the children's hospital at Westmead

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SUBMISSION TO NSW HEALTH

ACCELERATING MOBILE ACCESS BY CLINICIANS TO KEY CLINICAL SERVICES AND APPLICATIONS TO IMPROVE THE SAFETY, COST-EFFECTIVENESS AND QUALITY OF PATIENT CARE

SEPTEMBER 2006

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About Children's Hospital at Westmead

The **CHW** is a specialist hospital dedicated to paediatric care. It has 290 overnight and 49 same day treatment beds and is a teaching hospital of the University of Sydney and University of Western Sydney. The CHW is one of Australia's most technologically advanced centres for clinical research into causes, treatment and cure of childhood diseases and has been operating for 125 years.

For more information visit its website www.chw.edu.au

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About Cisco Systems

Cisco is the leading international and Australian supplier of networking equipment and network management for the internet. Its products and services include those designed for wireless, voice and unified communications, server networking, interoperability, security, routers and routing systems and storage networking.

It is a leading provider of services and products to the NSW government and business and a major sponsor of community based information technology education programs for the under privileged and unemployed in NSW. It has funded the wireless technology trial at CHW which this submission is about.

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CONTENTS

EXECUTIVE SUMMARY

Title	:	Approval of funding to complete the rollout of wireless capability on a “medical grade” infrastructure and communication system to improve patient care
Proponent	:	Children’s Hospital AT Westmead (CHW)
Date of Submission	:	September 2006
Main Purpose	:	To **(1)** report on the performance of the wireless capability currently being trialled at CHW; **(2)** report on the benefits and economic value of full mobile capability at CHW; and **(3)** obtain funding for the capital and recurrent cost in 2006-07 of a permanent wireless infrastructure and communications system at CHW.
Resources required for implementation	:	The following funding is being sought for the next 4 years to 2009/10. **(1)** $4.05 million in 2006/07 for the capital cost and **(2)** $0.575 million for the recurrent costs in 2007/08- 2009/10 of a wireless infrastructure and communications system.
Previous Government Decisions	:	As part of its steady transformation into a ‘digital hospital’, in 2005 CHW agreed to a trial of wireless infrastructure and communications in its emergency department, surgical wards and theatres. The trial has been funded through private sector sponsorship.
Departure from Previous Government Decisions	:	Nil
Relation to Existing Policy	:	Consistent with CHW and NSW Health ICT policies
Priority	:	Urgent
Legislative Programming	:	Not Applicable

Announcement of Decision	:	By Minister
Action Required Before Announcement	:	NSW Health recommendation

2. PURPOSE OF THE PROPOSAL

2.1 To report on the performance of the current trial of wireless communication technology to enable a mobility capability in the emergency department, surgical ward and theatres at the Children's Hospital at Westmead (CHW).

2.2 To report on the benefits and economic value of applying wireless technology permanently in all departments at CHW.

2.3 To seek funding from Treasury for the capital and recurrent cost of making the use of wireless communication and wireless mobile computer technology permanent in all departments at CHW.

2.4 To identify for the NSW Government the potential benefits of extending a mobility capability for clinical services and applications using wireless infrastructure and communications for the whole NSW health system.

3. RECOMMENDATIONS

3.1 It is recommended that NSW Health NOTE that:

3.1.1 CHW is transforming itself into a digital hospital through a connected health model that is based on wireless technology and network upgrades.

3.1.2 That the transformation to a digital hospital involves a new business model for the design and delivery of healthcare based on three interdependent elements:

- New clinical services and applications;
- People and process reforms to improve workflow and underlying business process; and
- Pervasive information and communication technologies on a "medical grade" network.

What is key to this model is that each of the elements reinforces and enables the other. Each has a role in motivating and sustaining a long-term process of steady transformation across all aspects of a hospital's operations – culture, structure, work flow and technology integration. See Attachment A for a more detailed explanation.

3.1.3 International and national evidence demonstrates that digitally advanced hospitals use ICT systems such as wireless technology to

provide clinicians with faster accurate data and patient information and the capacity to speedily and easily communicate with each other at the point of care. The focus of these reforms is to combine new clinical applications, process reform and networked ICTs to improve the safety and quality of patient care and improve cost-effectiveness of current health assets and resources.

3.1.4 International and national evidence demonstrates that digitally advanced hospitals deliver higher rates of process efficiency and reliability than normal hospitals and that this leads to higher patient throughput and reduced health care costs.

3.1.5 The use of ICT systems to improve patient care and capture improved productivity in the delivery of health care is an effective demand management tool and reduces the need for spending on bed and other infrastructure capacity enhancements.

3.1.6 The full benefits for patient care that ICT systems can deliver generally accrue over time after technology has been effectively integrated or 'socialised' with clinical processes and the ways clinicians want to work. This means that once deployed ICT systems need to be continually monitored to ensure they are being used for maximum benefit.

3.1.7 A trial of wireless voice communication and data access for clinicians in the emergency department, surgical ward and theatres at CHW has been undertaken between April and June 2006. Under the trial wireless technology has saved over 20 hours per day or 7,439 hours per year in patient treatment time in the emergency department.

3.1.8 A conservative approach was taken when calculating time savings attributable to the wireless technology trialed. Firstly a comparison was made to emergency department patient waiting times in the 4 year period between January 2002 and March 2006 when no wireless technology was applied. Secondly the trial controlled for confounding variables that could also contribute to improved patient treatment times during the trial period.

3.1.9 When applied to all departments of CHW the time savings in clinical treatment time attributable to wireless technology are worth about 122 000 hours or over $7 million per year at 2005/06 prices. This cost saving may be conservative given the additional time savings medical staff may secure as they become more proficient with using the technology.

3.1.10 The savings which wireless capability generates can support NSW Health's efforts to reduce health system costs which are currently increasing by 8% per year. The technology being trialled at CHW is deployable in other public hospitals across NSW.

3.1.11 Based on the incremental cost of the application of wireless technology across all departments in CHW over nine years ($6.518 million), the net benefit of applying such technology has an estimated net present value (NPV) in 2005/06 prices of $33.2 million (when NSW Treasury's recommended discount rate of 7% is applied).

3.1.12 While these benefits are high they reflect the very labour intensive nature of current hospital practices and the potential for labour savings from the application of capital and technology. Even if the benefits were only half of the amount estimated in this report, the benefits of both the incremental project and total project would be substantially higher than the costs.

3.1.13 Other benefits attributable to wireless technology such as improvements in service quality have not been measured and valued as part of the trial.

3.2 It is recommended that NSW Health APPROVE:

3.2.1 A submission to Treasury for funding in addition to existing allocations to NSW Health for the procurement and implementation of wireless technology for voice communication and data access in all departments of CHW.

3.2.2 A request to Treasury of $4.575 million over the next four years (2006/07 – 2009/10) for the capital and recurrent cost of procuring and operating wireless technology in all departments of CHW.

3.2.3 A further examination of the benefits and economic value of extending mobile capabilities as part of a wider transformation to a 'digital hospital' business model using wireless technology in CHW itself and in all hospitals in the public health system in NSW.

4. BACKGROUND AND SUPPORTING INFORMATION

4.1 Children's Hospital at Westmead (CHW)

4.1.1 The CHW is a specialist hospital dedicated to paediatric care. It has 290 overnight and 49 same day treatment beds and is a teaching hospital of the University of Sydney and University of Western Sydney. The CHW is one of Australia's most technologically advanced centres for clinical research into causes, treatment and cure of childhood diseases and has been operating for 125 years.

4.1.2 In 2005, CHW celebrated the 25th anniversary of its Oncology Unit performing bone marrow transplants with the treatment of over 400 children in that time. In 2005 the hospital was also awarded the iAward for innovative development in health care reflecting its partnership with NSW Health over 10 years to create an electronic medical record (EMR).

4.1.3 In advance of the Council of Australian Government's (COAG) February 2006 commitment to improve Australia's health by tackling chronic disease, the CHW's Cardiology Unit established in 2005 Australia's first Risk Reduction Clinic for childcare at high risk of cardiovascular disease.

4.1.4 In these and other ways CHW remains a pioneer in improving the quality of paediatric care. This includes the deployment of information and communication technology (ICT).

4.2 Current Trial of Wireless Technology at CHW

(a) Objectives – Demand Management and Improved Quality of Care

4.2.1 A trial of wireless, hands-free communication devices (WHFCDs) and mobile computer devices (MCDs) has been undertaken in the emergency department, surgical ward, and theatres of CHW to identify the extent to which such technology can improve the quality and capacity of health care compared to current fixed line PABX and pager systems and desktop PCs.

4.2.2 The trial is another step in a natural progression towards the potential transformation of CHW into a digital hospital, where networked ICT, especially new mobility capability through robust, secure wireless technologies, enables clinicians to quickly access patient information

and clinical data and communicate with each other at any time and any where in the hospital.

