around the world. Guo and DiPietro, (2010) noted that obesity, diabetes, smoking, and the use of medications that can suppress the immune system have a significant impact on wound healing. The Public Health Agency of Canada (PHAC) (2011) indicated that in 2009 over one in four Canadian adults were obese, and 8.6% of children aged 6 to 17 were obese. International data provided by Sen et al., (2009) suggested that by 2015, 2.3 billion people would be overweight. The number of Canadians living with diabetes is expected to increase from 3 million to 3.7 million by 2020, and the total number of people affected by diabetes worldwide is predicted to reach 438 million by 2030. Further, the Heart and Stroke Foundation (2012) estimates that 4.9 million (18%) of Canadians over the age of 15 smoke an average of 14.9 cigarettes per day, and the number of Canadians living with heart failure will continue to increase as cardiac care improves.

Quality of Life and Lower Leg Venous Ulcers

Queen and Sibbald (2007) noted that clients with chronic wounds experience a reduced quality of life similar to people who experienced a stroke. These individuals can also become socially isolated, frustrated, and can experience fear associated with the risk of amputation (Queen & Sibbald). Sen et al. (2009) added that these individuals often find themselves having to choose between their work and compliance with care. For younger patients, lower leg wounds have been correlated with time away from work, job loss, and adverse effects on finances (Sen et al.). However, Sen et al. and Burrows et al. (2006) noted that rapid access to evidence based care can minimize the potential for long-term disability while decreasing the cost of providing care. Assertions made by Sen et al. and Burrows et al. have been confirmed by Harrison et al. (2005).

In a study to assess the impact of evidence based practice on individuals with lower leg ulcers, Harrison et al. (2005) collected wound care outcome data one year before, and one year after evidence based practice was implemented to manage lower leg wounds in the community. Prior to implementing evidence based practice, wound care referrals were made to nursing agencies, a manager located in an office was responsible for clients with leg ulcers, staffing included RNs and RPNs, and care was based on physician orders (Harrison et al.). Further, nurses worked through a family physician and were not able to consult a wound care expert directly. Initial wound care assessments and follow up appointments were not standardized (Harrison et al.). After the implementation of evidence based practice, leg ulcer services were centralized to one agency, care was provided by RNs educated in best practice, care protocols were developed, and RNs consulted directly with wound care specialists. A standardized initial assessment and

follow up schedule was also developed (Harrison et al.). A pre and post analysis of wound care outcomes identified that three month healing rates more than doubled and the number of nursing visits declined for 37 to 25. Further, the median supply cost per case was reduced from $1923 to $406 (Harrison et al.). The authors concluded that the use of an evidence based documentation system using a paper chart significantly reduced the cost of care while improving outcomes for individuals with lower leg ulcers.

The Cost of Lower Leg Venous Ulcers

Researchers investigating the cost of venous leg ulcers have separated cost into two categories: financial impact and social impact. Friedberg, Harrison, and Graham (2002) conducted a descriptive survey to assess the cost of providing wound care services in Ontario, Canada. The authors identified the total cost of managing leg ulcers in Ontario could be as high as $1.3 million annually. Based on their calculations, the authors estimated that the cost of caring for people with leg venous ulcers in Canada ranges between $245 and $350 million annually. In the US, the annual treatment cost for venous leg ulcers ranges between $750 million and $1 billion (Woo et al., 2007). Based on the prevalence of lower leg ulcers in the US, Woo et al. indicated the cost of providing care to one individual over a lifetime could exceed $40,000.

Managing Lower Leg Venous Ulcers: A Canadian Perspective

In Canada, the management of wound care has shifted from acute care to home care (Sibbald et al., 2007). The Canadian Home Care Association (CHCA) (2008) indicated that governments and health care stakeholders are increasingly recognizing the integral role of home care in the health care system. This section will provide an overview of home care in Canada based on a report published by the CHCA, a review of the national

approach to the management of lower leg ulcers, and a discussion of challenges related to access and the provision of wound care services in home care.

Home Care in Canada

The CHCA (2008) noted that publically funded home care made possible through provincial funding mechanisms was established in Ontario in 1970. Since then, additional services have been added to meet the needs of the general public. However, home care in Canada is funded by provinces and territories and is not a part of the Canada Health Act. The exclusion of home care from the Canada Health Act means that many services funded in acute care are not funded when provided in a home care setting. For example, when individuals require intravenous antibiotics (IV) for skin infections receive antibiotics in a hospital setting the medication and the supplies are covered. If the client chooses to receive IV therapy at home, the client is required to pay for the antibiotic and the supplies.

Nationally funded home care programs for Veterans, First Nations and Inuit, the Royal Canadian Mounted Police, and individuals living in Nunavut have also been implemented (CHCA). In general, the mandate of home care across Canada has been "to provide a comprehensive range of coordinated health care services for individuals of all ages for the purpose of promoting, maintaining or restoring health within the context of their daily lives" (CHCA, 2008, p. 10). The services have been designed to meet the needs of people who require assistance or support in order to remain at home.

Eligibility.

To receive home care, individuals must demonstrate basic eligibility criteria. Proof of residency, landed immigrant status, or proof of citizenship is often required (CHCA,

2008). Additional requirements vary by province and may or may not include age or income testing (CHCA).

Structure and Governance.

Fundamentally, the overall governance structure that supports the planning, funding and delivery of home care has remained highly consistent across the country. In 12 of 13 provinces and territories, home care falls under the jurisdiction of the respective provincial or territorial Ministries of Health. The only exception occurs in New Brunswick where home care falls under the Department of Health and Wellness, and long-term home support is administered by the Department of Social Development (CAHC, 2008). These Ministries are responsible for providing leadership and direction for home care within their respective provinces or territories through the enactment of legislation, policies, and funding decisions, while care is provided by a combination of not for profit and for profit organizations (CAHC, 2009). The lack of a national home care strategy has led to substantial differences in access to care from province to province

Collier (2011) identified that provincial and territorial legislation, policies, and the type of services covered by home care varies widely across Canada. A comparison of services provided in each jurisdiction identified that most jurisdictions offer core services, including case management and home care nursing, but the availability of additional services can vary. For example, in Alberta, speech language therapy is part of the core services, but it is not available in Saskatchewan or Manitoba (Collier).

Coverage.

An inconsistency in the definition of home care services is also impacting care. In some jurisdictions, bathing and grooming assistance falls under home support services,

whereas in other jurisdictions they fall under adult day services (Collier, 2011). These inconsistences can result in one Canadian having the services paid for by home care, while others living in a different province may be able to access the services free of charge. The situation is further complicated by variations in the type of supplies that are covered. For example, in Alberta, the cost of specialized footware for individuals with foot ulcers is covered, but not in Ontario (Queen & Sibbald, 2007).

The cost associated with accessing home care services also varies from province to province. The CHCA (2008) indicated that four provinces and the three territories do not charge direct fees for home care services. In the remaining provinces, the costs of professional services are covered, but additional costs for home support and homemaking services are billed to the client. The amount that clients are required to pay is based on their level of income (CHCA,). Collier (2011) indicated that in provinces where fees are required, the maximum payment is $421 per month.

Finally, inconsistencies exist in the amount of home care services that individuals can access. For example, in Prince Edward Island, clients have access to a maximum of 28 hours per week (Collier, 2011). By comparison, Canadians living in Ontario can receive up to 80 hours of home care per week during the first month and up to 60 hours for each additional month.

Quality and Accountability.

Increasingly, the home care sector is embracing a culture of quality and accountability. At the time of their publication, the CHCA (2008) indicated that four provinces have made accreditation mandatory. Further, the authors identified that the majority of jurisdictions either have achieved, or are in the process of achieving

accreditation through the Canadian Council of Health Services Accreditation (CCHSA). The movement towards national accreditation may facilitate the development and implementation of a national information tracking system for home care (CHCA, 2008).

Information Tracking.

Tracking home care data has become a national priority. Without exception, all provinces and territories are collecting home care data on expenditures and the amount of services being delivered (CHCA, 2008). Additional indicators collected with less consistency include, the client's diagnosis, safety issues, number of home care staff, and the number of referrals to community support organizations (CHCA, 2008). This information is being used to inform policy and decision making on a provincial and territorial level, but may not be sufficient to inform national decisions regarding the future of home care.

Additional strategies designed to collect home care data suitable for comparing resource utilization and health outcomes between jurisdictions are also being implemented. The interRAI-HC home care assessment tool, a minimal data set endorsed by the Canadian Institute of Health Information (CIHI), is being adopted by home care providers across Canada as a means of collecting nationally standardized home care data elements. Home care organizations using the interRAI-HC assessment tool are uploading the data to a national data based using the Home Care Reporting System. The data is being used to establish national benchmarks for home care (CHCA, 2008).

Home Care Nurse Reimbursement Models

In Canada, the majority of home care nurses are paid based on the number of hours worked. However, some home care agencies have adopted a nurse reimbursement model that pays nurses per client visit. Under this model, the nurses' income is directly impacted by the number of visits that he or she is able to complete within a given time frame. Sibbald, Grinspun and Orridge (2007) noted that this reimbursement model has a significant impact on the quality of care. Specifically, the authors indicated that paying a nurse for a visit and not for the complexity of the detailed assessment to support a holistic treatment plan can result in an incomplete assessment and incomplete documentation.

A review of the impact that physician fee for service (FFS) models can have on the provision of health care services provides further insight regard the link between health care provider reimbursement models and the quality of care. In a report published by the National Commission on Physician Payment Reform, the Society of General Internal Medicine (2013) identified that fee for service reimbursement models that rewards physician per client visit are a major health care cost driver. Therefore, the committee recommended that a rapid transition plan be developed to reduce the prevalence of fee for service models. The recommendation is supported by Gosden et al. (2000), who indicated that FFS models are associated with more patient visits, less patient satisfaction and an increase in the quantity of services provided. Further, Calsyn and Lee (2012) indicated that FSS models do little to encourage care providers to adopt low cost, high value intervention, such as preventative care and patient education.

When compared with the FSS model, reimbursement models that do not pay health care providers per visit appear advantageous. Drossos (2002) indicated that transitioning

away for FSS models to alternative funding models can enhance the relationship between the care provider and the client, encourage care providers to adopt illness prevention and education strategies, and reduce the likelihood that client care will be influence by profitability.

A National Approach to the Management of Lower Leg Venous Ulcers

In Canada, the Canadian Association of Wound Care (CAWC), and academic learning centres are improving access to wound care education and best practice. Nurses working in home care now have access to lower leg venous ulcer best practice guidelines, hands on skills training, and access to preceptorship courses (Sibbald, Grinspun, et al. 2007). Nurses can also complete a certification, diploma, or a Master's degree in wound care, and can become involved with the World Union of Wound Health Society (WUWHS) (Sibbald, Grinspun et al.).

Best practice guidelines for the management of lower leg venous ulcers, published by Burrows et al. (2006), and endorsed by the CWCA and the RNAO, are currently recognized as the national standard for the management of lower leg venous ulcers in Canada. The guidelines include an approach to assessing and managing venous leg ulcers, and a recommendation that the care provider's first priority should be to identify and treat the cause of the wound. The guidelines further indicate that when identifying and treating the cause of a wound, nurses should complete a comprehensive history and physical exam (http://cawc.net/images/uploads/wcc/4-1-vol4no1-BP-VLU.pdf). The assessment should investigate alternative diagnoses, assess the client's pain level, and identify factors that may impair wound healing (Burrows et al.). A physical assessment should build on the knowledge obtained from the history and should include an evaluation of venous

characteristics. Bilateral lower leg assessments including an ankle-brachial pressure index (ABPI) should also be completed (Burrows et al.) Individuals with an ankle-brachial pressure index greater than 0.8 should be considered candidates for compression therapy. However, those with an ABPI less than 0.8 require additional follow up that may include a doppler ultrasound of the leg. When the results of an ABPI are inconclusive, Bonham (2011) indicated that toe pressures are warranted. Burrows et al. further noted that individuals with an ABPI less than 0.5 require an urgent referral to a vascular surgeon (Burrows et al.). Once the cause of the wound has been identified, client and family concerns should be addressed. Further, realistic expectations for healing should be discussed, information regarding the care of venous insufficiency should be provided, and the client's level of social support should be evaluated (Burrows et al.).

To optimize the client's outcome, the wound bed should be examined. Clinicians are advised to assess for the presence of inflammation or infection, the need for chemical or sharp debridement, and for moisture balance. When considering the type of dressing required Burrows, et al. (2006) noted that there is insufficient evidence to determine whether a particular dressing increases healing or reduces pain. Therefore, the guidelines indicate the most important factor in selecting a dressing is the client's level of comfort and the cost of the product (Burrows et al.). The value of alternative therapies including hyperbaric oxygen, electronic stimulation, or vacuum assisted closure, should also be considered (Burrows et al.). Consultations with multidisciplinary team members should also be considered if the client's mobility or nutrition is compromised (Burrows et al.).

Despite the efforts of the Registered Nurses Association of Ontario (RNAO), (2012) and the Canadian Wound Care Association (CAWC), (2012), access to evidence based wound care services for all Canadians has not been achieved. Orsted and Queen (2007) selected 16 community home care nurses practicing across Canada and asked them to complete a survey. The survey was designed to determine the range of care and gaps in the provision of care for individuals with lower leg ulcer (Orsted & Queen). Nurses were selected based on opinion leader criteria which required that nurses possess knowledge and training in the provision of wound care, be acknowledged by their peers as leaders in the provision of wound care, and that they be employed in their area of expertize (Orsted & Queen). Of the 16 nurses surveyed, seven were enterostomal therapy (ET) nurses, while the additional nurses had completed advance training in wound care. Responses from nurses identified that only half of them had access to a multidisciplinary team capable of completing a comprehensive assessment, none of the respondents had access to additional funding to support a best practice approach to wound care in the community, and several nurses identified that they had limited access to sharp debridement (Orsted & Queen).

Feedback regarding efforts to monitor the quality and the cost effectiveness was mixed. Nurses indicated that in some locations, home care organizations were starting to collect wound care data using an electronic documentation system while others wsere using basic chart audits described by nurses as “not very effective.” Only 25% of respondents indicated that their organization was monitoring the cost effectiveness of care (Orsted & Queen, 2007). Based on the responses of those surveyed, Orsted and Queen concluded that nurses were concerned about the quality of wound care across

Canada.

Barriers to the Implementation of Evidence Based Practice Wound Care Services

A review of wound care in Canada indicates that the management of wound care has moved from acute care to home care, and that Canadians have access to a core set of home care services (CHCA, 2008). However, significant challenges have been identified associated with accessing wound care services in home care.

Awareness and Funding

Despite advocacy efforts driven by the RNAO and the CWCA, further awareness regarding the knowledge and resources needed to provide best practice is required. With time, promotional campaigns and collaboration with health care providers could achieve the level of awareness needed to influence funding for the development of evidence based wound care programs. Queen and Sibbald (2007) noted that in the development of evidence based wound care programs, administrative support and funding are the primary roadblocks to implementing good-quality care. It is possible that increased awareness by health care administrators regarding the impact of lower leg ulcer on the cost of care may direct additional funding to improve access to qualified care providers and diagnostics. However, Queen and Sibbald noted that much work remains to be done to improve access to the necessary human and financial resources.

The Nurse / Physician Relationship

As noted by Harrison et al. (2005) nurses managing wounds in home care are often required to worked through family physicians and are not able to consult a wound care expert directly. Further, despite having significant expertise in the management of complex wounds and having completed a national certification program, many nurses

still require a physician's order to apply best practices. If the nurse is unable to obtain an order for a lower limb assessment, compression therapy, a suitable dressing, or a referral to a wound specialist, care can be compromised. Orsted and Queen (2007) documented feedback from nurses regarding their experience working with physicians when managing lower leg wounds. Nurses indicated that physicians often disregarded their opinion, insisted on using a non-evidence based approach to care, and could withhold information needed by the nurse to optimize client care. Nurses further identified that the situation can be frustrating when the client believes that his/her physician is a wound care expert (McAuliffe, 2007), and when the client is receiving care that will have a negative impact on his/her outcome (Orsted & Queen, 2007).

The Nurses' Scope of Practice

Nursing legislation has also been identified as a barrier to care. Shannon et al (2007) in an article documenting the importance of sharp debridement in the management of foot ulcers in the community, identified sharp debridement as superior to forced irrigation. Yet, there is an inconsistency in the nurses' scope of practice across jurisdictions. In regions where sharp debridement is not included as part of a nurse's scope of practice, access to care can be limited.

Access to Health Human Resources

The availability of professional health care staff is increasingly impacting access and the quality of care. The CHCA (2009) indicated that most provinces and territories have a shortage of nurses and identified that the situation is more pronounced in rural and remote areas. This situation is predicted to intensify as the population ages (CHCA, 2008).

Adopting Handheld Computers

Given the potential impact that handheld computers may have on nurses, clients, and health care organizations, an awareness of user acceptance models explaining factors that affect end user adoption of technology in health care is necessary. A review of factors identified by nurses themselves as impacting their acceptance of portable technology is also required.

User Acceptance Models

Several researchers have investigated factors affecting the acceptance of portable computers by health care providers. Jayasuriya (1998), Chau & Hu (2002), and Hu, Chau, & Tam (1999) examined the use of a technology acceptance model (TAM) developed by Davies, Bagozzi, and Warshaw (1989). The model, based on the theory of reasoned action (TRA), suggests that external factors affect internal beliefs, attitudes, and intentions related to the acceptance of the technology. Central to the model are two concepts: perceived usefulness and perceived ease of use (Davies et al., 1989). When testing the model on non-health care end users, Davies et al noted that both perceived usefulness and perceived ease of use accurately predicted end user acceptance. However, Gururajan (2009) noted that in all three studies conducted by Jayasuriya (1998), Chau & Hu (2002), and Hu et al., the TAM was inadequate in explaining the complex matrix of issues affecting the adoption of technology in health care. Specifically, perceived usefulness was identified as impacting end user acceptance, but perceived ease of use was not (Gururajan, 2009).

In response to the lack of a comprehensive model explaining factors that affect the end user acceptance of technology in health care, Venkatesh, Morris, Davis, & Davis (2003) examined eight different acceptance models. These models included the theory of reasoned action (TRA), technology acceptance model (TAM), motivational model (MM), theory of planned behavior (TPB), a combined TPB model and the TAM, model of PC utilization (MPCU), innovation diffusion theory (IDT), and social cognitive theory (SCT). An analysis of all eight models resulted in the creation of the unified theory of acceptance and use of technology model (UTAUT). The model consisted of three constructs identified as performance expectancy, effort expectancy, and social influence. Venkatesh et al. (2003) asserted these variables played a significant role in establishing user acceptance and usage behavior.

Venkatesh et al. (2003) defined performance expectations as the degree to which an individual believes that using technology will help attain gains in job performance and noted that this construct is the strongest predictor of intention to use. Venkatesh et al. also noted that performance expectations are moderated by the end users' gender and age. Effort expectancy, defined as the degree of ease associated with the use of technology was identified as significant during the initial implementation of technology, and was a strong determinant of intent to use technology in older women with relatively little experience in the use of technology. Social influence, or the degree to which an individual perceives that others important to them believe they should use the system was also identified. However, Venkatesh et al. indicated that this factor was only significant in an environment where the use of technology was mandated. In addition, the author snoted the impact of social influence on end user acceptance dissipates with time. Those

most impacted by social influence interventions were identified as older women who work in an environment where the adoption of technology is voluntary and their experience using the technology is limited (Venkatesh et al.).

In spite of the rigorous development and testing of the UTAUT, Venkatesh, et al. (2003) noted the model only accounts for 70 % of the variance associated with end user acceptance and intention to use. The authors further indicated that given the complexity of these issues it is possible that scientific modeling has approached the limits of its ability to predict an employee's level of acceptance of technology when the technology is implemented in an organization.

Factors Identified by Nurses as Impacting the Adoption and Use of Handheld Computers

In addition to a review of user acceptance models that may explain factors affecting end user adoption of technology in health care, several studies contain feedback provided by frontline nurses. The following section will provide a review and analysis of these studies.

The Nurses' Perspective

Zhang, Cocosila, and Archer (2010) investigated the acceptance of handheld technology in homecare. They randomly recruited and surveyed 91 Canadian home care nursing personnel who were using handheld computers in their clinical practice. The researchers found that the nurses' intent to use the technology was increased if they saw their respected colleagues using the technology, and if the technology improved the image of their employer (Zhang et al.).

Dillion, McDowell, Salimian, & Conkin (1998) surveyed 612 nurses working in a 450 bed hospital to determine their level of acceptance associated with the use of bedside computers and gathered information about perceived ease of use, perceived usefulness, and attitude. Feedback from 140 nurses (22.9%) revealed that nurses who worked full-time had a better attitude toward the technology then nurses who worked part-time (Dillion et al.).

Hughes and Pakieser (1999) interviewed 17 nurses to identify factors that impact nurses' use of e-mail in the work place. Focus group content analysis established that personal variables including lack of experience using computers, working as a staff nurse, increasing age, lack of recent education, and lack of typing and writing skills served as barriers to the implementation of computers (Hughes & Pakieser). Conversely, prior computer skills, recent nursing education, working as a nurse manager or nurse educator, and a perceived expectation that technology will play a greater role in nursing in the future served as facilitators in the nurses' acceptance of computers (Hughes & Pakieser). These finding were supported by Ting-ting, Kuan-Chia, and Juin-Shu (2007) who added that acceptance of technology is further improved when health care providers do not feel pressured to use the device.

Dillon, Blankenship, and Crews (2005) surveyed 140 nurses working in a 450-bed hospital. The purpose of the study was to predict nurses' willingness to adopt and to use an electronic record. The study focused on the nurses' attitude toward the technology and on what nurses believed about the impact of electronic patient record systems on the image of nursing. The authors asserted that "image" is created through a combination of work experience, gender, age, level of education, computer expertise, or home computer

ownership combined with information communicated by others. Demographic data identified that of the 140 nurses enrolled in the study, 25% were in their twenties, 34% were in their thirties, 30% were in their forties, 9% were in their fifties, while 2% were sixty years of age or older. Ninety-six percent were female, 77% of all nurses worked full-time, 84% held a degree in nursing, 78% owned a computer, and 71% rated their computer expertise as average or above average. The authors noted that image had a significant effect on nurses' attitudes toward handheld computers. As the definition of image used in this study appears highly consistent with the definition of social influence proposed by Venkatesh et al. (2003), this study appears to support the impact of social influence on end user acceptance in health care.

To explore factors that impact home care nurses' attitudes toward computers, Stricklin, Bierer, and Struk (2003) surveyed 138 home care nurses. A 20 item instrument measured nurses' attitudes along three dimensions: nurses' work, security issues, and perceived barriers. Results obtained from the survey indicated that home care nurses' attitudes toward point of care technology were not one-dimensional, and that all three factors contributed to nurses' attitudes toward computers. Stricklin et al. further noted that of the three factors identified, nurses' work and perceived barriers had more impact on nurses' attitudes then security issues. When these findings are evaluated based on the UTAUT model, the type of work that nurses are involved in, perceived barriers to the use of technology, and security issues, could be conceptualized as issues affecting the level of effort that nurses must contribute to the implementation of handheld technology. Therefore, conclusions reached by Stricklin et al. provide further support for the validity of the UTAUT model.

Finally, Garrett and Klein (2008) conducted a qualitative interpretivist study of 76 nurse practitioners working in western Canada. Of the 76 surveys distributed, 43 were returned. An analysis of the data and focus group interviews noted that some nurses were reluctant to support the implementation of handheld computers because of the cost and the short technological lifespan of devices (Garrett & Klein). However, nurses valued the improved access to resources made possible with the use of wireless technology.

Education and Orientation Programs

Hockenjos and Wharton (2001) and Wright (2004) documented an approach to educating and orientating nurses in the use of portable computers with an integrated electronic health record in home care. An examination of each approach identified two general themes. First, education programs designed to prepare nurses in the use of portable technology in home care should be measured in days and not hours. Second, the orientation program should include formal education in a classroom environment and preceptor support at the point of care.

When developing recommendations for an orientation program, Hockenjos and Wharton (2001) drew on their findings as consultants for over 20 agencies who had implemented point of care technology (POC) in home care. The authors indicated that an approach to education should be established at the onset of the initiative. Specifically, the authors noted that home care organizations should recruit a clinical information systems trainer with experience as a change-agent, educator, writer, evaluator, and mentor. Wright (2004) did not identify the role of a Clinical Information Systems (IS) specialist specifically, but stated that nurses being orientated to a POC system should develop a relationship with their technology preceptor early in the orientation process. In small

organizations, Hockenjos and Wharton recommended that individuals employed as Clinical IS specialists work collaboratively with the IS department and the clinical team, as collaboration between the departments could improve the content of the orientation.

Wright (2004) and Hockenjos and Wharton (2001) also made recommendations regarding an approach to developing curriculum. Wright recommended that orientations be based on a list of clinical and informatics competencies designed to assist nurses in transitioning from novice to expert, while Hockenjos and Wharton recommended that trainers review curriculum developed by vendors and make an organization specific manual. Additional content including how to navigate Microsoft Windows was recommended (Hockenjos & Wharton).

