Wireless handheld devices in a clinical setting: a Queensland case study

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Abstract

The purpose of this paper is to provide an overview of a recent trial undertaken, in the domain of wireless handheld devices, to ascertain the clinical decision making through technology by the University of Southern Queensland in conjunction with Queensland Health. Specifically the research project sought to address the research question: 'will the decision making algorithms that are built on a handheld devices improve the clinical decision making analysis by Queensland nurses?' Both qualitative and quantitative data collection methods were utilised, with the qualitative methods consisting of initial focus groups and a field test, while a quantitative questionnaire was distributed to trial participants to endorse the in-depth qualitative findings. Overall, the trial provided substantial information relating to time saving, patient safety, and training of graduate and student nurses all of which should be taken into consideration when moving forward with this health care technology in the future. Additionally, areas for improvement in the technology were identified through conducting this trial in a clinical setting. These areas involved such things as the size of the PDA, the information loaded onto these handheld computers, possible linkage into hospital's main computer systems, transportability between hospital wards, the possibility of touch screen kiosks in patient rooms, and finally the usage of the technology in nursing education within the University's courses.

Introduction

This paper provides an overview of a recent trial undertaken by the University of Southern Queensland in conjunction with Queensland Health. This trial involved the implementation of wireless hand-held devices in a clinical setting within Queensland hospitals. The overall aim of the project was to assist in providing a patient focused health system based on quality service and safety of clinical decision making to improve health outcomes in Queensland Health. Based on this research aim, the overarching research question that was asked throughout this trial was: 'will the decision making algorithms that are built on a handheld device improve the clinical decision making analysis by Queensland nurses?' Specific objectives were also addressed through the trial, and they included:

1. Identification of clinical problems requiring essential and assistive decision making frameworks for nursing resulting in improved clinical outcomes;
2. Development of a clinical decision-making framework for novice as well as expert nurses working in the clinical environment leading to dependable health care; and
3. Measurement of the effectiveness of innovative wireless handheld technology to provide timely, reliable access to nurses for clinical decision-making resulting in an increase in the quality of delivered clinical health services.

Literature Review

To construct a clinical decision support system (CDSS) useful in practice, it is necessary to understand how nurses make decision and clinical reasoning skills. While decision frameworks typically address on finite decision point, nursing practice involves an ongoing series of cascading decision. To systematically examine serial decision events, a theoretical framework of nurse decision making is essential and should guide understanding of how nurses represent knowledge implicitly in memory to construct explicit knowledge representations for the computer that fit nurses' working models (Hasman, Safran & Takeda, 2003). Such a framework is also expected to consist of two models, a clinical decision-making model that is grounded in information-processing theory (Charlin, Tardif & Boshuizen, 2000; Custers, Regehr & Norman, 1996; Elstein & Schwarz, 2002) and a new model of nurse clinical reasoning development.

Reasoning conducted by O'Neill, Dluhy & Chin (2005) proposes a process by which a nurse develops working knowledge, described by Kennedy (1999, p. 193) as the 'organised body of knowledge that is used spontaneously and routinely in the context of one's work'. Owing to anxiety and knowledge limitations, the nurse initially has a limited perception of the situation. Cognitive processing at this stage is deliberate and rule driven. But over time, with repeated practice experiences, the nurse begins to develop a complex system of organised clinical patterns. These patterns form the foundation of working knowledge. The model also includes factors in the practice situation that promote the development of working knowledge, such as the availability of experienced nurses and supportive leadership (O'Neill, Dluhy & Chin, 2005). A crucial aspect that guides the decision making is to confront the issue of what is the best evidence. Most existing support systems use either textbooks or available clinical guidelines as the support base for diagnoses and interventions. But is this approach adequate? When nurses are relying on a system to help them make critical decisions, what evidence should be used to develop and maintain the system? Several other concerns could arise such as locating the best evidence to answer clinical questions, deciding what should be done in the grey zones of nursing practice where answers are not apparent,

and determining what merit experiential information should have as evidence (Rashotte & Carnevale, 2004).

Literature suggests that in response to these concerns, further research should be conducted to develop comprehensive frameworks for nursing knowledge acquisition, validation, and synthesis as well as knowledge-mapping frameworks (O'Neill, Dluhy & Chin, 2005). O'Neill, Dluhy & Chin (2005) discuss that frameworks need to outline types of evidence, levels of confidence in different types of evidence, and a tracking grid to determine the value of collective evidence. Their findings also suggest the use of clinical experts and a network of acute care nurses to incorporate recent and regional practice patterns.

