QNC Report

An investigation into the factors of adoption of wireless applications for data management by nurses

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Executive Summary

Many healthcare providers in Australia are in the process of exploring the options introducing wireless technology to address some of the challenges they are encountering in providing service to their stakeholders. It appears that the solutions are currently dictated by the hardware vendors and the business case is yet to drive the solution implementation. Despite this, it appears that there are challenges yet to be identified, addressed and resolved in order to realise an enterprise wide implementation of wireless technology. The authors explored some of the challenges through a review of literature and conducted a set of interviews with selective nurses in the Toowoomba Health Service District to verify the themes developed through another focus group discussion facilitated in Western Australia with health policy executives.

The use of wireless hand held devices is becoming popular in healthcare due to its flexibility and mobility. In the nursing domain, the use of handheld devices, a specific component of wireless technology appears to be beneficial for data collection and other information management functions nurses may undertake. Studies in nursing literature have indicated that handheld devices deliver advantages and benefits at the point of care. In this study a set of 30 interviews with Queensland Nursing Staff in one district health centre was conducted over a period of three months to establish the drivers for the introduction of wireless technology among nurses. The outcome of these interviews is developed into a preliminary model and reported in this paper.
Title: An investigation into the factors of adoption of wireless applications for data management by nurses

Introduction

The grant was given to study the factors that impact the adoption of wireless technology in a nursing domain due to the popularity of wireless handheld devices in healthcare applications for data management. Therefore, the scope is restricted to handheld devices only. While the concept is attractive, difficulties identified in the literature included the small size of the device, problems in fitting current data collection forms into one screen of a handheld device and data entry using the 'grafitti' option. It appears that prior studies, while highlighting the importance of wireless applications in healthcare, failed to ascertain factors that determine the adoption of these applications in hospitals. This study was investigating the factors of adoption of wireless applications (specific to handheld devices) by nurses in order to enhance healthcare data management.

The data collection involved 2 specific stages. In the first stage we reviewed the existing literature in order to identify various issues impacting the healthcare domain where handheld devices can be used. This is called as the ‘exploratory’ stage. The main purpose of this stage was to identify factors in order to derive an interview instrument. The second stage involved actual data collection. These two stages are explained below.

Stage 1 – Literature Review (exploratory):

Extensive literature review was carried out at this stage to integrate the materials available into the interview questionnaire. The questionnaire consisted of over 20 themes and an information sheet was prepared after this comprehensive literature review. The specific purpose of this stage of the study was to ensure that nursing staff were comfortable in answering the technical aspects of wireless technology as appropriate to their working environment. This stage did not identify any mediating factors and only main factors influencing the adoption of technology were the focus of this stage.

Stage 2 A – Interviews (confirmatory):

In second stage of the research a set of interviews were undertaken. In order to ensure the interviews were conducted on time, the local health district was approached through
one of the authors of this paper and suitable candidate groups were identified. After obtaining ethical clearance from both the principal university and the health district, a research associate from the health district was contracted to undertake the interviews. The interviews were conducted in such a fashion as to minimise any disruption to nurses’ work schedule, ensure comfort of nurses in answering questions, minimise any travel time by interviewees, synchronise the ‘interview’ language with participants and to prompt nurses when unknown aspects were encountered by participants.

Prior to the interviews, the line managers were approached for permission to release staff for interviews. Initially a consent letter was distributed to obtain consent for interview and the list of people interviewed was provided to the health district. The interview was recorded using a digital recorder and catalogued as per ethics requirement. These interviews were then transcribed for data analysis.

Participants for the interview were selected from the nursing staff in Queensland Health. The participants were initially screened for suitability as only nurses working with technology were considered for this purpose. Any nursing staff involved with administration only is eliminated from the interview to remove any unforeseen bias. The nurses were chosen from a wide range of background including pharmacy, oncology and emergency departments. As the nurses belonged to the health department, no further screening was employed for sampling.

Stage 2 B – Surveys (confirmatory): In this stage, a comprehensive survey instrument was prepared as a result of literature review and the interviews. This questionnaire was administered by the Toowoomba Health Service District in the district. We distributed over 500 questionnaires are received about 202 responses (about 32% response rate). We did not collect any demographics for this study as we were keen to identify factors. We will be doing more analysis with the combined data in the future.