4.2.3 The concept of a digital hospital is one where clinical services, people and process reforms and ICT infrastructure combine to facilitate the connectivity and accessibility of medical staff and the accuracy and speed of information delivery.

4.2.4 These objectives are being pursued at CHW because Australian and international experience already demonstrates that the speed with which medical staff can access information and communicate with each other in emergency and other situations is critical to the quality of patient care and the capacity of hospitals to meet demand for care. Unlike mobile wireless information and communication technology, common fixed line PABX and pager systems and desktop PC arrangements currently applied at CHW limit this speed.

4.2.5 In the United States hospital system for example information technology is often viewed as an enabler, with the value of an ICT project being measured in the resulting improvement in the clinical or operational process. "The improvements can be in the form of fewer tasks in the process, better information at decision points, fewer handoffs, quicker cycle times or better availability of information. They all translate into higher quality and more efficient patient care".[1]

4.2.6 The improved patient care and demand management outcomes that appropriate ICT use can enable reduces the need for capital investment in bed and other infrastructure capacity, particularly where clinicians optimise the functionality and applications of ICT tools. Accordingly ICT systems can assist the NSW Government to bypass the policy and political debates around hospital infrastructure spending which tends to characterise the relationship between the Commonwealth and State governments regarding health care.

4.2.7 Whilst clinicians may tend to seek more infrastructure spending rather than admit that process efficiency and reliability should be targeted to improve demand management, the trial sought to introduce ICT systems that clinicians could benefit from in terms of convenience, work speed, time savings and quality of care. In establishing the trial CHW considered that ICT systems that could deliver these outcomes for clinicians would maximise their acceptability to medical staff.

[1] Jim Albin, CIO, Mercy Health Partners, Toledo, Ohio

(b) Scope and Cost of the Trial

4.2.8 The trial was conducted between 15 April and 1 June 2006 and involved eighty staff including registrars, medical officers, visiting medical officers, and nurses. The trial consisted of the deployment of:

- Wireless infrastructure in the emergency department (ED), operating theatres and the surgical ward;
- Forty WHFCDs in the ED; and
- Ten MCDs – three located in the ED, one in the surgical ward, one in the day theatre complex and five in the general theatres.

4.2.9 The trial was funded by various private sector sponsors including Cisco Systems, IBM, Vocera, Intel, Dimension Data and Dell. The costs of the trial include the purchase and application of technology used; training of medical staff on using the chosen technology for maximum benefit; and implementation of a system to monitor, identify, record and assess trial results, including surveys of medical staff. The NTF Group, an independent marketing and research company, was engaged to collect and analyse the trial results.

4.2.10 The expenditure by sponsors on the trial to date has been $765 000. This has consisted of:

- $622 000 for wireless infrastructure and consultancy;
- $73 000 for the WHFCDs; and
- $70 000 for the MCDs; and

(c) Technology Used in the Trial

4.2.11 There are various kinds of mobile wireless technology, such as mobile phones, PDA's, laptop computers, and others. Within the broad categories of wireless technology there are a variety of brands, tools, applications and products. The CHW project is not a test of any specific access technologies or devices as technology options will change and improve over time. The key focus of the trial is to provide simple, reliable and secure mobility capability, using widespread wireless technologies enabled and supported by a "medical grade" network infrastructure.

4.2.12 The technologies used in the trial at CHW represent only two of the available products in the market. The products used in the trial should

only be viewed as demonstrating the actual and potential benefits from the use of wireless technology. Any future tender for products to support a permanent wireless technology system at CHW would specify the applications required for the purposes for which funding is secured. These applications may be less or greater than those currently demonstrated in the trial.

(i) *Wireless Hands Free Communication Devices (WHFCDs)*

4.2.13 The particular voice communications device used in the trial is called Vocera. This product is a small device that can be worn on a medical workers lapel, pocket or around their neck. It is a voice activated product based on IP telephony. Within and outside the hospital staff can communicate with each other by simply speaking the name of the person they are seeking to contact into the Vocera device. This action triggers a call to that person's contact numbers.

4.2.14 A conversation can be held via the Vocera device. Conversations can occur where each participant is using a Vocera or where one is using normal mobile of fixed line telephony or voice over internet communication. Text messages and alerts can be sent to the LCD screen on the back of the Vocera device.

4.2.15 Wireless voice communication of this type enables medical staff to contact each other wherever and whenever they need to. This is particularly important in emergency situations or to obtain information or data quickly.

Pictured here is an example of the Vocera device used in the trial.

(ii) *Mobile Computer Devices (MCDs)*

4.2.14 In the trial a series of laptop computers with independent power supplies on trolleys have been used to facilitate immediate on line access to patient information and detailed clinical data at the point of care.

4.3 Consistency of Trial with CHW Service and ICT Policy

(a) Connected Health Model

4.3.1 CHW is committed to a service delivery model of 'connected health' to support its quality of care. At its core this model seeks to ensure that ICT systems are identified and used within the hospital to maximise the knowledge, capacity for care and accountability of clinicians, and trust and confidence that patients have in the quality of care offered to them.

4.3.2 CHW's commitment to the connected health model provides the context in which it is striving to become a digital hospital. Its effort to digitise can be categorised into the following integrated pathways.

(i) *Wireless Technology*

Within this pathway there are two main steps:

- Introducing a mobility capability to provide medical staff in the emergency department, surgical wards and operating theatres with immediate access to clinical data and the internal and external communications necessary for patient care; and

- Extending the use of wireless technology across the hospital to provide all medical staff with immediate access to clinical data and the internal and external communications necessary for patient care.

(ii) *Network Infrastructure*

Within this pathway there are two main steps:

- Enhancement of network capacity across the whole hospital to ensure the security and quality of all applications needed to support medical care. The success of these innovations will depend on a "medical grade" network infrastructure; and
- Replacement of existing PABX telephone system with IP telephony integrated with enhanced network capacity.

Infrastructure and capacity that is "medical grade" means infrastructure that can support the following four key network attributes:

- <u>Highly Reliable</u> - Health Services, and thus networks, never stop. There is never a good time to take the network down.

- Highly Secure - Security is not about protecting the edge of the network only. Health Security is holistic and operates at all levels, end-to-end in a Health System – including the network.

- Service Mobility - Health Services must not be tethered to fixed locations. Health Networks must allow Health Services and information to occur wherever the Health care provider is – Hospital, Home, National Roaming, Disaster.

- Any Service, Anywhere - Health Information is diverse in nature – data transaction, telephony, rich media messaging, medical image transfer. Health networks need to support simultaneous transmission of all Health Information without service degradation or cross transaction impact.

It is important to understand that these attributes cannot be delivered by extending existing network infrastructure. Rather, they represent capabilities supported by a new generation of network technologies whose availability will determine the speed and reliability with which NSW Health can rollout the new service improvements they enable and achieve the patient care and cost-effectiveness they promise.

(b) Existing ICT Infrastructure

4.3.3 Under these pathways CHW has already developed a network and ICT infrastructure for administrative and clinical applications which deliver significant care and efficiency benefits. For example, the hospital provides electronic discharge and electronic ordering tools for clinicians. A patient identifier assists to co-ordinate patient services and reduces the risk of error. In addition the picture archiving and communication system and remote access connections to CHW systems have been upgraded. These priorities are consistent with the information management and technology reform program endorsed by NSW Health.

4.3.4 Attachment B details the network and ICT infrastructure enhancements already undertaken at CHW.

(c) Rationale for Wireless Data Transfer and Communications

4.3.5 Nevertheless, the existing network infrastructure only supports the delivery of data and communications to fixed positions in administrative areas and nurses stations in each ward. Current infrastructure is not

"medical grade " and therefore not secure or robust enough to enable mobile access to clinical and patient data incorporated in video, pictures, communications and information that is essential to the connected health model.

4.3.6 The inadequacy of current infrastructure to support mobile access to data and communications prompted the trial of wireless technology at CHW and is the primary reason for this submission.

4.4 Consistency with NSW Health Policy

(a) Meeting Patient Demand with Limited Resources

4.4.1 Investment in mobility capability at CHW is consistent with NSW Health policy where it assists patient care improvements and to improve efficiencies in care that help to relieve the demands on the NSW health system caused by patient needs and budgetary constraints. Improved demand management can reduce the need for spending on bed and other capacity infrastructure enhancements.

