Effects of Mobile Computing on the Quality of Homecare Nursing Practice

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Abstract

The purpose of this study was to evaluate the effects associated with use of a new mobile technology on the quality of home care provided by the nurses of nine ambulatory care units. The core of the intervention consists of software that optimizes the process used to structure nursing activities taking place in patients' homes. Several tools were used to collect and triangulate the data: (1) interviews, (2) questionnaires, and (3) nursing notes in patient records. Our results suggest that the use of the mobile solution resulted in more complete nursing notes in the patient records. The fact that information on the patients' states of health and their medical histories could now be consulted by all the nurses allowed for better client monitoring and more continuous care. According to the patients themselves, the nurses’ use of the software significantly improved the quality of care received. In conclusion, our results show that, much like hospital care, the home care sector can benefit from mobile technologies, particularly in terms of the quality of nursing care provided.

1. Introduction

Although the aging of populations has become a worldwide phenomenon, the situation is more advanced in the more developed countries [1]. A United Nations report suggests that the world’s population will continue to age, reaching 9 billion by 2050. In the developed countries, the number of people over 60 years of age is expected to almost double, from 245 million in 2005 to 406 million in 2050 [2]. People aged 65 years or older represented 12.8% of the U.S. population in 2008, and this ratio is expected to grow to 19% by 2030 [3]. Even in the developing countries, life expectancy is increasing and the number of older people is growing. In 2015, there will be 597 million elderly people in these countries, or 67% of the world's elderly [2].

Health systems represent one of the economic sectors most affected by these sociodemographic changes due to the close relationship between age, the prevalence of chronic diseases and health care consumption [4-6]. Among OCDE member countries, over 40% of total health spending is already being used to manage patients 65 years of age and older [7]. It is therefore expected that the economic weight of the health sector will continue to grow, as populations are expected to continue aging. In this respect, the health sector in the United States grew from 7.4% of its gross national product (GNP) in 2000 to 17.3% in 2009, and this rate expected to reach 19.3% in 2019 [8]. In Canada, health represented 9.1% of GNP in 2000 and grew to 11.9% in 2009 [9].

This marked increase in the number of elderly people has already had a significant impact on the health care services provided in the home, and many governments acknowledge the importance of proving these kinds of services. In fact, expanding the range of health services provided in the home – one of the recommendations made by WHO [10] – is part of a fundamental trend observed in many health systems, including those of Canada, the United States and many European countries [11]. Not only do governments acknowledge the importance of home care, but, as several surveys have shown, the elderly themselves want to live in their homes longer, and consider the growth of home services a necessity [e.g., 12-14].

Home care is therefore playing a significant role in the reorganization of health systems in many countries. The goal is to help people with specific vulnerabilities or needing short-term, long-
term, palliative or rehabilitative care to live autonomously in their communities. The current and future growth of home care is reflected in a marked increase in expenditures for this type of service. In Canada, these expenditures have doubled in the last decade, from $1.6 billion to $3.4 billion [15]. In the United States, home care expenditures grew 11.7% from 2008 to 2009 and should continue to grow at an average annual rate of 8.1% from now until 2019 [8]. A similar trend has been observed in several European [11] and Asian [2,16] countries.

Technological progress represents one of the major trends influencing how home care will be provided. Some of the information technologies that have been tested in home care experiments or pilot projects include home telemonitoring [e.g., 17,18]; mobile technologies to support the work of nurses and other health professionals in patients’ homes and on the road [e.g., 19,20]; various forms of communication between care providers and patients through Web portals and email [e.g., 21]; and the automation of business processes in the ambulatory units charged with providing home care services [e.g., 22].

While it has been shown that the use of modern information technologies offers many opportunities to increase the productivity of home care professionals and the overall effectiveness of home care services [e.g., 19,23,24], very few empirical studies have evaluated the effects of emerging technologies on the quality of home care services. The present study aims to fill this gap. More specifically, we wanted to assess the effects associated with the use of a mobile technology on the quality of home care provided by nurses working in nine ambulatory care units in Quebec, Canada. This assessment was performed from three complementary points of view or perspectives. First, two independent experts applied a pre and post research study design to assess the completeness of nursing notes in 150 patient records. Second, a total of 57 semi-structured interviews were conducted with the nurses using the mobile technology in order to collect data on their perceptions of the quality of care provided. Third, we used a questionnaire survey to collect the points of view of a sample of 223 patients.