Literature Review: In healthcare literature, the concept of wireless technology is discussed by many studies (Wisnicki, 2002; Dyer, 2003; Simpson, 2003; Sausser, 2003; Hu et al., 2002). For
example, Wisnicki (2002) provides details of how broadband technology, a component of wireless technology, can be used in healthcare. The discussion provided by Wisnicki (2002) involves the high cost of setting up a wireless technology in a healthcare setting, improvements to patient care using this technology and potential cost-effective quality of service to patients. Sausser (2003) provides information on how to improve clinical quality using wireless technology including challenges for maintaining security and privacy. Sausser (2003) also discusses the concept of portable devices for data collection purposes by providing an argument on benefits that can be realised using these devices. Simpson (2003), while critiquing the nursing domain, stresses the need for the innovative use of IT to improve the patient care. He points out that new IT technologies can help to address some of the chronic problems encountered including saving nurses time, skilled nursing care and home health care. He also provides details on the expended time per every hour of nursing care and suggests that new technologies would provide solutions to some of the acute problems of nursing due to this time factor. Dyer (2003) on the other hand provides details of how text messaging using wireless devices can be effectively used to remind patients of their appointments. He reports the idea behind a radically new system of managing patient care in conjunction with modern telecommunication applications using wireless devices to improve the quality of patient care. Common to all these studies is the use of emerging technologies in healthcare and potential benefits that can be achieved.

While many other studies reviewed in the healthcare literature echo similar sentiments, none of these studies have examined the potential problems in data collection methods using wireless devices. It appears that almost all studies have taken this crucial aspect for granted. While some studies have indicated existing problems in collecting patient data and provided some theoretical solutions, these studies have seldom analysed the changing nature of information systems using wireless devices. For instance, Sausser (2003) mentions the advantages of using mobile devices in collecting patient data, but did not provide an in-depth analysis of the strengths and weaknesses of such a procedure.

To understand the issues associated with data collection using wireless devices, the Information Systems literature is also reviewed. Such a review indicated that this area is not fully researched. For example, Redman (2002) states that the wireless technology is
in its infant stages and warns of the potential pitfalls if IT providers rush to implement the technology; Shah (2001) warns of the slower speed of wireless networks compared with the desktop computers and highlights the potential problems that could be encountered by healthcare; the relative high costs to initially set up these wireless networks is highlighted by Shroeder (1999); lack of real time connectivity due to the mobility of the device and the problems associated with such mobility is highlighted by Stevenson (2001); the size of the screen and hence the problems that may be encountered to display data due to screen size while capturing data is stressed by Toms (2000); the problems that may be encountered due to the lack of provision for high quality graphic display on wireless devices is highlighted by Atwal (2001) and Bevan (2001) discusses the potential problems of capturing data using wireless devices due to the ‘hard-to-see display’ nature of these devices. While the studies mentioned above warned the problems that could be encountered while using wireless devices, they also tend to agree that the usage capabilities of these devices are growing and hence these hardware related problems will disappear in a few year’s time.

What can be realised from this review is that the majority of the studies have focussed on the ‘hardware’ or ‘physical’ component of wireless devices as this appears to be a focal point of interest to many authors now. Others studies can be grouped into the ‘implementation’ or ‘management’ of these wireless technology in healthcare organisations as cost appears to be a determining factor in such implementations. None of the studies reviewed appears to have examined the ‘usage’ aspects of wireless devices. While studies such as Davies et al. (1989) have examined the ‘Technology Acceptance’ in organisation and derived a model for such acceptance, the outcomes of such studies can’t be generalised for wireless technology as the technology is radically different from the traditional desktop technology. In a desktop technology, users go to data by accessing them using wired and fixed devices. On the other hand, in a wireless technology, the data comes to the users via the hand held devices and this new paradigm gives users a lot of mobility and hence access to data.

This mobility has prompted healthcare organisations to consider wireless devices for data collection and management purposes. Further, the data collection at point of care can eliminate transcription of data onto computer forms realising cost savings. Once the data
is collected and verified, it is possible to integrate this data with existing systems for
distribution to various organisational units in a healthcare setting. Collectively, these
activities would realise significant financial savings.