Finally, Hockenjos and Wharton (2001) and Wright (2004) noted that orientation programs for nurses should be comprehensive. Five different orientation programs were documented. Each program included a combination of classroom instruction and preceptorship. A program that provided an orientation over a one month period was highlighted. The program included four days of education and one day of field preceptorship during week one, two days of classroom education and three days of field preceptorship during week two, and additional preceptorship opportunities during weeks three and four (Hockenjos & Wharton). Wright supported the duration of the education noting the nurses' orientation to POC technology could take up to one month. Further, Wright confirmed the need for a combination of classroom education and field preceptorship experience.

The recommended approach for orientating nurses to an electronic health record in home care appears suitable to meet the needs of frontline nurses. However, the duration of the orientation and the amount of human resources required to deliver the program could prove to be cost prohibitive for many home care agencies.

Device and Software Functionality

To ensure that technology meets nurses' expectations, knowledge of the characteristics of a successful software user interface is required. Stone, Jarrett, Woodroffe, & Minocha (2005) defined the term "user interface" as that part of the computer system with which a user interacts in order to undertake his or her tasks and achieve his or her goals. Therefore, the components of the user interface include the hardware, the device itself, and the software.

Hardware Functionality

In her article identifying what home care nurses require from a handheld device, Struk (2002) collected feedback from home care nursing staff working in Cleveland, Ohio. Nurses indicated that in order for the technology to be accepted, the device user interface must be lightweight, portable, have a long battery life, and be ergonomically designed so that quick adjustments in control settings can be made. Further, the user interface must be simple to use, customizable to the needs of the end user, allow for ease of data entry, and possess the capacity to access decision making support (Struk). Berglund, Nilsson, Revay, Patersson, and Nilsson (2007) supported the findings of Struk and added that technology must also provide an advantage over systems and procedures currently in place to manage client care. Table 1 provides a list of the functions and resources most desired.

Table 2.

Proposed Functionality of Portable Computers

Proposed Functionality In Handheld Computers		
Calculator	Alarm function	Calendar
Camera	Internet/Intranet/Email	Medical Calculator
Journal Notes	Function like a desktop	Simplicity
Med references	Connected to hospital data server	Access to evidence based practice/journals
Word processing	Dictation	Integrated assault alarms
Notepad	Large storage capacity	A beeper
Versatility	Templates	Adequate battery life

Software User Interface

To achieve compliance with best practice guidelines for the development of a software user interface, Fadeyev (2009) indicated that software programs need to be clear, concise, familiar, responsive, consistent, attractive, efficient, and forgiving. Further, attention to usability factors including learnability, efficiency memorability, errors, and satisfaction must be considered. (Viitanen, Kuusisto, & Nykanen, 2011).

In a study conducted in 2011, Viitanen et al. explored the usability of four electronic nurse record systems (ENRs). Eighteen nurses from Finland who represented the public and private sectors, were asked to evaluate the documentation systems using usability criteria. These criteria included:

- The fluency or effortlessness of reporting practices
- Accuracy of documentation
- Learnability
- Exploitation or usefulness of documented information
- Support for collaborative care

Nurse feedback gathered from an evaluation of all 4 ENR software user interfaces identified that ENRs did not support effective or efficient nurse documentation, and did not follow the nurses' mental models for the documentation and delivery of care (Viitanen et al). Further, nurses' indicated that due to the complexity of user interfaces, the likelihood of making documentation errors was significant. Other areas of concern included the time needed to learn how to use the system, an inability to get a general view of the patient's situation and care needs, and difficulty identifying nursing interventions that had been completed (Viitanen et al.).

Despite the mainly negative finding regarding the usability of ENR systems, Viitanen et al. (2011) indicated that nurses seemed to prefer electronic documentation and were not willing to return to paper-based practice. When compared with paper-based documentation, nurses valued the improved accessibility of information, and an ability to document once and use the information many times.

Privacy and Confidentiality

In Canada, the Canadian Personal Information Protection and Electronic Documents Act (PIPEDA), **(**Government of Canada, 2004) establishes rules governing the collection, use and disclosure of personal information by organizations when completing commercial activities. As PIPEDA is not deemed appropriate to address the needs of the Canadian health care system, many jurisdictions have developed their own health care privacy legislations. The key difference between PIPEDA, Canada's federal privacy legislation, and provincial privacy legislation is that PIPEDA applies to organizations that collect, use, and disclose personal information in the course of commercial activities, while provincial legislation applies to health information custodians and is appropriate for

commercial and non-commercial activities. In Ontario, this legislation is known as the Personal Health Information Privacy Act (PHIPA) and is substantially similar to PIPEDA. All health care custodians collecting, using, and disclosing personal information within Ontario must comply with PHIPA. In Alberta, the provincial legislation governing privacy in health care is known as the Health Information Act (HIA) (Government of Alberta, 2012).

When collecting health care information using computer technology, PHIPA indicates the health care custodians must take steps to ensure that personal health information in their custody or control is protected against theft, loss, and unauthorized use or disclosure. The custodian is also responsible to ensure that information is protected from unauthorized copying, modification or disposal (Government of Ontario, 2004).

Pancost, Patrick, and Mitchell (2003), Thompson (2005), and Knox and Smith (2007), support the privacy law as outlined in PHIPA and the HIA. The authors noted that when developing policies to support the implementation of handheld computers, clinicians should be required to maintain physical control of the device at all times, to use data encryption technology, and to use "power on" password protection. Further, support policies restricting universal access to client data and defining the appropriate use of cameras in a healthcare setting was identified (Goss & Carrico, 2002). Hockenjos and Wharton (2001) added that during the transition from paper to an electronic documentation system, organizational policies should be made available to nursing staff to ensure the clients' health care information will be protected as both the paper based and the electronic system may exist simultaneously for a short period of time.

Data Security

As the move to electronic documentation accelerated, concerns regarding the security of healthcare information have become more apparent. In 2011, the Ponemon Institute report noted that of the 72 American health care organizations who participated in their survey, 96% had experienced a data breach during the past 24 months. Fifty-two percent of all lost data was the result of loss or theft of mobile devices, while the number of records stolen per breach was 2,575. Of those individuals affected by a data breach, 29% noted the data breach led to identify theft (Symantic Cooperation, 2011).

Multiple strategies have been suggested to improve security. Health care organizations have been advised to install whole disk encryption on all devices prior to deploying the technology, provide secure remote access to private health information, only store de-identified data on the device, and to ensure that all data located on a device can be deleted if the device is lost or stolen (Emam, 2012; Ponemon, 2009). Organizations are also advised to track access to private health information from mobile devices, establish formal agreement with end users regarding the use of mobile devices to access patient data, and to provide end users with ongoing education about privacy and security practices (Emam, 2012; Filkens & Radcliff, 2008). Policies requiring mandatory and immediate reporting of all lost or stolen devices, and protocols to ensure that all data is removed from devices before they are disposed off are suggested (Emam, 2012; Valaitis & O'Mara, 2005).

Implementing best practice interventions can prevent data breaches (Ponemon, 2009), however, new challenges to maintaining the security of heath care data are emerging. The cost and logistics of having employers provide their employees with

portable devices has resulted in a shift to a "bring your own device" framework. Under this model, employers encourage end users to use their personal device for work related purposes. The device is connected into the employer's information technology system and the end user is required to use a password. Despite this security feature, poorly designed personal applications installed on the end users' devices can "leak" confidential information. This leaking of data can result in a data breach. Further geotagging, or the use of a Ground Positioning System (GPS) integrated into a device to connect a text message or a picture with an employee's geographical location could have a significant impact on client confidentiality. When providing home care, nurses who use their device to communicate with others using text messaging or photographs while in a client's home could reveal information regarding a client's health and the client's location concurrently. Further, the impact of moving health care data into "The Cloud" has not been determined, but will require a degree of trust in services providers responsible for storing the data (Emam, 2012).

Stricklin et al. (2003) and Garrett and Klein (2008) noted that nurses have long been concerned about security and the use of technology. Given the current trends and advancement in handheld technology, it is conceivable that their level of concern regarding the security of the data will play a larger role in achieving end user acceptance in the future.

Patient Safety

Advocates for the implementation of portable computers in healthcare have asserted the technology will lead to improvements in patient safety. Bates and Gawande (2003) noted that information technology made available through the use of portable devices

could reduce the rate of errors by preventing errors and adverse events, by facilitating a more rapid response after an adverse event has occurred, and by tracking and providing feedback about adverse events.

Grasso, Genest, Yung, & Arnold (2002) studied the potential impact that PDAs could have on preventing medication transcription errors. In their study, the authors assessed the number of discharge medication list transcription errors that occurred when physicians wrote their medication lists by hand, versus the number of errors that occurred with physicians who used a PDA to input their medication orders. A retrospective chart review conducted by a certified pharmacist examined the rate of transcription errors that occurred four months before and four months after the implementation of PDAs. Of the 110 medication lists transcribed by hand during the first four months, 20 contained errors, while during the four months following the implementation of PDAs, seven out of the 90 discharge medication lists reviewed contained errors. The results of the study demonstrated that using PDAs to complete discharge medication lists decreased medication errors by 14% (Grasso et al., 2002).

Tate et al. (1995) evaluated the impact of handheld computers on clinical response times for clients with abnormal blood work. The study took place in a 520 bed tertiary care hospital. Prior to the implementation of an automated notification system, a one-week study of critical value reporting at the hospital noted that of the 294 critical laboratory values identified, only 28 (9.5%) were telephoned to the nursing floor (Tate, et al.). After implementing a wireless handheld device that transmitted abnormal results directly to the patient's nurse, the authors noted that 100% of 335 alerts were reported to the clinician within 38.6 minutes, while 51% of the alerts were received within 12

minutes. The data also indicated that 92% of the time, nurses considered the alert to be valid, and that 67% of nurses were unaware of the abnormal results prior to receiving the alert. These findings suggest the use of handheld computers can increase the quality and timeliness of nursing care provided to clients in an acute care facility.

Not all studies discussing the impact of portable technology on patient safety have reported positive results. In their article entitled, "Work-arounds, Make-work, and Kludges", Koopman and Hoffman (2003) indicated the interface between humans and computers is not always optimal and that users often develop "work-arounds" that can impact the safety of the technology. The authors identified that adverse events can result from a need to compensate for design flaws in the technology, hardware or component failures, or when end users attempt to use the technology for purposes that is was not originally designed for (Koopman & Hoffman). Further, Powell-Cope et al. (2008) cautioned that when there is a need to develop a "work-around", new and unforeseen risks to patient safety might be introduced into the client's environment that might not be identified until an adverse event occurs. Given the increased potential for adverse effects when "work-arounds" are developed to compensate for actual or perceived limitations in the technology, ongoing feedback from nurses regarding the development and use of "work-arounds" when using handheld computers in clinical practice is necessary (Power-Cope et al.).

The Patient's Perspective

In addition to end user acceptance, the patient's acceptance of portable computers must also be considered (Powell-Cope et al., 2008). Aydin, Anderson, Rosen, Felitti, and Weng (1998) evaluated the impact of using computers to document a history and physical exam on patient satisfaction. Survey findings identified that older clients were more satisfied with the use of computers, while patients who used computers at home were less satisfied (Aydin et al.). However, patients generally agreed with the statement "if given an choice, I would choose an examiner who uses a computer." The authors concluded that overall, using computers in a consultation room did not lower or enhance patient satisfaction, and did not depersonalize the experience (Aydin et al.). For patients who participated in this study, the presence or absence of a computer was less important than their relationship with their care provider (Aydin et al.).

Nahm and Poston (2000) conducted a quasi-experimental modified time series study to assess the impact of portable computers on patient satisfaction. One hundred and eight patients were recruited from four randomly selected nursing units located in a not for profit hospital. Satisfaction was measured using the Risser Patient Satisfaction Scale. The scale contains 25 item self-reporting items divided into three subscales. The three subscales included technical professional behaviours, interpersonal-educational relationships and interpersonal-trusting relationships (Nahm & Poston). Risser (1975) previously reported reliability coefficients for the three subscales at 0.64, 0.83, and 0.82 respectively and confirmed the content validity of the tool. Of the 108 patients enrolled in the study, 49 patients were included in the pre-implementation group, 30 were enrolled in the 6-month post implementation group and 29 were enrolled in the 18-month post-

implementation group. A one-way analysis of variance comparing the pre-implementation and the post-implementation data with alpha set at 0.5 failed to identify a statistical significance between any of the subgroups. Nahn and Poston concluded that point of care computer systems do not appear to affect the patient's level of satisfaction with the nurse-patient relationship. However, when assessing patient attitudes towards physicians who used handheld computers to complete patient assessments in a low-income university clinic, Houston, Ray, Crowford, Giddens, & Berner (2003) noted that 25 out of 246 (9.8%) responded negatively.

Ting-Ting (2007) further explored the patients' perceptions of nurses who used portable computers to record patient data at the bedside. The descriptive, exploratory study used a semi-structured, in-depth client interview to assess the attitudes of 14 patients admitted to a 600-bed hospital in Taiwan. Each interview was recorded, and took 15 to 25 minutes to complete. Following the interview, the recording was transcribed verbatim. During the interview the interviewer explored the patient's observations regarding the nurses' use of Personal Data Assistants (PDAs), the impact of PDAs on their care, and suggestions for nurses who use PDAs. Of the 14 patients interviewed, 12 participants were between the ages of 24 and 56. One patient was younger than 24 and one was older than 56. An analysis of the data indicated that patients perceived that devices increased the nurses' work efficiency, but they preferred that nurses explain the purpose of the device (Ting-Ting). In general, patients noted that the use of a PDA was not a concern as long as it did not negatively impact the care that they received.

Organizational Issues Affecting the Sustainability of Handheld Technology in Home Care

The sustainability of health care initiatives involving the implementation of portable technology is impacted by factors that extend well beyond the opinions and perspectives of end users and patients. Zhang et al. (2010) noted that to achieve long term sustainability, mobile technology must provide benefits for health care institutions. Therefore, this section will explore the potential impact of handheld technology on health care organizations that provide professional nursing services to patients living in the community. Cost drivers associated with the implementation of handheld technology will be presented and organizational efficiencies that may be achieved as a result of the implementation will be discussed.

Cost Drivers

To increase the likelihood of achieving a return on investment associated with the implementation of portable computers, organizations implementing the technology must consider the cost of developing, implementing, and sustaining the initiative. These factors are presented here.

The cost of technology.

When preparing to implement portable computers, the cost of purchasing and maintaining devices, software costs, and the cost of data plans must be considered (L. Popof, personal communication, January, 20, 2012). Historically, devices and data plans have been purchased by employers and distributed to staff based on their employment status (Mckesson, 2004). Full time nurses typically received a device, while part-time nurses and contracted workers did not. The author noted that when only a select number

of clinicians used the technology there was a potential that organizational efficiencies could be compromised. Therefore, a cost effective approach to ensuring that every nurse is provided with a device is essential to the success of the implementation.

Hardware costs.

The recent adoption of a policy called "bring your own device" (BYOD) may reduce an organization's cost of procuring devices, ongoing maintenance, and the cost of data plans. As previously identified, BYOD policy encourages nurses to use their personal device for work related purposes. In return, many organizations offer the end user a one time stipend to cover a portion of the cost of purchasing the device and subsidize the employees' monthly data plan (Unisys Corporation, 2010). In exchange, the end user is typically required to sign a professional use agreement that governs the end user's personal and professional use of the device (Citrix, 2011). Further, password software that meets the security requirements of the organization is installed on the device, and access to websites deemed inappropriate for viewing are restricted. Given the potential cost savings associated with the BYOD policy, and based on current levels of acceptance by end users, it is estimated that 90 percent of companies, will adopt BYOD policies by the year 2013. If this assumption is accurate, home care organizations that adopt BYOD could substantially reduce the cost of purchasing devices and the cost of maintaining ongoing data plans (Unisys Cooperation). An affordable and cost effective approach to ensuring that every nurse has access to a device could be achieved.

Software costs.

Organizational efficiencies may be optimized with the use of a mobile software solution. To improve efficiencies, the software solution would need to monitor the nurse's level of compliance with his/her scheduled visit, the duration of the visit, and the mileage, and automatically submit the information to a payroll department (Telus, 2012). The software would also need to improve the nurses' access to their schedules (CellTrak Technologies, 2012). An ability to communicate the nurse's schedule electronically, document assessments, interventions, and evaluations, and to electronically distribute the client's health care record to the care team is also required. Finally, an ability to generate electronic reports by extracting data from the client's electronic file would be needed (H. Quinn, personal communication, September, 20, 2011). These software capabilities could allow organizations to improve nurses' efficiencies by using global positioning technology to map the most direct route that nurses can use to navigate between their patients' homes, reducing mileage costs, and by automating payroll departments. Further, improved efficiencies when documenting care, an ability to distribute documentation to the team, and an ability to provide automated reports could improve the quality of care while reducing cost.

Currently, few vendors provide a comprehensive software solution that addresses the needs of home care organizations. Tapper et al. (2012) indicated that when selecting a software vendor to provide a mobile software solution, organizations should make every attempt to validate assertions made by vendors regarding the ability of the vendors' software to communicate with the home care organizations existing technology infrastructure. Further, the cost of modifying electronic documentation to reflect future

changes in evidence based practice and reporting requirements should be discussed (L. Popov, personal communication, January 20, 2012).

Education Costs

Based on findings obtained from a review of the literature regarding the use of electronic health information systems in home care, Stolee et al. (2010) indicated that implementing EHRs in home care could be very resource intensive. The authors also noted that cost concerns and training requirements were the most prevalent barriers to implementation. As identified previously, Hockenjos and Wharton (2001) indicated that orientation programs for nurses transitioning from paper charting to electronic charting in home care should include six days of classroom instruction. Based on a cost of $45 per hour required to compensate a nurse for attending the orientation the total cost of providing one nurse with 6 days of classroom instruction would be approximately $2,025. For 100 nurses, a one-time start-up cost of approximately $202,500 should be anticipated. Further, the cost of adding one full-time educator position to the team, the reduced productivity that could be anticipated during the transition period, and the cost of providing ongoing education for end users each time the software is updated must be considered.

Staffing.

As mobile technologies are integrated, additional staff with specific competencies and knowledge regarding the implementation of mobile devices and supporting software may be required. Hockenjos and Wharton (2001) indicated that the addition of a clinical information systems (IS) educator to the team would be required. The authors indicated that a clinical IS educator is critical to the success of the project and identified that

successful candidate(s) should have experience as a change agent, educator, writer, evaluator, mentor, and as an authority figure. Further, Hockenjos and Wharton (2001) noted that organizations should be prepared to replace front line nurses who will not be available to provide clinical services while attending educational secessions.

Tapper et al. (2012) also commented on staffing requirements associated with the implementation of portable computers. The authors noted that the complexity of the implementation process requires that organizations have access to a highly skilled project planner and informatics specialists. These positions can facilitate the timely completion of the project while ensuring that the end product meets the needs of all departments within the organization (L. Popov, personal communication, January, 20, 2011). Twenty-four hour access to an information technology specialist who can assist front line nurses with trouble shooting issues associated with the device and the software solution should also be considered (Tapper, et al.). Hockenjos and Wharton (2001), and Gurber, Cumming, Leblanc, and Smith (2009), concluded that when implementing technology, limiting access to training and limiting long-term support for staff could jeopardize any anticipated return on investment and the quality of client care.

Opportunities for Cost Containment

To be sustainable, Powell-Cope et al. (2008) stated that the implementation of technology in health care must result in improvements in staff organizational efficiencies, recruitment and retention, and in the quality of care. This section will address the potential of achieving organizational efficiencies based on the parameters previously identified.

Improvements in operational efficiencies.

Hardwick et al. (2007) and Cavoukian (2009) noted that when handheld technology was used by nurses working in home care, the electronic format facilitated improved efficiencies in data collection, improved access to the client's health care data, improved communication between office staff and the end-users, and improved the scheduling of staff. Work published by Stazesky (2003) and Long (2001) supported conclusions reached by Hardwick, et al. and Cavoukian. Stazeksy added that the combination of improved documentation and communication made possible through the use of portable computers facilitated more informed decision making regarding patient care. Further, Long noted that when portable documentation systems are integrated in home care, an analysis of the client's electronic file could identify clients who require complex care early in the care process and could lead to early intervention, improved health outcomes, and reduced healthcare costs.

Long (2001) described the implementation of an electronic point of care documentation system using portable computers in home care. The software included a structured charting system that was used by nurses at the point of care. The technology was integrated with the home care organization's automated billing system. The author indicated that after implementing the technology system wide, automations resulted in a decrease in the number of support staff from 17 full time employees to eight, and achieved a cost savings of $326,598 annually. Long also noted that the number of days required to process accounts decreased by 37%. Kreb (2007) further indicated that the automation in home care organizations can result in a decrease in the number of billing receipts rejected by insurance companies and heath care organization. In the absence of

an electronic documentation system, Davenport (2006) suggests that nurses could still benefit from the use of handheld devices through opportunities to network with other nurses, share information, and participate in mentoring.

In contrast to the previously identified efficiencies, Tapper et al. (2012) surveyed 75 home care nurses 18 months after the implementation of handheld computers in home care. Of the 26 nurses who responded to the survey, only 15% of nurses believe that handheld computers decreased the time required to document. Fifteen percent of nurses were neutral, while 70% of nurses disagreed. Narrative responses provided by nurses identified that for some, the time required to document had double or tripled. Shiffman et al. (2000) noted that when handheld computers with integrated evidence based guidelines are used to manage patients, visits can be prolonged, and the cost of providing care can increase.

Maximizing recruitment and retention.

To date, very little research exists identifying the impact of handheld technology on nurse retention and recruitment. However, Hockenjos & Wharton (2001) noted the introduction of handheld computers means that clinicians must learn an entirely new way of documenting and processing information. The process of rebuilding often causes stress, frustration, anxiety, and fear. The authors suggested these issues be considered when developing and implementing an orientation program. Further, Wright (2004) stated that without a detailed orientation, and attention to the specific learning needs of each nurse, newly recruited staff might become frustrated and develop a negative attitude towards technology. If not prevented or addressed promptly, the nurses' negative attitudes may impact the organization's efforts to recruit and retain nurses, and could cost the agency in

terms of productivity (Wright, 2004).

Improved client outcomes.

In a descriptive correlational study completed by Doran (2009), the author used a combination of survey methods and reflective journaling, and monitored nurses' usage of point of care databases to evaluate the impact of portable computers on nursing care. Feedback was obtained from 489 registered nurses and licensed practical nurses working in hospitals, home care, long term care, correctional and primary care centres. Nurses who participated in the study felt that being able to access best practice guidelines and medication data bases at the point of care improved their confidence when communicating with their colleagues, and when providing patient teaching. Specifically, nurses noted that access to medication references had the potential to decrease the number of medication errors, which could result in improved client outcomes. Further, nurses noted that access to evidence based guidelines could improve client outcomes by facilitating improvements in their clinical practice.

When assessing the impact of mobile technology on client outcomes, Quinn et al. (2011) randomly assigned 26 primary care practices to one of three stepped treatment groups or to usual care. Group 1, the control group received routine care, Group 2 received coaching using a mobile diabetes software application, Group 3 received coaching access to the physician's data base, while Group 4 received coaching using mobile software, access to the physician's data base, and access to decision support. The primary outcome was defined as a change in glycated hemoglobin levels. An analysis of the data identified that when compared with regular care, the combination of regular care and coaching using mobile software produced a significant and sustained reduction of

1.2% in glycated hemoglobin levels at six months and at one year.

Further, while practicing as infection control practitioners in a 404 bed level one trauma centre, Goss and Carrico (2002) examined the value of using portable computers to gather information regarding the use of peripheral and central access intravenous infusion catheters. To be useful, nurses required that mobile devices and the software be able to record and update data regarding the type of vascular device inserted, link the data to a specific patient, and document the location of the client. Further, nurses identified a desire to document the location of care providers who required assistance with using infusion catheters. Finally, an ability to analyze the data was required (Gross & Carrico). Once the system was implemented, infection control and intravenous infusion nurses were able to identify and track the quality of nursing care provided on specific nursing units, and evaluate the quality of care based on the number of actual and potential patient complications (Gross & Carrico). Further, infection control practitioners were able to identify specific device-related concerns (Gross & Carrico). The authors noted the ability to collect and analyze data resulted in the development of quality improvement initiatives for nursing staff, and informed their decision to review the quality of infusion devices.

Summary

The results of this literature review indicate that handheld computers are progressively being implemented in health care. While a body of research identifying the impact of the technology on the larger health care system is expanding, evidence to support the use of portable computers in homecare is largely descriptive, opinion based and inconsistent. Given the potential impact the technology could have on clients, nurses, and organizations, further research regarding the use of portable computers in home care

is required.

Chapter 3

Methods and Procedures

The purpose of this descriptive retrospective study was to assess the impact of portable computers on the utilization of evidence-based practice, clinical outcomes, and on the cost effectiveness of care, when the technology was used by home care nurses to manage clients with lower leg venous ulcers. This chapter presents the research methodology used in this study. In addition, a description of the study's design, sample, instrument(s), procedures, and statistical analysis has been included. Factors affecting the validity of the study and issues impacting the protection of human subjects are also presented.