The next section presents a summary of the literature on the use of information technologies in the specific context of nursing care provided in the home. We then present the study design and the various methodological issues associated with this study. The following sections present and discuss the key findings and their implications.

2. Background

The extant literature reveals that a growing number of IT applications are being used in the specific context of home care services. One such innovation, commonly known as home telemonitoring, is a telemedicine application in which physiological and biological data are transferred in order to monitor patients, interpret the data and make clinical decisions [25]. It is a relatively recent intervention approach with growing numbers of applications, not only in many industrialized countries but also in some developing countries [26]. The underlying goal is to organize the telecare approach according to case and care management principles, and as a substitute for the integrated and continuous monitoring used in the classical approach to monitoring patients by episode of care. Several reviews have shown that home telemonitoring of chronic diseases represents an effective patient management approach that produces accurate and reliable data, empowers patients, influences their attitudes and behaviors, and potentially improves their medical conditions [e.g., 17,18,27].

Another form of technological innovation, which is the focus of this study, targets homecare nurses as its main users. While home telemonitoring allows nurses to monitor patients and intervene from a distance, mobile computing allows nurses to integrate the care process on site at the patient’s home. In this perspective, it allows on-site management of the patient’s clinical data, visit scheduling, care planning and data sharing with the care team [28]. With the help of various devices, including personal digital assistants (PDAs), notebooks, or tablet PCs, nurses can access clinical information from a distance or update the patient record or care plan in real time.

While prior studies have shown that nurses have favorable attitudes towards mobile computing [29-31], there is a paucity of research exploring the effects of mobile applications in the particular context of homecare nursing. As a first example, Archer [32] described an innovative project that uses mobile technology to support homecare nurses employed by a home healthcare agency in an Ontario Community Care Access Center. In this project, paper-based operations were replaced by a reengineered system that provided wireless PDAs to homecare nursing staff to be used to access the
central system remotely through secure communications over the cellular network. Two modules were included in the initial phase. One was to be used to manage medical supplies for patients, and a second module was to be used to collect data on wound care status. Nursing staff also had access to the system through desktop computers in their internal network. A return-on-investment analysis prior to system development indicated a net savings on tangible costs alone, although it was anticipated that intangible improvements due to reductions in errors and delays in the delivery of supplies would also be substantial. These conclusions were verified post-implementation [32].

As another example, Hong et al. [33] performed a service trial in Korea with a small group of experienced visiting nurses who used a systematic and efficient point-of-care home hospice information system. Nurses used the new system to carry out tasks ranging from registering a new patient to providing nursing services based on the patient’s condition, as well as accessing guidelines on cancer patient management and searching past information for better nursing performance. While the pilot project allowed marginal efficiency gains, it enabled improvements in the quality of point-of-care services.

Lastly, Paré et al. [19] evaluated the benefits resulting from a mobile computing technology that was deployed in an oncology and palliative care unit in Quebec, Canada. The project consists of a software application that structures and organizes the nursing activities delivered in patients’ homes. In order to have access to the software application, each nurse was provided a tablet PC with a stylus. Data collection was performed over three periods: one pre- and two post-implementation periods. All seven nurses who participated in the pilot project were satisfied with the quality of the information stored in the system. Eight months after the deployment of the software application (post 2 period), the number of treated patients had increased by 6% (p=.04), the average number of home visits by nurses had increased by 0.7 visits per day (p=.02), and the time allocated to direct patient care had increased by 14% (p=.003).

As presented above, there is a paucity of studies on the use of mobile computing in the specific context of home nursing care. The present study is among the first to investigate the effects of a mobile technology on the quality of homecare nursing practice.