While healthcare organisations are keen to save money, they are also keen to provide
high quality services to their patients. Crucial to this high quality care is data collation
and analysis for decision making. The raw data collected at point of care by nursing staff
is converted into information by feeding the raw data into various organisational
databases. Current literature highlights the importance of incorporating wireless devices
in organisations without discussing how effectively can nurses collect data. Limited
information is found on the factors of adoption and barriers associated with such devices.
Therefore, this study will conduct an investigation into the factors of adoption of wireless
applications for data collection by nurses. By doing so, this study will fill-in the gap in the
literature and provide insights into those factors that need to be given priority while using
wireless handheld devices for data collection purposes. It is also hoped that the outcome
of this study would enhance the data collection procedures in healthcare by nurses,
realising significant cost and time savings.

**Research Plan**

**Research Problem Issue:**
This research aimed to identify factors that determine adoption of wireless handheld
applications in hospitals for data management by nurses. This research examined
potential challenges in adopting wireless handheld devices due to the rapidly changing
nature of technology and associated legislative framework.

**Research Questions:**
1. What were the factors determining the adoption of wireless handheld devices in
hospitals for data management purposes?
2. What were the factors impeding the adoption of wireless handheld devices in hospitals
for data management purposes?
3. What were the emerging challenges in adopting wireless handheld devices in hospitals
for data management purposes?
**Research Design:**
This research was designed to capture a cross-sectional snapshot and a dynamic longitudinal picture of the acceptance of wireless handheld devices and their applications in hospitals. The data was collected in two stages that are six months apart. In the first stage, data was collected from nursing staff involved in patient care about their adoption and usage behaviour of data collection using current technologies. In the second phase, respondents were contacted again for a follow-up survey to understand their changing views and behaviour pattern. Three specific hospitals were identified for this purpose where wireless devices are used for data collection purposes. The hospitals were derived from government, private and regional sectors respectively.

The focus of this research study was to investigate the factors of adoption of wireless applications. Inference from the literature revealed that this was an under explored area which demanded investigation into the role of technology and that of human context in using the technology. Although prior studies in Information Systems and Health indicated that quantitative approach would suffice, recent studies recommended that a combined approach (mixed methodology) of qualitative and quantitative methods would provide strength to the research outcome. Experienced researchers indicated that there was a need to include qualitative approach to study the human social and psychological factors (Remenyi et al., 1998).

The research study investigated human, psychological factors such as training, ease of use, motivation, culture, causal ambiguity, absorptive capacity, and retention as factors influencing the adoption factors of new technology. Factors identified for this research were limited and needed to be expanded further to accommodate other unknown factors that effect the adoption of wireless technology in a given setting. Hence this study included qualitative approach such as interview method to strengthen the research outcome.

In summary, the research adopted the qualitative-quantitative interactive continuum model as suggested by (Zikmund, 1994; Remenyi et al., 1998). The study employed qualitative method such as semi-structured in depth-interviews to gain sufficient understanding on the topic from nurses using wireless technology in hospitals. These
interviews helped to identify any unknown factors that affect the adoption of wireless technology.

Subsequent to the qualitative study, this research planned to employ quantitative methods such as survey/questionnaire methods to collect data. The quantitative study elicited open-ended responses to obtain factors that were not constrained by a pre-determined identification of constructs found in traditional surveys, as well as to determine the importance of the pre-determined factors. The nature of the quantitative study was determined by the pilot study (exploratory study), which demanded specific approach to research issues. Therefore this study employed a positivist philosophical approach and combined both qualitative and quantitative methods to determine the outcome of this research. Given the exploratory nature of this study, these two techniques were essential to this study.

**Data Collection:**

It was anticipated that about 250 nursing staff would be surveyed. The staffs were chosen randomly from available lists. For the purpose of randomness, a random number generator was utilized and the staff details were fed into this generator. Similarly, about 30 nursing staff underwent the interview process, with each interview lasting 45 minutes. This method had been employed by many studies (Remenyi et al., 1998; Zikmund, 1994). The instruments were developed in such a way to elicit responses of 'how' and 'why'. This was deliberately done in order to discern differences between adoption and usage decision of wireless handheld applications. In addition, comparing responses to the question about adoption and questions about use provided evidence that respondents were reporting their adoption drivers and not simply their current behavior. The interview questions were semi structured or partially structured to guide the research.