Study Context

In Ontario, Canada, Community Care Access Centers (CCACs) are responsible for assigning and coordinating home care services (Kerzner, 2004). However, CCACs do not provide direct client care. Both professional and non-professional health care services are contracted out to home care agencies successful in a competitive bidding process.

As one of the home care agencies contracted by the Ontario Ministry of Health and Long Term Care (OMHLTC), Bayshore Home Health (BHH) provides comprehensive home care services, including wound care, to citizens living in both urban and rural areas in Ontario. A collaborative relationship between BHH, CCACs, and the OMHLTC has resulted in the introduction of portable computers in home care. Rationale for the introduction and use of these devices included the desire to improve the use of clinical practice guidelines, optimize client outcomes, and as a means of decreasing the cost of providing care. Further, the technology presents an opportunity for BHH, CCACs, and

the OMHLTC to collect electronic data at the point of care. The data could be used to establish the prevalence of disease, track the effectiveness of quality improvement initiatives, and to collect home care data suitable for comparison between CCACs and between provinces.

When providing wound care services, nurses employed by BHH work collaboratively with CCAC case managers. Clients referred for wound care receive an initial assessment from a nurse employed by Bayshore. The results of the assessment are communicated back to the CCAC case manager along with recommendations regarding the frequency of visits and the duration of care. The case manager is then responsible for authorizing the proposed plan of care. Once authorized, BHH nurses implement the care plan and are reimbursed for their services on a per visit basis.

When managing venous leg ulcers, home care nurses employed by BHH use evidence based guidelines developed by Burrows et al. (2006). A paper-based wound care documentation system developed from the guidelines(http://cawc.net/images/uploads/wcc/4-1-vol4no1-BP-VLU.pdf) has been converted into an electronic format (Appendix B), and has been integrated into C5 and F5 motion tablets, Panasonic H2 tablet computers, and into Levono S103T Idea Pads (Appendix C). Home care nurses use the technology at the point of care to complete client assessments, develop care plans, and to evaluate the client's progress.

When managing venous leg ulcers, evidence based guidelines developed by Burrows, et al. (2006) state that wounds should be assessed for their ability to heal and should be classified as non-healable, maintenance wounds, or healable wounds. For healable wounds, use of best practice standards should result in a 30% closure within 4

weeks, with complete closure at 12 weeks (CCAC, 2009). For ease of use, CCACs have extended the 12 weeks to 100 days. Further, the guidelines indicate that with the use of evidence based practice, clients should not require more than 3 dressing changes per week after 4 weeks (CCAC). Currently, these best practice standards are being used to evaluate the quality of care provided by contracted care providers.

To further support clinicians at the point of care, portable devices were equipped with E-mail and Internet access. Clinicians requiring additional decision support could access reference material embedded in the wound care documentation and could access evidence based web sites using 3G or Wifi.

Before implementing the technology at BHH, nurses were required to complete an orientation program. Module 1 of the orientation provided a review of tablet functionality, Microsoft email, options for connecting to the Internet, and an approach to infection control. Module 2 provided an overview of wound care guidelines and included an evidence based approach to assessing a wound, controlling and eliminating the cause of the wound, cleansing a wound, identifying and eliminating infection, and debridement. An approach to eliminating dead space, managing exudate, moisture balance, odour control, and protecting wounds was also presented. Module 3 included a review of the electronic documentation system, and module 4 provided an overview of changes in policy, procedure, and communication practices associated with the implementation of portable devices. The content of each module was included in a Microsoft powerpoint presentation, while the educational environment provided significant emphasis on the didactic learning model. All four Modules required approximately 12 hours to complete.

Design

This descriptive retrospective chart review used a convenience sample of home care clients with lower leg venous ulcers who received home care services from nurses working in Ontario, Canada.

Variables

The independent variable in this study was the presence or absence of portable computers with integrated evidence based practice guidelines and decision support, when caring for clients with lower leg venous ulcers in their homes. Dependent variables included compliance with evidence-based practice, clinical outcomes, and the cost of care. Further, covariates including the client's gender, age, smoking status and wound acuity where evaluated. The nurse's age, years of experience, and level of education were also assessed.

Research Questions:

The following three research questions were investigated:

1 Was there a difference in adherence to clinical practice guidelines when home care nurses used portable computers with integrated evidence based guidelines and decision support to provide wound care services to home care clients with lower leg venous ulcers, and home care nurses who used an evidence based paper documentation system?

2 Was there a difference in clinical outcomes (wound healing at 30 days and 100 days) for home care clients with lower leg venous ulcers who received wound care from nurses using portable computers with integrated evidence based guidelines and decision support, and clients who received wound care from nurses who used an evidence based paper documentation system?

3 Was there a difference in the cost of providing wound care services when home care nurses used portable computers with integrated evidence based practice guidelines and decision support, and the cost of providing care when home care nurses used an evidence based paper documentation system to manage home care clients with lower leg venous ulcers?

Sample

The following inclusion criteria were applied when selecting a convenience sample of clients (charts) from the total population of clients with lower leg venous ulcers who received care at Location 1, Site A and Site B, and Location 2:

- The client must be 18 years of age or older;
- Referred to the home care agency for the management of lower leg venous ulcers;
- Received wound care from nursing staff;
- Referred to the home care agency between January 1, 2011 and December 31, 2011.

Sample Size

When conducting an analysis of the data using a Chi Squared test of independence with alpha set at 0.05, it is preferred that the sample size be sufficiently large enough to ensure that the expected number of cases for each category will be five or more. In situations where the sample size is not large enough to include a minimum of five cases in each category, a Fishers exact test is recommended. Given these stipulations, a total sample size of 70 charts, 35 charts per location, was deemed sufficient.

Treatment Groups

A convenience sample of clients who received wound care from nurses working at two locations was selected from the total population of clients who received wound care for lower leg venous ulcers at each location. For this retrospective chart review, Group A served as the control group, and was selected from Location 1, Site A and Site B. Clients included in Group B, the intervention group, were selected from Location 2. Clients at both locations received wound care services as previously described. Further, nurses working at Location 1, Site A and Site B had received training on how to complete the

paper documentation, while nurses working at Location 2, had received instruction on how to complete the electronic documentation. Clients included in treatment Group A received care from nurses who used an evidence based paper charting system to document and to guide their practice, while treatment Group B had received care from nurses who used the same evidence based wound care guidelines integrated into portable computers. Nurses using the devices also had access to decision support built into the electronic documents, web based decision support resources, and email.

The nature of a retrospective chart review requires that paper based charts be highly accurate, complete, and comprehensive (Jansen et al., 2005). Therefore the selection of Location 1, Site A and Site B was informed based on the results of an organization wide chart audit. The audit identified these sites as having the most complete and comprehensive paper-based wound documentation.

Collecting data from two sites within Location 1 required validation that each site had used a standardized approach to the delivery of wound care services during the time the charts were eligible for inclusion. A comparison of Site A and Site B indicated that prior to January 1, 2011, the date of the proposed data collection, nurses working at both sites received the same wound care education from the same nurse educator. During this time period, both sites also used the same policies, procedures and documentation standards. Only one home care branch at BHH uses portable computers. Therefore, this site was selected as Location 2.

A review of population and health data for individuals living close to Location 1, Site A and B identified the following points. Of the total population living in the Erie St. Clare Local Health Integration Network, 14.5% were 65 years of age or older, with

12.2% classified as low income. Obesity rates were established at approximately 57%, and the incidence of diabetes and smoking were estimated at 7.3% and 22% respectively. (Erie St. Clare Local Health Integration Network (LHIN), 2009).

The North Simco Muskoka LHIN (2010), Location 2, indicated that the region was growing and aging faster than many other areas of the province, with 20.7% of the population being over 65 years of age or older. The report also indicated that 7.9% of families living in the region were below the low income cut-off. Further, smoking and obesity rates were 22% and 51% respectively, with diabetes affecting 6% of women and 8% of men (North Simcoe Muskoka LHIN, 2010).

A review of the nursing staff located at Location 1 identified that 43 nurses were involved in client care. Nineteen were Registered Practical Nurses (RPNs), and 24 were Registered Nurses (RNs). Of these, 1 RPN and 3 RNs held a wound care certification. At Location 2, 57 nurses provided direct patient care. Of these, 39 were RNs and 18 were RPNs. One RN was a certified wound care nurse.

Unit of Analysis

This study used patient charts and nurse administrative records as the units of analysis. Table 3 contains a summary of the unit(s) of analysis, the instrument(s), dependent variables and covariates.

Table 3.

Unit of Analysis/Instrument, Dependent Variables, and Covariates

Unit(s) of Analysis/Instrument	Dependent Variable	Covariates
Patient Chart Nurse employment record	<u>Adherence to clinical practice guidelines:</u> The completion of a Lower Leg Assessment. The completion of a Pain Assessment The completion of a Quality of Life Assessment The application of compression therapy	Patient demographics (Age, gender smoking status, and wound acuity) Nurses' age The nurses' years of experience working with Bayshore Home Health Number of nurses with a wound care certification based on location The nurses' level of education (RN, RPN)
Patient Chart Nurse employment record	<u>Client outcomes:</u> Number of wounds that achieved 30% closure in 30 days Number of wounds that achieved closure at or before 100 days of receiving care	
Patient Chart Nurse employment record	<u>Cost effectiveness of care:</u> Number of clients who initially required more than 3 visits per week but required 3 or less visits per week within the first 4 weeks of receiving care The total number of days of wound care to a maximum of 100 days Total number of visits within the first 100 days	

The use of an electronic chart at Location 2 allowed for data to be extracted in the form of an automated electronic report. However, at Location 1, the data needed to be extracted manually by a third party data extractor and entered into an electronic data base. A discussion with the Site Director for Location 1, Site A and Site B, to recruit a qualified data extractor identified an office administrator with experience in chart reviews and data extraction. This individual was employed by BHH and had the knowledge and security clearance necessary to complete the task.

During the manual data extraction process, demographics including gender and age were extracted from the client's chart and were recorded in questions five and six of the data extraction tool (Appendix D). In addition, the date of occurrence of the wound, client's wound type, wound acuity, and smoking history, were extracted and recorded in the data extraction tool (Appendix D) in questions 3, 7, 11, and 13.

The use of evidence-based practice was also assessed. Lorimeret al. (2003) defined evidence based practice as "the conscientious, explicit, and judicious use of current best evidence in making decisions about client care" (p. 133). In this study, the use of evidence based practice was evaluated based on the CCAC's (2009) wound care management guidelines, and on the use of wound care best practice guidelines developed by Burrows et al. (2006). The evidence suggests that a reduction in the number of wound care visits to three or less per week within four weeks should be achieved. In addition, a lower leg assessment, the use of compression therapy when indicated, a pain assessment, and a quality of life assessment should be completed. This information was extracted from the documentation and recorded in questions 16, 20, 26, and 28 of Appendix D.

As identified under the definition of terms, client outcomes are defined as the result

of efforts by healthcare providers to optimize patient care that can be evaluated based on the appropriateness of the services provided, and the ability of the service to achieve the desired results (Hoxie, 1996). Further, the results can include partial or complete restoration of functions, a reduction in physiological anomalies, or improvements in the psychosocial wellbeing of clients (Hoxie). For the purpose of this study, client outcomes were defined as the percentage of wound healing at 30 days, and the percentage of wound closure at 100 days. The information was recorded in questions 41 and 42 of the data extraction tool (Appendix D).

Further, both locations were compared based on the cost of providing care. Metrics used to assess and compare cost at each location included the number of clients who initially required more than 3 visits per week, but were reduced to 3 or less visits per week within the first four weeks, the number of healable wounds that achieved closure within 100 days, and the average number of visits provided. This approach to establishing the cost effectiveness of providing care is consistent with recommendations made by Donaldson et al. (2002). These authors identified that cost effectiveness should be determined through a comparison of a new intervention against current practice. Information regarding the cost of care was recorded in section 36, 37, 38, 41, and 42 of Appendix D.

Finally, nurses' age, professional designation, and the number of years of experience, were compared across locations. This information is routinely collected at each Bayshore branch and is used to anticipate the level of staff turnover, develop nurse recruitment and retention initiatives, and to inform the development of continuing education initiatives. As the Senior Clinical Consultant for Bayshore Home Health, I was

authorized to access this information, but requested the data be scrubbed of all nurse specific identifiers prior to being reviewed and analyzed. Scrubbing the nursing data ensured that each nurse's confidentiality was maintained.

Instruments

A data extraction tool and a coding manual were developed and inserted into an electronic web-based document (Appendix D). The document served to facilitate a systematic approach to data extraction.

Data Extraction Tool

Banks (1998) indicated that a well-designed data abstraction instrument should be formatted to ensure efficient and accurate data entry. Therefore, the electronic data extraction tool was developed based on a review of the paper-based chart and a review of evidence based practice guidelines for the management of lower leg ulcers (http://cawc.net/images/uploads/wcc/4-1-vol4no1-BP-VLU.pdf). Indicators of evidence based care; benchmarks for measuring clinical outcomes, and parameters for calculating the cost of providing care were identified. After a review of both documents, the researcher developed a data extraction instrument that included the required metrics and facilitated a systematic review of the paper-based chart.

Coding manual

To further improve the reliability of the data extraction process, a coding manual was embedded within the electronic data extraction instrument. As suggested by Gearing, Mian, Barber, and Ickowicz (2006), a clear set of data extraction protocols and guidelines should be provided to guide the data extractor in the data extraction process. Detailed and non-ambiguous instructions identifying the location of the desired variables were

included beneath each section of the data extraction form.

To ensure the data extraction tool and the coding manual met the needs of the data extractor, the branch manager at Location 1, Site A, was asked to trial the instrument. After an independent review of eight charts, the branch manager identified that the instrument provided a clear and systematic approach to the data extraction process. Banks (1998) supported the process of constructing the instrument as outline above and indicated that when the data extraction tool is designed with an awareness of the documentation process, and based on knowledge regarding the location of the data, the likelihood for errors in the data extraction process is decreased.

Procedures

The implementation of this study required approval from the University of Alberta Ethics Review Board; Bayshore's Ethics Review Committee, and the Director of Quality at both of the Community Care Access Centres involved in the study. Once the approval process was completed, the data collection process began.

Location 1

Access to paper based charts located at Location 1, Site A and B was established through collaboration with Bayshore's administrative team responsible for the branch. Discussions with both administrative teams identified support for the study, and a commitment to allocating the resources necessary to complete the data extraction process.

In preparation for the data extraction process, the researcher visited Location 1, Site A and Site B. Access to secure office space; a computer terminal, and a locked filing cabinet was confirmed. Further, a consultation with the data extractor was completed. During the consultation, the researcher confirmed that the data extractor had been granted

the security clearance necessary to complete the chart review. Once confirmed, the researcher provided the data extractor with a secure user name and password required to access the electronic data extraction tool and coding manual. Orientation to the tool, and the process for saving data was facilitated through a review of charts belonging to the first five clients who were enrolled in the wound care program starting January 1, 2011. As the data extractor reviewed the charts, the researcher monitored and evaluated her ability to interpret the questions and the content included in the tool, and her ability to locate the data. While piloting the instrument, ambiguities in the data extraction tool and the coding manual were clarified, and minor revisions to the electronic data extraction form were completed. Further, the data extractor was informed of the need to remain blinded to the reason for the study as an awareness of the purpose of the study could have impacted the validity of the research findings. The data extractor was also informed of the need to review 10% of all charts a second time to validate the accuracy of the chart review process.

To ensure client confidentiality, data extracted from each chart was coded. Prior to reviewing a chart, the data extractor placed a secure but removable label on the cover of the chart. The first chart was identified as chart 0001 and coded in the electronic data extraction tool as 0001. Subsequent charts were coded as chart 0002 and so on. After each chart was reviewed, it was stored in a locked cabinet until the necessary sample size was obtained.

After all paper-based charts were reviewed and the data had been collected, the data extractor contacted the researcher. At that time, the researcher removed the data extractor's access to the electronic data extraction tool and closed the electronic file. The

researcher then forwarded a new user-name, password, and electronic link to a new data extraction tool to the data extractor. The data extractor was also provided a list of random numbers that corresponded with 10% of the charts that have been reviewed. The charts, selected based on a list of random numbers, were reviewed for the second time and the data was entered into the second data extraction tool. A comparison of data collected during the first and second data extraction process, completed by the same data extractor was used to assess the data extractor's ability to collect the same data on two separate reviews of the same chart. The level of accuracy was used to calculate intra-rater reliability.

Once the second data extraction process was completed, labels previously placed on the cover of the paper charts were removed, and the charts were refiled using the existing branch protocol. Removing the coding numbers ensured that data extracted from the files could not be traced to a specific client. After the data was collected at Location 1, Site A and Site B, it was converted into an SPSS file. The file was then stored in an electronic data-base and password protected.

Location 2

At Location 2, client care was documented electronically. Therefore, manual data extraction was not required. To access the electronic documentation, the researcher needed to collaborate with the Bayshore's Data Analyst. As part of her job description, the Data Analyst required an awareness of Bayshore's electronic database, and the process for generating electronic reports. As a Bayshore employee, the Data Analyst also had the security clearance necessary to access the data.

In preparation for the data extraction process at Location 2, the researcher met with

the Data Analyst and reviewed the final version of the electronic data extraction tool. The Data Analyst then created search criteria designed to generate an electronic report. Further, the Data Analyst confirmed that all data extracted from the paper-based charts at Location 1 could be extracted from the electronic data base located at Location 2.

Unlike the paper-based data extraction process, the reliability of electronic data was difficult to verify. Hypothetically, a second independent Data Analyst blinded to the purpose of the study could have generated an additional report to confirm the reliability of the data. However, a second Data Analyst with the skills necessary to independently generate an electronic report was not available.

Accessing Nursing Data

The nurse's age, years of experience, and level of education was collected from branch managers located at each of the locations. This information is routinely collected at each branch and is used to inform the development of staff recruitment strategies, and to plan educational in-services. To protect the identity of staff, staff identifiers were removed from the report before the report was forwarded to the researcher. To ensure anonymity, the specific age of each nurse was not collected. Instead, age was categorized using an interval scale.

Data Preparation and Analysis

An SPSS Statistical Analysis Program was used to analyze all data. Descriptive statistics were used to summarize: key demographics (age, gender) and clinical characteristics (smoking status, wound acuity) of the patient sample; key characteristics of the nursing staff (age, years of nursing experience, level of education) and the outcome variables (client outcomes, compliance with practice guidelines, and cost). Frequencies

and percentages were used to summarize nominal data and means and standard deviations were used to summarize continuous data. Patient and nursing staff data was entered into one of two groups: Group A, the control group and Group B, the intervention group.

Group comparisons were conducted to determine group equivalences on demographic and clinical characteristics. An independent student t-test and the chi-square test of independence were used to make group comparisons on continuous and nominal data respectively. A series of 2 X 2 contingency tables with a continuity correction were used to compare Group A and Group B on measurements of compliance with practice guidelines, client outcomes, and cost of care (Table 5, Appendix E). Odds ratios and 95% Confidence Intervals were reported for each outcome comparison, while Alpha was set at .05.

Hess (2004) indicated that odds ratios are often used as part of a statistical analysis when conducting a retrospective chart review. Defined as the ratio of the odds of an outcome occurring in an exposed group, to the odds of the same outcome occurring in a non-exposed group, odds ratios provide insight regarding the potential impact of portable computers on the use of evidence based practice, client outcomes, and the cost of providing care.

For the purpose of this study, paper-based charts and electronic charts that did not contain the dependent variables and covariant data (Table 3), necessary to conduct the data analysis were excluded. This approach to addressing missing data is supported by Gearinget al. (2006).

Internal and External Validity

Issues affecting the validity and reliability of this study were addressed. Allison, et al. (2000) defined internal validity as the degree to which research findings can be attributed to the effect of the independent variable on the dependent variable(s). To optimize the internal validity and reliability of this study, multiple evidence-based approaches were implemented. These interventions included the use of a standardized, non-ambiguous data extraction tool to improve the reliability of the data extraction process, and the use of intra-rater reliability techniques to ensure consistency, accuracy and reliability of the data (Allison et al., 2000; Gearing et al., 2006; Jansen et al., 2005). In addition, the data extractor was blinded regarding the purpose of the study (Gearing et al.).

In this study, only the Location 1 control sites were required to manually extract data from paper-based charts. Therefore, only one data extractor was required to complete the task. As the intervention site and the control site are located approximately 400 kms apart, it is unlikely that the data extractor working at Location 1 became aware of the purpose of the study during the data extraction process.

To further ensure the accuracy of the data extraction process, a process to confirm intra-rater reliability was developed. Gearing et al. (2006) defined intra-rater reliability as a process whereby the same data extractor extracts data from the same chart on two different occasions. The data was then compared for accuracy. During the completion of this study, 10% of the charts were randomly selected for reassessment. The consistency of the data collected from the same chart on two separate occasions was calculated at 92.9 %. As a minimum of two data extractors was required to calculate inter-rater

reliability, inter-rater reliability could not be assessed.

The lack of randomization inherent in a retrospective chart review will prevent the authors from asserting that the findings of this study can be generalized to a larger population. However, findings could be used to inform the development of a randomized control trial that could establish a cause and effect relationship between the use of portable technology, the utilization of evidence based practice, client outcomes, and the cost effectiveness of care.

Protection of Human Subjects

This study required the use of health care information not originally collected for the purpose of conducting research. Therefore, approval from an Ethics Review Committee was required.

To ensure the protection of human subjects, data extraction from the paper-based charts was coded. Coding remained in place until intra-rater reliability had been calculated. Once the internal validity of the data had been documented, all coding information was purged. The process ensured that data extracted from paper-based charts could not be traced to patients. Further, electronic reports generated at Location 2 did not include client identifiers, and information pertaining to the nursing staff working at each location was purged from existing documents.

As with any research study, ownership of the data must be determined prior to the initiation of the data collection process. Clarification regarding ownership of data was essential in this case as the PhD student was also an employee of Bayshore Home Health (BHH). Further, the research data was collected at two branches owned by BHH. To avoid any potential concern that the employer might attempt to influence the findings of

the study, or influence the content of any publications resulting from the study, a written agreement confirming that the researcher was the sole ownership of any data related to the study was requested and received prior to initiating the study protocol. A copy of the letter of request and an official response from BHH establishing the researcher as the sole owner of all data associated with this research study are included in Appendix F and Appendix G.

This study was conducted by a PhD student enrolled at the University of Alberta. However, the study took place in Ontario, Canada and required collaboration between Bayshore Home Health (BHH) and two Ontario Community Care Access Centers (CCACs). To ensure that ethical standards were maintained across organizations and across provinces, multiple ethics reviews were conducted.

Initially, the study received ethics approval from the University of Alberta (U of A). Official documentation provided by the U of A confirming that the study had received ethics approval was then submitted to BHH for their review. Once approved by BHH, documentation provided by the U of A, and BHH, along with a copy of the research proposal was forwarded to the Director of Quality for the CCACs involved in the study. The process was consistent with contractual obligations between BHH and the CCACs (Appendix H), and was consistent with the request for information documented by the Director of Quality for the Erie St. Clair CCAC (Appendix I). The study was initiated after final approval was obtained from both the CCACs (Appendix M and Appendix N).

Budget

A review of the budget proposed for this retrospective chart review (Appendix J) estimated the total budget for this study at $10,740.00. Given that much of the cost of this study was absorbed by BHH, no external funding was required.

Chapter 4

Results

In this retrospective chart review, data was collected to assess the potential impact of portable computers with an electronic documentation system on the use of evidence-based practice, clinical outcomes, and cost of providing wound care to clients with lower leg venous ulcers. This chapter presents data obtained from a convenience sample of paper based charts collected at Location 1 (paper), Site A and Site B, the sites where paper-based data was collected, and Location 2 (EMR), the site where electronic data was collected. The demographic characteristics of nurses who provided care to clients with lower leg venous ulcers will be discussed, and a comparison of the use of evidence based practice, clinical outcomes, and the cost of providing care will also be presented.

Sample

A review of paper based charts for clients with lower leg venous ulcers who were referred to Location 1 (paper) between January 1, 2011 and December 31, 2011 resulted in the identification of 35 paper-based charts ($n = 35$). An electronic chart review conducted at Location 2 (EMR) identified an additional 45 electronic charts ($n = 45$), for a total of 80 ($N = 80$) charts.

Nursing Demographics

Data identifying the demographic characteristics of nurses directly involved in the delivery of client care were also collected (Table 4). Both groups of nurses were compared based on their professional designation as a registered nurse or registered practical nurse, age, and the number of years they had worked for BHH.

Of the total number of nurses working at Location 1 (paper) (n =43), who were directly involved in providing patient care, 44.2% were registered practical nurses and 55.8% were registered nurses. Of these, one RPN and three RNs had wound care certification. At Location 2 (EMR), the total number of nurses directly involved in the delivery of care (n =57) was greater. Of these, (31.6%) were registered practical nurses, and 68.4% were registered nurses. Only one RN was certified in wound care.