### 3. Methodology

#### 3.1 Mobile technology and site

The core of the intervention consists of the deployment of a software package intended to optimize the process used to plan and organize nursing activities in patients' homes. The software, called SyMO™, consists primarily of a series of modules. It is first composed of a dictionary of nursing care plans that covers all the procedures registered nurses need to perform in response to patient health problems (e.g., assessing physical pain, weighing patients with gastro-intestinal symptoms, teaching patients how to use a medical device). For each intervention, the dictionary indicates the frequency (e.g., once every three days, once a week), the time typically required for the procedure (in minutes) and other details (e.g., use of a particular type of bandage). The current version of the dictionary contains about 40 nursing care plan models, organized by system type (e.g., the brain system, the pulmonary system, the digestive system, generalized malignancy). The nurse’s role consists of evaluating the health status of patients and creating the appropriate treatment plan for them. Using the Intervention Plan module, she enters the list of actions to be taken with the patient. At the patient’s home, the nurse uses the Patient Diary module, which provides a list of the interventions to be performed and allows her to take notes. The nurse must enter a note for each procedure in the patient’s care plan. This module enhances both the quality and continuity of care by providing access to the full history of nursing records associated with each intervention.

The software was implemented in nine ambulatory care units located in the province of Quebec, Canada. The units chosen to participate in this pilot project are very diverse in terms of team size, the area covered by the nursing staff, and the geographical distribution of the clients who received home care (rural vs. urban settings) in order to reflect the variety of ambulatory units found across the province. The sites were selected by authorities with the department that funded the project.

All nurses in these units (n=137) were provided with a Table PC or a laptop computer and use of the system was mandatory. In each unit, a nurse pilot was selected among all nurses involved prior to the kick-off meeting. Each of these pilot nurses was actively involved in a clinical committee whose primary mandate was to develop the clinical
content (i.e., 40+ care plans) of the new system. Pilots were also responsible for training nurses and providing technical support in their respective unit.

3.2 Data collection and analysis

In order to assess the effects of using the software on the quality of nursing care, the researchers undertook an intensive period of data collection in the summer and fall of 2009. As suggested by Kaplan [34] and, more recently, by Ammenwerth et al. [35], several data collection tools were used.

Completeness of nursing notes in the patient records

First, the content of nursing notes entered into patient records was analyzed in order to measure the effect of software use on the completeness of patient records. To ensure that results from different sites would be comparable, the assessment targeted a single client group: patients who had received an atrial fibrillation diagnosis followed by anticoagulant therapy in the home. This condition was chosen because it is common in home care. A nurse at each site was made responsible for identifying patient records. The inclusion criteria selected patients who presented a diagnosis for atrial fibrillation, were newly admitted to a program of anticoagulant therapy in home care, and did not have any cognitive problems. A total of 150 patient records were analyzed: 77 paper records (pre period) and 73 SyMO records (post period). At this stage of the research project, its ethics were been approved at each of the facilities involved. Prior to system deployment, free-form narrative charting was the gold standard in all ambulatory units.

In order to assess the completeness of nursing notes, an assessment sheet covering all the clinical data that should normally be found in a patient’s file after the nurse’s first three visits was developed. The sheet consists of two sections. The first section covers information related to nursing notes made during the first home visit: general health status, symptoms of fibrillation, measurements made of different parameters (e.g. blood pressure, pulse, breathing) and the collection of a blood sample, a general note on medication, a note on the patient’s knowledge of their medication, and a note on their adherence to their medication regime and bleeding. The second section deals with patient education on anticoagulant therapy and has five items: general patient education, regular use of medication, use of non-prescribed drugs, diet, and what to do in case of an emergency. The content of the assessment sheet was developed by members of the clinical committee, i.e. nurse pilots.

The assessment was made by two nurses who were not otherwise involved, either closely or from a distance, in the development and implementation of the software. Each assessor filled out the sheet independently for all patient records (both paper records and electronic records). They then compared their results. At slightly over 94%, the overall agreement rate is highly satisfactory. Chi-square analyses were conducted to compare the completeness of the nursing notes (pre and post).

Nurses’ perceptions of the software’s effect on quality of nursing care

A total of 57 semi-structured interviews were conducted to assess the nurses’, nurse pilots’ and head nurses’ perceptions of the perceived effect of the software on quality of care. These interviews, conducted from June to November 2009, lasted 40 minutes on average and were recorded and transcribed. The interview protocol included general questions designed to identify, as required, the nature of effects associated with software use three months after deployment.

We also asked all 137 nurse users to complete a structured questionnaire that measured the effects of the SyMO software on the continuity of nursing care provided in the home. More specifically, we asked them to indicate their satisfaction with the quality of the clinical information included in the software and the extent to which their use of the software had had a positive effect on their various activities documenting their home visits in patient records. A total of 101 completed questionnaires were returned to the investigators, representing a 74% response rate.