There are variations in qualitative interviewing techniques such as informal, standardized and guided. Structured interviews and partially structured interviews were subjected to validity checks similar to those done in quantitative studies. Participants were asked about their usage of wireless devices including mobile telephones and other hospital systems during the initial stages of the interview. They were probed further as to identify factors that would lead to the continual usage of these devices and any emerging challenges that they foresee such as training. The interviews were recorded on a digital
recording system with provision to convert automatically to a PC. This approach was taken to minimize transcription time as well as errors that can occur during transcription. The interview questions were developed in such a way that both determinants and challenge factors could be identified. This then increased or enhanced the research results, which was free of errors or bias. Also, validity tests done on interview methods helped to avoid or overcome the criticism often laid out in conducting pilot/exploratory studies as stated by Zikmund (1994) as being informal, lacking rigor and precision. The survey questions were mailed and followed up with telephone calls, interviews were scheduled at respective working locations of these nursing staff between 8 AM and 5 PM on working days. The nursing staff were asked to give written consent and their supervisors were informed of the time slots in order to get time release from their duties.

The instruments of this research would constitute two broad categories of questions. The first category of questions were related to the adoption and usage of wireless devices in hospitals for data collection purposes. The second category consisted of demographic variables. Open ended questions were included in the instrument to obtain unbiased and non-leading information. Prior to administering the questions, a complete peer review and a pilot study were conducted in order to ascertain the validity of the instrument. A two stage approach was used in administering the instrument, where the first stage would gather information about the key factors influencing users' decision to use wireless applications and the second stage on the importance of those key factors. This approach was followed in this study in order to complement the open ended questions so as to determine the importance of the individual factors determining the adoption and usage of wireless devices and applications.

**Data Analysis:**
Data was coded by two individuals into a computer file prior to analysis and a file comparator technique will be used to resolve any data entry errors. A coding scheme was developed for this study based on the instrument developed. The coders were given sufficient instructions on the codes, anticipated responses and any other detail needed to conduct the data entry. Coders were given a start-list that will include definitions from prior research for the categories of the construct. Some of the categories included
utilitarian outcomes such as applications for personal use and barriers such as cost and knowledge.

Data was analyzed using statistical software applications. Both quantitative and qualitative analyses were performed using these software applications. Initially a descriptive analysis was conducted, including a frequency breakdown. This was followed by a detailed cross sectional analysis of the determinants of behavior. A factor analysis was conducted to identify factors of adoption. Once this was completed, tests for significance were performed between various factors.

**Results:**
The analysis using NVivo and SPSS confirmed that the following drivers and barriers can be extracted from the data collected from nursing participants. Our aim was in identifying the factors impacting wireless technology adoption. We did not attempt to classify them in an order of priority. However, we will be conducting more data analysis to classify them in proper groups and this exercise is beyond the scope of this project. The following tables list the drivers and barriers to wireless technology adoption in nursing.

**Table 1: Organized drivers of the adoption of wireless hand held technology**

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<td>5=reduction of documentation</td>
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<td>6=quicker response</td>
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<td>7=more timely recording</td>
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<td>1=Barriers</td>
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Table 2: Organized barriers of the adoption of wireless hand held technology
Significance to Nursing

The study is significant to nursing for many reasons including the mobile nature of nurses, heavy data access when on the move, hand over reports etc. Literature indicates that handheld devices can provide significant advantages to nursing by providing solutions to some of the existing problems such as the reduction in transcription errors arising from paper based documents (Sausser, 2003), data collection at point-of-care (Simpson, 2003), reduction in considerable amount of paper work (Sparks et al., 2001), administering medications by having text-based alerts using these handheld devices (Dyer, 2003), remote monitoring of patients and connecting to other systems such as patient care (Yacano, 2002). While prior studies have highlighted the advantages of handheld applications, they have not yet ascertained factors that determine adoption of such a
technology. This study is perhaps the first attempt in Australia to identify these advantages by talking to nurses using an interview instrument.

**Factors of adoption**

Once these drivers were identified from the interview notes, an effort was made to group them. While the interview data were analysed based on context, it was possible to extract four broad themes namely, documentation, information management, advantages and benefits. The documentation theme refers to any incentives to reduce paperwork encountered by nursing staff. Information management refers to access to information and associated aspects. Advantages refer to positive and direct influences encountered in their daily operations. Benefits refer to influences at organisation level as viewed by nurses. Themes that fitted these groups were identified and clustered under these four factors and a model was derived using NVivo.