An analysis of data reflecting the age of nurses working at both locations identified that nurses were not significantly different based on age[$\chi^2(4, N = 100) = 6.440, p = .169$], with all nurses ranging from 20 to 70 years of age. However, a review of the data indicated that although not statistically significant, nurses working at Location 2 (EMR) were slightly younger. At Location 1 (paper) 81.4% of nurses were between 20 – 50 years old, while 85.9% of nurses working at Location 2 (EMS) were between 20 -50 years old.

An analysis of nurses working at both locations based on professional designation, and the number of years of experience working for BHH identified the following results. Nurses working at Location 1 (paper) and Location 2 (EMR) were statistically similar based on professional designation[$\chi^2(1, N = 100) = 1.174, p = .279$]. However, nurses working at Location 2 (EMR) had more years of experience working with BHH[$\chi^2(3, N = 100) = 28.875, p = .000$]. Given that four of the nurses working at Location 1 (paper) had a wound care certification compared to one nurse working at Location 2 (EMR), clients who received care at Location 1 (paper) were more likely to have received care from a nurse with a wound care designation, while clients care for at Location 2 (EMR) were more likely to have received care from a registered nurse.

Table 4.

Nursing Demographics

Demographic Characteristic	Paper/Location 1 *n*=43		EMR/Location 2 *n*=57		*p*
	f	%	f	%	
Designation					
RPN	19	44.2%	18	31.6%	.279
RN	24	55.8%	39	68.4%	
Age					
20-30 years	11	25.6%	8	14.0%	
30-40 years	9	20.9%	21	36.8%	.169
40-50 years	15	34.9%	20	35.1%	
50-60 years	3	7.0%	6	10.5%	
60-70 years	5	11.6%	2	3.5%	
Years with Bayshore					
< 1 year	9	20.9%	6	10.5%	.000*
1-4 years	16	37.2%	3	5.3%	
4-10 years	13	30.2%	15	26.3%	
> 10 years	5	11.6%	33	57.9%	

Client Demographics

Of the charts included for analysis at Location 1 (paper), 48.6% were male and 51.4% were female. At Location 2 (EMR), 60.0% were male and 40% were female. A comparison of the convenience samples selected at each of the two locations using a χ^2 test for significance with $\alpha = .05$ did not identify any significant difference in the samples based on gender[$\chi^2(1, N = 80) = 0.629, p = .428$], age[$\chi^2(7, N = 80) = 6.832, p = .292$], or smoking status[$\chi^2(1, N = 80) = 0.738, p = .390$] (Table 5).

Table 5

Client Demographic Characteristics

Demographic Characteristic	Paper/Location 1 *n*=35		EMR/Location 2 *n*=45		p
	f	%	f	%	
Gender					
Male	17	48.6%	27	60.0%	.428
Female	18	51.4%	18	40.0%	
Age					
25-34	0	0.0%	2	4.4%	
35-44	0	0.0%	3	6.7%	
45-54	3	8.6%	2	4.4%	
55-64	7	20.0%	7	15.6%	.292
65-74	7	20.0%	9	20.0%	
75-84	9	25.7%	15	33.3%	
85-94	8	22.9%	5	11.1%	
95-104	1	2.9%	2	4.4%	
Smoking Status					
Non smoker	32	91.4%	37	82.6%	.390
Smoker	3	8.6%	8	17.8%	

When assessed based on wound acuity, 80% of clients at Location 1 (paper) had an acute wound and 20% had a chronic wound (Table 6). At Location 2, (EMR) 67.4% of clients had an acute wound and 32.6% had a chronic wound. A χ^2 analysis of the data did not identify a statistically significant difference in wound acuity[$\chi^2(1, N = 78) = 0.974, p = .324$] based on location. However, data identifying wounds as acute or chronic for two clients enrolled at Location 2 (EMR) was not documented and therefore not included in the analysis.

Table 6

Wound Acuity

Wound Acuity	Paper/Location 1 n=35		EMR/Location 2 n=43		p
	f	%	f	%	
Acute	28	80%	29	67.4%	0.324
Chronic	7	20%	14	32.6%	

Adherence to Clinical Practice Guidelines

Chart data collected at Location 1 (paper) and Location 2 (EMR) were compared to assess the frequency of use of clinical practice guidelines by nurses when managing clients with lower leg venous ulcers. Guidelines for comparison included the completion of a lower leg assessment, a pain assessment and a quality of life assessment, and the use of compression therapy.

Lower Leg Assessment

A comparison of Location 1 (paper) and Location 2 (EMR) based on the number of lower leg assessments completed indicated that 97.1% of clients care for at Location 1 (paper) did not receive a lower leg assessment and only 2.9% did (Table 7). Data collected at Location 2 (EMR) indicated that 71.1% of clients did not receive a lower leg assessment while 28.9% did. A χ^2 analysis of the data identified a statistically significant difference [$\chi^2(1, N = 80) = 7.526, p = .002$], OR, 13.813, CI[1.708, 111.723] between the samples.

Table 7

Frequency of Lower Leg Assessments

Adherence to clinical practice guidelines	Paper/Location 1 *n*=35		EMR/Location 2 *n*=45		*p*
	f	%	f	%	
Lower leg assessment completed					
No	34	97.1%	32	71.1%	.002*
Yes	1	2.9%	13	28.9%	

Clients who received wound care at Location 2 (EMR), the site where portable computers with an integrated client management system was used to provide care, were almost 14 times more likely to have received a lower leg assessment than those who received care at Location 1 (paper), the site where a paper based documentation system was used to provide wound care services.

Pain Assessment

At Location 1 (paper), 88.6% of clients received a pain assessment and 11.4% did not (Table 8). However, only 46.7% of clients cared for at Location 2 (EMR) received a pain assessment while 53.3% did not. A comparison of the number of clients who received a pain assessment at both sites using a χ^2 analysis identified a statistically significant difference [$\chi^2(1, N = 80) = 13.410, p = 0.000$], OR, 8.857, CI [2.682 -29.151] in the number of pain assessments conducted. Clients cared for at Location 1 (paper) were almost 9 times more likely to have received a pain assessment than those cared for at Location 2 (EMR).

Table 8

Frequency of Pain Assessments

Adherence to clinical practice guidelines	Paper/Location 1 *n*=35		EMR/Location 2 *n*=45		*p*
	f	%	f	%	
Frequency of Pain Assessments					
No	4	11.4%	24	53.3%	.000*
Yes	31	88.6%	21	46.7%	

Quality of Life Assessment

A comparison of the frequency of quality of life assessments based on location indicated that at Location 1 (paper), 80% of clients received a quality of life assessment and 20% did not (Table 9). At Location 2 (EMR), 28.9% received a quality of life assessment but 71.1% did not. A analysis of the data [$\chi^2(1, N = 80) = 18.590, p = .000$], OR, 9.846, CI [3.447, 28.124] revealed a significant statistical difference in the number of quality of life assessments conducted based on location. Clients who received care at Location 1 (paper) were almost 10 times more likely to have received a quality of life assessment than those who received care at Location 2 (EMR).

Table 9

Quality of Life Assessments

Adherence to clinical practice guidelines	Paper/Location 1 *n*=35		EMR/Location 2 *n*=45		*p*
	f	%	f	%	
Quality of life assessment completed					
No	7	20.0%	32	71.1%	.000*
Yes	28	80.0%	13	28.9%	

Use of Compression Therapy

The use of compression therapy was compared (Table 10). At Location 1 (paper), 74.3% of clients received compression therapy and 25.7% did not. A review of the frequency of compression use at Location 2 (EMR) identified that 44.4% of clients received compression therapy and 55.6% did not. A χ^2 analysis of the data identified that clients who received care at Location 1 (paper) were more likely to receive compression therapy [$\chi^2(1, N = 80) = 6.005, p = .014$], OR, 3.611, CI [1.384, 9.425] than clients who were cared for at Location 2 (EMR). Specifically, clients cared for at Location 1 (paper) were 3.61 times more likely to have received compression therapy than clients who received care at Location 2 (EMR).

Table 10

Frequency of Compression Therapy Based on Location

Adherence to clinical practice guidelines	Paper/Location 1 *n*=35		EMR/Location 2 *n*=45		*p*
	f	%	f	%	
Compression therapy applied					
No	9	25.7%	25	55.6%	.014*
Yes	26	74.3%	20	44.4%	

Clinical Outcomes

A comparison of clinical outcomes achieved at Location 1 (paper) and Location 2 (EMR) was completed to determine the potential impact that portable computers with an integrated client documentation system could have on wound care outcomes. Evidence based outcomes assessed included the achievement of a 30% reduction in the size of a venous leg ulcer at or before the client received 30 days of care, and the number of clients who achieved wound closure at or before 100 days of care.

30% Closure After 30 Days of Care

A χ^2 analysis of wound care data collected at Location 1 (paper) and Location 2 (EMR) to compare the number of venous leg ulcers that achieved a 30% reduction in wound size after 30 days of receiving wound care was conducted (Table 11). At Location 1 (paper), 42.9% of clients achieved a 30% reduction in wound size at 30 days, while 57.1% did not. At Location 2 (EMR), 42.2% of clients achieved a 30% reduction and 57.8% did not. The findings indicated that clients who received care from nurses who used paper-based documentation were as likely [$\chi^2(1, N = 80) = 0.000, p = 1.000$], OR, 1.026, CI [0.420, 2.508] to have achieved a 30% reduction in wound size after 30 days of

receiving would care as those who received care from nurses who used portable computers.

Table 11

Reduction in Wound Size after Receiving 30 Days of Care

Client Outcomes	Paper/Location 1 *n*=35		EMR/Location 2 *n*=45		*p*
	f	%	f	%	
The client achieved a 30% reduction in wound area at 30 days					
No	20	57.1%	26	57.8%	1.000
Yes	15	42.9%	19	42.2%	

Achieved Wound Closure within 100 Days

A review of data obtained from Location 1 (paper) identified that 54.3% of clients achieved wound closure at or before 100 days of receiving care, and 45.7% did not. At Location 2 (EMR), 46.7% of clients achieved wound closure at or before 100 days of receiving care, while 53.3% did not [$\chi^2(1, N = 80) = 0.203, p = 0.652$], OR, 0.737, CI [0.304, 1.787] (Table 12). The results did not suggest a significant difference in wound closure rates within 100 days of receiving wound care with or without the use of portable computers as a means of providing care.

Table 12

Wound Closure At or Before 100 Days Based on Location

Client Outcomes	Paper/Location 1 *n*=35		EMR/Location 2 *n*=45		*p*
	f	%	f	%	
Status of the wound upon discharge after 100 days of care.					.652
Closed	19	54.3%	21	46.7%	
Not Closed	16	45.7%	24	53.3%	

Cost Effectiveness

An analysis of the impact of portable computers with an integrated client management system on the cost effectiveness of providing wound care was conducted. Cost was evaluated using three metrics. These metrics included a comparison of the number of clients who initially required more than 3 visits per week for wound care but required 3 or less visits per week within the first 4 weeks, the total number of days required to close the wound up to a maximum of 100 days, and the total number of visits required to close the wound within 100 days.

Clients Who Received More than Three Visits Per Week

Of the total number of clients included for analysis at Location 1 (paper), 22.9% received more than 3 visits per week within the first 4 weeks of receiving care and 77.1% did not. Of those clients enrolled at Location 2 (EMR), 22.2% received more then 3 visits per week during the first 4 weeks of care, and 77.8% did not. A χ^2 analysis of the data indicated that when compared based on location, the number of clients who initially required more than 3 visits per week during the first 4 weeks was not statistically significant [$\chi^2(1, N = 80) = 0.000, p = 1.000$], OR, 1.037, CI [0.361, 2.983].

After 4 weeks of care, 75% of clients at Location 1 (paper) who initially required 3 or more visits per week were reduced to less than 3 visits per week. At Location 2 (EMR), 70% of those who initially required 3 or more visits per week within the first 4 weeks required less than 3 visits per weeks at the end of 4 weeks (Table 10). Data analysis indicated that there was no statistically significant difference[$\chi^2(1, N = 16) = 0.000, p = 1.000$], OR, 0.778, CI [0.096, 6.322] between the samples after 4 weeks of care based on location (Table 13).

Table 13

A Reduction in the Frequency of Visits to 3 or Less Visits per Week within 4 Weeks of Receiving Wound Care

Adherence to clinical practice guidelines	Paper/Location 1 *n*=8		EMR/Location 2 *n*=10		*p*
	f	%	f	%	
The client was receiving more than three visits per week for dressing changes but required three or less visits per week within the first 30 days of care					
No	2	25.0%	3	30.0%	1.000
Yes	6	75.0%	7	70.0%	

Number of Days that Clients Received Wound Care

A comparison of the number of days that clients received wound care services at each location (Table 14) provided further insight regarding the impact that portable computers could have on the cost of providing care. Mean averages of the total number of days that clients received wound care visits based on location identified that within the first 100 days, clients receiving care at Location 1 (paper), received an mean average of 68.6 days of care. At Location 2 (EMR), clients received a mean average of 53.84 days of care. However, the results of a Mann-Whitney U test ($U = 80$, $z = -1.153$, $p = .249$) did not identify a statistically significant difference in the number of days of care that clients received base on location.

Table 14

Mean and Standard Deviation Data for Number of Days of Wound Care to a Maximum of 100 Days

Cost Effectiveness of Care	Paper/Location A n=35	EMR/Location B n=45	*p*
Total number of days of wound care provided to a maximum of 100 days			
Mean	68.6	53.84	.249
Std Deviation	34.288	39.975	

Number of Wound Care Visits Provided in 100 Days

An analysis of the number of wound care visits that clients received within the first 100 days based on location identified statistically significant findings (Table 15). Clients who received care at Location 1 (paper) were more likely to have received a greater number of wound care visits (U = 439, z = -3.383, p = .001) than clients cared for at Location 2 (EMR). When compared based on mean averages, clients receiving care at Location 1 (paper) received almost double the number of visits within 100 days than those cared for at Location 2 (EMR).

Table 15

Mean and Standard Deviation Data for the Number of Wound Care Visits Provided Within 100 Days

Cost Effectiveness of Care	Paper/Location 1 *n*=35	EMR/Location 2 *n*=45	*p*
Total number of visits within the first 100 days of wound care.			.001*
Mean	23.57	12.67	
Std Deviation	16.811	10.817	

Summary

Data collected during the completion of this study compared nursing and client demographic data obtained from two locations. Location 1 (paper) used paper based tools to provide wound care services to clients with lower leg venous ulcers, while Location 2 (EMR) used an electronic client management system to provide wound care services. In addition, both locations were compared based on adherence to clinical practice guidelines for the provision of care, clinical outcomes, and on the cost of providing care.

Results indicated that nurses working at both locations were statistically similar based on age[$\chi^2(4, N = 100) = 6.440, p = .169$] and professional designation[$\chi^2(1, N = 100) = 1.174, p = .279$]. However, nurses working at Location 2 (EMR) had more years of experience working for Bayshore[$\chi^2(3, N = 100) = 28.875, p = .000$], and had a greater number of RNs providing direct patient care. Finally, more nurses working at Location 1 (paper) had a wound care certification.

A comparison of client demographic data based on location identified that both samples were statistically similar based on all measure parameters. These parameters included gender[$\chi^2(1, N = 80) = 0.629, p = .428$], age[$\chi^2(7, N = 80) = 6.832, p = .292$], smoking status[$\chi^2(1, N = 80) = 0.738, p = .390$], and wound acuity[$\chi^2(1, N = 78) = 0.974, p = .324$].

When compared based on adherence to clinical practice guidelines, clients cared for at Location 1 (paper) were more likely to receive a pain assessment, quality of life assessment, and compression therapy. However, clients cared for at Location 2 (EMR) were more likely to receive a lower leg assessment.

When compared based on clinical outcomes, results indicated that clients cared for at both locations were just as likely to have achieved 30% wound closure within the first 30 days of care[$\chi^2(1, N = 80) = 0.000, p = 1.000$], OR, 1.026, CI [0.420, 2.508], Further, clients were just as likely to have achieved wound closure at or before 100 days of care[$\chi^2(1, N = 80) = 0.203, p = 0.652$], OR, 0.737, CI [0.304, 1.787].

An analysis of the cost of care identified that, clients who initially required more than 3 visits per week during the first 4 weeks of care were just as likely to have been reduced to 3 or less visits per week during the first 4 weeks[$\chi^2(1, N =16) = 0.000, p = 1.000$], OR, 0.778, CI [0.096, 6.322] regardless of location. In addition, no statistical significance findings was observed in the average number of days that clients received care($U = 80, z = -1.153, p = .249$) based on location. When both locations were compared based on the average number of visits, a statistically significant difference in the number of visits provided was identified. On average, clients cared for at Location 1 (paper) received twice as many wound care visits (M = 23.57, SD = 16.81) within the first one hundred days, compared to clients care for at Location 2 (EMR) (M = 12.67, SD = 10.82)

Chapter 5

Discussion

The purpose of this study was to assess the impact of portable computers with an embedded client management system on the use of evidence-based practice, clinical outcomes and the cost of care when used by home care nurses to manage clients with lower leg venous ulcers.

The study was designed to address three research questions:

1. Was there a difference in adherence to clinical practice guidelines when home care nurses used portable computers with integrated evidence based guidelines and decision support to provide wound care services to home care clients with lower leg venous ulcers, and home care nurses who used an evidence based paper documentation system?

2. Was there a difference in clinical outcomes (wound healing at 30 days and 100 days) for home care clients with lower leg venous ulcers who received wound care from nurses using portable computers with integrated evidence based guidelines and decision support, and clients who received wound care from nurses who used an evidence based paper documentation system?

3. Was there a difference in the cost of providing wound care services when home care nurses used portable computers with integrated evidence based practice guidelines and decision support, and the cost of providing care when home care nurses used an evidence based paper documentation system to manage home care clients with lower leg venous ulcers?

This chapter will begin with a discussion of the research findings, followed by an interpretation of the findings with reference to the existing body of literature. Conclusions reached from an analysis of the data will be discussed with reference to the conceptual framework proposed by Powell-Cope et al. (2008). Limitations associated with the study methodology will be presented followed by a discussion of the implications of the research findings on patient care, nursing education and nursing research.

Adherence to Clinical Practice Guidelines

A review of clinical practice guidelines for the management of lower leg venous ulcers (Sibbald et al., 2006) indicated that evidence-based care should include a lower leg assessment, compression therapy when indicated, and a pain and quality of life assessment. This section provides a comparison and a discussion of the data collected at Location 1 (paper) and Location 2 (EMR).

Lower Leg Assessment

A review of data collected at Location 1 (paper) and Location 2 (EMR) revealed a significant difference in the number of lower leg assessments completed. Clients who received care at Location 2 (EMR) were 14 times more likely to have received a lower leg assessment than those cared for at Location 1 (paper). The fact that this finding is congruent with previous research regarding the impact of portable computers on the provision of health care services supports the interpretation that this finding reflects a true difference in the delivery of care when portable computers are use to provide health care services.

When investigating the effects of portable technology on the management of children with asthma, Shiffman et al., 2000) also found that use of portable computers with embedded clinical practice guidelines increased the application of guidelines at the point of care. Further, Lobach and Hammond (1997) noted that when primary care givers were randomly selected to receive a computer generated clinical practice guideline during a client interview, the clinician's compliance with evidence based practice increased from 15.6% to 32.0%.

Alternatively, the group difference found in the number of lower leg assessments in this study could be due to possible intervening variables related to non-random sampling. The fact that the technology group showed a greater frequency of lower leg assessments although there were significantly fewer nurses certified in the provision of wound care in the technology group compared to the paper based group somewhat counters this alternative interpretation.

Compression Therapy

Unexpectedly, clients cared for at Location 1 (paper) were more likely to have received compression therapy than those cared for at Location 2 (EMR). True group differences in the use of compression therapy resulting from the use of technology versus paper-based access to clinical practice guidelines may have been masked by the fact that more nurses in the paper-based group were certified in wound management.

Alternatively, an increase in the utilization of compression therapy at Location 1 (paper) may reflect a true lack of impact of portable computers on the application of this intervention. Although technology may increase the frequency of a lower leg assessment, the frequency utilization of compression therapy may require specialized skills such as those offered in wound care certification programs. Further, greater access to resources necessary to safely apply compression at Location 1 (paper) as compared to Location 2 (EMR) could have further masked the impact of using portable computers could have on the application of compression therapy. This observation is supported by Burrows et al. (2006) who identified that access to clinical practice guidelines alone may not result in an increased use of evidence based practice.

Pain Assessments and Quality of Life Assessments

The results suggested that more pain and quality of life assessments were completed when nurses used paper documentation at Location 1 (paper), than when nurses used portable computers to provide care at Location 2 (EMR). Given that the use of portable computers at Location 2 (EMR) appeared to result in greater number of completed lower leg assessments, a reduction in the use of pain and quality of life assessments associated with the use of portable technology was unexpected. A review of the framework proposed by Powell-Cope et al. (2008) for the implementation of technology in health care provides rationale for this unexpected finding.

When implementing technology in health care, Powell-Cope et al. (2008) proposed that a number of mediating and moderating factors must be addressed (Figure 1) to ensure a successful implementation. The authors asserted that if these factors are not addressed, the effectiveness and efficiencies made possible through the use of technology would be compromised, and adoption of the technology could be jeopardized (Powell-Cope et al.).

A review of the characteristics of the software embedded in the portable device may explain the lower rates of completion of pain and quality of life assessments associated with the use of portable technology compared to the paper based group. Upon opening the software, nurses were required to complete an initial wound care assessment. However, completing a pain assessment or a quality of life assessment required that nurses open additional documents. The process for opening additional documents may have introduced significant inefficiencies in the system that may have impacted the usability of the technology. System performance metrics obtained from the software

manufacturer identified that between September 5th and October 13th, 2011, the average time required to open a pain assessment form or a quality of life assessment form was approximately 20 seconds. Moreover, saving a document took anywhere from 10 to 47 seconds. Software performance data also identified that significant system error rates ranging from 1 per day to 29 per day may have deterred nurses from documenting using the software.

When evaluating the usability of four electronic nursing record systems, Viitanen, et al. (2011) collected feedback from nurses regarding five usability factors. These factors included learnability, efficiency, memorability, errors, and satisfaction. The findings indicated that all four documentation systems tested did not provide adequate failure protection support, and reduced the nurses' productivity. Venkatesh et al., and Morris and Davis, and David (2003) further noted that when issues associated with the technology increased the amount of effort that end users need to expend to implement the technology, the risk that end users will abandon the technology increased. Given the results of these studies, it appears reasonable to conclude that usability factors within the software implemented at Location 2 (EMR) may have resulted in the completions of fewer pain and quality of life assessments when portable computers were used to provide care.

The quality of education provided to prepare nurses for the implementation of portable computers has also been identified as essential to an effective implementation (Powell-Cope et al., 2008). A review of the process for educating nurses in the use of technology at BHH suggests that the quality of education provided to staff may have impacted the use of evidence based practice at the point of care.

During the time that portable computers were being implemented at BHH, the majority of educational content was presented in a didactic environment. McParland, Noble, and Livingston (2004) noted that, when compared to didactic or passive learning, active learning produced better exam results and improved critical thinking skills (Frankel, 2009; Ozturk, Muslu, & Dicle, 2008). Further, Williams et al. (2012) identified that when they are actively involved in the learning process, learners view themselves as being self-directed with an ability to engage in evidence based practice. Based on the results of these studies, it appears reasonable to suggest that the didactic educational model implemented at BHH to educate nurses in the use of portable technology may have negatively impacted the nurses' ability to use the technology. If this was the case, lack of familiarity with the device and the software could explain the significantly lower number of pain assessments and quality of life assessments that were completed at Location 2 (EMR) compared to Location 1 (paper).

A comparison of BHH's approach to educating and orientating nurses in the use of portable technology with evidence based recommendations for the development of a portable technology orientation program, suggests that significant improvements may be required. Bayshore's orientation program consisted of only 8 hours of classroom orientation, while Hockenjos & Wharton (2001) noted that effective orientation programs require a number of days to complete. Further, Hockenjos and Wharton indicated that orientations should include a classroom component and a field preceptorship. Feedback collected from nurses who completed the educational in-service at BHH during the time that portable technology was being implemented identified that, of the 35% of nurses who responded to the survey, 34% indicated that the education they received to prepare

them for the implementation of portable computers at BHH was inadequate (Tapper et al., 2012). Based on the findings associated with these studies it appears reasonable to conclude that the lack of an evidence based approach to implement portable computers at BHH may have also limited its impact in the use of pain and quality of life assessment at Location 2 (EMR)

The relationship between a fee for service (FFS) reimbursement model for nurses working at BHH, and the implementation of clinical practice guidelines for the management of lower leg venous ulcers, should also be considered. Sibbald et al. (2007) indicated that paying a nurse per visit could result in an incomplete assessment and incomplete documentation. Calsyn and Lee (2012) further indicated that FSS models do little to encourage care providers to adopt low cost, high value interventions such as preventative care and patient education. Given that implementing portable computers with an electronic documentation system can introduce inefficiencies in the nurses work flow (Keenan, Yakel, Tschannen, & Mandeville, 2008), nurses may have chosen not to complete a pain or quality of life assessment as a way of maintaining their income and productivity. The conflict between maintaining income and providing evidence based care may have contributed to the unexpected decrease in the use of pain and quality of life assessments when technology was used to provide care. Drossos (2002) noted that to prevent the potential that profitability will impact client care, FSS models should be replaced with alternative funding models.