Patients’ perceptions of the software’s effect on quality of nursing care

A mail questionnaire was also designed for the patients receiving home care. The study targeted approximately 1,240 patients who were receiving home care services before the nurses began using the software during their visits. The patients were therefore able to make an appraisal of the comparative advantages provided by the new system. The nurses at each site were responsible for distributing the questionnaires, and the patients
sent their completed questionnaires directly to the researchers. The questionnaires were filled out anonymously to protect the identities of respondents. A total of 223 patients filled out and returned the questionnaire, for a response rate of approximately 18%.

4. Results

In this section we present results from the quantitative and qualitative analyses performed for the study. We begin by presenting the results on the completeness of the nursing notes found in the patient records. Then we present the benefits of the software, in terms of quality of care, as perceived by the nurses who used it and their patients.

4.1 Completeness of nursing notes

As mentioned above, in order to measure the software’s effect on the completeness of nursing notes, we analyzed the content of 150 patient records, including 77 paper files and 73 SyMO files. The results are presented in Table 1.

<table>
<thead>
<tr>
<th></th>
<th>PRE Paper Records</th>
<th>POST SyMO Records</th>
<th>Chi-square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part 1: Data recorded during the first visit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient’s general health status</td>
<td>89%</td>
<td>87%</td>
<td>1.8 ns</td>
</tr>
<tr>
<td>Symptoms of atrial fibrillation</td>
<td>10%</td>
<td>66%</td>
<td>51.2 ***</td>
</tr>
<tr>
<td>Vital signs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood pressure</td>
<td>43%</td>
<td>67%</td>
<td>9.8 **</td>
</tr>
<tr>
<td>Pulse</td>
<td>40%</td>
<td>66%</td>
<td>10.7 **</td>
</tr>
<tr>
<td>Breathing</td>
<td>23%</td>
<td>47%</td>
<td>10.2 **</td>
</tr>
<tr>
<td>Blood sample</td>
<td>99%</td>
<td>99%</td>
<td>0.1 ns</td>
</tr>
<tr>
<td>Medications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medication taken</td>
<td>45%</td>
<td>82%</td>
<td>23.2 ***</td>
</tr>
<tr>
<td>Understanding</td>
<td>1%</td>
<td>73%</td>
<td>83.7 ***</td>
</tr>
<tr>
<td>Adherence</td>
<td>2%</td>
<td>65%</td>
<td>94.9 ***</td>
</tr>
<tr>
<td>Verification of bleeding</td>
<td>13%</td>
<td>67%</td>
<td>48.1 ***</td>
</tr>
<tr>
<td>Part 2: Anticoagulant therapy taught during the first three visits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive education</td>
<td>13%</td>
<td>99%</td>
<td>36.8 ***</td>
</tr>
<tr>
<td>Regularity with which medication is taken</td>
<td>11%</td>
<td>12%</td>
<td>4.5 ns</td>
</tr>
<tr>
<td>Medication prescribed</td>
<td>9%</td>
<td>8%</td>
<td>9.8 *</td>
</tr>
<tr>
<td>Diet</td>
<td>5%</td>
<td>33%</td>
<td>26.0 ***</td>
</tr>
<tr>
<td>What to do in an emergency</td>
<td>0%</td>
<td>15%</td>
<td>4.3 *</td>
</tr>
</tbody>
</table>

*** p<.001; ** p<.01; * p<.05; ns = not significant

The first column of the table lists various types of information that should be found in the record of a patient presenting a diagnosis for atrial fibrillation. For example, on the first visit the nurse should not only make an assessment of the patient’s general health, but should also record their vital signs, take a blood sample and investigate what medication they are taking. In terms of patient education during the nurse’s first three visits, the file should include information on how regularly the medication is being taken, diet and measures to be taken in the event of an emergency, to name just a few. The following two columns present the percentage of paper records and SyMO records in which the desired information was found. The last column in the table presents the Chi-square statistic, which measures pre-post differences.