Findings presented by Narayan et al. (2003) outline the necessary steps to take when formalising decision analysis algorithms including decision flow diagrams and assigning probabilities. The goal of using formal decision analysis is to arrive at a decision that is consistent with what is known and what one values (Narayan, et al., 2003). Narayan et al (2003, p. 1) state 'Decision analysis should be offered as a tool to aid nurses decision making in complex and troublesome situations where there are mutually exclusive actions and time is available for deliberation'. Decision analysis should enable nurses to deliberate alternative courses of action, their likely risks and benefits in specific situations, and personal and/or social values related to potential outcomes of each action (Heathfield & Wyatt, 1993).

The decision analysis process of accessing knowledge to support the evidence base, and of codifying and evaluating the quality of this knowledge, has led to new insights into evidence-based practice. In addition, the process has exposed gaps in our knowledge, which required creative strategies to bridge (Musin & Vander, 1989). Decision-support developers often do not select clinical problems that clinicians find most difficult (Healthfield & Wyatt, 1993). To avoid this mistake, researchers should examine previous research and discuss with clinicians their most frequent and difficult decisions. On the basis of this data, clinical problems can be chosen as the content focus for a prototype development. Researchers should then develop a typology to identify the acute and chronic clinical problems that need to be mapped. This can be followed with practice maps for acute and chronic care problems (Kennedy, 1999). In order to facilitate nurses to deliberate alternatives while making decision, any prototype developed considered can be implemented on a handheld device such as a PDA. This is because PDAs offer mobility and access to information at point of care. A possible mechanism to accomplish the prototype development could be interdisciplinary collaborative research.

It is important to note however, that interdisciplinary research requires attention to perspectives, language, and methods within each discipline (O'Neill, Dluhy & Chin, 2005). If decision making frameworks are going to be developed for a handheld device, then nursing domains, clinical domains, computing domains, telecommunications domains, as well as user behavioural aspects must be properly examined as the interaction among these domains can have a profound impact on the final product. O'Neill, Dluhy & Chin (2005) emphasise the importance of ensuring the target discipline remains the central focus when creating algorithms for clinical decision making. Nurses with differing levels of experience will help challenge, expand, refine, and validate algorithms. Ensuring ownership on the creation of algorithms will assist the research in refining methods to build maps in the future (O'Neill, Dluhy & Chin, 2005).

Methodology

The methodology undertaken in this clinical trial used both quantitative and qualitative methods in the approach. Specifically three stages of methodology were undertaken. The first comprised of developing the algorithms for the handheld devices. This involved focus groups being conducted with key personnel including medical officers and nurses at three Queensland Health Facilities. Written decision making pathways were derived from these focus groups and compared with evidence based practice. Based on this information derived from the focus groups, the research team acquired the software and hardware requirements for the algorithms, tested and verified the software codes in accordance with the efficiency of the developed programs.

The second stage in the methodology involved a laboratory trial. This stage was undertaken in a university laboratory and tested the algorithms for their functionality. An example of this testing was that nurses were given a mock scenario and required to respond on paper as well as on the handheld device. They were asked to determine a solution to the task and this was then compared to the computer solution based on input parameters.

The third and final stage of the methodology involved real time implementation (field test) of the software algorithms. This involved a control group experiment where nursing staff were randomly allocated to the PDA experiment. These nursing staff members that were selected used the devices in their workplace. The purpose of this methodology stage was to evaluate the usability of the handheld devices. A key part of this final evaluation was for the users of the devices to complete a questionnaire. This provided basic statistics in the form of frequencies that supported the in-depth qualitative findings of the study.

Findings and Results

Overall, the feedback received from nursing staff, who were given the opportunity to use the PDAs in their day-to-day work activities, was positive. The point was made by nursing staff that the technology has great potential in the future of nursing. The advantages seen in the use of this technology primarily revolve around the issues of time saving, patient safety, and student and graduate nurse training.

Time Saving

Regarding time saving, this was achieved through the nurses who had access to a PDA were not required to walk back to the nurse's desk or medication room to obtain information. This information was provided in the form of an electronic version of MIMS (medicine information) being made available on the hand-held computers. Through this availability nursing staff were able to view the information they required at the patient's bedside. In addition to the MIMS information, policies and procedures were also loaded onto the PDAs for nursing staff to access. Again this was seen as a major benefit by staff, in that they were not required to access a computer in the nurse's station and try and find their way through QHEPS (health policies). It was estimated by one staff member that this perhaps saved twenty minutes per shift. It was noted by nursing staff that the PDAs provided a quick and efficient manner in which to access the procedures they required.