Clinical Outcomes

In addition to assessing the potential impact of portable computers on the use of clinical practice guidelines, this study addressed the impact of the technology on clinical outcomes. This section will include a comparison and discussion of the findings associated with wound care outcomes obtained at Location 1 (paper) and Location 2 (EMR).

30% Wound Closure at 30 Days

A comparison of the wound care data collected at Location 1(paper) and Location 2 (EMR) did not identify a statistically significant difference in the number of wounds that achieved 30% closure after 30 days of care. This finding should be considered with respect to previously identified factors that may have impacted the use of clinical practice guidelines. Specifically, it appears reasonable to assume that nurses may have not completely integrated the technology into their practice due to inadequate education, challenges navigating the software, and a nurse reimbursement model that discouraged nurses from providing comprehensive care. If this was the case, limited adoption of the technology by nurses would have limited the nurse's access to point of care guidance and evidence based reminders built into the system, and would have minimized the impact of the technology on wound outcomes at 30 days. Although this scenario appears likely, research suggests that additional factors may have played a role in limiting the impact of the technology on wound care outcomes.

The availability of home care services for the management of lower leg venous ulcers may have also impacted wound outcomes. Orster and Queen (2007) indicated that accessing wound care resources, wound care experts, and diagnostics can be extremely

challenging. In some locations, referrals can take up to 2 months (Orster & Queen). If nurses were challenged with limited access to resources in this study, it is possible that lack of wound care resources and consulting services could have prevented nurses from intervening quickly enough to achieve 30% wound closure in 30 days.

Accessibility to client data may have also impacted wound care outcomes. Takahashi, Kiemele, Cha, and Chandra (2009) noted that factors associated with the development of a lower leg venous ulcer include, but are not limited to, a diagnosis of diabetes, congestive heart failure, and renal insufficiency. In addition, Kuri, Nakagawa, Tanaka, Hasuo, and Kishi (2005) identified that smoking can impact the wound healing process. A review of data obtained from Location 2 (EMR) indicated that information regarding the client's past medical history, medications use, and blood work results were largely absent from the chart. As this information can have a direct impact on wound healing, lack of access to the information could have prevented nurses from providing evidence based care, and may have compromised wound care outcomes at the site. Lack of information may explain why nurses who used portable computers at Location 2 (EMR) did not achieve better wound outcomes than nurses who used a paper based documentation system. To improve access to information, nursing documentation standards will need to be addressed. Further, a process to ensure that the client's latest blood work, diagnostic results, and client referrals are uploaded to Bayshore's EMR during the initial referral process will be required.

The client's level of compliance with their care plan has also been identified as a factor affecting wound care outcomes (Orsted & Queen, 2007). This finding was further validated by van Dulmen et al. (2007) who noted that consistent adherence to care plans

in clients with chronic conditions is disappointingly low, and drops dramatically after the first six months of therapy. Given that lower leg venous ulcers are often reoccurring and can require life-long compression therapy (Burrows, 2006), it is possible that clients who were prescribed compression therapy at Location 2 (EMR) may not have been compliant with the plan of care. If this was the case, inconsistent application of compression therapy may explain the lack of improved wound care outcomes for clients cared for at Location 2 (EMR).

The use of ineffective compression therapy at Location 1 (paper) may also explain why higher rates of compression documented at Location 1 (paper) did not result in improved wound closure rates when compared to those obtained at Location 2 (EMR). Given that only 2.9% of clients cared for at Location 1 (paper) received a lower leg assessment, but 74.3% received compression therapy, it is likely that nurses applied minimal compression to comply with evidence based practice, while ensuring that the application of compression did not compromise the client's circulation and increase the need for limb amputation.

Complete Wound Closure at or Before 100 Days

The frequency of complete wound closure rates at or before 100 days of care was compared based on location. The data identified that clients cared for at Location 1 (paper) were just as likely to have achieved complete wound closure after 100 days of care as those cared for at Location 2 (EMR). Explanations for the lack of improvement in complete wound closure rates at Location 2 (EMR) appear consistent with explanations for the limited impact of portable computers on the use of clinical practice guidelines, and factors that may have compromised wound closure rates within the first 30 days of care.

As these factors have been previously discussed, they will not be reintroduced in this section. However, it is important to identify that despite reminders built into the electronic documentation system, a reminder that the wound did not achieve 30% closure at 30 days, did not result in the corrective action required for the wound to achieve closure at 100 days. This findings suggests that a review of the effectiveness of the reminder system built into the software, the wound care resources available to nurses, and the number of nurses who consulted with wound care specialists when the wound was not improving is required.

Cost Effectiveness

A comparison of the cost of providing wound care with and without the use of portable computers was completed. When assessing for differences in the cost of providing care, data were analyzed to determine the number of clients who initially received more than 3 visits per week for wound care and were reduced to 3 or less visits per week within the first month of receiving care. The data was then compared based on location. Although this metric is a reflection of compliance with clinical practice guidelines for the management of lower leg venous ulcers, it is also an indicator of cost. Therefore, this metric was included as an assessment of the cost of providing care. In addition to this metric, data collected at Location 1 (paper) and Location 2 (EMR) were compared based on the number of days that clients received wound care up to a maximum of 100 days. A comparison of the number of wound care visits provided based on location was also completed.

Achieving 3 or Less Visits Per Week Within 4 Weeks

A comparison of the data based on location identified that each of the two samples were statistically similar in the number of clients who initially required more than 3 wound care visits per week. A further analysis of the data noted that after 4 weeks of care, the number of clients who achieved a reduction to 3 or less visits per week at Location 1 (paper) and Location 2 (EMR) was not statistically significant. At Location 1 (paper), 75% of those who initially required more than 3 visits per week were reduced to 3 or less visits per week within the first 30 days, while 70% of those cared for at Location 2 (EMR) were reduced to less than 3 visits per week within 30 days. This finding suggests the use of portable computers at Location 2 (EMR) did not provide any added cost benefit associated with a reduction to less than 3 visits per week within the first 30 days of receiving care. A review of the process whereby wound care services are authorized at Location 1 (paper) and Location 2 (EMR) provides additional insight into the consistent reduction observed in the number of visits within the first 30 days across the locations.

In the province of Ontario, Community Care Access Centres (CCACs) are responsible for the coordination of home care services. However, CCACs do not provide direct client care. Home care services are contracted out to home care providers including BHH. When providing services, BHH nurses complete client assessments and provide client care recommendations to CCAC client care coordinators. These care coordinators are responsible for reviewing and authorizing the level of care requested by BHH nurses. If both CCACs included in this study implemented evidence based guidelines requiring that clients receive less than 3 visits per week after the first 4 weeks of care, standardization in the number of visits approved at both CCACs could explain why the

use of portable computers at Location 2 (EMR) did not result in fewer visits and cost reductions within the first 30 days.

Number of Days that Clients Receive Wound Care

A review of the number of days that clients received wound care was conducted. The results did not reveal a statistically significant difference in the number of days that clients received care based on location. Considering that compression therapy is the gold standard for treatment of lower leg venous ulcers, and that higher rates of compression therapy were documented at Location 1 (paper), it is reasonable to assume that clients cared for at Location 1 (paper) should have achieved better wound outcomes. However, this was not the case. The findings supported an earlier assumption that, despite higher rates of documented compression therapy at Location 1 (paper), the amount of compression applied by nurses working at Location 1 (paper) was not enough to impact wound closure rates. Assuming this assumption is correct, the limited application of compression therapy documented at Location 2 (EMR), and the application of ineffective compression therapy at Location 1 (paper) resulted in ineffective wound care management at each location. This scenario would explain why no difference was observed in the number of days that clients required wound care based on location despite the significantly high rate of compression therapy documented at Location 1 (paper) compared to Location 2 (EMR).

Number of Wound Care Visits Provided in 100 Days

When Location 1 (paper) and Location 2 (EMR) were compared based on the number of visits, the data analysis indicated a statistically significant difference in the number of visits provided. When analyzed, the number of visits that clients received at

Location 1 (paper) was approximately double that of Location 2 (EMR). Clients cared for at Location 1 (paper) received approximately 24 visits within the first 100 days, while clients cared for at Location 2 (EMR) received approximately 13 visits within the first 100 days. Perhaps even more interesting is that despite receiving half the number of visits, there was no statistical difference in wound care outcomes, or in the total number of days that clients received wound care services based on location.

It is possible that the move to electronic documentation at the point of care resulted in a decrease in the number of visits. As nurses were aware that electronic documentation facilitated improved access to client data, an increase in accountability for the number of visits provided by BHH nurses may have resulted in fewer visits and a corresponding decrease in the cost of providing care. Given that nurses are reimbursed for every visit they complete, an actual or perceived increase in accountability for the number of visits provided may have resulted in an overall decrease in visit rates. If the assumption that nurses perceived a greater degree of accountability when technology was implemented, and that improved accountability can decrease the number of wound care visits required to achieve the same wound care outcome, a substantial cost savings could be realized. Based on a reduction from 24 visits to 13 visits, and given an average cost of 30 dollars per nursing visit, the cost of providing one nurse to close a lower leg wound ulcer could decrease from $707.10 per wound to $380.10. This cost reduction would represent a 54% ($327.00) savings in the provision of care per wound.

Perhaps a more likely reason for a reduction in the number of visits provided at Location 2 (EMR) is an enhancement in monitoring by the CCAC. (T. Baker, personal communication, July 17, 2011).

Baker (2013) identified that during the time of the study, the North Simco Muskoka CCAC was committed to reducing the cost of providing wound care services, and was advocating that clients receive one nursing visit per week after the 30 day stabilization period was complete. If this was the case, a reduction in the number of wound care visits authorized by the North Simcoe Muskoka CCAC at Location 2 (EMR) compared to the number of visits authorized at Location 1 (paper) after the first 30 days of care, may account for the difference in the number of visits provided at each location.

Summary

An analysis of health system outcomes across locations indicated that when both locations were compared based on the use of clinical practice guidelines, staff working at Location 1 (paper) completed fewer lower leg assessments than those working at Location 2 (EMR). However, staff working at Location 1 (EMR) utilized more compression therapy and documented more pain and quality of life assessments. Further, no differences were found between locations when compared based on wound closure rates at 30 days and after 100 days of care. Finally, no differences were identified when the locations were compared based on the number of clients who were reduced to 3 or less visits per week within the first 30 days, and the total number of days that clients received care. However, clients cared for at Location 2 (EMR) received fewer visits.

A review of factors that may have compromised the implementation of portable computers in this study suggests the conceptual framework proposed by Powell-Cope et al. (2007) can be used to guide a successful implementation of technology in home care. Specifically, the framework identifies the need to review organizational policies such as funding models, the organizations approach to educating staff, and the characteristics of

the technology that could impact adoption prior to implementation. As these factors have been identified as issues that may have compromised the implementation of portable technology at BHH, use of the framework to guide future implementations is strongly recommended.

Study Limitations

The use of a convenience sample was a limitation in this study. Further, lack of equivalency in nursing staff based on the number of years that nurses had worked at each location, and lack of equivalency in the number of nurses with wound care certification may have impacted the results of this study.

Although a comparison of the convenience samples did not identify differences in the samples when compared on age, gender, smoking status, and wound acuity, there may have been a number of other differences in the samples that could have influenced the findings. These differences could have included the prevalence of obesity, diabetes, and congestive heart failure among clients. Differences in blood glucose levels (Hemoglobin AIC), the use of medications that could have impacted wound healing, the duration of time that past since the client quit smoking, and the prevalence of wound infection could have also influenced the findings.

The lack of an evidence based approach to implementing portable computers at BHH may also be a limitation. Therefore, the results should be evaluated within the context of the implementation.

Implications for Patient Care

The findings of this study have significant implications for patient care. The results suggest that a non-evidence based approach to the implementation of portable computers, combined with inefficiencies in the design of the user interface may reduce the quality of nursing documentation, resulting in the potential for errors in the delivery of care. If these inefficiencies redirect the nurse's attention away from the client and towards the technology, the development of a therapeutic relationship between the client and the nurse may be compromised.

As the software used during this implementation was not connected with the client's primary or acute care electronic medical record, access to the client's home care documents was limited to BHH staff. It is likely that lack of communication between BHH staff and other health care providers could have resulted in inefficiencies in the scheduling and coordination of the multidisciplinary team.

To decrease the likelihood that computer technology will introduce inefficiencies in the provision of patient care, Stone et al. (2005) suggest that organizations adopt a user-centered interface design model. The model provides four principles to guide the development of the interface. These principles include the active involvement of users, an appropriate allocation of function between user and system, iteration of design solutions, and the use of a multidisciplinary design team. Further, the model outlines four design activities to be completed when developing a software user interface. These activities include understanding and specifying the context in which the technology will be used, assessing user and organizational requirements, the development of prototypes, and an evaluation of the design base on system requirements.

Implications for Nursing Education

To address issues associated with the implementation of portable technology in home care, nurses will require advanced competencies in the area of health care informatics. Nursing faculties are advised to continue their work to support expanded access to undergraduate level programs that prepare nurses with the informatics competencies needed for entry to practice. The addition of informatics competencies developed by the Canadian Association of Schools of Nursing (CASN) (2012), to the list of entry to practice competencies for baccalaureate prepared nurses represents a significant step forward. However, nursing faculty members may require additional support to expand on their competency to ensure that these competencies are effectively implemented within the existing nursing curriculum. Access to graduate nurse informatics programs should also be expanded and should be facilitated through online education. The continued transition to online education will also ensure that nurses continue in their transition from novice to expert in the use of technology as they progress with their education.

Implications for Nursing Research

The expected differences found in the number of lower leg assessments conducted, and in the number of wound care visits provided when portable computers were used to provide care, suggests that further research is required. Additional comparisons of sites that use computer technology with those that use paper based documentation could be used to confirm or refute the findings of this study. Further, additional research designed to validate the conceptual framework proposed by Powell-Cope et al. (2008) as an effective approach to implementing technology in health care is needed.

Conclusion

As the provision of care continues to expand to the community, health care organizations will intensify their focus on ensuring that clients receive high quality, cost effective care. Evidence suggests the use of portable computers with an integrated client management system has the potential to improve the quality of care while decreasing cost. However, the results of this study indicated that the successful implementation of portable technology requires that organizations conduct a comprehensive review of factors that may impact the implementation. If these factors are not addressed prior to the implementation of portable technology, the impact of the technology on the use of clinical practice guidelines, client outcomes, and on the cost of care may be compromised.

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Appendix A

Paper-Based Wound Care Documentation

Bayshore Home Health

INTERIM WOUND CARE ASSESSMENT

❑ Interim Report (completed ❑ 2 weeks)
❑ Wound Specialist Assessment ❑ Discharge Report

Client Name: _____ **DOB:** _____

Date Wound Originated: _____ Braden Score:_____

Conditions: ❑ Diabetes ❑ Cancer ❑ CAD ❑ PVD ❑ Autoimmune ❑ Other _____

Medications: ❑ Steroids ❑ Immunosuppressants ❑ Anticoagulants ❑ Chemotherapy ❑ Other _____

Nutrition: ❑ Excellent ❑ Adequate ❑ Probably Inadequate ❑ Very Poor ❑ Supplements: _____

Mobility: ❑ No limitations ❑ Slightly limited ❑ Very limited ❑ Completely immobile

Aids to Mobility: ❑ Walker ❑ Cane ❑ Wheelchair ❑ Other _____

Equipment/Pressure Redistribution Devices: ❑ Mattress; Type: _____ ❑ Cushion(s); Type: _____

Orthotics; Type: _____ Other: _____

WOUND/ULCER TYPE:

❑ **Surgical** ❑ **Pilonidal Cyst** ❑ **Trauma** ❑ **Lymphedema** ❑ **Venous Leg Ulcer** ❑ **Arterial Ulcer** ❑ **Mixed Leg Ulcer**
❑ **Burn** ❑ **Skin Tear** ❑ **Malignant** ❑ **Inflammatory** ❑ **Diabetic Ulcer** ❑ **Pressure Ulcer: Stage** _____
❑ **Unknown** ❑ **Other:** _____

PROGRESS TO OPTIMAL WOUND CARE

Frequency of Dressing change:
❑ Daily ❑ Q 2 Days ❑ M, W, F ❑ Other:_____

Wound Measurement(s) (LxWxD):
❑ Done weekly (see Wound Care Flow Sheet CLE34)
❑ Surface Area (LxW): _____ cm^2
❑ % of Healing: $\frac{\text{Original LxW - Current LxW}}{\text{Original LxW}} \times 100 =$ _____

Moisture Balance: appropriate ❑ Yes ❑ No (if No, review transdiciplinary treatment plan).

Debridement:
Autolytic debridment required ❑ Yes ❑ No ❑ See TDN CLE09
Conservative sharp debridement required
❑ Yes ❑ No ❑ See TDN CLE09
(If yes, refer to ❑ ET, ❑ M.D., ❑ Other_____).

Infection:
❑ **None**
❑ **Superficial/Localized**
-Non healing
-↑ exudate
- Red, friable tissue
- Debris
- Smell
- Pain
❑ **Deep/Spreading**
-↑ size
-↑ temperature
- probe to bone
- New breakdown
- Edema, erythema, ↑ exudate
- Smell
- Pain
❑ **Systemic** (refer to physician immediately)

Compression Therapy: ❑ Yes ❑ No ❑ N/A, Type:_____
❑ **Refused (see TDN CLE09)**

Interdisciplinary treatment plan:
❑ Nursing Care Plan – Wound CLE115 reviewed with client/family and revised (as required).
❑ Wound Care Flow Sheet CLE34 reviewed.
❑ Health teaching provided (see Transdiciplinary Notes CLE09).
Tests requested/ordered: _____
_____
Completed/results received: _____
_____

Specialist Referral(s): ❑ Wound Care Clinic ❑ Wound Resource
❑ Nurse ❑ ET ❑ Dietitian ❑ Social Work ❑ Chiropody/Podiatrist
❑ OT ❑ PT ❑ Other: _____
_____

TREATMENT GOALS

❑ **No change** from last assessment
❑ **New treatment goal:**
❑ Healing
❑ Maintenance/ Non- healing

PAIN MANAGEMENT

Does the client have pain?
❑ Yes ❑ No
Is pain management adequate?
❑ Yes ❑ No
(if no, review CLE51 Pain Assessment Form)
❑ See TDN CLE09

IMPACT OF WOUND

Does the wound adversely affect the following:

Appetite:	❑ Yes	❑ No
Sleep:	❑ Yes	❑ No
ADL/IADL:	❑ Yes	❑ No
Social Activities:	❑ Yes	❑ No
Adherence to collaborative care plan:	❑ Yes	❑ No

Does your wound effect your day to day living:
❑ Very Little ❑ Moderately ❑ A lot

Referals/Supports: _____
_____

LAB VALUES

Albumin: _____ HgbA1C:_____
Blood Glucose: _____ Other: _____
_____

OUTCOMES

❑ **YES** progressing towards healing
❑ Decrease in size (area) by 20-30% within 2-4 weeks of treatment
❑ Etiology confirmed
❑ Frequency of dressing change decreasing
❑ **NO** not progressing towards healing as per **FUN** criteria (see below)
❑ **F** - frequency of dressing changes has not decreased to less than 3 x/week within 4 weeks
❑ **U** - unknown wound cause
❑ **N** - not decreased in size by 20-30% within 2-4 weeks of treatment
❑ **Maintenance/non-healing wound:** No deterioration

Date	Name (Print)	Signature	Designation	Initials

CLE117 NCR OCTOBER 2009 White Copy - Client File Yellow Copy - Client

Bayshore Home Health

INTERIM WOUND CARE ASSESSMENT - NURSING PROVIDER REPORT

❑ Interim Report (completed ❑ 2 weeks)
❑ Wound Specialist Assessment ❑ Discharge Report

Client Name: _____ Physician Name: _____
Phone #: _____ Phone #: _____
Address: _____ Fax #: _____
Date of Birth: _____ Case Manager: _____ Team: _____
Funder: _____ Funder/Client Identification Number: _____

Type of Consult:
❑ Wound Care Specialist/ET/IIWCC
❑ Wound Care Resource/Champion (WCR/WCC)

Specialty/ET/IIWCC Visit Requested: ❑ yes ❑ no
By: ❑ CM ❑ WCR/WCC ❑ Per Funder guidelines
Date requested: _____

Wound Care status:
❑ Healed ❑ Maintenance ❑ Discharged to self care ❑ Transferred to alternate care facility
❑ Hospitalized ❑ Deceased ❑ Other: _____

Service Needs:
❑ Discharged from nursing service ❑ Continue service for wound care
❑ Continue service for non-wound care related needs

Comments: _____

Treatment Recommendations: _____

Physician contacted by nurse: ❑ Yes - via Fax or Phone (circle one) ❑ No _____
Current orders in chart: ❑ Yes ❑ No
Supplies ordered: ❑ Yes ❑ No Delivery date requested: _____ Supplies received: ❑ Yes ❑ No Date: _____
Further specialty nursing involvement required: ❑ Yes Next recommended visit: _____ (d/m/y) ❑ No
explain: _____

Nurses Signature: Designation: Date: Faxed to office: Received by officer

CLE117 NCR OCTOBER 2009 White Copy - Client File Yellow Copy - Client

Bayshore Home Health

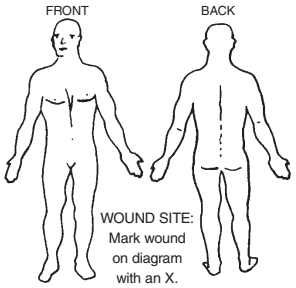
WOUND CARE FLOW SHEET

Client Name: _____ Date of Birth (mm/yy) _____Total Braden Score: _____

Treatment Goal: ☐ Healing ☐ Maintenance ☐ Palliative Vascular Assessment (completed Y/N) _____

Treatment Plan: _____

_____



WOUND DIAGRAM

Type of Wound: A-surgical; B-traumatic; C-venous; D-arterial; E-diabetic; F-mix; G-pressure, Other:_____
Stage: (pressure wound only): I-Redness Skin Intact; II-Superficial Ulceration; III-Deep Ulceration; IV- Bone/muscle/tendon; X-Unable to Stage
Exudate: N-none; P-purulent; S-serous; B-sanguinous; SS-serosanguinous
Amount of Exudate: D-dry; M-moist; W-wet; H-heavily exudating
Wound Base: E-black/brown eschar; P-pink/epithelialization; R-red/granulation; G/Y SL-green/yellow slough. Percentage.
Odour: A-absent; P-present; S-slight; F-foul
Peri-wound Skin: M-maceration; E-erythema; I-induration; C-callous; D-dry; S-scale
Edema: N-none; NP-non-pitting; P-pitting (1+=2mm, 2+=4mm, 3+=6mm, 4+=8mm); I-induration; L-lymph edema
Pain Description: N-none; I-incidental; E-episodic; C-continuous

Date							
Time							
Type of Wound							
Stage: (pressure wound only)							
Length (cm)							
Width (cm)							
Depth (cm)							
Undermining/Tunneling (cm & location)							
Packing - Amount Out (cm)							
Packing - Amount In (cm)							
Exudate (description & amount)							
Wound Base (description & %)							
Odour							
Peri-wound Skin (description & location)							
Edema (description & location)							
Pain (0-10 & description)							
Intervention for Pressure Relief/Health Teaching (Y/N – See MDN)							
Compression (Y or N & Type)							
See Multidisciplinary Notes (Y or N)							
Nurse's Signature/Title							

CLE34 MAY 2006

Bayshore Home Health

PAIN ASSESSMENT FLOW SHEET

Client Name:_____ Date of Birth (mm/yyyy): _____

Pain Scale: No pain 0 1 2 3 4 5 6 7 8 9 10 Worst Pain Imaginable

Date	Time	Pain Rating	Location of Pain	Quality of Pain	Freq. of Pain	Use of Breakthrough	Duration of Pain	Effect on mood/ function	Relieving/ Aggravating Factors	Level of Arousal	See Progress Notes	Nurse's Signature/Title

Quality descriptors: Describe in one word; i.e. ache, dull, throbbing, stabbing, pressure, burning, sharp, shooting, squeezing, piercing, tender, stinging, cramping, pulling, intermittent/constant.