4.4.2 In NSW emergency departments treat an average of 5,490 people each day. At CHW an average of 120 people are treated at the emergency department each day. Between July 2005 and March 2006 an additional 97,457 or 8.5 per cent more people attended emergency departments across NSW compared to the same period in 2004/05. During the 2005/06 period the number of emergency department patients at CHW increased by approximately 5000 to 45,818. This is an increase of 11.25 per cent on the 2004/05 period which is 2.75 per cent more than the NSW average. [2]

4.4.3 Each day in NSW an average of 3,877 people are admitted into public hospitals with 30 per cent entering through emergency departments. At CHW the number of people admitted each day is on average 73 with approximately 18 per cent entering via the emergency department. Between July 2005 and March 2006 admissions through emergency departments across NSW grew by 21,739 or 8.3 per cent compared to the same period in 2004/05. [3]

4.4.4 These statistics demonstrate the increasing demands on emergency departments to make fundamental decisions at the point of care about the immediate and longer term treatment of patients. This is particularly

[2] NSW Budget Estimates 2006-07, 10-3 and CHW data.
[3] Ibid

the case for hospitals such as CHW where demands on the emergency department exceed State averages.

4.4.5 These decisions have flow on effects on navigation of the 'patient journey', the quality of health care outcomes and the use of hospital resources and beds in delivering patient care. A connected health model that provides medical staff in emergency departments, surgical wards, theatres and general wards with mobile access to critical data and communications supports speedy, well informed decision making at the point of care.

4.4.6 Where mobile access to data and communications improves the speed and accuracy of treatment identification, decisions and application it can assist to improve clinical care, the pace with which patients move through the system and the productivity of health care workers, which are all critical paths to meeting the increasing demand for health care with limited resources. These benefits that wireless technology can enable become even more critically important where existing resources for health care are shrinking.

4.4.7 Under the Australian Health Care Agreement 2003-2008, which governs Commonwealth funding to State governments for health care, NSW is projected to lose about $704 million. As a result the health care costs for NSW are rising. In 2006-07 NSW is estimated to need to contribute $1.81 for every dollar the Commonwealth provides to meet patient demand compared with $1.61 for every dollar in 2003-04.[4]

(b) Delivering the 'Healthy People – Now and in the Future' Strategy

4.4.8 To meet increasing demands on the health system with limited funding the NSW Government has seven key goals under its 'Healthy People – Now and in the Future' strategy. Of these a connected health model that puts patient care at centre of a business model that links new clinical service, process reform and network technologies can directly and indirectly assist to deliver the following five key goals:

- Improving capacity and access to public hospital, emergency services and other core health programs.
- Ensuring the best possible patient outcomes through the provision of high quality and integrated care in the most appropriate setting.
- Improving access to clinical information.

[4] NSW Budget Estimates 2006-07, 10-3

- Directing resources to fontline clinical services.
- Improving accountability.

(c) Precedent ICT Programs to Improve Health Care

4.4.9 There is strong precedent for the use of information and communication technology and systems by NSW Health to improve clinical care and patient flow. For example: [5]

- A state wide unique patient identifier is being developed for mental health patients so that they can be recognised whenever they present in the public health system.

- In 2006/07 an electronic record system called CHIME will be implemented state-wide as part of the Community Health Information Strategy. It is expected that this will assist an additional 1,200 clinicians by enabling them to share vital patient information and people being cared for in the community including people with chronic diseases and the elderly.

- The nation's first electronic health record trials are underway in NSW to support the capacity of clinicians to provide quality and integrated care in various delivery settings. The Maitland Electronic Health record has commenced and the Sydney West trial is planned to begin in late 2006.

4.4.9 These precedents demonstrate that NSW Health does recognise the need to use information technology to improve service delivery and patient care over time. This approach is consistent with international trends. In the United States for example the nation's 100 most wired hospitals and health systems pair ICT with strategic plans in an effort to improve quality, streamline processes and drive financial returns. The evaluation of ICT systems in this context is undertaken via a balanced scorecard that values qualitative and quantitative measurement.

4.5 Trial Results

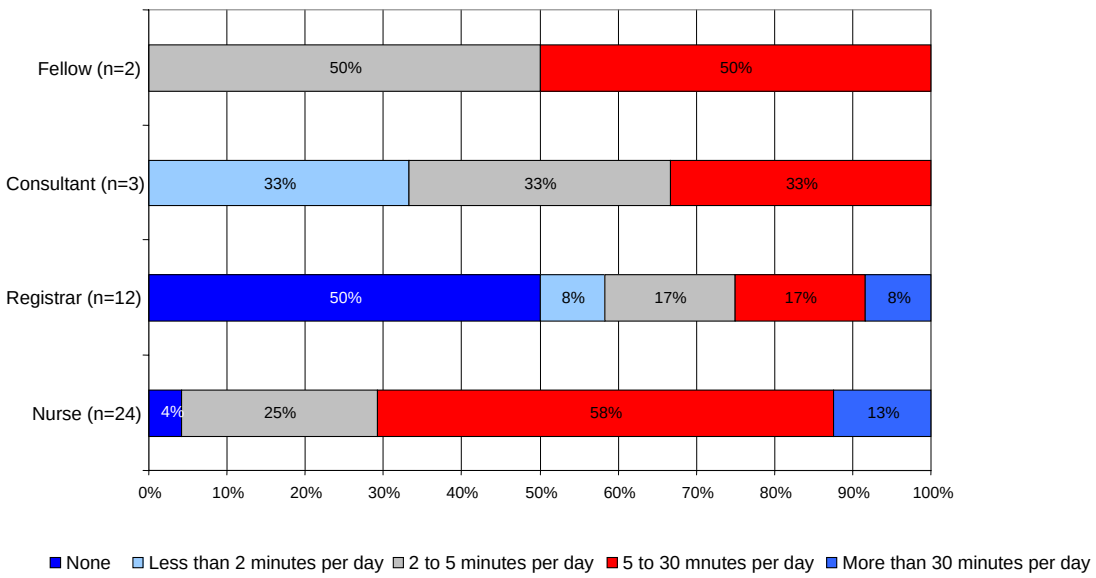
4.5.1 The trial was undertaken to identify three categories of actual and potential results – user satisfaction, time savings and cost savings. The trial results in these areas are discussed below. A report on the trial is at Attachment E. The benefits of wireless technology identified by the trial and their economic value are discussed in section 4.6.

[5] NSW Budget Estimates 2006/07, 10-15

(a) User Satisfaction

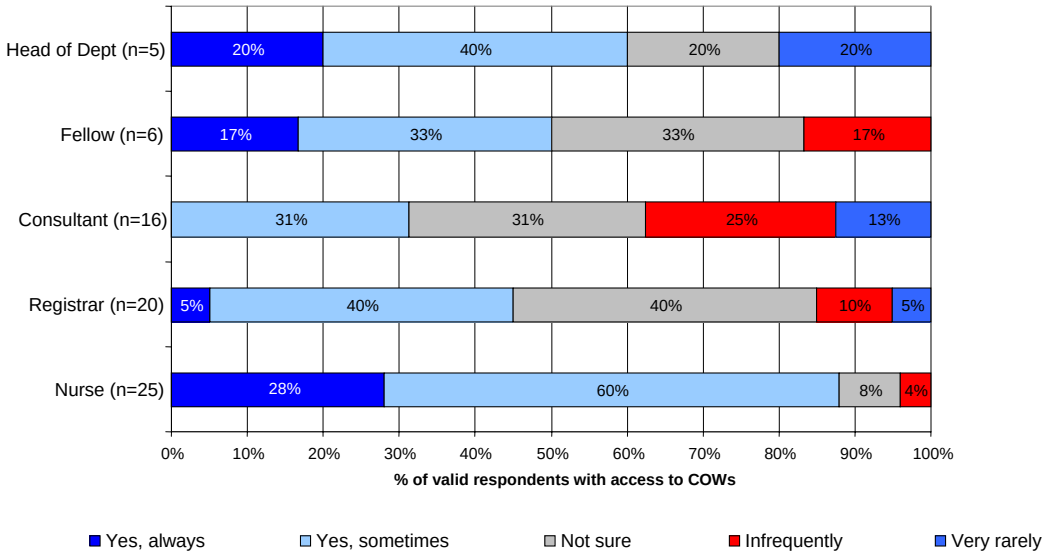
4.5.2 There are two main questions that participants were asked regarding their satisfaction with the WHFCDs and MCDs they used during the trial. The responses to the questions demonstrate that clinical staff using wireless technologies during the trial had a very high level of satisfaction with the way in which the systems supported their delivery of care. The questions and results are described below. [6]

Question 1: *How much time do you estimate WHFCDs has saved you each day?*



Question 2: *Has the introduction of MCDs improved your access to patient information at the right place and the right time?*

[6] NTF Group



(b) Time Savings

4.5.3 For the purposes of an economic assessment the trial identified and assessed two kinds of time savings delivered by WHFCDs and MCDs. These are:

- Savings in patient waiting time in the emergency department (ED); and
- Savings from eliminating work bottlenecks experienced by ED staff.