Patient Safety

Patient safety was also considered to be another significant advantage associated with the usage of the PDAs by nursing staff. It was thought that patient safety was increased due to the nursing staff having access to medication information at their fingertips. This ensured that the nursing staff knew exactly what drugs they were administering, thus making the nurses more confident in giving that particular drug. It was also seen in the trial that the patients reciprocated this feeling of safety. This was evident in the patients appreciating the nurses using the devices and them being capable of answering questions from patients immediately. An additional aspect of safety that was evident throughout the trial was the system allowing the nursing staff to remain in the room with the patient at all times, enabling staff to monitor the patient whilst administering medications, and overall making it a much more efficient process.

Student and Graduate Nurse Training

The training of student nurses from Universities and first year graduate nurses was also seen to be advantaged throughout the PDA trial in Queensland Health. It was generally seen that the student and graduate nurses utilised the PDAs on a regular basis, and noted the great potential in such a technology being used for them in the near future. These early career nurses found the devices very easy to use and could navigate the devices with no difficulty. Regarding the relationship between preceptors (registered nurses who are given the job of training student nurses) and student nurses, this technology was determined to be extremely beneficial. It was noted in the trial that preceptors can be uneasy with some nursing students as a result of their limited drug knowledge. Training these students takes time and some registered nurses worry that they may be putting their registration in jeopardy by being responsible for student nurses. It became evident however in the PDA trial, that this new technology provided an immense amount of reassurance to the preceptors. The PDAs allowed the student nurses to access the MIMS information very quickly and with ease, thus reassuring their preceptor.

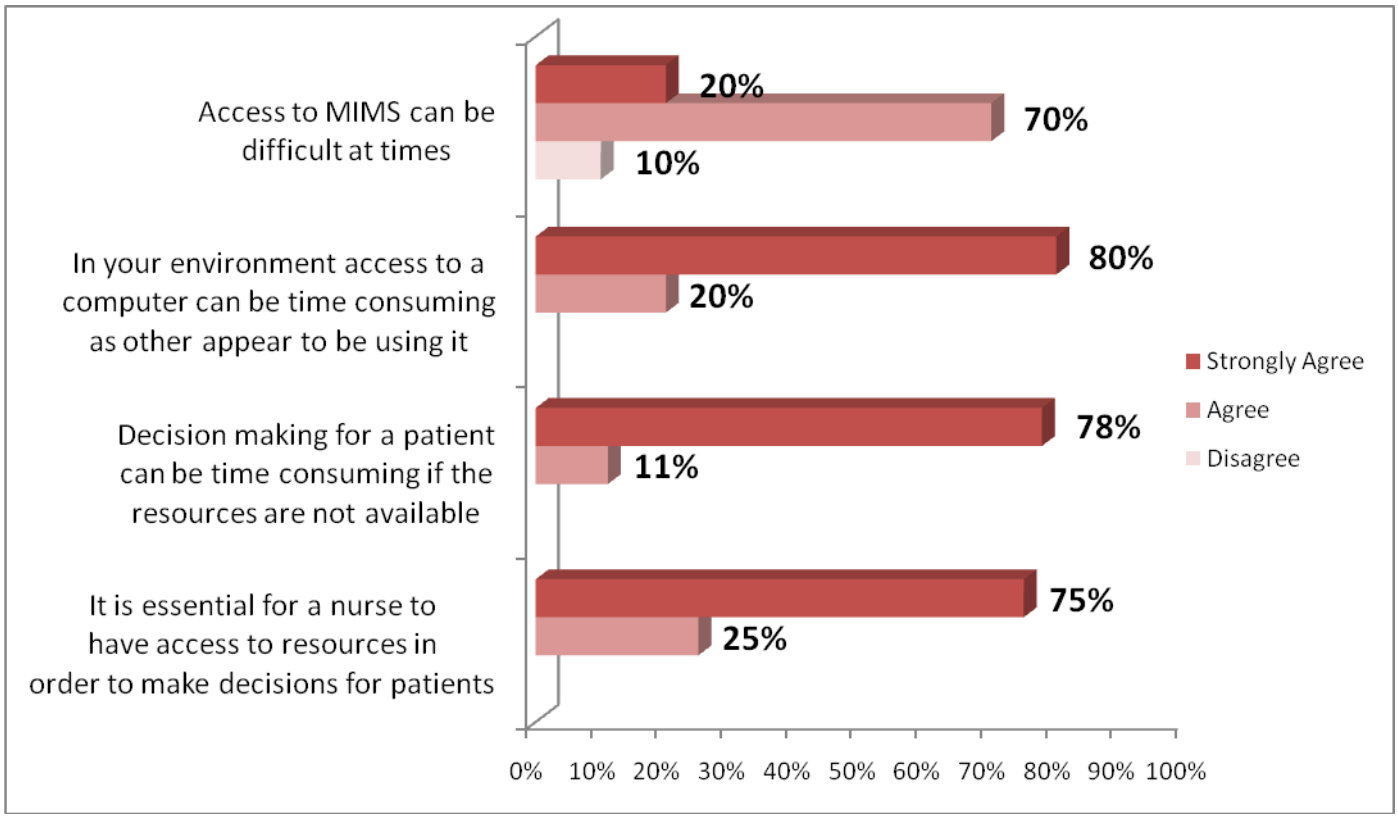
The potential in this technology for student nurses and graduate nurses was made clear throughout the trial as it speeds up the process of administering medications, and provides reassurance to students, staff, and patients. It is also important to note that this reassurance provides a relaxed working environment for the students thus positively influencing the learning process. It was also noted by one student nurse that the implementation of this technology in nursing programs at Universities would prove to be extremely beneficial to the learning experience and employability at the end of their degree.

