

2006

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## Recommended Citation

Fisher, Julie; Dawson, Linda; Weeding, Stephen; and Heslop, Liza, "Implementing a Mobile Wireless Environment in a Hospital Ward: Encouraging Adoption by Nursing" (2006). *BLED 2006 Proceedings*. 21.  
<http://aisel.aisnet.org/bled2006/21>

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## Implementing a Mobile Wireless Environment in a Hospital Ward: Encouraging Adoption by Nursing

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### Abstract

*Sophisticated technology is commonplace in most hospitals and increasingly mobile devices are being used in hospitals by clinical staff. Although the growth in mobile device usage in hospitals has the potential to contribute to better health and medical services delivery, nurses and doctors are still very reliant on paper-based information. Much of the research reported to date has focused on technical and design issues around mobile devices. Research that has focused on mobile device use in practice has tended to be from the perspective of doctors. This paper describes research which investigated key issues that arose as a result of the implementation of mobile wireless (MW) devices in a hospital ward from the perspective of the nursing staff. Although some of the nurses' concerns related to technological aspects the main concerns focussed on access to, and security of the devices and organisational implementation problems they experienced. From the findings we have identified the factors that need to be addressed in the implementation environment for successful adoption of the technologies. Further, we propose a holistic approach to the introduction of MW technologies in hospital ward settings.*

**Keywords:** *Mobile devices, wireless, health, hospitals, nurses*

### 1. Introduction

Increasingly a mobile device for a worker who is mobile is an essential tool of trade. Healthcare workers who are highly mobile are, not surprisingly, also adopting mobile devices (Baumgart 2005). Accessing drug information, patient information, prescribing drugs and other administrative functions are tasks commonly undertaken by physicians using a personal digital assistant (PDA) (McAlearney et al. 2004). One study among the American paediatricians found that “*The most commonly used applications were for drug*

*reference (80%), followed by scheduling (67%), medical calculations (61%), prescription writing (8%), and billing (4%)."* (Baumgart 2005, 1213)

Current research indicates the use of PDAs can improve the quality of care (Baumgart 2005). However, this could depend on several elements, including the type and number of applications available, the technology competency of medical staff, and the perceived areas of patient care that will benefit from PDA use (Rosenthal 2003). The use of PDAs needs to be critically assessed in health care to fully understand its wider potential and application for the delivery of health information at the point of care (Baumgart 2005). Further, the complexity of health care organisations and in particular hospitals requires organisational and cultural changes for the benefits of such technologies to be realised (Istepanian et al. 2004).

There are few reported case studies describing the deployment and integration into hospital settings of mobile devices and even fewer studies have looked at implementation issues from the perspective of nursing staff. Further, studies have tended to focus more on the value to nurses of using a PDA than actual studies of use. With the rise in PDA and other mobile device usage in hospitals it is important to understand the context and the issues around the implementation of mobile wireless (MW) technology in the same way that it is important to understand implementation issues of any technology.

## **2. Use of Mobile Wireless Devices in Hospitals**

Technology is an integral part of modern Australian hospital ward settings, and nurses are an integral part of the delivery of patient care. While nurses continue to provide a high level of patient care, it is important to study the perception, adoption, use and effect of technology such as MW technology. This paper details the cultural and implementation issues the nurses are experiencing and proposes recommendations for establishing a MW environment in a hospital setting.

Current research on the use of mobile devices suggests that PDAs are the most common mobile devices used in healthcare (Newbold 2003; Dee et al. 2005; Gururajan and Murugesan 2005). A study by McAlearney et al. (2004) investigated the use of PDAs by US doctors and found that the doctors expect devices such as PDAs to become more useful, however, issues around reliability, connectivity, and security still remain. A range of technology issues also impact on uptake. Screen size and the limitations this places on information presentation is a problem (Gururajan and Murugesan 2005). Other issues include data transmission problems and a lack of integration with other hospital systems (Gururajan and Murugesan 2005; Istepanian et al. 2004).

Timmons (2003) highlights issues relating to nurses and the implementation of a hospital information system. Timmons (2003) investigated the implementation of a new system in a hospital and found various examples of nurses' resistance to technology. Examples of resistance included: refusal to use the systems, attempts to minimise use of the systems, criticism of the system. Security issues such as use by unqualified staff and nursing issues which included working away from the patient and degrading of skills were problems Timmons (2003) identified in the adoption of IT by nurses.