(i) *Savings in ED Patient Waiting Times*

4.5.4 Patients are admitted to the ED in five triage categories. Categories 1and 2 are patients admitted by ambulance and they are treated immediately. Categories 3, 4 and 5 represent cases that are urgent, semi-urgent and non-urgent respectively.

4.5.5 The trial compared the patient waiting times in triage categories 3, 4 and 5 in a four year pre-trial period without WHFCDs and MCDs (1 January 2002 – 14 March 2006) with the impact on waiting times of wireless technology during the trial (15 April – 1 June 2006). Data during the trial period began to be collected one month after the introduction of wireless technology. The trial controlled for confounding variables such as illness type, period of peak patient load and seasonal influences such as public holidays and time of day, day of the week, and month of the year.

4.5.6 The trial did not control for other inputs (labour and capital) or for other possible changes in operating practices in the emergency department. However CHW confirms that there were no substantive changes in resources or technology used in the emergency department during the trial period other than the introduction of wireless technology.

4.5.7 Nurse initiated protocols to improvement treatment time of triage category 3 patients were introduced in tandem with the wireless technology trial as part of a separate CHW project. This may have had the effect of making it harder to attribute the identified total time savings in patient treatment times during the trial period only to the use of wireless technology. However, given the size of the measured economic value arising from time savings in patient treatment during the trial period (NPV of $33M), it is not possible for nurse initiated protocols to be the single or major contributor to such value.

4.5.8 As a result the presence of nurse initiated protocols during the trial period does not reduce the significant and fundamental contribution wireless technology made to reducing patient treatment times.

4.5.9 The tandem implementation of wireless technology and nurse initiated protocols is also reflective of the operational reality in a digital hospital model where the application and benefits of wireless capability cannot be disentangled from a closely connected cluster of related operational changes whose impact is joint and cumulative rather than independent.

4.5.10 Accordingly it is considered that the tandem application of the wireless technology trial and nurse initiated protocols confirms rather than detracts from the benefits of providing mobility capability through technology.

4.5.11 The trial estimates that patients in triage category three saved an average of nearly 7 minutes per visit, triage four patients saved 15 minutes per attendance and triage five patients saved 14 minutes per attendance. Multiplying the time savings per attendance by the number of ED attendances, the estimated total waiting time for ED per day during the trial period amounted to 20 hours and 23 minutes.

4.5.12 The time savings delivered during the trial are described in the table below.

Table 1 - *Daily saving in patient waiting time for the ED with wireless infrastructure, 15 April – 1 June, 2006* [7]

Triage category	*Attendances per day*	*Savings per visit*	*Daily savings*
3	33.06	6.94 minutes	3 hours, 50 minutes
4	34.49	15.20 minutes	8 hours, 44 minutes
5	34.19	13.73 minutes	7 hours, 49 minutes
Total			**20 hours, 23 minutes**

(ii) *Savings to ED Staff Time*

4.5.13 The trial asked eight ED staff to assess whether the use of WHFCDs and MCDs to improve access to information and communication would remove bottlenecks to the speed and efficiency of their work and therefore increase their allocation of time to patient care. The staff included registered nurses, nurse specialists and staff specialists.

4.5.14 The staff reported that wireless technology would remove the daily bottlenecks to their capacity to deliver faster but accurate patient care. The time savings enabled by wireless technology were estimated by the staff to range from 21 to 78 minutes per clinician per day. The average time saving was estimated to be 53 minutes per day.

(c) Cost Savings

4.5.15 The savings in costs generated by time savings in the delivery of care have been assessed by the independent economic consulting firm, Applied Economics, as part of its economic evaluation of the demonstrable benefits of the trial.

4.5.16 The trial demonstrated that, as a minimum, the use of wireless technology in the ED saved 20 hours and 23 minutes per day or 7,439 hours per year of labour by the FTE 83 clinicians in that department.

4.5.17 The CHW considers that as the ED is highly representative of all other departments in the hospital these minimum time savings can be applied to the hospital as a whole. Based on this assumption, Applied

[7] NTF Group

Economics has calculated that the use of wireless technology across all departments in CHW would save a potential 122 000 clinical hours. Using 2005/06 prices this is estimated to save CHW $7.4 million per year.

4.5.18 The calculation of these savings is described in more detail in the economic evaluation by Applied Economics at Attachment C.

4.6 Benefits of Using ICT to Support Health Care

(a) National and International Evidence of the Benefits of the Connected Health Model

4.6.1 There are numerous national and international examples of hospitals embracing the connected health model. In general the model and technology supporting it is being adopted to improve three activities that are often related - access to information; process efficiency and process reliability. All of these outcomes improve patient care and health outcomes, optimise demand management and reduce the need for capital spending on bed and other infrastructure capacity enhancements.

4.6.2 In these national and international examples the implementation of ICT to deliver connected health models is accompanied by equally sophisticated measurement and management. To maximise value from information technology hospitals must "look to measure improvements in process and quality that are made possible by IT systems". The systems themselves very rarely have a return on investment. It's how you use them".[8]

(i) *Access to Information*

4.6.3 Faster access to clinical and patient data at the point of care has been demonstrated to improve clinical care because it enables medical staff to make properly informed decisions in reduced time and increases the reliability of treatment and medication. Internationally, various tools are used to provide clinicians with access to information from any location, including, personal digital assistants (PDAs), electronic tablets, wireless laptops and bedside monitors.

[8] George Brenckle, Chief Information Officer, University of Pennsylvania Health Systems, Philadelphia. Based on a 2005 survey of 1200 US hospitals.

4.6.4 The qualitative benefits of faster access to information are represented in the following international and national examples. [9]

- *NorthCrest Medical Center, Springfield, Tennessee, USA* – replacement of paper based administrative system in the emergency department (ED) with an ICT network and pocket PCs for clinicians. The capacity of clinicians to access patient data at the point of care via their pocket PCs has reduced the time patients spend in the ED by an average of 30 minutes and enabled the hospital to maintain existing staff levels to meet demand, despite an increase in the volume of patients by about 15 per cent.

- *Washington Hospital Centre, USA* – deployment of a real time clinical data system in the emergency department (ED) to increase the speed of treatment. Since the system was implemented in 1996 the ED has been able to increase admissions from 35 000 to 70 000 without expanding its bed capacity.

- *Inland Northwest Health Services, Washington State, USA* – implementation of an electronic medical record (EMR) across 5 State hospitals and 25 regional facilities covering 2 million patients. Under the EMR system all clinicians can access patient data as well as clinical images required for diagnostic and treatment purposes via their wired and wireless desktop, laptop and PDAs devices. The system has saved between 30 and 45 minutes in the daily rounds of clinicians.

- *Sentara Norfolk Hospital, Norfolk, Virginia, USA* – deployment of wireless based remote monitoring technology to create a 'virtual' Intensive Care Unit (ICU). The virtual ICU consists of medical staff who monitor a patient's condition through video of the patient's room, and the patient's vital signs, EMR and heart rate and other alerts. The virtual ICU can trigger necessary patient attention by communicating with onsite medical staff. The system has delivered a number of benefits including a 25 per cent decrease in mortality rates for ICU patients; and a 26 per cent decrease in the cost of treating and 17 per cent decrease in the length of stay of ICU patients leading to savings of US$2150 per patient. Total savings for the hospital is estimated at US$3 million per year.

- *St Vincent's Hospital, Melbourne, Victoria, Australia* – clinicians use small wireless handheld computers and laptops to access patient

[9] These examples are taken from research undertaken by CHW and its consultants as well as a 2003 report on the international development of digital hospitals by the US based First Consulting Group.

information at the point of care and patient bedside. The system has enabled clinicians to save about 15 minutes per transaction and reduced their need to leave a patient's bedside to access information by 50 per cent.

(ii) *Process Efficiency*

4.6.5 The qualitative benefits of process efficiency are represented in the international and national examples below.[10]

- *Denmark* – an independent study has demonstrated that electronic patient referrals to hospitals can save the health system about €$3.5 million annually.

- *York, UK* – an internet telephony system is used to locate available beds for patients transferring out of emergency departments. This is estimated to have reduced about 8% of the time nurses spend on administrative work, thereby enabling them to dedicate more time to patient care.

- *Mount Carmel St Ann's Hospital, Ohio, USA* – implementation in the emergency department (ED) of a system that automates all features of patient data collection and care delivery in order to drive workflow and alert clinicians to critical tasks including the time patients are spending in the ED and any clinical blockages to patient flow. The system is estimated to reduce costs by $1.5 million each year.

- *St Vincent's Hospital, Birmingham, Alabama, USA* – Vocera communication badges are used to speed up contact between clinical staff in the neurology unit. The system is estimated to have saved clinical staff about 30 minutes each day in the time normally spend searching for each other.