It is also interesting to note that the usage of the technology in the trial extended beyond that of just nursing staff. Both doctors and pharmacists showed a keen interest in the PDAs, with both groups of medical professionals utilising the technology at one time or another.

In addition to the above qualitative data collected, some quantitative data was also collected with basis frequencies being conducted to highlight and support the previously discussed qualitative findings. The relationship between resources, such as time, and PDAs is outlined

in the following chart (see Figure 1). It is apparent that the access to MIMS is cause for concern amongst nursing staff with 90% of respondents agreed that access to MIMS is difficult, with the remaining 10% disagreeing. Access to computer resources is also proving to be difficult for nursing staff. 100% of respondents were in agreement that gaining access to a computer within their work environment was time consuming. Decision making and resources available for support in this area were also examined in quantitative light in this trial. 89% of respondents agreed that patient decision making is time consuming without the correct resources, while 100% of nursing staff agree that it is essential they have access to resources in order for them to make decisions.

Figure 1: Support for the usage of PDAs in a clinical setting



Opportunities for improvement were also identified during the trial and should be taken into consideration when moving forward with this technology. Nursing staff made it clear that the larger devices used in the trial were not suitable, and they preferred the smaller version of the PDA. This was especially true for the female nursing staff involved in the trial. The female uniforms did not allow for the usage of a belt, limiting where the PDA could be placed on the uniform. This was especially a hindrance with the larger versions as the weighed a significant amount more than the smaller versions. Male nursing staff on the other hand were able to attach the larger PDAs to their uniform belt and that was sufficient.