The literature also reports a reluctance by nurses to use mobile devices. Rosenthal (2003) reports that in the US only 1% of nurses compared with 18% of physicians use a PDA. It is not therefore surprising that most reported studies on the use of mobile devices in healthcare have focused on use by doctors rather than nurses. To date much of the research conducted in hospital settings has focused on various mobile devices many of which are not wireless enabled.

### **3. Research Method**

The research reported in this paper is part of a larger action research project studying the implementation of a wireless infrastructure for mobile devices in a hospital ward. In this larger study the researchers are interacting with the implementation team and examining all aspects of organisational, cultural, technical and work practice related issues in the implementation process of this mobile, wireless environment for doctors, nurses, allied health professionals and managers. This paper draws on observational data and data from nursing staff who are in the process of adopting the new MW devices and associated technology.

As an action research project the design of the data collection is guided by the outcomes of previous phases of the research (Oosthuizen, 2002). In this case earlier interviews had been conducted with nurses prior to any mobile wireless infrastructure being implemented this work established the concerns of the nursing staff (Fisher, 2006). The phase reported in this paper explored early reactions of nursing staff, post mobile wireless device implementation. Data has been collected over a period of 18 months and included weekly observations covering the establishment of the technical environment and interviews with nurses and nurse managers. However it is only in the last six months that some of the devices have been available for general use (a laptop on a trolley wirelessly connected to the network has been available for more than 12 months). To date interviews have been conducted with seven nurses working on the ward and two nurse managers Nurse Unit Manager (NUM) of the ward and the Stroke Liaison Manager (SLM). Interviews on the ward focused on questions relating to the current clinical ICT environment, the new wireless environment and nurses experience, expectations, use and reactions to the new wireless environment. In addition observations and notes taken at project planning meetings have also contributed to the data. The approach taken is consistent with other reported research for example McAlearney et al. (2004) used focus groups and interviews to investigate the use of PDAs by doctors. Papazafeiropoulou et al (2005) examined the implementation of a local Health Authority system drawing on data from interviews and meetings.

### **4. Results**

This section describes the ward setting and details the research findings. It describes the issues raised by the nurses and the researchers' observations. At the time of the interviews some MW technology was in use by some medical staff, while other devices were still being tested. Most staff were aware that implementation was underway, and many knew the equipment was available for use.

#### **4.1 Background of mWard (Mobile Ward)**

The mWard (mobile Ward) project is being implemented in the Neuroscience ward which has 30 beds and 42 full time staff (nurses and registrars). As well approximately 30 allied health professionals – physiotherapists, occupational therapists, neuropsychologists, social workers, dieticians etc. rotate through the unit at any one time, this results in many staff needing access to the same records and the same data to track the patients.

Two years ago the NUM and the SLM began investigating how using MW devices on mWard might improve patient care. Discussions occurred with IT professionals and researchers about a potential wireless infrastructure and 18 months ago the first wireless infrastructure was installed and used in addition to the ward's existing hospital local area network. Currently the only nurses' desk on the ward has two desktop PCs, eight pagers, one facsimile machine and four telephones. Some clinicians use mobile phones. The MW

infrastructure installed included, one wireless switch, three wireless access points (base stations), two wireless laptops, one wireless tablet PC (for displaying x-rays in particular), one ruggedised PDA (including bar code reader – used to retrieve and display pathology results), two customised trolleys for holding and moving the wireless laptops around the ward, and three wireless IP phones.

## 4.2 Current Use of ICT

Most nurses appear comfortable with technology generally. They all use the paging system and the computers located at the front desk of the ward. This computer and the laptop on a trolley were mainly used for “... *looking up path results, x-rays and things like that, ... Internet information, MIMS 1 ... to find drugs around the hospital if we don't have any, ... if there is a medical condition the girls might not have heard of, have a quick look, using Yahoo! or Google.*” (NUM) Several nurses have used a variety of fixed and wireless devices in their work. Many were aware of and had seen the PDA and tablet PC being trialled but few had used them.

Use of any of the devices by the nurses is optional. There is little evidence of nurses actively refusing to use the system. In some areas such as pathology, the senior nurses indicated that there is widespread use and this was confirmed by the ward nurses. The only MW equipment currently used regularly by the nursing staff to look up results is the laptop on the trolley.

Using the laptop on the trolley to provide data at the point of care is not yet standard practice. One nurse explained “*I actually walk to the trolley instead of taking it anywhere.*” Other nurses agreed and said that they tend to leave the trolley parked somewhere “*I find it good because often there is a doctor on one of those [fixed] computers and the other [laptop on a trolley] computer is quite near the ward clerk ... so you can wheel it out of the way and do what you need to do that way.*” but “*For the doctor's round it is really good, they actually take them around to each of the rooms*”.