Overall, we see that the software had a beneficial effect in terms of the completeness of the nursing notes found in the patients’ records. The results presented in Table 1 show that almost all the items under the heading “During the first visit” were found much more often in the electronic records than in the paper records. For example, assessments of symptoms were documented in 66% of the post records, as compared to only 10% of the pre records. Another revealing item is related to the medication being taken, which was documented twice as often in the electronic records than in the paper records (82% and 45%, respectively). As for the “teaching” dimension of the nursing notes, the differences were also significant. Even if the results show that electronic records generally contain more information on the teaching of anticoagulant therapy than paper records, which is in itself an encouraging finding, the information was nevertheless not very complete. In sum, based on a careful examination of patient records, it would appear that the software has a positive and significant impact on the completeness of nursing notes.

4.2 Perceptions of the nurses using the software

The great majority of the nurses using the new software believe that it represents a user-friendly tool with a clear and understandable structure and is relatively easy to use. They appreciated almost all of its functionalities and see it as a useful tool for carrying out their tasks. In this spirit, it should be mentioned that the great majority of the nurses we interviewed perceive SyMO not as a simple computer tool but, above all, as a clinical tool.

Table 2 (below) presents the nurses’ opinions on the quality of information included in the SyMO software. The measure, which was inspired by the work of Bailey and Pearson [36], provided a Cronbach’s alpha of 0.92. This represents a very high level of reliability. The results indicate that, overall, the nurses reported a very high level of satisfaction with the quality of clinical information collected (averaging 8.2 on a scale of 10).
Table 2. Nurses’ Perceptions of Information Quality

<table>
<thead>
<tr>
<th>Quality of the information included in the software</th>
<th>Mean (standard deviation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliable and valid</td>
<td>8.4 (1.6)</td>
</tr>
<tr>
<td>Complete</td>
<td>8.0 (1.9)</td>
</tr>
<tr>
<td>Relevant</td>
<td>8.1 (1.8)</td>
</tr>
<tr>
<td>Readable and understandable</td>
<td>8.7 (1.6)</td>
</tr>
<tr>
<td>Presented in a clear and useful format</td>
<td>8.1 (1.9)</td>
</tr>
<tr>
<td>Secure and confidential</td>
<td>8.6 (1.7)</td>
</tr>
<tr>
<td>Available when required</td>
<td>7.5 (2.1)</td>
</tr>
<tr>
<td>Mean score</td>
<td>8.2 (1.6)</td>
</tr>
</tbody>
</table>

Cronbach’s alpha: 0.92

The comments collected from the semi-structured interviews support the results obtained from the questionnaire survey. Nurses appreciate the completeness, availability, relevance and accuracy of the clinical information on their patients. The completeness of the information was particularly evident when they spoke of the therapeutic plans and the intervention dictionary. The following comments are a good summary of most of the nurses’ thoughts on this subject:

“I now have access to all the information I need during my home visits: the patient’s current condition, why I’m following him, his last hospitalization, the notes entered by the last nurse who visited him, and the care she provided during that visit. For example, I can see when a nurse last took a blood sample, consult the patient’s history, etc. I really appreciate having access to all this clinical information.”

“The data on our patients is much more accurate than what we had before. SyMO now gives us access to standard care plans, so when I am asked to monitor diabetes, for example, I’m unlikely to forget what I need to do because the typical plan covers it all. It’s a big help. Several of us are doing things that weren’t an integral part of our practices before.”

The nurses were unanimous in stating that the main benefit of using the software was that it improved quality of care. More specifically, a consensus emerged from the interviews around the two main types of gains in quality of care achieved through SyMO: a better follow up of patients and better quality nursing notes in the patient records. Each of these benefits will be discussed below.

The SyMO software, through its standardized care plans and intervention dictionary, helped improve the quality of the nurses’ interventions by structuring their reasoning. In addition, all the nurses (including the most experienced among them) used the therapeutic plan as an invaluable reference on care-related knowledge when making their patient assessments. For example, SyMO automatically presents the parameters that need to be monitored and the teaching they need to provide based on the patient’s condition. Several nurses reported that this feature helped them remember what needed to be done. As a result, they found themselves making fewer phone calls in the afternoon to patients they had visited in the morning because they had forgotten to mention certain things during the visit:

“We tend to forget less when assessing the patient’s general condition. Such as signs of dehydration You know them a bit, but now you’ve got them all right in front of you. It’s a big help. Given the many different cases we handle, there’s a lot of clinical knowledge to remember, and SyMO lays it out for us. It’s a big help.”