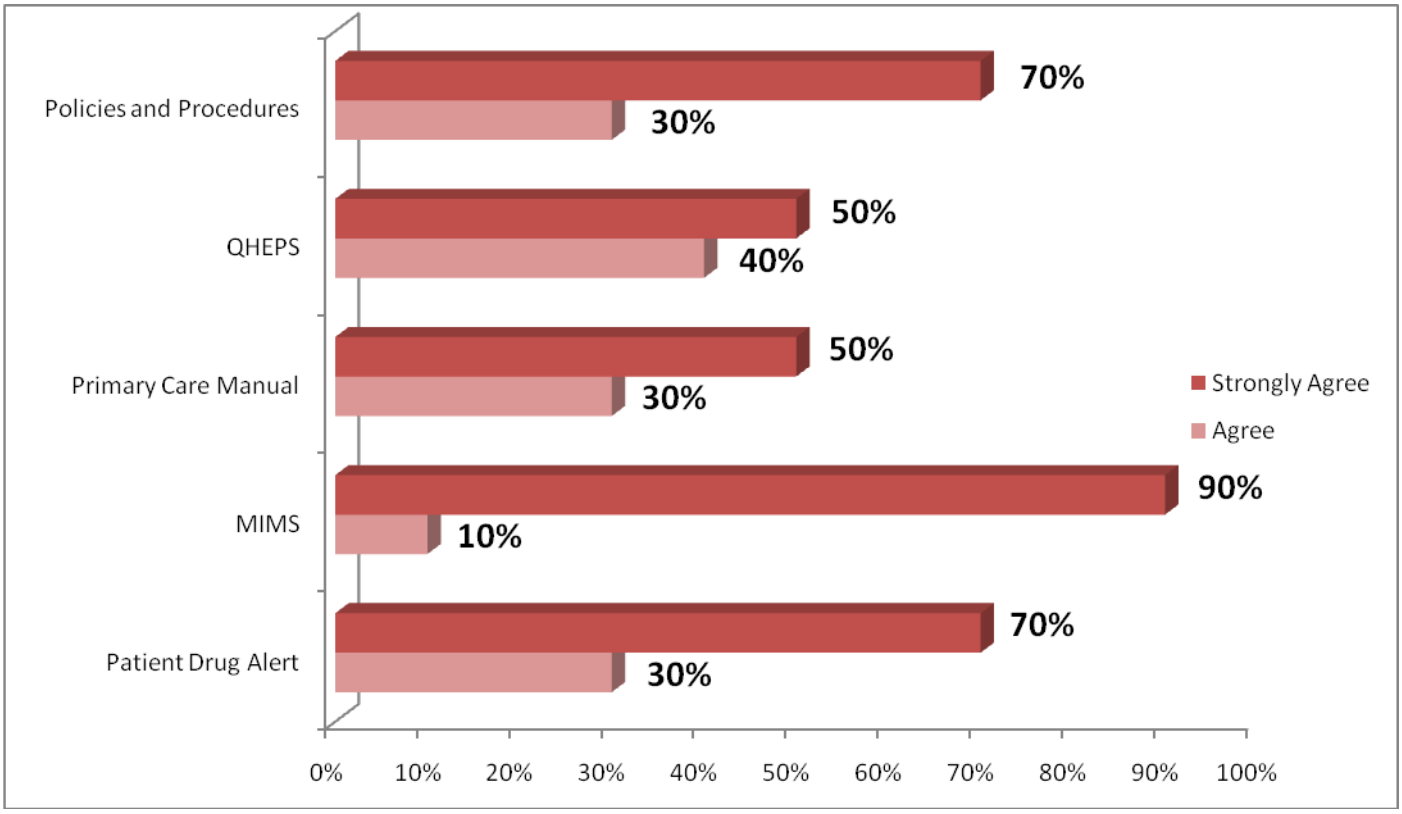
It was also expressed throughout the trial that in the future it would be very beneficial for the technology to include access to hospital's main computer frameworks. This would allow nursing staff to page wardsmen, access TrendCare (software system that monitors patient

acuity, nursing hours, and patient care planning), and obtain patient results from AUSLAB (reporting and laboratory management software system). A touch screen was another aspect for future consideration determined in the trial, with these possibly being made available in each room enabling nurses to access this information from a 'kiosk' form of system.

Other suggestions that should be considered in the future were that the PDAs be transportable between hospital wards. During the trial the PDAs were only used within one ward at each hospital, however in being able to move the PDA from ward to ward, nursing consults between wards would be conducted with significantly more ease and efficiency. Overall a positive uptake of the technology was recognised in the trial, however it was suggested that incorporating even more relevant information, such as a paging system, TrendCare, and AUSLAB, would result in an instantaneous uptake of the technology by all nursing staff.

Again, some quantitative data is depicted in the following chart (see Figure 2) which supports previous discussion as to future user requirements of this technology. It is evident that 100% of respondents are in agreement that it would be useful to refer to policies and procedures on a PDA, with 90% of respondents indicating their desire to see QHEPS on the PDAs. Other information sources to include on the PDAs based on the quantitative data collected during this study for example include primary care manuals, MIMS, and patient drug alerts.

Figure 2: Future inclusions on clinical PDAs



Conclusions

Overall this trial has provided substantial information that should be taken into consideration when moving forward with this health care technology in the future. It was noted by one trial participant that any technology that can improve nursing efficiency, production, information and thus result in improved patient care will be beneficial. In going forward with this technology it is important to consider the size of the PDA, the information loaded onto these computers, possible linkage into hospital's main computer frames, transportability between wards, the possibility of touch screen kiosks in patient rooms, and finally the usage of the technology in nursing education within University's.

The research team would also like to take this opportunity to offer a special acknowledgement and thank you to Motorola who provided free of charge the wireless access points and PDAs for this trial, MIMS for providing free of charge the MIMS software that was loaded onto the PDAs, and finally Queensland Health for allowing the trial to be conducted in their facilities and the use of staff time throughout the trial.

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