Previous studies have already indicated that information management (Sparks et al., 2001) is a significant advantage using wireless technology. This was discussed by previous studies in terms of time management due to reduced information load (Sparks et al., 2001), reduction in medication errors (Sausser, 2003), and reduced documentation (Yacano, 2002). This study agrees with the previous notion that information management can be made easy by using wireless technology adoption. The new factors such as user friendliness, quicker responses, timelier recording and availability of more time for routine work appear to be the drivers of adoption for technology for healthcare professionals. Other comments indicate that healthcare professionals believe that the reduction in documentation and the quicker responses associated with the technology would be significant drivers of adoption. If adoption is slow, it may be more an indication of implementation problems rather than the perceptions of the relative advantage of the technology.

The barriers reveal details that are not found in the literature yet. For instance, respondents considered the surrounding infrastructure to be a barrier to enable the technology. This is reflected in their statements to the effect that short staff, policy and work schedules are all considered barriers in adopting the wireless technology. This needs further investigation. The lesson from this exclusive exercise is that the factors of
data management will drive the adoption of wireless technology in healthcare as this is where significant advantages can be gained. While some factors reported in this study are already highlighted by previous studies, this is perhaps the first attempt to extract views from users in a systematic manner. In addition to wireless technology, work settings appear to be impeding the adoption of technology. The implication of this aspect is that, in addition to the introduction of wireless technology, healthcare managers should consider the working conditions of their staff as these conditions enable the use of technology.

In terms of theories used in the Information Systems Domain, there are five dominating aspects to technology adoption in any given setting. They are (i) relative advantage, (ii) compatibility, (iii) complexity, (iv) trialability and (v) observability. These five themes are well justified in this study. For instance, the theme ‘Relative Advantage’ is justified by the information management concept as expressed by the healthcare people in this study. ‘Compatibility’ is established through various discussions on access to resources including technology and devices. ‘Complexity’ is discussed by the participants by the information overload and the benefits that technology can bring in terms of time savings. ‘Trialability’ is highlighted by the fact that ‘the technology is here to stay’ and their implied willingness to trial new systems. Finally, the ‘Observability’ is mentioned in terms of various benefits that can be provided by the technology.

In essence, while some factors correspond to the literature, emerging new factors indicate the benefits that this technology can bring to healthcare and associated drivers of adoption. The next level of this research will look at the factors outlined by Rogers using an in depth analysis of the interviews and relate them to the factors identified by the nurses during their interviews.

**Specific comments on the factors**

**Drivers** – this factor indicates the positive influence of wireless technology on nursing. This factor also indicates that due to the positive mind frame, nurses will be keen to adopt the new technology in their setting.
Volumes of information – nurses indicated that wireless technology will help them to manage the volumes of information. This can be realized due to the mobility and flexibility offered by the technology. This factor also correlates with data management, more timely recording and medication schedule.

User friendly – participants indicated that user friendliness of mobile applications will enable them to get their work done better. The distinction between user friendly and the next factor user friendliness was not clear. However, the term user friendly was discussed while we were probing the technical aspects. Therefore, we believe that participants are referring to the applications used to conduct their daily work schedule and predominantly indicate IT systems.

User friendliness – this factor was seen as a driver and was discussed while the management of technology was discussed. Therefore, we assume that the participants refer to the management of IT applications and the resources provided to them to conduct their jobs.

Reduction of documentation – this factor has been identified as a major driver by almost all interviewees. The nursing participants felt that wireless technology can provide the greatest advantage in this domain. This factor was linked to hand over reports.

Quicker response – this factor was mentioned in three specific contexts. The first one was accessing information in order to respond to various queries. The second aspect was in terms of various care management procedures. The third aspect was in terms of hand over reports and any query arising at this point of hand over. Participants believed that wireless technology in conjunction with better access would provide significant benefits in this domain.

More timely recording – participants felt that the mobility offered by the technology would enable them to record events in a better manner than the paper based system. This factor was stated in conjunction with quick response and reduction of documentation.

Mental health – this factor was not recognized by all participants. We believe that this may be specific to a domain and highlighted in that context. Participants felt that wireless technology can help to track mental health issues such as monitoring patient
movements using a handheld device. They expressed that wireless technology in conjunction with another technology such as Geographic Information System will accomplish tracking of patients specific to this domain.

**Medication schedule** – this is another area where participants felt that wireless technology can bring in significant benefits. Participants felt that handheld devices can help to track various details of medication schedule pertinent to patients. This factor was also linked with reduction in paper work and timely recording.