- In 2004 the USA Centres for Medicare and Medicaid Services compared the average length of stay (ALOS) of patients in digitally advanced hospitals with all hospitals. ALOS for patients is considered an indicator of efficiency. A comparison of the operating revenue of digitally advanced hospitals with all hospitals was also made as this can be a result of efficiency. Whilst it is not being suggested that the results of these comparisons are definitive about the value of digital hospitals it is clear that use of modern ICT in the US environment has had positive benefits for the efficiency and cost of health care in a 4

[10] Ibid

year period. The results of the ALOS and revenue comparisons are described in the tables below.

Table 2 – *Average length of stay (ALOS) for digitally advanced hospitals compared with all hospitals* [11]

Year	ALOS for digitally advanced hospitals	% change	ALOS for all hospitals	% change
1999(a)	5.91		5.9	
2000	5.89	-0.20	5.8	-1.69
2001	5.89	-0.10	5.7	-1.72
2002	5.76	-2.10	5.7	-0.00
2003(b)	5.62	-2.40	5.7	-0.00

(a) The first year of ICT investment towards digitalisation.
(b) Advanced digitalisation has occurred.

The results demonstrate that over a 4 year cycle digitally advanced hospitals were able to reduce ALOS for patients at a significantly higher rate that all hospitals, although the largest gains are achieved after an initial 2 year ramp up period and at a time when ICT systems are most advanced.

Table 3 – *Change in operating revenue for digitally advanced hospitals compared with all hospitals* [12]

Year	Digitally advanced hospitals % change	All hospitals % change
2000(a)	11.09	6.32
2001	5.05	8.35
2002	11.02	9.69
2003(b)	8.02	7.64
Cumulative Increase	40.18	36.01

(a) The first year of ICT investment towards digitalisation.
(b) End of 4 year budget cycle.

The results demonstrate that over a 4 year cycle digitally advanced hospitals were able to increase their operating revenue by about 4% more than all hospitals. The spikes in revenue for digitally advanced hospitals in 2000 and 2002 reflect an increase in health care applications enabled by ICT

[11] PricewaterhouseCoopers, Reactive to Adaptive: Transforming Hospitals with Digital Technology, 2005
[12] Ibid

investment undertaken in 1998. The lower than average revenue for digitally advanced hospitals in 2001 reflects an increase in expenses and full time equivalents (FTEs).

(iii) *Process Reliability*

4.6.6 The qualitative benefits of process reliability are represented in the following international and national examples.[13]

- A 2004 study by the USA centres for Medicare and Medicaid Services demonstrates that the compliance of digital hospitals with the quality indicators for acute myocardial infarction and heart failure care consistently exceed the US national average for all hospitals by up to 5 per cent. [14]

- *Darwin Hospital, Northern Territory, Australia* – a wireless system for medication management has been introduced. Medical staff use wireless laptop computers to prescribe, administer and review medication. The system has delivered time savings and reduced the risk and incidence of errors in the medication management process.

4.7 Cost, Benefits and Economic Evaluation of the Permanent Use of Wireless Technology at CHW

4.7.1 The economic evaluation of the trial results has been undertaken by Applied Economics, an independent economic consultancy. Its report is at Attachment C. A summary of its findings is provided below.

(a) Cost of Applying Wireless Technology at CHW

4.7.2 The cost of applying medical grade wireless technology in all departments at CHW on a permanent basis consists of both capital and recurrent expenditure. The incremental costs have been calculated over a nine year period allowing for capital spending in 2006/07, recurrent spending from 2006/07 – 2014/15 and recapitalisation of equipment in operational year 4 (2010/11).

4.7.3 Over the nine year period estimated incremental expenditure consists of:

[13] These examples are taken from research undertaken by CHW and its consultants.
[14] PricewaterhouseCoopers, Reactive to Adaptive: Transforming Hospitals with Digital Technology, 2005

- $4.05 million in 2006/07 for the capital cost of a wireless ICT system.
- A recurrent cost of $100 000 each year from 20007/08 for the licence fee to use WHFCDs.
- A recurrent cost of $275 000 every two years from 2007/08 to replace batteries for the MCDs.
- A recurrent cost of $843 000 in 2010/11 for the recapitalisation of equipment.

4.7.4 Over the 4 year budget cycle from 2006/07 – 2009/10 the funding required to implement medical grade wireless technology across CHW is estimated to be $4.625 million consisting of:

- $4.05 million in 2006/07 for the capital cost of a wireless ICT system.
- $575 000 in 2007/08 – 2009/10 for the recurrent costs of operating the system.

4.7.5 If the funding already provided by private donors for the trial (about $765 000) is taken into account the total capital cost for the project in 2006/07 is $4.8 million.

(b) Benefits of Applying Wireless Technology at CHW

4.7.6 The international evidence discussed in this submission identifies that ICT systems that improve access to patient and clinical information and speed up communication between clinicians provide real savings in treatment time and accuracy. This has a direct benefit on the quality and safety of patient care, process efficiency and reliability. The results of the wireless technology trial at CHW discussed in this submission affirm the international evidence that advanced ICT systems save clinical treatment time for staff and patients.

4.7.7 Savings in clinical treatment time lead to direct savings in health care costs because labour is used more effectively. The labour costs at CHW represent 70 per cent of the hospital's operating costs. Of total labour costs, clinical labour costs represent 68 per cent. Substantial time savings in clinical treatment can therefore represent significant cost savings. As discussed in this submission at 4.5(c) the cost savings that result from applying wireless technology to all departments in CHW is estimated to be about $7.4 million per year (based on constant 2005/06 prices).

4.7.8 This estimated cost saving is considered to be conservative given that it is based on constant year to year prices and because it ignores the reality that greater time savings would accrue in outgoing years as

medical staff become more familiar with wireless technology applications and functions.

4.7.9 Based on international evidence, other benefits can accrue from the use of wireless technology, including safer and higher quality patient care, when it is combined with, and used to accelerate, the adoption of new clinical applications and fundamental business process and workflow reform. Given the length of the trial undertaken at CHW is has not been feasible to measure this and other related benefits as part of the economic evaluation.

(c) Economic Evaluation of Using Wireless Technology at CHW

4.7.10 The estimated benefit of the project is reflected by the net present value (NPV). The NPV is the sum of the net benefit for each year of the project over its nine year life. The NPV calculation is applied to the sum of net benefits whether based on the incremental cost (which does not include the trial capital costs already funded) or the total cost (which considers the entire capital cost). The table below illustrates the net benefit for each year of the project based on incremental and total costs.

Table 4 - *Summary of costs and benefit, Wireless Infrastructure, CHW, constant 2005/06 prices, $000s* [15]

	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Incremental project:									
Costs	4,050	*100*	100	375	943	375	100	375	100
Benefit	-	6,939	6,939	6,939	6,939	6,939	6,939	6,939	6,939
Net benefit	**-4,050**	**6,839**	**6,839**	**6,564**	**5,996**	**6,564**	**6,839**	**6,564**	**6,839**
Total project:									
Costs	4,815	100	100	375	943	375	100	375	100
Benefit	0	7,390	7,390	7,390	7,390	7,390	7,390	7,390	7,390
Net benefit	**-4,815**	**7,290**	**7,290**	**7,015**	**6,447**	**7,015**	**7,290**	**7,015**	**7,290**

4.7.11 As recommended by NSW Treasury, the NPV can be assessed by discounting the sum of net benefits by 4%, 7% or 10% to reflect varying sensitivities. The economic assessment of the trial results applies all these discount rates to assess the NPV in varying scenarios. Based on a central 7% discount the NPV for the project based on incremental costs is $33.2 million and the NPV based on total costs is $$35 million.

[15] Applied Economics

4.7.12 It should be recognised that even if the benefits were only half of the amount estimated in the economic evaluation, the benefits of the incremental and total project would be substantially higher than the costs.

4.7.13 Accordingly, the economic assessment concludes that the investment by NSW Health in the implementation of wireless technology across all departments in CHW is a worthwhile allocation of funds.

5. CONSULTATION

5.1 This submission has been prepared in consultation with the Chief Information Officer and other senior management at NSW Health as well as the private companies sponsoring the trial.

6. IMPACT ON THE RURAL COMMUNITY

6.1 The investment of wireless technology at CHW would assist to reduce the time taken to treat the children of all families, including rural families, who require admission to the hospital. Faster accurate responses by clinicians at the point of care because of improved access to data and communications can reduce the need for longer hospitalisation of children and improve the safety and quality of patient care.

6.2 This can deliver significant cost savings for rural families where it reduces the need for travel to and from and accommodation in Sydney and permits them to attend to the primary activities that underpin their livelihood.