When asked why nurses did not routinely take the laptop on a trolley into patients' rooms the general feeling seemed to be that there were security issues “*I think you would have problems with privacy ... [also] ... you get patients who are aggressive. We have had already one of those [laptops] smashed.*” and, in most cases, access to data was only occasionally necessary and that it was not worth bringing the computer with them. “*There is still a lot of walking backwards and forwards, as nurses you just tend to walk. The thing is that when you are looking at blood results you are not taking it into the room and writing it down, there is no specific time for looking up blood results it is a one-off thing. There is no purpose in wheeling the trolley into the room if you are only doing random things on it.*”

There is extensive use of pagers, phones and fax. Fax is used “... for photocopying discharge summaries, we fax a lot of things to pharmacy and to the GPs about the people being discharged. Also fax to other departments. The discharge summaries are handwritten and we photocopy it and fax it to the GPs.” Phones are used to talk to relatives of patients and doctors. Doctors who are paged usually respond by telephone.

## 4.3 Expectations of the Implementation of Mobile Wireless Devices

The NUM and the SLM were the initial project drivers of the installation of wireless devices on the ward and are enthusiastic supporters of the technology. The NUM reflecting on the use of the technology said “*We've got more computers than any other*

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1 MIMS is an international pharmaceutical database

*ward in the hospital with the exception of Intensive Care. We're quite privileged in that regard but we have so many people that want to use computers that it doesn't make it any easier. We almost need one for every single person on the floor."*

When the nurses were asked "Why do you think the wireless infrastructure is being installed here in this Ward?" many had positive expectations. *"If it is used correctly when we do the morning surgical rounds at 7.30 – it would be good to have a computer to take around on the round, you could look up path results, you can look at CTs, you can look up the x-rays, you can see what people are due for - that sort of thing. You would know there and then what is happening for the day."*

And *"Having information you can access right there and then and not having to go back to the computer all the time providing it is accessible to everyone and carry it around with them and actually have it there at the bedside and do that then I think it will be quite beneficial time management and for the patients getting their results a lot quicker. And for us to get our results a lot quicker instead of having to go back and looking through and flicking through the results and for us to upload and say to the doctor this is like this can we have x or an order or something."*

Some nurses were wary of dependence and system failure and some were even cynical. *"We do everything else so why not do this as well. We get plugged to do any trial ... we are [the hospital's] guinea pigs for everything. This is just another one to add to the list."*

#### **4.4 Access and Security Issues**

Access to all ICT equipment including mobile equipment was a major issue for all nurses who were interviewed. There were two major categories of access which were problematic, difficulty in getting physical access to the equipment and difficulty in getting access to the Internet and hospital information systems through login systems.

##### **Physical Access and Security**

Lack of equipment availability either because of heavy use during the day or because it is locked away at night has discouraged some nurses; and they are particularly unenthusiastic if logging in is difficult. *"There are tablets (tablet PCs) sitting in Y's (NUM) office collecting dust."* And *"X (SLM) is very focused ... he always has a laptop in his hand and the medical people always have laptops and often we don't get the access to the laptops and if we do they are locked by another person and we can't use them."*

Physical security risks such as losing a PDA *"Something like that will just be left at the bedside and lost, you know they put their glasses down unless you did it like the pagers with the chain on it."* As well there are the physical risks to the device such as getting wet or as one nurse asked *"What happens when you get poo on it?"* Another nurse said: *"It would come down to who was responsible for carrying it ... [and] ... I don't think you could have everyone have it would get ruined, wetness."*

The major security issue relates to the actual devices. One of the laptops on a trolley has already been damaged by a disoriented patient and the nurses raised this as a concern. *"... we have already lost one laptop with a patient hitting it with a walking stick ... [and] ... the day before someone nearly knocked [the laptop] right off [the trolley] going past."*

## Data Access and Security

Login times and password are very slow and as would be expected many of the systems the nurses need to access require passwords. Some of the nurses have been waiting for passwords for some time.