**Medication errors** – this factor was almost agreed as a driver by all participants. The greatest benefit of wireless handheld technology was seen to be reduction in medication errors. Participants opined that by introducing proper validation checks in the computer systems running on the wireless devices, instant validations can be facilitated leading to reduced medication errors.

**Managing data** – this factor emerged as a strong driver due to the mobility offered by wireless technology. Participants expressed their view that handheld devices will enable them to carry data as they move. This is also seen as a major paradigm shift in the way data is handled now. This factor is strongly correlated with medication schedule and reduction in documentation factors.

**Intensive activities** – this factor was considered to be a less significant driver by the participants as they feel that the advantages provided by the wireless technology may be able to minimize the burden placed by their intensive schedule of activities.

**Health policy** – this factor emerged as a driver despite the fact that certain participants questioned the current health policy. The consensus appears to be that if there is a proper health policy then the technology can deliver promises. Due to the positive perception exhibited by participants, we classified this factor as a driver, rather than an inhibitor.

**Handover reports** – participants expressed this as a major driver as almost everybody agreed that the wireless handheld devices can provide significant benefits in this domain.

**Fantastic benefit** – this aspect is categorized as a factor because the term ‘fantastic benefit’ emerged in many conversations. While participants were not able to clearly
identify benefits, there is a positive feeling that the technology would be bale to deliver benefits.

**Falls** – this factor was identified as a driver with a very specific cohort of participants coming from the aged care sector. We believe that these participants are already familiar with the handheld device to monitor aged care patients’ falls details.

**Cut down on the paperwork** – this factor emerged as a strong driver with links to reduced paper work and improved medication schedule. Participants agreed that handheld technology can definitely cut down paper work due to timely digital recording of data. Further, they also felt that this may reduce the errors such as transcription errors.

**Current competence** – this factor was discussed in a multitude of contexts. Some participants expressed nurses are already handling a variety of technology and competent enough to handle handheld technology. Some others expressed that they are familiar with computing systems and hence possess necessary competence to manage handheld devices. This factor clearly indicates that nursing staff are not afraid of using new technology in their work.

**Benefits** – this factor was stated by few participants while discussing the handheld technology. While this is a driver, the factor needs to be investigated further to identify what are the actual and perceived benefits.

**Availability of more time** – this factor emerged strongly with a number of people agreeing on this factor. The perception was that participants felt that they will be able to have more time to perform core functions because wireless handheld technology can assist them with data management.

**Alert clinicians** – participants felt that by using wireless technology, it may be possible to alert physicians in a more sophisticated way than the current ‘pager’ schemes. They also felt that physicians can see various data associated with patients in a better way using the handheld technology.

**Adverse event** – this factor emerged as a driver because participants felt that wireless handheld technologies can provide more information in regard to adverse events because it is possible to store aspects of adverse events and retrieve them using this technology.
Advantages – this factor needs more investigation as participants stated there are advantages using wireless handheld technology. We were not able to glean more details from the interview schedule beyond this word.

Access massive amounts of information – this factor emerged as a major driver due to the perception that currently nursing professionals have to handle massive information and these information need to be carried in folders adding to the burden. Participants felt that the use of handheld technology may alleviate varying voluminous files and also provide access to data that are not available on hand while handling patients.

Remote monitoring – participants felt that wireless technology can facilitate remote monitoring using sophisticated methods. This emerged as a major driver because majority of the participants agreed this to be a driver. However, the concept of remote monitoring was expressed from monitoring a patient from their chairs to managing a patient in regional locations using this technology. This has weak correlation with management policy factor.

Barriers - this factor indicates the negative influence of wireless technology on nursing. This factor also indicates that due to the negative mind frame, nurses will NOT be keen to adopt the new technology in their setting.

User friendly – this factor indicates the technical component of wireless applications as applicable to nursing. Participants indicated that applications and computing systems should be user friendly in order to be adopted. It appears that current systems are not very user friendly and hence the negative bias in adopting a new technology.

User friendliness – this factor was discussed by participants in terms of management support. Participants expected the supporting environment to be friendly in order for them to get necessary support.

Unreliable – this factor emerged as a major barrier because a number of participants discussed this under varying contexts from technology to management. The technical reliability of wireless coverage within health appears to be an issue. In addition, some
participants also questioned the robustness of health policies in the wireless technology domain leading to major skepticism of adoption of this technology.