6.3 Supporting the mobility capabilities within CHW that improve remote access to clinicians, reduce treatment time and improve the accuracy, safety and quality of patient care also assist to reduce the burden on the network of health services upon which rural communities rely for primary, secondary and rehabilitative care.

7. REGULATION

7.1 There is no legislation required for this proposal.

8. FINANCIAL IMPACT

8.1 Funding is being sought from Treasury worth $6.518 million over nine years or $4.575 million over 4 years. This funding would be in addition to other ICT funding that may be sought by CHW or NSW Health as part of budget estimates.

8.2 A Financial Impact Statement is at Attachment D.

9. ATTACHMENTS

A - A New Business Model for Health Service Delivery
B - Existing ICT Infrastructure Enhancements at CHW
C - Economic Evaluation of Wireless Technology at CHW
D - Financial Impact Statement
E - Report on Trial Data

CEO
Children's Hospital at Westmead

ATTACHMENT A – A New Business Model for Health Service Delivery

Since 1999, the US magazine Hospitals & Health Networks has undertaken a survey to find the "most wired" hospitals. More recently, the survey has also included a section on the "most wireless" hospital as well. What the survey reports is progress in the evolution and application of a new business model for the delivery of hospital-based health care. That business model, described by some as the emergence of the "digital hospital", is based on three basic elements:

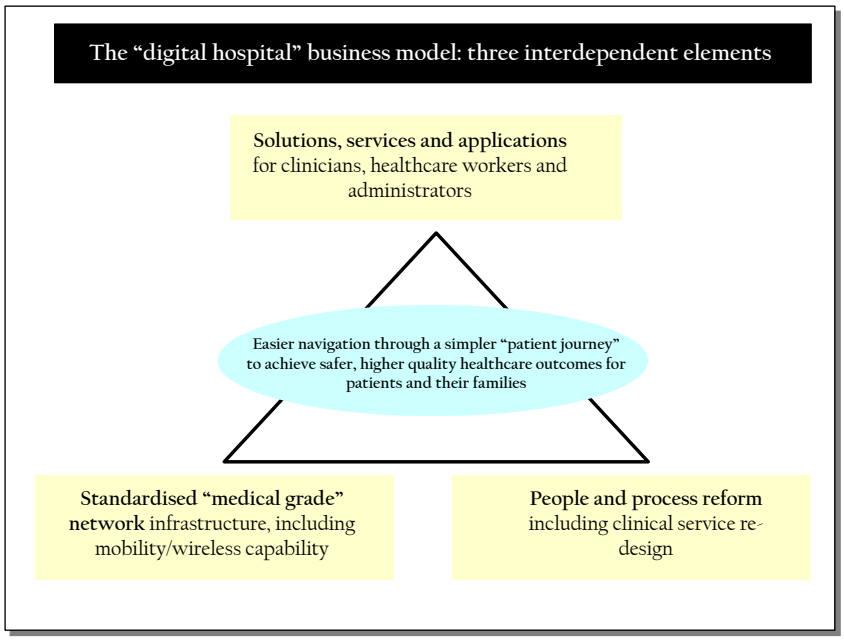
A central focus on patients and the safety and quality of the healthcare they receive

Using the integration of networked information and communication technologies to enable and accelerate deep process change to entrench clinical workflow changes and administration reforms

Careful and inclusive planning to determine technology priorities, to define a "balanced scorecard" of financial, health quality and patient satisfaction metrics and to ensure regular reviews to ensure that intended benefits are being realized to motivate successive waves of performance improvement.

The results of the latest "most wired" survey reinforce the impact of sustained reform strategies fuelled by more effective use of networked information and communication technologies, including especially the use of wireless technologies. This reflects the need to find platforms that give clinicians, healthcare workers and administrators access to their core (and new) applications while they are on the move.

The current wireless project at The Children's Hospital, Westmead should be seen within the context of its own journey towards becoming a digital hospital. It's real significance should be judged as a contribution to a longer-term process that is integrating clinical services workflow and business process reform, the introduction of new applications and services and the widespread availability of robust, secure and reliable networked ICTs.



Not only does this model explain the full value and potential implications of the mobility project. It also reinforces the need to assess the

business case not just in terms of one dimension of that model – providing the "medical grade" network infrastructure as the key enabling platform – but also in terms of the linkage between the three elements in this new healthcare delivery business model.

ATTACHMENT B - Existing ICT Infrastructure Enhancements at CHW

Project	Description	Main Users	Benefits
Electronic Orders	Ordering of pathology, Radiology and other patient services online via Powerchart	Clinical staff Doctors Senior Nurses	• Improved orders workflow and tracking • Reduce duplications of services • Allowed patient test results to viewed from multiple access points • Formed the basis for the Electronic Medical Record (EMR)
Email Upgrade	Upgrade emails system from GroupWise to MS Outlook/ Exchange	All Staff	• Update the email system to meet the current user requirements • Allow for enhanced functionality such as integration with MS Office and third party products • Improve meeting and resource scheduling capabilities • Move further toward the single logon/ synchronised passwords
Electronic Discharge Summaries	System that allows JMOs to complete inpatient discharge summaries	Clinical staff Doctors Senior Nurses	• Improved the quality of the inpatient discharge summary • Feed directly into the EMR to allow other staff access to the DS • Could generate copies for multiple providers eg GPs, Community Health, Paediatrician, etc. • Could track compliancy of the completed summaries
Patient Management/UPI /Scheduling – Phase 1	PM replaces Hospas and NPR with a system integrated with CHWs point of care system	Clinical staff Doctors Nurses Allied Health (eg Physio, Social worker) Clerical	• Improve coordination of patient services and activities within the hospital • Assist in delivering a more cost effective service. • Improve patient identification procedures to reduce the risk of errors. • New technical infrastructure that improves performance and security. • Improved reporting
Business Objects	Implement business objects management reports	Management Clinical/Admin	• Implement system in accordance with DOH strategy. • Allow managers to have access to an enhanced reporting tool. • Able to further develop reports using this tool that will allow further information in relation to the hospital activities.

Project	Description	Main Users	Benefits
EHR (Health e Link)	The NSW Health Electronic Medical Record. (CHW one of the pilot sites)	When live Clinical staff Doctors Nurses Allied Health (eg Physio, Social worker) Clerical	• Consumers are better informed about their health status • Consumers have access to and control of their health record • Consumers can be actively involved in the creation of their own health record • Timely access to health records for authorised health providers • Improved legibility and accountability as event summaries are electronically transmitted • Fewer errors and duplication of treatment as episodes of care can be tracked across all • A best practice evidence based health system • Better communication and access to information • Accessible information for audit and research purposes
PACS (Upgrade)	Medical Imaging	Clinical staff Doctors Nurses Allied Health (eg Physio, Social worker) Clerical	• Maintain the viability of PACS as current system at end of life • Modernisation of Legacy system • Reduce breakdowns and maintenance costs • Maintain the viability of the EMR • Eliminate need for major upgrades as a technology upgrade program proposed as part of maintenance strategy

Project	Description	Main Users	Benefits
Network Upgrade	Upgrade data network	All Staff	• Upgrade the Medical Imaging data Network to reduce risk and improve performance • Allow the distribution of Medical and Document images to the desktop without affecting other services • Improve performance of existing data network • Allow CHW the flexibility to use new technology, as it becomes available – such as digital telephony (Voice over I/P), video conferencing, video, etc • Reduce the risk of the existing Network failure • Improve staff productivity by having faster access to systems
Document Imaging	To digitally capture the paper medical record post patient visit to enable clinical access to the entire record via Powerchart	Clinical staff Doctors Nurses Allied Health (eg Physio, Social worker) Clerical	• Immediate access to patient records from an integrated system resulting in improved patient care. • Decreased likelihood of lost records • Multiple users able to access the record simultaneously • Meet the IM&T strategy of a single patient record • Replacement of microfiche system • Reduction in stationary costs • Long term reduction of staff within Medical Records
Health e Care ED	Upgrade the Emergency Department System	Clinical staff Doctors Nurses Allied Health	• Improved triage processes and data capture capabilities using templates • Improved patient flow processes and screen capture to assist medical staff. • Included the fever study requirements • Updated technology to improve the reliability and performance.