Security of data access is a constant problem. Because of the slow login/logout process generally nurses rely on one person logging in at the start of a shift and then everyone else using the laptop through that login. However, if a user logs in to a MW laptop, uses it and then walks away without logging off, after a short time the hospital's network 'screen saver' locks the screen restricting further network access; and only the user can unlock the screen with their password or as in most cases, medical staff shutdown and reboot the laptop to enable subsequent logins. This leads to frustration as expressed by this nurse: *"One of the disadvantages is that you don't have a password. If someone opens it on their password and don't close it at the end of the day then the computer goes into like a shutdown and gets locked and you can't open it unless you know the password. ... If I go to the laptop this afternoon the chances are that X. [SLM] has opened it on his password and because he hasn't used it for X. number of hours (referring to one of the laptops on a trolley) if I don't know X's password I can't reopen – so you literally have to crash the computer to reopen it. If I recognise someone's number (referring to a particular nurse's user number) I have actually rung them at home to find out their password. It sounds silly but it is a process you don't need."* Although this is a criticism of the system it has not resulted in the nursing staff resisting use. Most nurses can get around the problem as indicated in the previous quote.

The NUM described her security concern *"There are issues of logging on and off; having your own passwords; so you can have things open where anyone can access; so we need security there. In the bigger picture the hospital needs to look at how people can be identified onto system, so that what's happening is happening in the right name. You know, so it's traceable, and that's a huge can of worms."*

## 5. Work Practice Issues

Many nurses did not see ICT as integral to their nurse practitioner role. The use of ICT was seen as a separate and often intrusive activity taking them away from their "proper" nursing role. *"Nurses look after people, computers don't look after people. Computers have results; computers can show you things that have been done technology-wise. They can look at blood results and that sort of thing but personally nurses look after sick people."* One nurse describes herself as a *"plain hands-on nurse"* that was what she did, looked after patients; she did not want to worry about technology.

Many of the ward staff are not permanent employees of the hospital, they are agency nurses often called bank nurses, employed on a casual basis. Ward nurses raised the issue of how these staff would be trained or introduced to the technology. *"We have so many part-timers as well on the Ward who often miss out on the education of things so they will just continue to go through and not want to learn or whatever, that is always hard. We have agency and bank nurses a lot as well. If we were to have it [MW technology] you would have to educate all the bank staff that regularly come up here"*. The hospital does not appear to have readily available technology trainers, training programs or facilities. Most of this training is conducted either 'on the job' by other 'knowledgeable' ward staff, ad-hoc by outside technical persons visiting the ward, or not at all.

## 5.1 Implementation Issues

### PDA Specific Issues

A wireless PDA at the point of care was seen as a specific advantage:

*“If you have physically aggressive patients or something. If you are in charge and someone deteriorates you are the first person to get called so in that respect if you've got information in your pocket and what are their blood gases, what are they doing and I would go bang there you are and look it up instead of having to run out go away from the patient who was not breathing look for a computer see if it is charged, take it back, wait for it to log in oh my God someone has locked it, take that away get another computer and come back, that would be better.”*

However, the practicality of mobile devices is an issue. Handheld PDAs appear to be a useful device for a constantly mobile ward nurse but their usefulness is perceived as limited in practice. The issues that emerged included:

- Most nurses felt carrying another device such as a PDA would be a nuisance. *“You've got neuro torches which you are supposed to have in your pocket. A lot of people try to have say forceps and a pair of scissors in their pocket plus you have one of these.”* This comment reflects enthusiasm but there are also practical concerns *“it would be cool to play with though. We have a lot of things in our pocket. Already we are carrying quite a lot with the pagers.”* Alternatives for carrying a PDA were explored with the nurses such as wearing it around their necks, this nurse's response indicates that is impractical: *“No we would not like it. It is just that when you are leaning over patients all the time you are at risk of it banging against the bed side and then having patients grabbing it, we work with confused patients. A pouch or a holster would be better.”*
- Willingness to carry a PDA. *“[But would you carry it?] It would annoy the hell out of me after a while, I don't think it is something that everyone would carry.”* And *“I am not the sort of person who likes to have things on and around me, I really don't, it would really annoy me..”*
- Who is responsible for the PDA? *“... that would be okay for me to carry I could quite easily carry that in my pocket, that would be fine. If you allocate it to certain people.... there was one person designated to carry it that would be OK.”*
- PDA screen size, loss of stylus and battery life are also issues. To view an entire pathology result the nurses have to scroll up and down, and left and right. This is cumbersome and time-consuming and reduces the nurses willingness to use and further adapt the PDA for patient use. Loss of stylus renders the PDA virtually useless, or awkward to use.