**Testing** – this factor assumed minor importance as a barrier as users insisted that wireless systems should be thoroughly tested prior to adoption. This factor was also correlated to education aspects.

**Short staff** – this factor emerged as a major barrier as many participants highlighted this issue. Participants highlighted the shortage of staff in health and its impact on technology adoption. One area that emerged here was the necessity for training and the impact it can have on the staffing issues. This was weakly correlated to the policy framework.

**Secure** – this factor also emerged as a major factor as participants were concerned about this issue. The security factor was also discussed in terms of privacy and their impacts on their job. This factor was perhaps the most negative influence on the adoption of wireless handheld technology as it impacted performance.

**Reliance** – this factor was discussed by participants in terms of technology failure and their concern to resume health activities without a reliable technology. This factor was correlated with a number of drivers such as access to information in a wireless environment.

**Problems** – this factor was categorized as a barrier because of the technical problems that can impact wireless handheld technology. This factor correlated with user friendliness in terms of support warranted when systems fail. Participants again have highlighted the need for robust policies in this domain and sufficient back up options.

**Schedule** – this factor was somewhat confusing as this was discussed under a variety of themes. The main negative feeling merged because of a proper schedule of wireless implementation in the participants’ working environment. This has introduced a lack of direction as many participants encountered many different schedules for wireless implementation through varying policy statements.
**How does it work** – participants expressed this factor as a barrier due to the lack of training provided in the wireless technology domain. This factor was stated with the need for training.

**Health policy** – the lack of clarity in developing a rigorous policy framework has introduced a barrier to the adoption of wireless handheld technology according to the participants. They felt that a clear policy framework is essential as to the procurement of devices, usage framework, training, measurement etc.

**Coverage** – participants were uneasy as to the coverage aspects. This was discussed in technical terms and correlated with the policy framework.

**Confidentiality** – this factor emerged as a barrier when discussing access to information aspects. Participants highlighted that they were unclear as to the various confidentiality clauses and the impact on these clauses by using a technology that is not well governed. This was considered to be a significant barrier by participants.

**Awareness** – this factor emerged as a result of the relative newness of the technology in the domain area. Participants expressed their concerns due to the newness of the technology in health and the need to raise the awareness as relevant to their profession. This also appears to be a major barrier in the adoption of wireless handheld technology.

**Conclusions/ Recommendations**

**What did we find out?**

We found out that the adoption of wireless handheld technology by nursing staff received a mixed feedback. While the drivers are more than the barriers, issues such as security and awareness indicate the concerns to adopt a new technology.

The driving force behind the adoption of wireless technology in a nursing domain appears to be the access to information and the management of volumes of information. While these two factors emerged strongly as drivers, participants also felt that these two factors can reduce errors and paperwork. We recommend that further research is now conducted on the issue of access to information, inclusive of an impact analysis.
In terms of barriers security, confidentiality and policy framework appear to be inhibiting the adoption. It can be noted that these factors are directly related to the management of technology rather than functional aspects of technology. These factors when combined with awareness and education issues indicate the reluctance of nursing staff to use the technology as the direction is not clear to them. If security, confidentiality and policy framework have effective corporate governance raising staff wareness should overcome this barrier.

In essence, the data indicate that the drivers are facilitated by the potentials the technology can offer and the barriers are the lack of management direction provided by the department or by the operating environment. In our opinion, while there is considerable enthusiasm to adopt a new technology such as this, the participants are reluctant because they were not given with comprehensive information as to how this technology can benefit them. This can be highlighted as an awareness issue, which is easy to rectify.

We believe that the effect of barriers can easily be minimised by adopting a training and education framework. This training framework will inform the nursing staff as to the benefits, the policy framework and regulatory framework in their working environment. Once this is covered, a simple trial, pushed from the top, will enable staff to actually experience the benefits. This coupled with better technical support will influence users decision to adopt wireless technology in their working environment.

We recommend that when considering implementation of wireless technologies into the nursing profession that the adoption factors outlined in this report are taken into consideration.

In summary we believe we have generated through this research an effective implementation model that will assist nurses considering the uptake of such technology.