Project	Description	Main Users (eg Physio, Social worker) Clerical	Benefits

Project	Description	Main Users	Benefits
VPN	Access to CHW systems using a Virtual Private Network (VPN) via the internet in a secure manner	Clinical staff Doctors Nurses Allied Health (eg Physio, Social worker) Management	• Allow staff /Vendors access to CHW systems via the Internet at faster speeds in a secure manner • Reduced Data communication costs for Bear Cottage • Reduce Data communication cost for Medical imaging and improve services • Set up the framework for access to the E.H.R via the Internet in a secure manner that will meet the DOH patient information security policies
Eclipsys - Critical care system	PICU/NICU Clinical staff	Point of care clinical system for Critical care	• EMR for critical care areas • Direct feeds from patient monitors • Provides point of care documentation • Interfaces to pathology results
Stocca	Pharmacy	Pharmacy system	• Manages drug dispensing to patients • Tracks hospital drug usage • Improve patient safety using DSS
WinOrsos	Theatres staff (Clinical and admin)	Theatre management system	• Schedules appropriate theatre time • Provides mgt reports
STAMP	Central Sterilising Staff	Instrument tracking and management system for operating suites and	• Provides theatre instrument tracking • Saves 12 FTEs by automating processes

		central sterilising services department	
CBORD	Nutrition and Dietetics Staff	Diets management system for patients diets and menus	• Interfaces with patient Mgt system • Allows diets entry by nursing staff • Provides appropriate meals based on patients dietary requirements

ATTACHMENT C - Economic Evaluation

Economic Evaluation of Proposed Wireless Infrastructure and Services at The Children's Hospital at Westmead

Prepared for Cisco Systems Australia Pty Ltd
&
The Children's Hospital at Westmead

Applied Economics

September 2006

Contents

Acknowledgements

For this report, the Information Services Department at The Children's Hospital Westmead (CHW) provided data on the nature and costs of the wireless installation and on payroll data for the clinical workforce. The NTF Group provided data on labour productivity arising from three separate analyses of work in the Emergency Department at CHW.

Executive Summary

This report provides an economic evaluation of investing in a 'medical grade' wireless infrastructure and communication system at The Children's Hospital Westmead (CHW). As currently planned, the wireless infrastructure would support two major applications across all areas of the hospital:

- a set of wireless, hands-free, communications devices (WHFCDs); and
- a series of mobile computer devices (MCDs).

Further applications are possible, but are not part of this study.

A sponsor-funded pilot installation is already operating fully in the emergency department (ED) and partly in the surgical ward and the operating theatres.

A detailed statistical study of ED activities indicates that the pilot installation has yielded significant labour savings amounting to some 20 hours of labour time per day in ED. This is equivalent to about 15 minutes per staff person in ED per day. Two other sample surveys, one before and one after the installation, provide supporting evidence.

The cost of extending the wireless infrastructure and its associated applications to the rest of the hospital would require an additional investment $4.05m which would have to be funded by the hospital. During its 8-year expected life, the project would also need to meet various operating expenses and to replenish part of its capital.

Given that the staff composition in the rest of CHW is similar to that in ED, CHW advises that similar labour savings can be expected in the rest of CHW. The estimated value of these incremental labour savings is nearly $7.0 million per annum. These savings are likely to result partly in lower operating costs for a given patient load and partly in provision of extra patient services that would otherwise require additional resourcing at CHW or elsewhere.

Using constant 2005/06 prices, with a central discount rate of 7%, the estimated net present value (NPV) of the *incremental* project over a 9-year time horizon (allowing an additional year for gestation) is $33m. Including costs already incurred and savings already achieved, the estimated NPV of the *total* project is $35m.

These estimated net benefits are very high. This reflects the very labour intensive nature of current hospital practices and the potential for labour savings by the use of capital and technology.

It should be acknowledged that the results depend on observations of hospital work practices over a short post-pilot installation period and on observations in a small part of the hospital that may not be entirely representative of the rest of CHW. However, in so far as there is a learning curve associated with the introduction of wireless infrastructure applications, the estimated labour savings from the initial ED pilot experience may be conservative. Also, there are likely to be other benefits associated with the wireless infrastructure, notably some improvements in service quality, which have not been measured and valued in this report.

Accordingly the report concludes that the basic finding that the proposed wireless system and its applications are cost-effective is robust. The nature of the new network introduces opportunities for significant process change into hospitals of a character similar to the business process change that was experienced in clerical and financial settings during the late 1980s and the 1990s.

1. Nature of the Proposal and Costs

1.1 Description of the proposal

The Children's Hospital Westmead (CHW) is a purpose-built specialist children's hospital located in western Sydney, with 290 overnight beds and 49 beds for same-day treatment. It is a teaching hospital of the University of Sydney and the University of Western Sydney, and it is a leader in children's clinical research.

Since 15 March, 2006, CHW has been piloting a 'medical grade' wireless communication system in its Emergency Department (ED), operating theatres and its surgical ward.

The wireless infrastructure at CHW builds upon its existing IT and communications infrastructure, and is used to deploy two new layers of information and communications technology consisting of:

- a set of wireless, hands-free, communications devices (WHFCDs) to facilitate converged, voice-activated communication with IP telephony to replace CHW's current PABX; and

- a series of mobile computer devices (MCDs), consisting of laptop computers with independent power supplies on trolleys, to facilitate immediate, on line access to patient information and to comprehensive clinical data at any point of care in the hospital, including the bedside.

The wireless infrastructure also has the potential to assist in the deployment of a range of other related technologies, including for example radio frequency identification tags to assist in the tracking and correct identification of patients and plant and equipment.

CHW proposes now to extend the wireless system and the present two applications to all other clinical operations and to all other areas of the hospital.

1.2 Installation to date

The pilot installation has been made possible by donations from various sponsors (including Cisco, IBM and Dell). It consists of:

- a wireless infrastructure in the ED, the operating theatres and the surgical ward;
- 40 WHFCDs in the ED; and
- 10 MCDs, of which 3 are located in the ED, one in the surgical ward, one in the day theatre complex and 5 in the general theatres.

Sponsors' expenditure on the pilot to date has involved a total of $0.765m, consisting of:

- $70,000 for the MCDs;
- $73,000 for the WHFCDs; and
- $622,000 for the wireless infrastructure and associated consultancy.

1.3 Cost to complete the project

CHW estimates that the cost of the additional investment to extend the pilot project and equip all departments of the hospital would be $4.05m. This cost would be the responsibility of the hospital. The major cost components would be:

- expansion of the wireless network at a cost of $2.8m;
- an additional 100 MCDs at cost of $0.7m; and
- an additional 300 WHFCDSs at a cost of $0.55m.

2. General Description of the Benefits

2.1 Nature of the benefits

Operating in conjunction with the wireless infrastructure, the MCDs and WHFCDs offer clinical staff "anytime, anywhere" access to information and knowledge that helps, at the point of care, to provide for safer, more cost effective and better quality care. It provides the ability to stream information to the point of care, whether in a ward, an operating theatre or in an outpatient setting (Cisco, 2006). In removing bottlenecks in the flow of information—such as waiting for a paper record to be delivered to a nursing station or retrieving an electronic record from a nursing station or separating an order-entry from a ward round—the new technology provides clinical staff with the opportunity to deliver care more speedily and accurately. It contributes thereby to greater efficiency in the use of overall hospital resources.

The nature of the new network for the first time introduces opportunities for significant process change into hospitals of a character similar to the business process change that was experienced in clerical and financial settings during the late 1980s and the 1990s.

By changing the way in which clinical staff work, the new technology makes it possible for hospitals to realise significant productivity gains. These gains permit a given patient load to be treated at a lower cost with fewer staff or alternatively, for existing staff to treat a larger flow of patients.

2.2 Estimates of labour time savings in the ED

The NTF Group has conducted three studies that indicate potential or actual savings of labour time in the ED. The main study on which we draw is a detailed statistical study of savings in patient waiting times for ED, which can be interpreted as a saving in labour time in ED. Second, we draw on an observational survey of staff work before the wireless system as installed in ED, which indicated the potential savings from the applications of mobile computers and wireless, hands-free, communication devices. Third, we cite the NTF survey of staff estimates of time savings after the wireless system was installed in ED.[16]

It is possible to measure productivity change by observing the work practices of clinical staff before and after the introduction of the wireless infrastructure. In order to evaluate the impact of the pilot project, NTF conducted a detailed statistical analysis of patient ED waiting time. The ED was selected for the study because it was the only setting at CHW where both MCDs and WHFCDs were used in conjunction.

[16] The NTF Group has provided these results to Applied Economics by way of working notes. We understand that these notes or more formal reports will be available to Cisco and to NSW Health.

Patient attendances at CHW's ED are differentiated by various triage categories. Triage patients 1 and 2 are urgent categories, generally arriving by ambulance. They are invariably seen almost immediately. Category 3 represents other "urgent" categories; category 4 is "semi-urgent" and category 5 is "non-urgent" (generally substituting for a primary care, GP services).

NTF compared data on patient waiting time in the ED for triage 3 - 5 patients between 1 January, 2002 and 14 March, 2006 (without a wireless infrastructure) with data for the period 15 April, 2006 to 1 June, 2006 (commencing one month after the introduction of the pilot project). Importantly, the NTF study controlled for confounding variables such as illness type, periods of peak patient load and seasonal influences (public holidays, time of day, day of week, month of year, etc). NTF did not control for other inputs (labour or capital) or for other possible changes in operating practices in ED. However, CHW advised us that there were no substantive changes in resources or technology used in ED other than the introduction of wireless technology.