Having access to all the patient data during their home visits helped the nurses monitor their patient’s clinical condition and allowed them to compare their patients’ state of health from one visit to the next. This provided for better and more continuous care. Similarly, this access to information on prior visits was particularly useful to those nurses who did not have a case load and to replacement nurses. The following quotes illustrate this important finding:

“I’m a substitute here. I don’t always see the same patients like a regular nurse does. The notes in the Cardex weren’t always so accurate. Sometimes they said, ‘It’s been a week since the patient was visited,’ when actually they had been visited two days before... For those of us who work as substitutes, it was hard to follow sometimes. But now, with SyMO, things are a lot easier. We have a permanent record of what happened before, and that makes it easier for us to follow up.”

The interviews reveal that the new software helps nurses make more accurate assessments of a patient’s condition. With the initial data collection required by SyMO and the intervention plans provided by the software, nurses ask more questions – and their questions are more thorough.
– when they are documenting the patient’s condition. In addition, nurses have the feeling that they are providing more patient education, and that they have a better understanding of their patients’ needs. Overall, the analysis of SyMO use shows that it changed the nurses’ approach to their work. Their interventions in patients’ homes were no longer focused on the prescribed task (blood samples, dressings) but rather on the patient as a whole. Two statements summarize well the perceptions of most of the nurses:

“SyMO leads to better client follow up. You find that you’re spending more time with your client, asking more questions, assessing more issues, and all this leads to better care.”

“The standard plans included in SyMO make for more consistent care. And the patients also appreciate us having this tool. They like the fact that we are spending more time with them.”

Finally, all the nurses acknowledged that the quality of the notes they make in patient records had significantly improved. More specifically, since the software had been deployed, their notes had become more complete and detailed, more consistent, and easier to read. Consultations, and even searches for information, took less time with the software. Other nurses mentioned that several interventions that had been carried out but not necessarily documented in patient records were now being documented due to their use of SyMO. This was particularly true in the case of patient education.

“I believe that my notes are much more complete and systematic than they used to be. Using SyMO imposes a certain structure on the intervention that I also see in my nursing notes. It’s good for continuity, too, when a colleague sees one of my patients and she consults notes I made earlier.”

4.3 Perceptions of patients

During our interviews, the nurses were unanimous in saying that patients had responded very well to the presence of the tablet PC. Some patients were reassured to see that the system carried a list of their medications, while others were pleasantly surprised to learn that they no longer had to repeat the same information to each care provider. Finally, others were impressed to see the nurse use a portable computer during the visit.

“At the start, many patients were impressed by the fact that we can verify their medication and enter changes to their personalized care plan in the computer. [...] There are benefits for patients, too, since their care is more consistent.”

In order to validate these comments, we asked patients at each site for their opinions. More specifically, we wanted to know whether they had perceived any changes in the care they received since SyMO had been introduced. The scale, which was developed to meet the specific needs of this study, shows a high level of internal consistency (Cronbach’s alpha = 0.89). As mentioned above, a total of 223 questionnaires were returned. This survey revealed that patients believe that they received several benefits through their nurses’ use of SyMO (see Table 3). For example, they believe that with SyMO, nurses have a more complete view of their condition and they do not need to repeat the same information to different care providers. It is also interesting to note the benefits in terms of case management. For example, respondents mentioned receiving more information from the nurses and, as a result, felt that they had a better understanding of their condition. Yet despite these findings, the patients did not appear to have become more involved in the management of their own conditions.

<table>
<thead>
<tr>
<th>Table 3. Effects as Perceived by Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (standard deviation)</td>
</tr>
<tr>
<td>[n=223]</td>
</tr>
<tr>
<td>Quality and continuity of care</td>
</tr>
<tr>
<td>More complete view of my condition</td>
</tr>
<tr>
<td>Receiving the same information to longer</td>
</tr>
<tr>
<td>Allows a better follow</td>
</tr>
<tr>
<td>Nurse is more aware of my health</td>
</tr>
<tr>
<td>Case management and autonomy</td>
</tr>
<tr>
<td>I am more involved in my health care</td>
</tr>
<tr>
<td>Receive more information from the nurse</td>
</tr>
<tr>
<td>Understand my health status better</td>
</tr>
<tr>
<td>General level of satisfaction</td>
</tr>
<tr>
<td>SyMO interferes in my relationship with the more serious</td>
</tr>
<tr>
<td>Generally speaking, I find that SyMO has been good for me</td>
</tr>
<tr>
<td>Mean score</td>
</tr>
<tr>
<td>Cronbach’s alpha</td>
</tr>
<tr>
<td>Scale: 1 = completely disagree and 7 = completely agree</td>
</tr>
</tbody>
</table>

5. Discussion

In light of the aging of the population and the increasing pressure on health care systems, the use of mobile computing, which allows nurses and other clinicians to integrate the care process on site at the patient’s home, appears to be a promising
approach for improving quality of care as well as clinicians’ productivity and efficiency.