Level of Arousal :
1= alert, orientated x3
2= alert; anxiety i.e. when getting up
3= talking to family but falls asleep easily
4= eyes closed but responds to name
5= no response to name
6= radiating

CLE52 JULY 2011

Bayshore Home Health

C-HOBIC CLIENT OUTCOME FLOW SHEET

Client Name: _____ Date of Birth: (mm/yy): _____

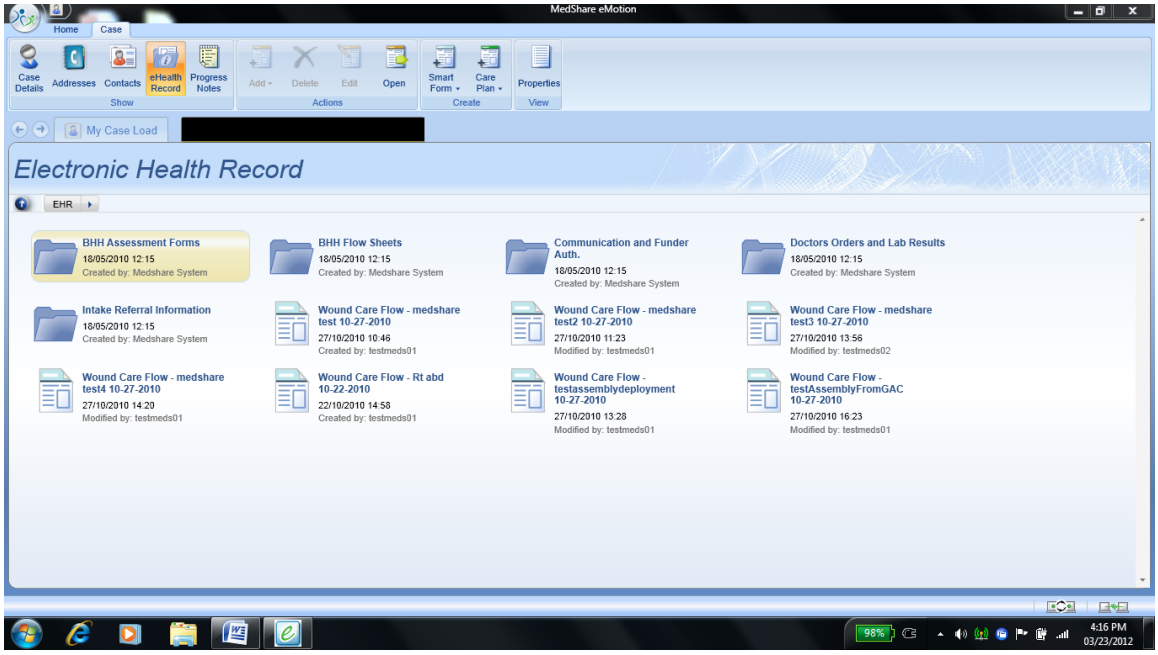
A = Admission, I = Interim, D = Discharge					
Date/Time					
Indicators					
Mobility in Bed (Code: 0 – 6, 8)					
Transfer (Code: 0 – 6, 8)					
Locomotion in home (Code: 0 – 6, 8)					
Locomotion outside of home (Code: 0 – 6, 8)					
Dressing upper body (Code: 0 – 6, 8)					
Dressing lower body (Code: 0 – 6, 8)					
Eating (Code: 0 – 6, 8)					
Toilet use (Code: 0 – 6, 8)					
Personal hygiene (Code: 0 – 6, 8)					
Bathing (Code: 0 – 6, 8)					
Meal Prep (Code: 0 – 3, 8)					
Ordinary housework (Code: 0 – 3, 8)					
Managing finances (Code: 0 – 3, 8)					
Managing medications (Code: 0 – 3, 8)					
Phone use (Code: 0 – 3, 8)					
Shopping (Code: 0 – 3, 8)					
Transportation (Code: 0 – 3, 8)					
Bladder Continence (Code: 0 – 5, 8)					
Pain Frequency (Code: 0 – 3)					
Pain Intensity (Code: 0 – 10)					
Fatigue (Code: 0 – 4)					
Dyspnea (Code: 0 – 3)					
Nausea (Code: 0 – 4)					
Falls (Code: 0 – 9)					
Pressure Ulcers (Code: 0 – 4)					
The following indicators are to be coded Code 0 – 5, 8					
Do you know what meds you take?					
Do you understand the purpose of the meds?					
Do you take your prescribed meds?					
Can you recognize changes in your body related to your health condition?					
Do you know & understand why you experience some changes in your body?					
Do you know what to do to control these changes in your body (symptoms)?					
Do you carry out the treatments or activities that you have been taught?					
Do you do things to look after yourself and to maintain you health?					
Do you know whom to contact to get help in carrying out your ADLs?					
Do you know whom to contact in case of a medical emergency?					
Do you perform your regular activities					
Do you adjust your regular activities when you experience body changes related to your health condition?					
Signature/Title					

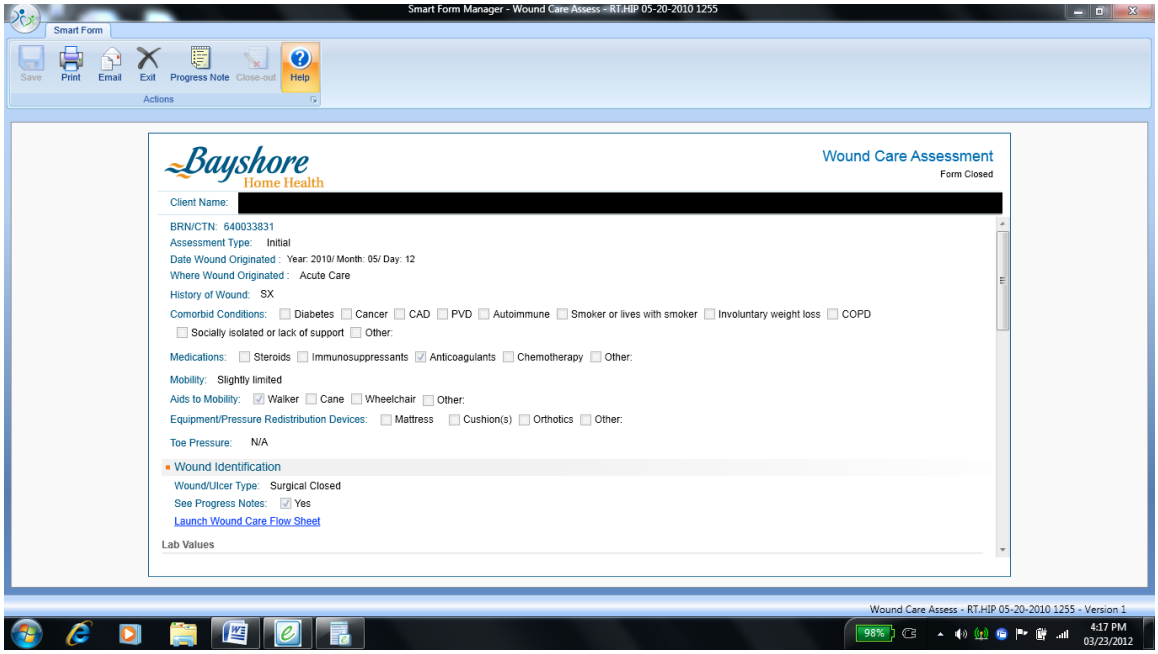
Indicators: Taken on admission, quarterly, and discharge.

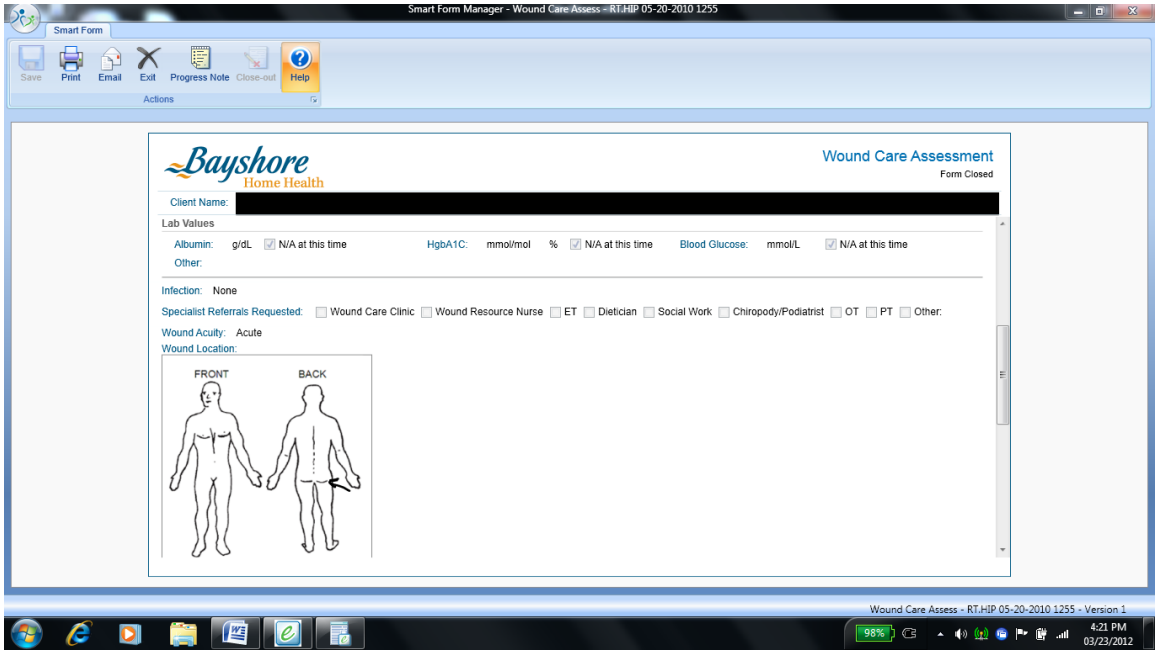
CLE109 APRIL 2010

Appendix B

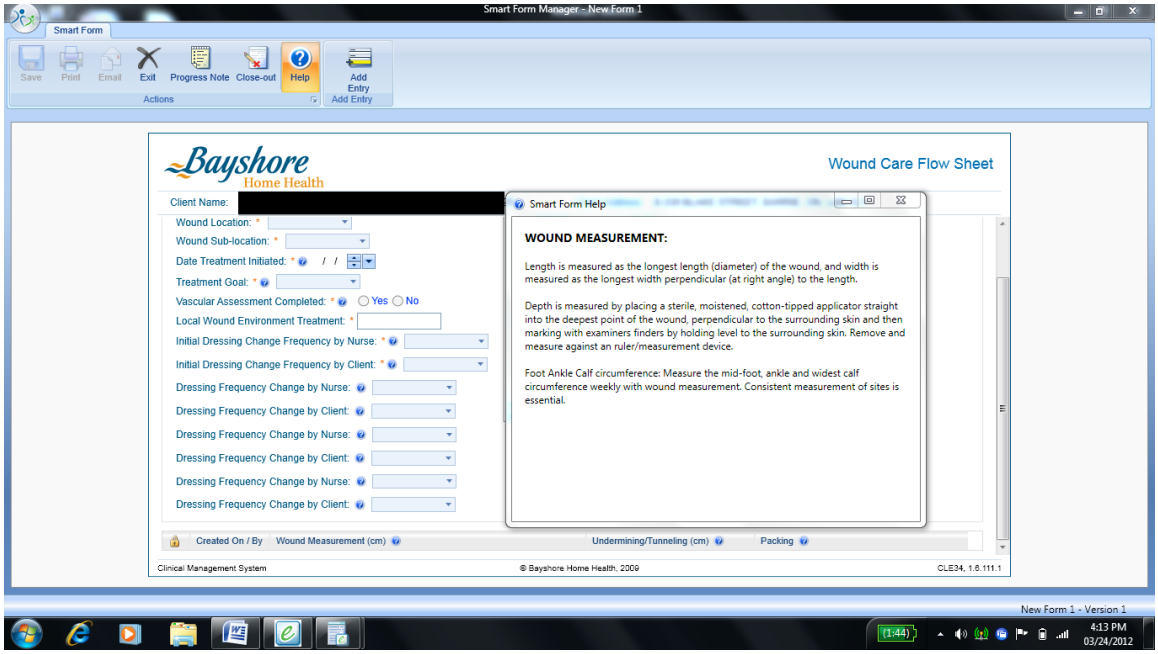
Electronic Wound Care Documentation

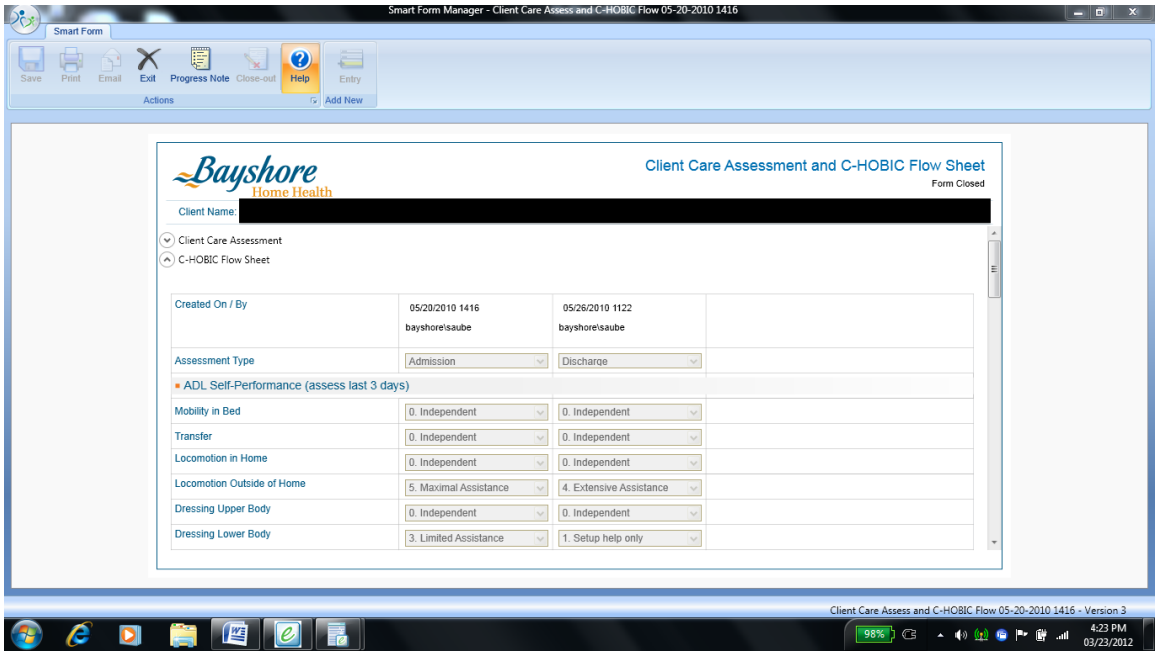





Smart Form Manager - Wound Care Assess - RT.HIP 05-20-2010 1255
Smart Form
Save
Print
Email
Exit
Progress Note
Close-out
Help
Actions
Bayshore Home Health
Wound Care Assessment
Form Closed
Client Name:
Lab Values
Albumin: g/dL N/A at this time
HgbA1C: mmol/mol % N/A at this time
Blood Glucose: mmol/L N/A at this time
Other:
Infection: None
Specialist Referrals Requested: Wound Care Clinic Wound Resource Nurse ET Dietician Social Work Chiropody/Podiatrist OT PT Other:
Wound Acuity: Acute
Wound Location:
FRONT
BACK
Wound Care Assess - RT.HIP 05-20-2010 1255 - Version 1
98%
4:21 PM
03/23/2012


Smart Form Manager - Wound Care Assess - RT.HIP 05-20-2010 1255
Smart Form
Save
Print
Email
Exit
Progress Note
Close-out
Help
Actions
Bayshore Home Health
Wound Care Assessment
Form Closed
Client Name:
Wound Location:
Arm/Shoulder Right
Buttock Right
Foot Right
Head/Neck Right
Hip to Knee (incl. knee) right
Ischium Right
Sacrum/Coccyx
Abdomen Left
Back left
Chest Left
Hand Left
Heel Left
Hip/Trochanter Left
Knee to Ankle (incl. ankle) Left
Toes Left
Abdomen Right
Back Right
Chest Right
Hand Right
Heel Right
Hip/Trochanter Right
Knee to Ankle (inc. ankle) Right
Toes Right
Arm/Shoulder Left
Buttock Left
Foot Left
Head/Neck Left
Hip to Knee (incl. knee) left
Ischium Left
Perineum
Location Description: RT.HIP
Pain and Quality of Life
Pain: Yes
Wound Affecting Quality of Life: Yes
Wound/Ulcer Impact on Daily Living: Very Little
Interdisciplinary Treatment Plan
Wound Culture/Biopsy: N/A at this time
Ankle/Brachial Pressure Index (ABPI): N/A at this time
Vascular Studies: N/A at this time
X-ray/Bone Scan: N/A at this time
Monofilament (Sensory) Testing: N/A at this time
Care Planning
Treatment Goal: Healing
Wound Care Assess - RT.HIP 05-20-2010 1255 - Version 1
98%
4:22 PM
03/23/2012


Smart Form Manager - New Form 1
Smart Form
Save
Print
Email
Exit
Progress Note
Close-out
Help
Add Entry
Actions
Add Entry
Bayshore Home Health
Wound Care Flow Sheet
Client Name:
Wound Location: *
Wound Sub-location: *
Date Treatment Initiated: *
Treatment Goal: *
Vascular Assessment Completed: * Yes No
Local Wound Environment Treatment: *
Initial Dressing Change Frequency by Nurse: *
Initial Dressing Change Frequency by Client: *
Dressing Frequency Change by Nurse:
Dressing Frequency Change by Client:
Dressing Frequency Change by Nurse:
Dressing Frequency Change by Client:
Dressing Frequency Change by Nurse:
Dressing Frequency Change by Client:
Smart Form Help
WOUND MEASUREMENT:
Length is measured as the longest length (diameter) of the wound, and width is measured as the longest width perpendicular (at right angle) to the length.
Depth is measured by placing a sterile, moistened, cotton-tipped applicator straight into the deepest point of the wound, perpendicular to the surrounding skin and then marking with examiners finders by holding level to the surrounding skin. Remove and measure against an ruler/measurement device.
Foot Ankle Calf circumference: Measure the mid-foot, ankle and widest calf circumference weekly with wound measurement. Consistent measurement of sites is essential.
Created On / By
Wound Measurement (cm)
Undermining/Tunneling (cm)
Packing
Clinical Management System
© Bayshore Home Health, 2009
CLE34, 1.6.111.1
New Form 1 - Version 1
4:13 PM
03/24/2012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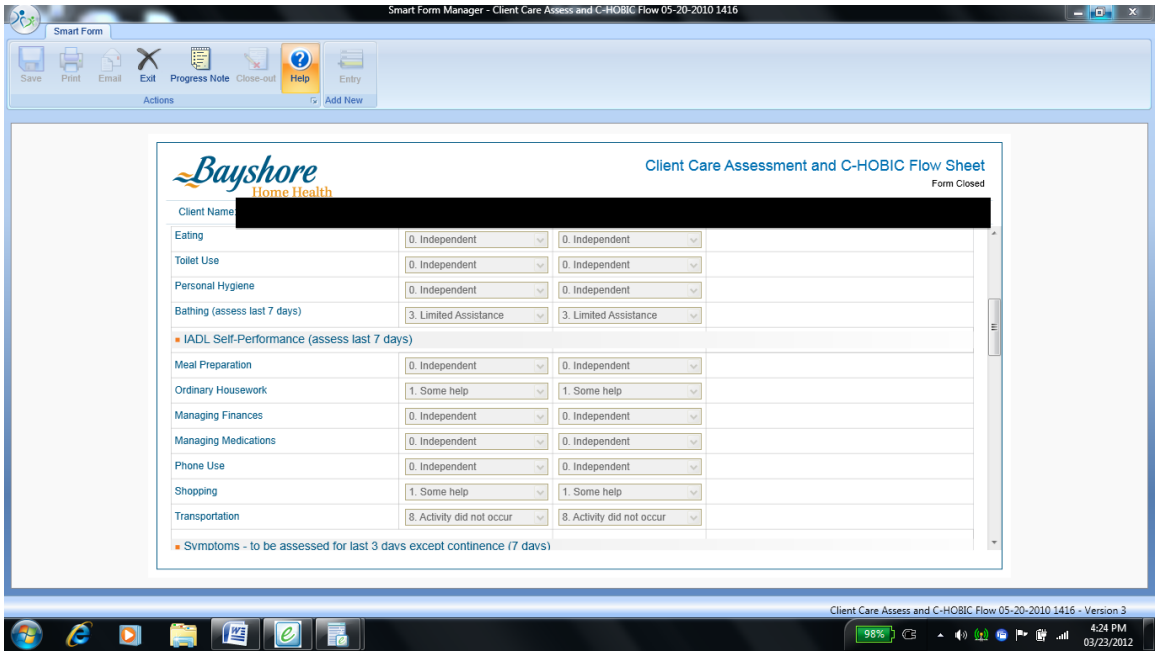
Save
Print
Email
Exit
Progress Note
Close-out
Help
Entry
Actions
Add New
Bayshore Home Health
Client Care Assessment and C-HOBIC Flow Sheet
Form Closed
Client Name:
Client Care Assessment
C-HOBIC Flow Sheet
Created On / By
05/20/2010 1416
bayshore\saube
05/26/2010 1122
bayshore\saube
Assessment Type
Admission
Discharge
ADL Self-Performance (assess last 3 days)
Mobility in Bed
0. Independent
0. Independent
Transfer
0. Independent
0. Independent
Locomotion in Home
0. Independent
0. Independent
Locomotion Outside of Home
5. Maximal Assistance
4. Extensive Assistance
Dressing Upper Body
0. Independent
0. Independent
Dressing Lower Body
3. Limited Assistance
1. Setup help only
Client Care Assess and C-HOBIC Flow 05-20-2010 1416 - Version 3
4:23 PM
03/23/2012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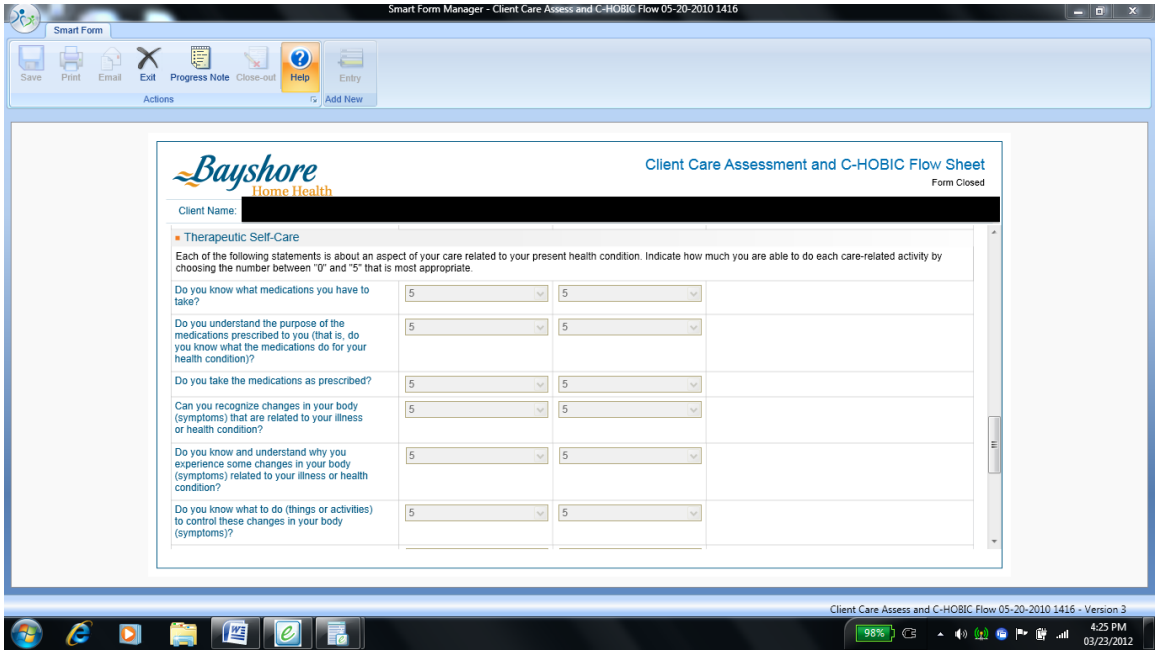
Smart Form
Save
Print
Email
Exit
Progress Note
Close-out
Help
Entry
Actions
Add New
Bayshore Home Health
Client Care Assessment and C-HOBIC Flow Sheet
Form Closed
Client Name
Eating
0. Independent
0. Independent
Toilet Use
0. Independent
0. Independent
Personal Hygiene
0. Independent
0. Independent
Bathing (assess last 7 days)
3. Limited Assistance
3. Limited Assistance
IADL Self-Performance (assess last 7 days)
Meal Preparation
0. Independent
0. Independent
Ordinary Housework
1. Some help
1. Some help
Managing Finances
0. Independent
0. Independent
Managing Medications
0. Independent
0. Independent
Phone Use
0. Independent
0. Independent
Shopping
1. Some help
1. Some help
Transportation
8. Activity did not occur
8. Activity did not occur
Symptoms - to be assessed for last 3 days except continence (7 days)
Client Care Assess and C-HOBIC Flow 05-20-2010 1416 - Version 3
98%
4:24 PM
03/23/2012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Smart Form
Save
Print
Email
Exit
Progress Note
Close-out
Help
Entry
Actions
Add New
Bayshore Home Health
Client Care Assessment and C-HOBIC Flow Sheet
Form Closed
Client Name:
Therapeutic Self-Care
Each of the following statements is about an aspect of your care related to your present health condition. Indicate how much you are able to do each care-related activity by choosing the number between "0" and "5" that is most appropriate.
Do you know what medications you have to take?
5
5
Do you understand the purpose of the medications prescribed to you (that is, do you know what the medications do for your health condition)?
5
5
Do you take the medications as prescribed?
5
5
Can you recognize changes in your body (symptoms) that are related to your illness or health condition?
5
5
Do you know and understand why you experience some changes in your body (symptoms) related to your illness or health condition?
5
5
Do you know what to do (things or activities) to control these changes in your body (symptoms)?
5
5
Client Care Assess and C-HOBIC Flow 05-20-2010 1416 - Version 3
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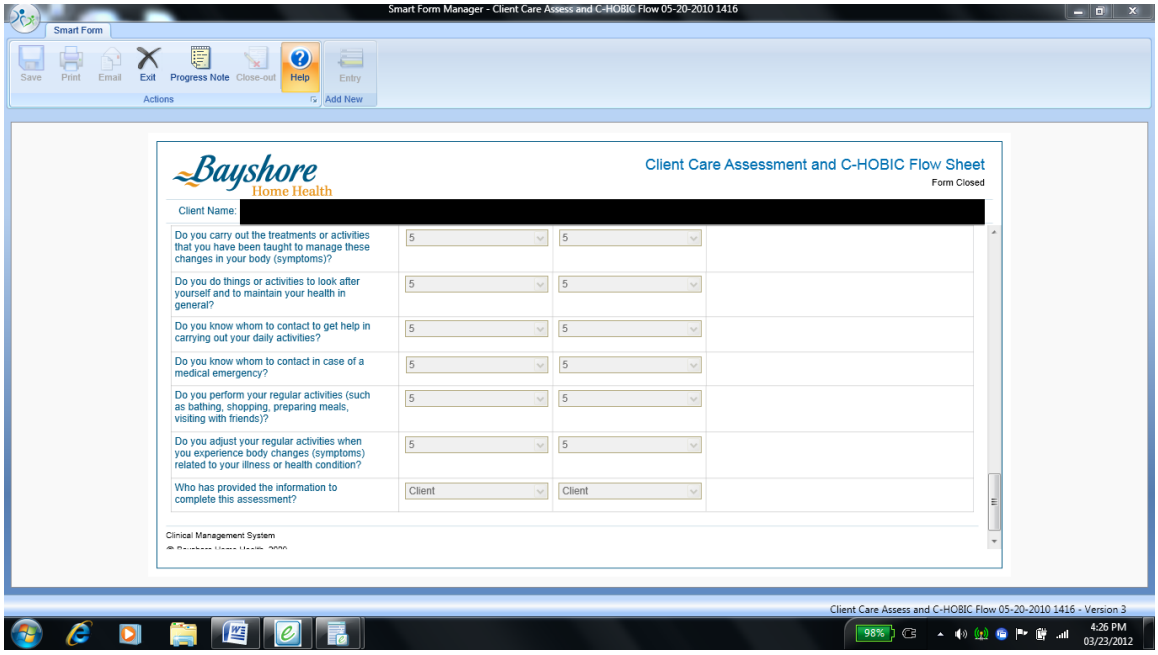
03/23/2012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Smart Form
Save
Print
Email
Exit
Progress Note
Close-out
Help
Entry
Actions
Add New
Bayshore Home Health
Client Care Assessment and C-HOBIC Flow Sheet
Form Closed
Client Name:
Do you carry out the treatments or activities that you have been taught to manage these changes in your body (symptoms)?
5
5
Do you do things or activities to look after yourself and to maintain your health in general?
5
5
Do you know whom to contact to get help in carrying out your daily activities?
5
5
Do you know whom to contact in case of a medical emergency?
5
5
Do you perform your regular activities (such as bathing, shopping, preparing meals, visiting with friends)?
5
5
Do you adjust your regular activities when you experience body changes (symptoms) related to your illness or health condition?
5
5
Who has provided the information to complete this assessment?
Client
Client
Clinical Management System
Client Care Assess and C-HOBIC Flow 05-20-2010 1416 - Version 3
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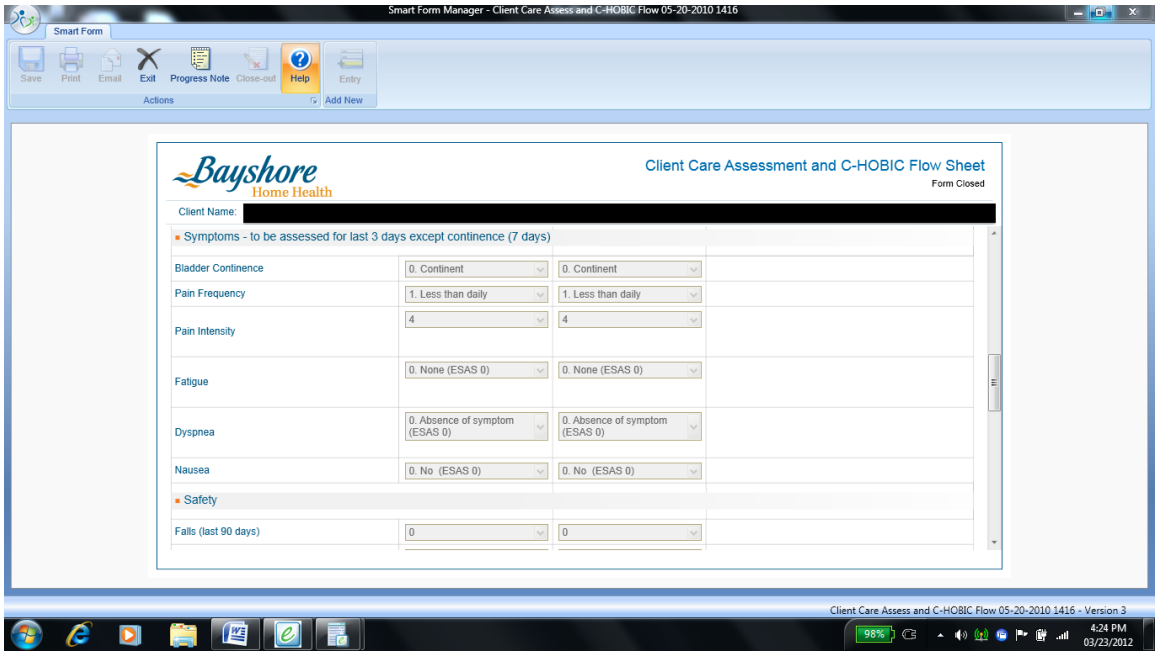
03/23/2012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Smart Form
Save
Print
Email
Exit
Progress Note
Close-out
Help
Entry
Actions
Add New
Bayshore Home Health
Client Care Assessment and C-HOBIC Flow Sheet
Form Closed
Client Name:
Symptoms - to be assessed for last 3 days except continence (7 days)
Bladder Continence
0. Continent
0. Continent
Pain Frequency
1. Less than daily
1. Less than daily
Pain Intensity
4
4
Fatigue
0. None (ESAS 0)
0. None (ESAS 0)
Dyspnea
0. Absence of symptom (ESAS 0)
0. Absence of symptom (ESAS 0)
Nausea
0. No (ESAS 0)
0. No (ESAS 0)
Safety
Falls (last 90 days)
0
0
Client Care Assess and C-HOBIC Flow 05-20-2010 1416 - Version 3
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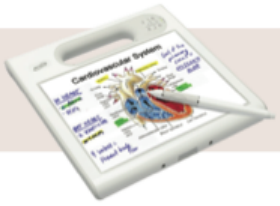
03/23/2012