### Change Management and Training Issues

Major change management issues became evident in the interviews where some nurses feel they do not have the background to cope with the new technologies. Rapid change on the ward previously has not been managed well. *“I have done my education in the old school. I have seen so many changes in nursing from where I trained, from where nurses train now and now technology. I am just a plain old hands-on nurse. I just think it is just getting more and more complicated to be just a plain hands-on nurse. Maybe it is just me not accepting major change I don't think it is. I think hell what is going to be the next change?”* and *“We are not given time for the acceptance of things on this ward, we don't get time for acceptance”* and *“Sometimes the pace of this ward changes so fast you are*

*trying to deal with it. You try and help each other but that takes you away from other admin duties. It has to be introduced slowly."*

Many nurses felt they were not prepared for using new technology as described by this nurse: *"There is going to be a lot of people from the old era basic training people like me who is going to go 'URGGHH' and going to shut off."*

Most of the nurses interviewed knew little about the wireless devices and network apart from the laptop on a trolley. One nurse said that the first she knew a new system had been implemented was the fact that we had asked to interview her.

A number of the nurses commented on the lack of training and the time needed to learn and integrate the new system into their daily activities delivering quality patient care. One nurse commented: *"We were just told. 'We are going wireless ... deal with it.' We were told a good while ago, ... it was mentioned and then it was quiet. Then suddenly the patient system happened and then suddenly the laptops are here."*

A number of the nurses felt their concerns had not been considered in the implementation process. Some of the nurses were clearly anxious about the change particularly those from the 'old School of nursing'. One comment that reflected this anxiety was *"My concern is that we don't (shouldn't) feel like it is being forced on us and that there is a bit of compassion shown to people who are a bit scared about using it and so you are learning something as opposed to being threatened by something."*

Many of the nurses felt disengaged by the implementation approach taken by management. There was concern that not everyone would feel happy and comfortable about the change as reflected in this comment: *"It has to be that everyone is comfortable and those that aren't you can't make them feel bad. ... You are not given the chance to express your feelings on it and your fears on it. You are just thrown into a lot of it. I mean you will have quite a few people who will feel that."* And another nurse commented *"You don't want to be made to feel silly, you don't want to feel incompetent which you can if you don't train people"*.

Some more technology aware nurses had self-trained *"I've taught myself how to look up scans once I found out what the password was - then I started to play a little bit. Now I realise you can type in a patient's number and you can get all the scans up and you see what people are booked in for."*

## **6. Discussion**

Understanding the needs and use of mobile devices by nursing staff in a hospital setting is critical to the successful implementation of such technologies. The major issues in the adoption of a MW environment as identified in this case study are:

- The design and implementation of MW environments must be based on appropriate change management practices such as consultation, information dissemination, education and training
- The need for the integration of mobile, wireless ICT environments with existing ICT – especially in terms of access and security
- The need for active encouragement of the acceptance of mobile ICT-based activities as an integral part of the nurse practitioner role

The identification of these issues indicates that the introduction of new ICTs such as MW technologies requires a holistic approach based on the following factors:

- Recognition and acknowledgement of the specific work place culture into which the mobile technologies are being introduced
- Foundation research – surveys, focus groups etc to establish an understanding of workgroup characteristics, competencies and culture
- Dissemination of accessible information including calling for feedback before introducing technology.
- Consultation with managers and end-users about timetables for introduction, training and implementation
- Ongoing and timely training and support
- Recognition of overheads involved in “ramping up” including incentives for buy-in
- Recognition and recruitment of “champions” to lead by example and provide support
- Continual, timely, accessible information of progress of the implementation including set backs and revisions
- Education based on how mobile-based ICT can support current work practices

## **7. Conclusion**

Rosenthal (2003) reports that “*Traditionally, nurses are reluctant to incorporate electronic devices into their clinical practice.*” (58). Our research found that lack of experience with the technology or fear of technology on mWard are not likely to be significant reasons why nurses resist MW device implementation. Many of the nurses acknowledged the usefulness of the devices but there is a high level of both scepticism and concern. The major issues are not technical. The technological aspects of the mobile working environment are operational, however, management issues such as change management and training are critical to the acceptance and use of new MW technologies. Practical aspects of implementation such as how to transport the MW devices (secure trolleys for laptops, holsters for PDAs etc) need to be trialled and customised based on users’ feedback – in this case the nurses at the bedside. To successfully implement a MW system in a hospital requires the active participation of nursing staff. More work is needed to understand the nurses’ needs and impediments to use, if their issues can be successfully resolved implementations will be much more successful and ultimately will result in better clinical outcomes.

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