This study presents an evaluation of the effects resulting from the deployment of a mobile application in various ambulatory units in Quebec, Canada. The pre and post nature of the study and the triangulation of data through various collection methods allowed rigorous analysis of the results and represent a significant strength of this research.

The analysis of the data allows us to make certain observations. First, the nurse users were quickly able to adopt and adapt to the new system. They showed a positive attitude toward the system and were satisfied with the quality of the clinical information stored in the software, which appeared to be of great value for accessing patient data during a visit. According to the nurses, the new system increased the completeness and quality of their interventions in the home, mostly in terms of patient assessment, treatment, and education. As a result, during the home visits SyMO was perceived first and foremost as a useful clinical tool rather than as a computer tool.

Second, and in line with the objectives set by the administrators of the care units, the nurses agreed that the main benefit was a significant increase in the quality of care provided to patients. Through its clinical content, the software structures the nurses’ reasoning during their home visits, allowing them to make more detailed, complete and accurate assessments of the condition of their patients. The higher quality of care can be seen in their notes, which are more complete and consistent. The fact that the information on state of health and patient histories is available to all the care providers, including replacement nurses and nurses from private agencies, also improves the quality of client care and ensures better continuity of care. This benefit was also mentioned by the patients themselves in their responses to our mail-in survey.

Third, nursing practices in the participating facilities were standardized through the implementation of an intervention dictionary and many shared, homogeneous care plans, and this represents another type of benefit associated with the experimental project that deserves mention. However, one might argue that such positive impacts are the result of a change in documentation practice (i.e., from free-form narrative charting to checklist charting), not of automation itself. We believe that both changes were necessary in order to observe benefits of this magnitude after such a short time.

Last, for the project sponsor, the success of this experimental project also lies in productivity and efficiency gains. More specifically, the authorities’ seek to increase: (1) the number of patients treated by nurses, (2) the average number of home visits made by a nurse per shift, and (3) the percentage of time nurses spend providing direct care to patients. We evaluated these outcomes based on an analysis of data provided by the ambulatory units’ information management system. Findings indicate that productivity outcomes varied widely across units 3 months after system go-live. More precisely, we observed positive and significant gains in three units, no effect in three other units, and a productivity decline in the last three units.

Plausible explanations for these variations are mainly related to the way the new mobile technology was “sold” and implemented in each unit. For instance, in some units the system was perceived as “just another tool” introduced by management in order to increase nursing staff productivity. It is mainly in those settings that no or little productivity gains were observed after three months. As another example, the efforts devoted to harmonize the new system with the downstream and upstream processes of homecare visits (e.g., planning of visits, management of medical supplies, requests to the archives department) varied from one site to another. In those sites where efforts were more important, generally higher productivity gains were observed. As a final example, user training and hand-holding provided by the nurse pilots and IT technicians also varied across sites. Indeed, we observed that nurses in smaller units tended to be much more satisfied with the quality and duration of the technical support that was provided than those in larger sites. Hence, this might have contributed to the discrepancies observed in terms of productivity gains. Productivity outcomes will be measured 12 months after system deployment in each site in order to confirm or disconfirm the early trends observed 3 months after system go-live. Results associated with this evaluation will be shared at the conference.

6. Conclusion

Introducing mobile computing in an ambulatory care unit represents a significant organizational change. The use of the mobile technology with SyMO software had positive and significant effects
on the quality of care provided by home nurses. The early success of this project required a sustained commitment from the decision makers, a considerable change management effort from the members of each project team, and close collaboration with the software supplier. Despite the positive results obtained so far, it is important to make a continuous assessment of the effects of the intervention over a longer period of time in order to monitor the progress of this innovative project.

7. References