Appendix C

Device Specifications



Motion® C5
PRODUCT SPECIFICATIONS

Motion Computing®

Processor/Cache	• Intel® Core™2 Duo Processor Ultra Low Voltage U7500 (2MB of L2 cache, 1.06GHz, 533MHz FSB)
Operating System	• Genuine Windows® 7 Professional (32-bit) • Genuine Windows® XP Tablet PC Edition (available through downgrade rights from Windows 7 or Vista Business)
Durability	• 3-foot drop test compliant to MIL-STD-810F • IP54 rated - Water, dust and splash resistant • Shock-mounted display and hard drive • Chemically strengthened glass • Rubberized for shock dampening • Magnesium-alloy internal frame • Molded handle to prevent drops
Software	• Motion Dashboard control panel • Motion/Softex OmniPass™ Security software •Windows Journal • Sticky Notes • Motion DataGuard™ • Acronis True Image • Infineon Security Platform Tools • Pen enabled BIOS setup • Intel Mobile Clinical Assistant • Adobe Reader
Chipset	• Intel® 945GME Express
Display	• 10.4" XGA TFT AFFS+ LED Backlight (1024 x 768) • Optional View Anywhere® with durable Gorilla™ glass • Intel Display Power Saving Technology (DPST)
Graphics	• Intel® Graphics Media Accelerator 950 • Rotation: 0°, 90°, 270°
Video RAM	• Maximum 256MB total with Intel Dynamic Video Memory Technology (DVMT)
Audio Controller	• Intel® High Definition Audio
System Memory	• DDR2 533MHz SDRAM memory • Base configuration of 1GB • Upgradeable to maximum 2GB at point of purchase
System Storage	• 1.8" Hard Disk Drive (HDD) with 80GB capacity • Optional SATA Solid State Drive (SSD) with 64GB capacity • PCI bus master enhanced IDE • Supports Ultra ATA 66/100
Integrated Communications	• WiFi® 802.11 a/b/g/n • Integrated Intel® Wireless 4965 a/b/g/n • Optional Integrated Mobile Broadband • Integrated Class 2 Bluetooth® Module
Audio	• Motion Speak Anywhere® noise cancellation technology (with Windows XP only) • Multi-directional array microphone design with 2 microphones • Integrated speaker
I/O Ports	• Docking connector • DC power-in port with rubberized cover
Embedded I/O	• 2.0 Megapixel Camera • Optional 1D/2D Barcode Reader • 13.56MHz RFID reader • 13.56MHz HF integrated passive RFID tag
Security	• Integrated Fingerprint Reader with OmniPass software • TCG Trusted Platform Module (TPM) 1.2 • Smart card reader (optional) - ISO 7816 PC/SC - EMV2 2000 Level 1 • ComputraceComplete (optional)
Dimensions	• 10.0" x 10.0" x .95" (256mm x 256mm x 24.3mm)
Weight	• 3.3 lbs.[1] (1.50 kg)
Battery	• Battery life approximately 3.75 hours[2] • Lithium-ion standard battery with 40WHr capacity
Battery Charging Time	• Standard Battery - 1.5 hours (Tablet PC on/off)[3]
System Status LEDs	• Power on/off/stand by LED ring around power button • Battery status LED • Wireless 802.11 LED • Bluetooth LED • RFID LED adjacent to RFID read trigger
AC Adapter	• 50W universal, 3-pin jack • 100-240V 1.5a, 50-60Hz
Control Buttons	• One 5-way directional for navigation • One function, one Dashboard and two programmable • Secure Attention Sequence (SAS) • Camera capture • RFID read trigger • Barcode scan trigger

For more information and localized websites, please visit www.MotionComputing.com
1-866-MTABLET

1

Motion® C5
PRODUCT SPECIFICATIONS

Motion Computing®

Built-in Camera
- Autofocus
- Up to 2.0 megapixel resolution
- JPG photo format with a resolution up to 1600 x 1200 pixels
- Illuminator light

Environmental
- Temperature
  - Operation: +5°C to +35°C (+41°F to 95°F)
  - Storage: -20°C to +60°C (-4°F to 140°F)
- Humidity
  - Operating humidity: 8% to 80% without condensation
  - Storage humidity: 8% to 90% without condensation
- Altitude
  - Operation: Sea level 0 to 10K ft. sea level to 15K ft. when configured with SSD storage
  - Storage: Sea level 0 to 15K ft.
- Enclosure class

Standards
- ACPI 3.0b compliant

Safety
- AS/NZS 3260:1997
- AS/NZS 60950-1
- FCC/ANSI C63.41
- UL, CUL, CE (IEC/EN60950-1 A11/2004)
- CAN/CSA RSS-102
- FCC OET65 Supplement C
- ETSI EN 50392
- LVD (73/23/EEC)
- EU Directive 2002/95/EC
- EU Directive 2002/96/EC
- EU Directive 2006/66/EC and its amendments
- California Proposition 65
- Technical Instructions for Safe Transport of Dangerous Goods by Air (ICAO Doc #9284)
- Emergency Response Guidance for Aircraft incidents involving Dangerous Goods (ICAO Doc #9481)

Regulatory
- AS/NZS 3548:1995 Class B
- AS/NZS 4771
- AS/NZS 4268
- AS/ACIF S042.1 (WCDMA/HSDPA)
- AS/ACIF S042.3 (WCDMA/HSDPA)
- AS/ACIF S042.1 (GSM/EDGE)
- AS/ACIF S042.3 (GSM/EDGE)
- CAN/CSA ICES-003 Class B
- CAN/CSA RSS-210 Issue 5
- CAN/CSA RSS-132 (1xRTT/EVDO-0/EVDO-A)
- CAN/CSA RSS-133 (1xRTT/EVDO-0/EVDO-A)
- CENELEC EN 55022 Class B (CISPR22)
- CENELEC EN 55024 (CISPR24)
- CENELEC EN 61000-3-2
- CENELEC EN 61000-3-3
- ETSI EN 301-893
- ETSI EN 300-328-2
- ETSI EN 301-489-1
- ETSI EN 301-489-3
- ETSI EN 301-489-7
- ETSI EN 301-489-17
- ETSI EN 301-489-24
- ETSI EN 300-330
- ETSI EN 301-511
- ETSI EN 301-489-1/-3
- FCC Part 15 Subpart B Class B
- FCC Part 15 Subpart C (2.4Ghz)
- FCC Part 15 Subpart E (5Ghz)
- FCC Part 22 H (1xRTT/EVDO-0/EVDO-A)
- FCC Part 24 E (1xRTT/EVD0-0/EVDO-A)
- R&TTE (89/336/EEC) & R&TTE (99/5/EC)

Warranty
- Standard 1-year field-ready warranty
- 3-year option available

For more information and localized websites, please visit www.MotionComputing.com
1-866-MTABLET

[1] Weight represents approximate system weight measured with a 40WHr battery. Actual system weight may vary depending on component and manufacturing variability.
[2] With SSD and 2GB RAM. Battery life is dependent on actual wireless radio usage and power settings.
[3] Approximate charging time. Validated charging from 5% to 90% with system on or system off.

Motion F5v

PRODUCT SPECIFICATIONS

Processor / Cache	• Intel® Core™ i7 vPro™ Processor 1.46 GHz with Intel® Smart Cache (4MB of L3 cache, 2 Cores/4 Threads) or • Intel® Core™ i5 vPro™ Processor 1.33 GHz with Intel® Smart Cache (3MB of L3 cache, 2 Cores/4 Threads) or • Intel® Core™ i3 Processor 1.33 GHz with Intel® Smart Cache (3MB of L3 cache, 2 Cores/4 Threads)
Operating System	• Genuine Windows® 7 Professional (32-bit)
Durability	• Meets MIL-STD-810G • IP54 rated - Water, dust and splash resistant • Shock-mounted display and hard drive • Durable Gorilla® Glass • Rubberized for shock dampening • Magnesium-alloy internal frame • Molded handle to prevent drops
Chipset	• Intel® QM57
Display	• 10.4" XGA TFT AFFS+ LED Backlight (1024 x 768) with durable Gorilla® glass (standard) • 10.4" XGA TFT AFFS+ LED Backlight (1024 x 768) with durable Gorilla® glass with View Anywhere® • 10.4" XGA Projective Capacitive Dual-Touch TFT AFFS+ LED Backlight (1024 x 768) with durable Gorilla® glass
Graphics	• Intel® HD Graphics with dynamic frequency • Rotation: 0°, 90°, 270°
Video RAM	• Maximum 256MB total with Intel Dynamic Video Memory Technology (DVMT)
Audio Controller	• Intel® High Definition Audio
System Memory	• DDR3 800MHz SDRAM memory • Base configuration of 2GB • Upgradeable to maximum 4GB at point of purchase
System Storage	• 1.8" SATA Hard Disk Drive (HDD) with 160GB capacity • Optional Solid State Drive (SSD) with various capacities up to 128GB based on configuration • AHCI
Integrated Communications	• WiFi® 802.11 a/b/g/n • Optional Integrated Mobile Broadband (Gobi™ connectivity) with GPS capabilities • Integrated Bluetooth® 2.1+EDR Module
Audio	• Motion Speak Anywhere® noise cancellation technology • Multi-directional array microphone design with 2 microphones • Integrated speaker
I/O Ports	• Docking connector • USB 2.0 port with rubberized cover
Embedded I/O	• Optional 3.0 Megapixel camera (rear-facing) • Optional 1.3 Megapixel front-facing web camera • Optional 1D/2D Barcode Reader • Optional 13.56MHz RFID reader • Optional 13.56MHz RFID MIFARE Classic with read/write capability (available with Touch display only)
Security	• Integrated Fingerprint Reader with OmniPass software • TCG Trusted Platform Module (TPM) 1.2 • Smart card reader (optional) - ISO 7816 PC/SC - EMV2 2000 Level 1 • Computrace® Complete (optional)
Dimensions	• 10.0" x 10.0" x .95" (256mm x 256mm x 24.3mm)
Weight	• 3.3 lbs.[1] (1.50 kg)
Battery	• Battery life greater than 4 hours[2] • Hot swappable Lithium Ion standard battery with 40WHr capacity
Battery Charging Time	• Standard Battery - 1.5 hours (Tablet PC on/off)[3]

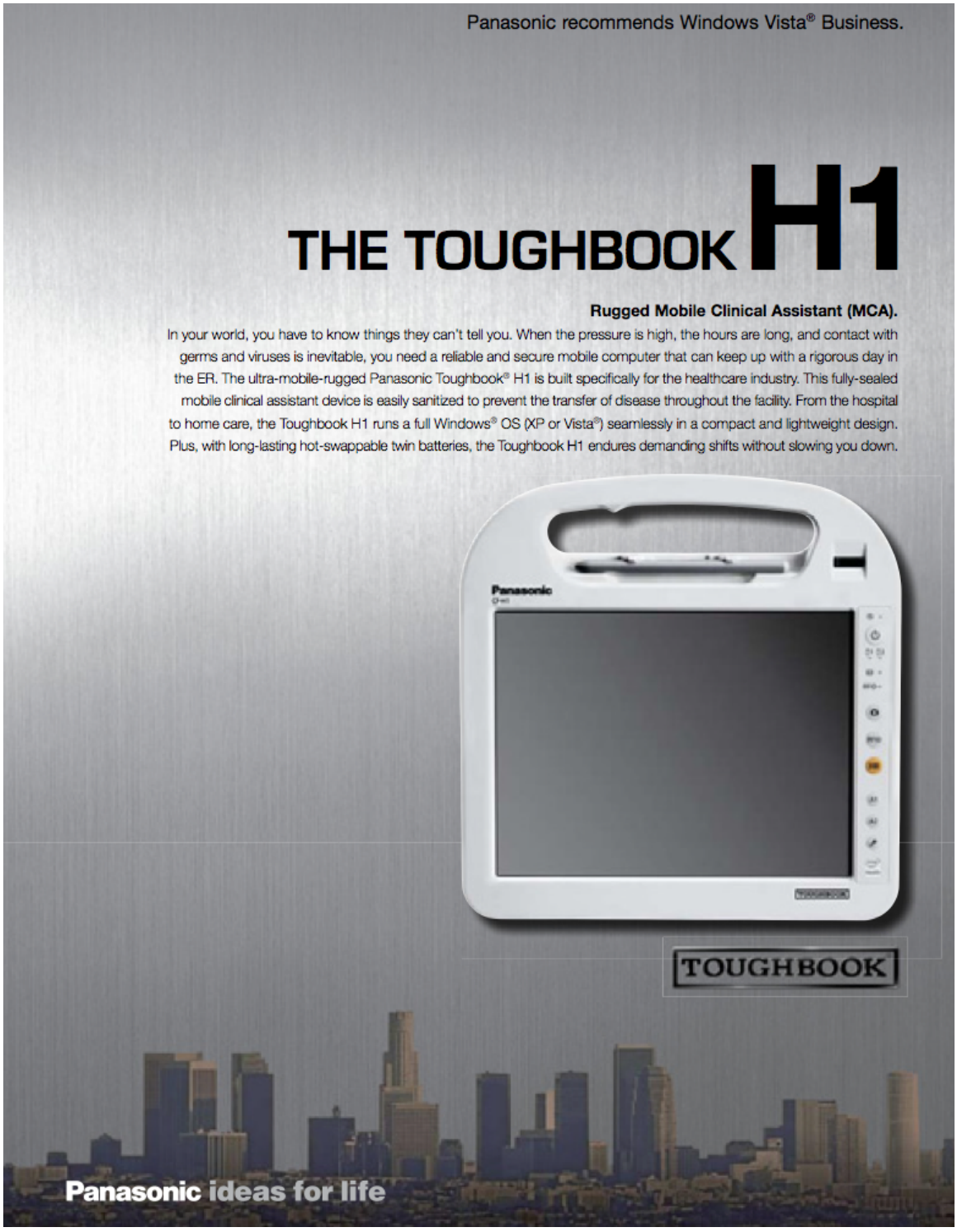
www.MotionComputing.com

Motion F5v

PRODUCT SPECIFICATIONS

Processor / Cache	• Intel® Core™ i7 vPro™ Processor 1.46 GHz with Intel® Smart Cache (4MB of L3 cache, 2 Cores/4 Threads) or • Intel® Core™ i5 vPro™ Processor 1.33 GHz with Intel® Smart Cache (3MB of L3 cache, 2 Cores/4 Threads) or • Intel® Core™ i3 Processor 1.33 GHz with Intel® Smart Cache (3MB of L3 cache, 2 Cores/4 Threads)
Operating System	• Genuine Windows® 7 Professional (32-bit)
Durability	• Meets MIL-STD-810G • IP54 rated - Water, dust and splash resistant • Shock-mounted display and hard drive • Durable Gorilla® Glass • Rubberized for shock dampening • Magnesium-alloy internal frame • Molded handle to prevent drops
Chipset	• Intel® QM57
Display	• 10.4" XGA TFT AFFS+ LED Backlight (1024 x 768) with durable Gorilla® glass (standard) • 10.4" XGA TFT AFFS+ LED Backlight (1024 x 768) with durable Gorilla® glass with View Anywhere® • 10.4" XGA Projective Capacitive Dual-Touch TFT AFFS+ LED Backlight (1024 x 768) with durable Gorilla® glass
Graphics	• Intel® HD Graphics with dynamic frequency • Rotation: 0°, 90°, 270°
Video RAM	• Maximum 256MB total with Intel Dynamic Video Memory Technology (DVMT)
Audio Controller	• Intel® High Definition Audio
System Memory	• DDR3 800MHz SDRAM memory • Base configuration of 2GB • Upgradeable to maximum 4GB at point of purchase
System Storage	• 1.8" SATA Hard Disk Drive (HDD) with 160GB capacity • Optional Solid State Drive (SSD) with various capacities up to 128GB based on configuration • AHCI
Integrated Communications	• WiFi® 802.11 a/b/g/n • Optional Integrated Mobile Broadband (Gobi™ connectivity) with GPS capabilities • Integrated Bluetooth® 2.1+EDR Module
Audio	• Motion Speak Anywhere® noise cancellation technology • Multi-directional array microphone design with 2 microphones • Integrated speaker
I/O Ports	• Docking connector • USB 2.0 port with rubberized cover
Embedded I/O	• Optional 3.0 Megapixel camera (rear-facing) • Optional 1.3 Megapixel front-facing web camera • Optional 1D/2D Barcode Reader • Optional 13.56MHz RFID reader • Optional 13.56MHz RFID MIFARE Classic with read/write capability (available with Touch display only)
Security	• Integrated Fingerprint Reader with OmniPass software • TCG Trusted Platform Module (TPM) 1.2 • Smart card reader (optional) - ISO 7816 PC/SC - EMV2 2000 Level 1 • Computrace® Complete (optional)
Dimensions	• 10.0" x 10.0" x .95" (256mm x 256mm x 24.3mm)
Weight	• 3.3 lbs.[1] (1.50 kg)
Battery	• Battery life greater than 4 hours[2] • Hot swappable Lithium Ion standard battery with 40WHr capacity
Battery Charging Time	• Standard Battery - 1.5 hours (Tablet PC on/off)[3]

www.MotionComputing.com


Panasonic recommends Windows Vista® Business.
THE TOUGHBOOK H1
Rugged Mobile Clinical Assistant (MCA).
In your world, you have to know things they can't tell you. When the pressure is high, the hours are long, and contact with germs and viruses is inevitable, you need a reliable and secure mobile computer that can keep up with a rigorous day in the ER. The ultra-mobile-rugged Panasonic Toughbook® H1 is built specifically for the healthcare industry. This fully-sealed mobile clinical assistant device is easily sanitized to prevent the transfer of disease throughout the facility. From the hospital to home care, the Toughbook H1 runs a full Windows® OS (XP or Vista®) seamlessly in a compact and lightweight design. Plus, with long-lasting hot-swappable twin batteries, the Toughbook H1 endures demanding shifts without slowing you down.
Panasonic
TOUGHBOOK
Panasonic ideas for life

Windows®. Life without Walls™.
Lenovo® recommends Windows 7.

lenovo

LENOVO IDEAPAD S10-3t TECHNICAL SPECIFICATIONS

Processor	Intel® Atom™ processor N470 (1.83GHz) Intel® Atom™ processor N450 (1.66GHz)
Operating System	Genuine Windows® 7 Home Premium Genuine Windows® 7 Home Basic Genuine Windows® 7 Starter
Display/Resolution	10.1" LED backlight display (1024x600), 16:9 widescreen Lenovo NaturalTouch Panel—multitouch capacitive
Video Graphics	Intel® GMA 3150 integrated graphics
Memory	Up to 2GB DDR2 667MHz
Hard Disk Drive	Up to 320GB HDD
Optical Drive	Optional external DVD drive
Sound	2.0 speakers with Dolby® Headphone surround sound
Integrated Communications	802.11b/g/n WiFi, 10/100/1000M LAN, Bluetooth® (optional), Wireless WAN (optional)
Connectors	2xUSB2.0, 6-in-1 card reader, headphones, mic, VGA
Camera	1.3M integrated web camera
Other Features	Touch tablet with 180°screen rotation and Lenovo NaturalTouch Panel—multi-touch capacitive
Weight	2.76 lb (1.25kg) with 4-cell battery 3.31 lb (1.5kg) with 6-cell battery
Dimensions	260x15~20.2x174 mm (WxHxD) with 4-cell battery
Battery Life	Approx. 4hr with 4-cell battery, approx. 8hr with 6-cell battery
Included Software*	OneKey™ Rescue System 7.0, Lenovo Energy Management Software 4.0, Adobe® Reader® 9.0, McAfee® VirusScan Plus 2009, Windows Live™ Essential, VeriFace™ 3.6, DDN (only for U.S. 1.7b Windows® 7 version), Microsoft® Office Professional 2007 (Trial for WW except China and Japan), Microsoft® Office Personal (only for Japan), Lenovo NaturalTouch, VeriTouch 1.0, Auto collage Windows® (only install in Windows® 7 Home Premium), GuardID (only for U.S.), Lenovo ReadyComm 5.1, Lenovo DirectShare 1.0, Lenovo Maplife 1.0, iFilter (only for JP MKT), Quick Start 2.0, Active Protection System™ 1.0 and Bump Top 1.0 *Software may vary by region.

ideapad S10-3t

0800 123 1234 **WWW.LENOVO.COM**

Appendix D

Data Extraction Tool and Coding Manual

Jump to page: Page 1 Go

Paper Based Data Extraction Tool

0%

1) Chart number (Start at 0001)

Please remember to place a note on the front cover of the cart that matches the number inserted in the field below. Once the data has been extracted for each chart, 10 percent of the charts with be randomly selected and reassessed. The purpose of the reassessment is to verify that the date has been extracted consistently and accurately. Once 10% the charts have been reassessed, the number attached to the front cover of the client's chart will be removed. The process will ensure client anonymity.