**References**


**Appendix**

*Papers published in major events on this project:*

**ABBSA Conference, Cairns, Queensland, Australia 2005**

**DRIVERS FOR WIRELESS HANDHELD TECHNOLOGY: VIEWS FROM QUEENSLAND NURSES**

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ABSTRACT
The use of wireless hand held devices is becoming popular in healthcare due to its flexibility and mobility. In the nursing domain, the use of handheld devices, a specific component of wireless technology appears to be beneficial for data collection and other information management functions nurses may undertake. Studies in nursing literature have indicated that handheld devices deliver advantages and benefits at the point of care. In this study a set of 30 interviews with Queensland Nursing Staff in one district health centre was conducted over a period of three months to establish the drivers for the introduction of wireless technology among nurses. The outcome of these interviews is developed into a preliminary model and reported in this paper.
APDSI Conference, Taiwan 2005

An investigation into the factors of adoption of wireless applications for data management by nurses

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ABSTRACT
The use of wireless hand held devices is becoming popular in healthcare applications for data management. While the concept is attractive, difficulties encountered by nurses included the small size of the device, problems in fitting current data collection forms into one screen of a handheld device and data entry using the 'garfiti' option. It appears that prior studies, while highlighting the importance of wireless applications in healthcare, failed to ascertain factors that determine the adoption of these applications in hospitals. This study conducted a set of interviews to investigate the factors of adoption of wireless applications by nurses in order to enhance healthcare data management. Preliminary findings of these interviews are presented here.
**Success and Failures in Tele-health 2005, Brisbane, Australia**

Challenges for implementing wireless handheld technology in healthcare: views from selective Queensland nurses

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**Abstract**

Many healthcare providers in Australia are in the process of exploring the options introducing wireless technology to address some of the challenges they are encountering in providing service to their stakeholders. It appears that the solutions are currently dictated by the hardware vendors and the business case is yet to drive the solution implementation. Despite this, it appears that there are challenges yet to be identified, addressed and resolved in order to realise an enterprise wide implementation of wireless technology. The authors explored some of the challenges through a review of literature and conducted a set of interviews with selective nurses in the Toowoomba Health Service District to verify the themes developed through another focus group discussion facilitated in Western Australia with health policy executives. This paper reports the outcome of the interviews.

*this paper is also under review by the Society of Royal Surgeons, Europe for their journal on Online Health*
Abstract Submissions
AQNL conference, Oct 2005 Brisbane Australia

WIRELESS HANDHELD TECHNOLOGY DRIVERS: VIEWS FROM QUEENSLAND NURSES

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The use of wireless devices is becoming popular in healthcare due to its flexibility and mobility. In nursing the use of handheld devices looks beneficial for data collection and other information management functions by nurses. Many conceptual studies in nursing literature have clearly indicated that handheld devices will deliver advantages and benefits at point of care. This study conducted a set of 30 interviews with Queensland Nursing Staff in one of the district health centres over a period of three months to establish the drivers of wireless technology adoption among nurses. The outcome of these interviews is developed into a preliminary model. The data indicate that the drivers can be loosely grouped into four categories as shown in the above diagram.


The study is an attempt to understand user feelings on the issues impacting the drivers and inhibitors of wireless technology in healthcare. User opinions extracted through interviews, while conforming the literature, appears to reflect what has been echoed for the past three years without much change. This implies that wireless technology is still debated without providing any proper solutions for healthcare industries. The next stage of this research will invite opinions from a wide range of users of healthcare on a questionnaire to quantify the opinion. It is hoped that this quantification will provide more insights into the adoption issues of wireless technology for healthcare enabling an IS model that can readily be used by healthcare organisations contemplating wireless implementation.

Key words: wireless technology, health care, IS

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Queensland Health Scientific Meeting conference, Nov 2005 Brisbane Australia

WIRELESS HANDHELD TECHNOLOGY DRIVERS: VIEWS FROM QUEENSLAND NURSES

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Funding: QNC Experienced Research Grant
Figures:

![Diagram of time management and its benefits]

**Figure 1: Adopters of wireless technology for nurses**
Figure 2: Adopters and Barriers of wireless technology for nurses

- Adopters
  - visitations
  - data access
  - data Mgt
  - cost savings

- Barriers
  - training
  - resources
  - $$ constraints
  - Fear for tech

Figure 3: The Research Model

- Drivers of adoption
- Inhibitors of adoption
- Other mediating factors
- Adoption of handheld wireless technology by the healthcare industry
Figure 4: Model derived from nursing data