2) Charting method

- (•) Paper Based
- ( ) Computer Based

3) Date of occurrence of wound

Found on the initial wound care assessment form, CLE116 under History of Wound.

YYYY/MM/DD

4) Date of visit by a home care nurse for wound care

Located on the bottom of the consent form.

YYYY/MM/DD

5) Sex

Located on the CCAC service referral form.

- ( ) Male
- ( ) Female

6) Age

Found on page 1 of service referral form. Please note: Only the birthday is recorded. A calculation is needed.

- ( ) 0-18
- ( ) 19-24
- ( ) 25-34
- ( ) 35-44
- ( ) 45-54
- ( ) 55-64
- ( ) 65-74
- ( ) 75-84
- ( ) 85-94
- ( ) 95-104

7) Smoking status

Found on page 2 of the CCAC service referral.

- ○ Smoker
- ◉ Non Smoker

8) Wound location

Locate on page 2 of the CCAC service referral under primay diagnosis or on CLE116 under wound location

---

9) Co-morbid condition

Found on the initial wound assessment, CLE116 under co-morbid conditions.

- ☐ Autoimmune disorders
- ☐ Cancer
- ☐ Coronary Artery Disease
- ☐ Diabetic
- ☐ PAD

10) Medications

Found on the initial wound assessment, CLE116 under medications and medication profile, CLE 35.

- ☐ Steroids
- ☐ Immunosuppressants
- ☐ Anticoagulants
- ☐ Chemotherapy
- ☐ Not charted
- ☐ None of those listed above

11) Wound acuity

The information is found on the initial wound assessement, CLE116 under wound acuity.

- ○ Acute (< 3 weeks)
- ○ Chronic (Not progressing through the normal phases of wound healing)

12) Was a medical wound diagnosis documented on the initial medical referral form?

This form is the document that is faxed to the branch as part of the admission package. The form is entitled "Service referral and medical treatment plan". Otherwise know as "Dr orders form".

- ○ Yes
- ○ No

13) Wound type

Found on the initial wound assessment, CLE116 under wound type. If the wound type is not documented or unclear, select unknown. To answer this question, the discretion and the expertise of the data extraction nurse may be required.

- ○ Surgical
- ○ Pilonidal Cyst
- ○ Trauma
- ○ Burn
- ○ Skin Tear
- ○ Malignant
- ○ Inflammatory
- ○ Lymphedema
- ○ Other
- ○ Unknown
- ○ N/A (Choose if the wound is an ulcer)

Ulcer Type

14) Ulcer present?

Information found on the initial wound assessment, CLE116 under "wound ulcer type."

- ○ Yes
- ◉ No
- ○ Unknown

15) Is this a lower limb ulcer?

Information located on CLE116 under the heading "Wound location".

- ○ Yes
- ○ No
- ○ Unknown

16) Has the client received a vascular assessment

Information located on CLE116, the initial wound assessment form, or CLE117 the interim wound assessment form.

Not Charted

17) Is this a diabetic ulcer?

Found on the initial wound assessement, CLE116 under wound ulcer type.

- ○ Yes
- ◉ No
- ○ Unknown

18) Has the pressure been off loaded?

Information located on CLE116, the initial wound assessment form.

Not charted

19) Is this a venous ulcer?

Information located on CLE116 under the heading "Wound ulcer/Ulcer type"?

- ○ Yes
- ○ No
- ○ Unknown

20) Is the client receiving compression therapy?

Information located on CLE116 under the heading "Wound ulcer type-Venous leg ulcer.

Blood Work

21) Albumin level indicated?

Albumin level is indicated and should be ordered in the presence of a chronic wound. The information is located on CLE116 under the heading "Wound acuity".

- ○ Yes
- ○ No
- ○ N/A if not a chronic wound

22) Was the albumin level documented?

The Information will be located on CLE116, the initial wound assessment form.

- ○ Yes
- ○ No
- ○ N/A if not indicated

23) HgbA1C indicated?

HgbA1C is indicated in clients with diabetes. A diagnosis of diabetes is documented on CLE116 under the leading "Comorbid condition." The HgbAIC value is located on form CLE116 under the heading "Lab values".

- ○ Yes
- ○ No
- ○ N/A if not a diabetic

24) Was the HgbA1C documented?

The Information will be located on CLE116, the initial wound assessment form.

- ○ Yes
- ○ No
- ○ N/A if not indicated

Pain Assessment

25) Does the client have pain?

The information is located on the client care assessment form CLE10 page 3.

- ○ Yes
- ○ No
- ○ Not Charted

26) If yes, was a initial pain assessment competed?

The information is located on CLE 51. CLE 51 may not be included on the chart if client care is active. If active refer to CLE 10 page 3 under intensity of pain. If "Intensity of Pain is coded 1 or greater, assume initial pain assessment was completed.

N/A (choose if no pain on initial assessement))

27) Was pain reassessed on an ongoing basis

The information is located on CLE 34 "Wound care flow sheet" or CLE 52 "Pain assessment flow sheet".

N/A (choose if no pain)

28) Was a quality of live assessment completed during the initial visit

The information is located on CLE116 under "Quality Of Life".

- ◉ Yes
- ○ No

Infection

29) Infection

Information is located on CLE116 under the heading "Infection"

- ○ Present
- ○ Absent

30) Was a wound culture / biopsy requested

The information is located on medical referral and on CLE116 under the heading "Transdisiplinary treatment plan".

Interprofessional Treatment Plan

31) Monofilament testing Indicated

A monofilament test is indicated if the client is a diabetic and if the would is located on the foot. The information is located on CLE116 under the heading "Transdisiplinary treatment plan".

---

32) Monofilament testing completed

The Information is located on CLE116, the initial wound assessment form.

N/A

Specialist Referral(s) Requested

33) Specialist referral requested

The information is located on form CLE116 under "Specialist referrals requested".

- ☐ Wound Care Clinic
- ☐ Wound Resource Nurse
- ☐ ET
- ☐ Dietitian
- ☐ Social Work
- ☐ Chiropody/Podiatrist
- ☐ OT
- ☐ PT
- ☐ Other

34) Was a care plan completed?

The information can be found on the care plan.

- ○ Yes
- ○ No

Treatment Goal

35) Treatment goal

The information is located on CLE 34 (Wound care flow sheet) or on the client's care plan. Please note: Chart the treatment goal on admission.

- ○ Healing
- ○ Maintenance
- ○ Non-Healing

36) Date of first visit for wound care

The information is located on CLE 34

YYYY/MM/DD @ HH:MM AM/PM

37) Date of last visit for wound care

The information is located on CLE 34.

YYYY/MM/DD @ HH:MM AM/PM

38) Number of days the client received wound care services to a maximum of 100 days.

The number can be calculated by determining the number of days between and including the first day and the last day of care.

1

39) What was the status of the wound upon discharge on after 100 days of care?

---

40) Did the client continue to require wound care past one hundred days?

The information can be found in the Procura data base.

- ○ Yes
- ○ No

41) Was the client receiving visits more then three times per week at anytime during the first 4 weeks?

The information can be found on the wound care Ffow sheet CLE34 and the interim wound assessment form CLE117.

- ○ Yes
- ○ No

42) If yes, was there a decrease in the frequency of visits to three times per week or less within the first four weeks?

The information is located in CLE117 under the heading "Outcomes" or in Procura.

---

43) Did the client achieve a reduction in the area of the wound during the first 4 weeks of care?

The infomating care be found on the interim wound assessment form CLE117.

- ○ Yes
- ○ No

44) If yes, what was the percentage of reduction at 4 weeks? Formula:

$$\frac{\text{(Original length x width - length x width at 4 weeks)}}{\text{(Original length x width)}} \times 100$$

The information is located on the wound care flow sheet, CLE 34.

---

45) Did the client achieve a reduction in the area of the wound at 100 days?

The information can be found on the interim wound assessment form CLE117.

---

46) What was the percentage of reduction at 100 days? Formula:

$$\frac{\text{(Original length x width - length x width at 4 weeks)}}{\text{(Original length x width)}} \times 100$$

The information is located on the wound care flow sheet CLE 34.

Next

Survey Software powered by FluidSurveys

Appendix E

The following 2 X 2 contingency tables with be used in this study. The odds ratios and 95% Confidence Intervals will be reported for each outcome comparison. The alpha will be set at .05.

Table 1a
Clinical Outcomes: Achieved 30% wound closure at 4 weeks

	Used Handheld Computers	**Did not use Handheld Computer**	**Totals**
Achieved 30% wound Closure at 30 days	A	B	A+B
Did not Achieved 30% wound Closure at 30 days	C	D	C+D
Totals	A + C	B+D	**Total = A+B+C+D**

Table 1b
Clinical Outcomes: Closure at 100 days.

	Used Handheld Computers	**Did not use Handheld Computer**	**Totals**
Achieved Closure at 100 days	A	B	A+B
Did not Achieved Closure at 100 days	C	D	C+D
Totals	A + C	B+D	**Total = A+B+C+D**

Table 2a
Evidence based practice: Clients who received a vascular assessment.

	Used Handheld Computers	**Did not use Handheld Computer**	**Totals**
Client Received a Vascular Assessment	A	B	A+B
Client Did not Receive a Vascular Assessment	C	D	C+D
Totals	A + C	B+D	**Total = A+B+C+D**

Table 2b
Evidence based practice: Clients who received compression therapy.

	Used Handheld Computers	**Did not use Handheld Computer**	**Totals**
Client Received Compression Therapy	A	B	A+B
Client Did not Receive Compression Therapy	C	D	C+D
Totals	A + C	B+D	**Total = A+B+C+D**

Table 2c
Evidence based practice: Clients who received an initial pain assessment.

	Used Handheld Computers	**Did not use Handheld Computer**	**Totals**
Client Received an Initial Pain Assessment	A	B	A+B
Client Did not Receive an Initial Pain Assessment	C	D	C+D
Totals	A + C	B+D	**Total = A+B+C+D**

Table 2d
Evidence based practice: Clients who received a quality of life assessment.

	Used Handheld Computers	**Did not use Handheld Computer**	**Totals**
Client Received Quality of Life Assessment	A	B	A+B
Client Did not Receive a Quality of Life Assessment	C	D	C+D
Totals	A + C	B+D	**Total = A+B+C+D**

Table 3a
Cost Outcome:
Clients who require less than 4 dressing changes per week at 4 weeks.

	Used Handheld Computers	**Did not use Handheld Computer**	**Totals**
Client required less than 4 dressing changes per week at the end of 4 weeks	A	B	A+B
Client required 4 or more dressing changes per week at the end of 4 weeks	C	D	C+D
Totals	A + C	B+D	**Total = A+B+C+D**

Table 3b
Cost Outcome: Closure at 100 day

	Used Handheld Computers	**Did not use Handheld Computer**	**Totals**
Achieve Closure at or Before 100 days	A	B	A+B
Did Not Achieve Closure at or Before 100 days	C	D	C+D
Totals	A + C	B+D	**Total = A+B+C+D**

Appendix F

Letter Request of Custodianship of Data

Lloyd Tapper
1620 Kerr Road
Edmonton, Alberta
T5E 4A7

May 23, 2012

Holly Quinn, Director of Clinical Programs,
Research Ethics Committee (Chair)
Bayshore HealthCare Ltd.
2155 Dunwin Drive, Unit 10
Mississauga, Ontario, L5L 4M1

Dear Ms Quinn:

As a condition of approval to conduct a Doctoral research study at the University of Alberta, the University of Alberta Research Ethics Committee's recommended best practice is to recognize that ownership of original research materials is held jointly by all collaborators, and to designate one individual as the custodial agent of the materials for all contributors (FGSR Council, 1996/11/15). Clarification of the custodial agent is required to receive ethics approval. These requirements are in place to ensure that conclusions reached from an analysis of the data are not subject to bias from individuals or organizations who may have a special interest in the results.

In anticipation of a review and approval of my Doctoral research proposal entitled "The Impact of Handheld Computers on the Management of Lower Leg Ulcers in a Home Care Setting," please consider this letter as an official request to be appointed the Custodial Agent for all data collected in the course of this research study.

As a condition of approval, Bayshore HealthCare will receive a copy of all data collected during the study.

Thank you in advance for your consideration.

Kind Regards,

Lloyd Tapper PhD(c), MN, NP

Appendix G

Letter Granting Custodianship of Data

Bayshore HealthCare

2155 Dunwin Drive Unit 10
Mississauga, Ontario
L5L 4M1
Tel: (905) 822-8075
Fax: (905) 822-4695

May 31, 2012

Lloyd Tapper PhD(c), MN, NP
1620 Kerr Road
Edmonton, Alberta
T5E 4A7

Re: Request for appointment as Custodial Agent

Dear Mr. Tapper,

Please consider this letter as confirmation that Bayshore HealthCare Ltd. agrees to your appointment as Custodial Agent for all data collected in the course of your Doctoral research, provisionally entitled "The Impact of Handheld Computers on the Management of Lower Leg Ulcers in a Home Care research study".

As Chair of the Research Ethics Committee at Bayshore, I have read and agree to the Guidelines for Ownership of Research Materials of the University of Alberta (Section 10.3 of the FGSR Council, 1996/11/15). Bayshore understands that, as the principal investigator and Custodial Agent, you will have access to the collected data for a minimum of five (5) years or such longer periods as required by funding agencies or funding oversight agencies.

I wish you all the best in your Doctoral research and know that you will make a valuable contribution to this important area of nursing knowledge.

Sincerely,

Holly Quinn

Holly Quinn
Director of Clinical Programs
Research Ethics Committee (Chair)

Better care for a better life

Appendix H

CCAC Process for Reviewing and Approving the Research Proposal

From: Stephens, Jacquie [mailto:jacquie.stephens@esc.ccac-ont.ca]
Sent: Monday, October 03, 2011 11:01 AM
To: Karen Reid
Subject: FW: Request for permission

Good morning Karen
I have had a chance to review your request internally, and I have been asked to request the following information from you:

- a formal research proposal
- a letter of approval from the U of Alberta's REB, and
- a letter of approval from Bayshore's research steering committee.

I hope that these will be easy to obtain.
Please let me know if you anticipate a problem getting them.
Thanks, and again I apologize for the delay!
Jacquie

Jacquie Stephens, RN, BScN, MHS
Director of Quality
Erie St. Clair Community Care Access Centre
Centre d'accès aux soins communautaires d'Érié St-Clair
Telephone / Téléphone: 519-436-2222 x.7270
Fax / Télécopie: 519-351-5842
Web Sites: www.esc.ccac-ont.ca / www.310ccac.ca
Outstanding care - every person, every day / Des soins exceptionnels - chaque personne, chaque jour

Appendix I

Bayshore's Contractual Obligations

(2) The Parties acknowledge that during an emergency situation set out in GC Section 3.9(1), the Parties may be required to comply with the instructions of the CCAC in order to address the emergency situation and that in so doing, the Parties may be required to take all necessary measures, including carrying out their obligations under this Agreement in a different manner for the duration of the emergency situation, in order to meet the requirements of GC Section 3.9(1).

3.10 Research Programs

The Service Provider shall obtain the prior consent of the CCAC prior to implementing any research or student programs that relate to the Service Provider's obligations under this Agreement.

3.11 Joint Venture Service Providers

If the Service Provider is a joint venture in accordance with the Form of Agreement,

(a) each joint venture participant shall be jointly and severably liable for all obligations of the Service Provider under this Agreement;

(b) the joint venture participants hereby confirm that the individual joint venture participants appoint the party named in the Special Conditions as the "Participant in Charge" to represent them in all matters of interaction with the CCAC (including accepting any Notice on behalf of the joint venture) and to make all decisions on their behalf pursuant to this Agreement, including the receipt of payments from the CCAC; and

(c) the joint venture shall not change its members without the prior consent of the CCAC.

3.12 Service Provider Accreditation

(1) The Service Provider shall, at its own cost and expense, obtain and maintain the accreditation specified in the Special Conditions, by a recognized third party accreditation body set out in the Ontario Association of Community Care Access Centre's list of approved accreditation bodies ("Accreditation Status") in accordance with the terms and conditions, including the deadline for achieving the Accreditation Status, set out in the Special Conditions.

(2) If the Service Provider fails to achieve Accreditation Status in accordance with the terms and conditions set out in the Special Conditions, including the prescribed deadline, it may not be eligible for renewal of this Agreement pursuant to the GC Section 2.5, in the CCAC's sole discretion.

(3) The Service Provider acknowledges and agrees that it shall not be entitled to payment of any costs or expenses related to the achievement of its Accreditation Status and that all such costs and expenses have been taken into account in the Prices set out in the Price Form in accordance with Section 1.2(5) of the Pricing and Compensation Schedule.

(4) The Service Provider shall, upon request by the CCAC, provide evidence of its Accreditation Status no later than ten days following receipt of the request from the CCAC.

3.13 Compliance with Accessibility for Ontarians with Disabilities Act

(1) Without limiting the Service Provider's obligations under GC Section 3.5, the Service Provider shall comply with the *Accessibility for Ontarians with Disabilities Act* and the regulations thereto (collectively the "Accessibility Act") and shall cooperate with the CCAC in its compliance with the Accessibility Act. The Service Provider shall comply with CCAC's policies and procedures established in accordance with the Accessibility Act (the "CCAC Accessibility Policies") at no additional cost or expense

Appendix J

Research Budget

Personnel	
Co-Investigator	
Travel to Site A	
Flight	900.00
Car rental	250.00
Hotel	300.00
Site A Data Extractor	
160 hrs (20 days) at 40.00/hr	6400.00
Site B Data Analyst	
3 hrs at 40.00/hr	120.00
Equipment/Software	
Office Space	Donated
Computer	700.00
Software Program (Fluid Surveys)	120.00
SPSS Software	Free
Miscellaneous Items	150.00
Dissemination	
Conference Registration	650.00
Flight	600.00
Car Rental	250.00
Hotel	300.00
Publication	Free
Total:	**10,740.00**

Appendix K

Ethics Review Board Approval Letter

UNIVERSITY OF ALBERTA

RESEARCH ETHICS BOARD

308 Campus Tower
Edmonton, AB, Canada T6G 1K8
Tel: 780.492.0459
Fax: 780.492.9429
www.reo.ualberta.ca

Notification of Approval

Date:	August 24, 2012
Study ID:	Pro00032807
Principal Investigator:	Lloyd Tapper
Study Supervisor:	Carolyn Ross
Study Title:	Assessing the Impact of Portable Computers on the Management of Lower Leg Ulcers in a Home Care Setting: A Research Proposal
Approval Expiry Date:	August 23, 2013

Thank you for submitting the above study to the Research Ethics Board 2 . Your application has been reviewed and approved on behalf of the committee.

A renewal report must be submitted next year prior to the expiry of this approval if your study still requires ethics approval. If you do not renew on or before the renewal expiry date, you will have to re-submit an ethics application.

Approval by the Research Ethics Board does not encompass authorization to access the staff, students, facilities or resources of local institutions for the purposes of the research.

Sincerely,

Dr. Stanley Varnhagen, PhD
Chair, Research Ethics Board 2

Note: This correspondence includes an electronic signature (validation and approval via an online system).

Appendix L

Bayshore Ethics Review Committee Approval Letter

Bayshore Home Health

2155 Dunwin Drive
Unit #10
Mississauga, Ontario
L5L 4M1

TEL 905 822-8075
Toll Free 1.800 668-9490
FAX 905 822 -8393

www.bayshore.ca

September 5th, 2012

Lloyd Tapper
2155 Dunwin Drive Unit # 10
Mississauga, ON L5L 4M1
ltapper@bayshore.ca

Dear Lloyd,

We are pleased to inform you that the Ethics committee at Bayshore Home Health has reviewed and accepted your request to participate in the University of Alberta study: Portable Computers and Health Care System Outcomes.

Should you have any questions, please feel free to contact me at: hquinn@bayshore.ca

Best regards,

Holly Quinn RN, BScN, MHS
Chief Nursing Officer
Ethics Committee Chair

Better care for a better life

Appendix M

Erie St. Clair CCAC Ethics Approval Letter

Connecting you with care
Votre lien aux soins
CCAC CASC
Community Care Access Centre
Centre d'accès aux soins communautaires

Head Office
712 Richmond St.
Box 306
Chatham, ON N7M 5K4

Siège Social
712, rue Richmond
CP 306
Chatham, ON N7M 5K4

Tel/Tél: 519-436-2222
888-447-4468
Fax/ Téléc: 519-351-5057

www.esc.ccac-ont.ca

November 28, 2012 Via E-Mail – ltapper1@me.com

Mr. L. Tapper
Faculty of Nursing
University of Alberta

Dear Mr. Tapper;

Re: Consent for Research

Your proposal entitled Assessing the Impact of Portable Computers on the Management of Lower Leg Ulcers in a Home Care Setting: A Research Proposal has been reviewed and has been endorsed from a quality and ethics perspective at the Erie St. Clair Community Care Access Centre.

We are pleased to provide permission to proceed with your study.

Good luck to you as you move forward with this informative work.

Sincerely,

Jacquie Stephens, RN, BScN, MHS
Director of Quality

Appendix N

North Simcoe Muskoka CCAC Ethics Approval Letter

15 Sperling Drive
Suite 100
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December 13, 2012

Lloyd Tapper
Faculty of Nursing
University of Alberta
Ltapper1@me.com

Dear Lloyd,

It was a pleasure to speak with you today regarding your research proposal "Assessing the Impact of Portable Computers on the Management of Lower Leg Ulcers in a Home Care Setting".

I am pleased, on behalf of the North Simcoe Muskoka Community Care Access Centre, to advise you that we have reviewed your proposal and are providing you with permission to proceed.

Should you have any questions, please feel free to contact me at: debbie.roberts@nsm.ccac-ont.ca

Sincere regards,

Debbie Roberts
Sr. Director Performance Management and Accountability
North Simcoe Muskoka Community Care Access Centre