As shown in Table 1, NTF estimated that patients in triage category 3 saved an average of nearly 7 minutes per visit, triage 4 patients saved 15 minutes per attendance and triage 5 patients saved 14 minutes per attendance. Subsequent econometric analysis based on data in June and July 2006 indicates that further reductions in waiting time have been achieved. However, these findings were received after this report was drafted and have not been included in this report.

Multiplying the time savings per attendance by the number of ED attendances, the estimated total waiting time for ED per day amounted to 20 hours and 23 minutes.

Table 1: Daily saving in patient waiting time for the ED with wireless infrastructure, 15 April – 1 June, 2006

Triage category	Attendances per day	Savings per visit	Daily savings
3	33.06	6.94 minutes	3 hours, 50 minutes
4	34.49	15.20 minutes	8 hours, 44 minutes
5	34.19	13.73 minutes	7 hours, 49 minutes
Total			20 hours, 23 minutes

Source: The NTF Group (2006).

NTF interpret these results for savings in patient waiting time as implying that there is an equivalent savings in labour time within ED. Although there may not be a precise one-to-one equivalence between patient waiting time saving and labour time saving in ED, this interpretation seems broadly plausible.

It may be noted that with just over 80 effective full time equivalent staff in ED, a savings of just over 20 hours per day is equivalent to an average savings of about 15 minutes per day per staff member in ED. As will be seen, this is conservative compares with the results to two other two studies conducted by NTF cited below.

In the first of these studies, NTF conducted detailed observations of eight members of ED over a day before the wireless applications were installed. The staff included registered nurses, nurse specialists and staff specialists.

NTF asked the staff about the likely time impact of their work bottlenecks and the plausible daily time saving if such bottlenecks could be bypassed by way of seamless and immediate access to information and person-to-person communication. The estimated total time savings ranged from 21 to 78 minutes per clinician per day and averaged 53 minutes per day.

Table 2: Examples of potential savings in ED with removal of bottlenecks associated with conventional work practices

Examples of identified potential bottlenecks	Daily frequency	Potential total minutes to be saved per day
Looking for another nurse to complete a medication check	3	3
Two professionals simultaneously wanting to access a patient's chart and / or medical history	2	6
Breakdown in communication of exactly what is wanted by a consultant	1	4
No single way of informing all doctors / units caring for a patient when they are admitted other than by multiple phone calls / emails	3	12
Needing to leave a sensitive / important meeting with parents in order to answer a page	2	10
Unable to locate a Dictaphone in outpatients and consequently obliged to take files back to office to dictate letters	1	5
Waiting for return page	4	12
Patient paperwork mislaid	1	10
Records dispersed between computer and physical notes	5	15
Constant interruption of pagers	12	12
Unable to access notes at the bedside	10	5
Duplicate paper documentation need to be transcribed to a computer	10	10
Needing to access computer whilst on the phone	1	2
Need to manually check to ascertain whether a consult has occurred	2	6
Difficulty contacting / tracking down VMO	3	15

Source: The NTF Group

Examples of particular bottlenecks and the associated potential savings that were identified are listed in Table 2.

The third survey work by NTF comprised a series of questions to staff in ED about their satisfaction with the new applications, the quality of access to computers, the time spent waiting for a computer or in waiting to contact someone, and the amount of time that the WHFCDs saved them per day. While most of the questions and answers were suggestive of service improvements, most cannot be translated directly into estimates of savings in labour time or into better quality services. For example, savings in time waiting for computers of for calls cannot be translated directly into labour savings as staff can work on other matters while waiting.

However, the responses to the question 'how much time do you estimate the WHFCD has saved you each day?' are indicative of early benefits. Of the 24 nurses responding, 58 per cent stated that the WHFCDs saved them between 5 and 30 minutes per day and 13 per cent said that they saved them over 30 minutes in the day. On the other hand, for the 12 registrars, only a quarter considered that the WHFCDs had saved them more than 5 minutes in the day. The small savings here may reflect in part early learning and teething problems as the voice communication devices require clear voice speech and certain minor technical applications.

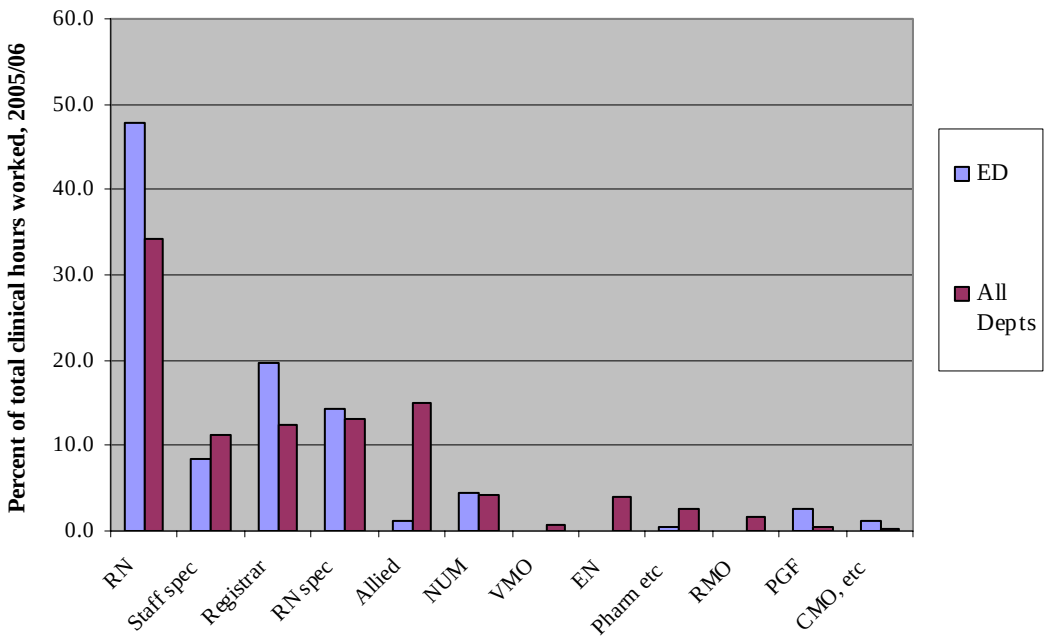
2.3 Estimated labour time savings in other areas of the hospital

The estimated labour time savings of 20 hours, 23 minutes per day in the ED due to the applications of the wireless infrastructure would translate into savings of 7,439 hours per annum (20.38 hours × 365 days).

CHW advised the consultant that the estimated labour savings of the 83 FTE clinical staff in the ED may be generalised to other departments at CHW as "the ED is highly representative of all other departments".

This view is supported by an analysis of the composition of clinical labour in the ED — represented by clinical hours per year per full time equivalent (FTE) type of labour—and the composition for the hospital as a whole. As shown in Figure 1, the compositions are similar. The main difference is that nurses are used more intensively and allied health less intensively in the ED than in the hospital as a whole.

Figure 1: Comparative mix of clinical labour: ED & all Departments, CHW



Accordingly, potential labour savings associated with extending the wireless infrastructure to all other areas of the hospital may be estimated by extrapolating the results for ED to the rest of the hospital. Given that there are 1,260 FTE clinical staff in all other Departments, there are 15.2 times as many equivalent clinical staff in these departments as there are in ED.

Multiplying the estimated savings of 7,439 hours per annum in ED by 15.2 produces an estimated savings of about 114,000 clinical hours per year in the rest of the hospital. (See Appendix B for more details). This represents the incremental benefit of installing the wireless system in the rest of the hospital.

Inclusive of labour savings already achieved, the estimated potential annual labour savings available to the hospital as a whole would be about 122,000 clinical hours (see Appendix B).

3. Economic evaluation

3.1 Introduction

In evaluating the economic benefit of the wireless infrastructure to the CHW, we distinguish between (i) the benefit of the incremental project, associated with its extension from the ED to all remaining Departments and (ii) the benefit of the total project, associated with its impact on the hospital as a whole.

The key parameters of the evaluation are the time horizon of the project and the discount rate to be employed. The former is governed by the expected life of the infrastructure and its applications. We are advised that the estimated commercial life of the wireless infrastructure is 8 years, while that of the WHFCDs and the laptop component of the MCDs is three years. The life of the trolley and power supply components of the MCDs is also about 8 years.

Allowing for the approval and installation of the incremental project during the remainder of 2006/07—during which time the incremental capital expenditure to complete the project would be disbursed—and a further eight operational years, we assume an overall 9-year time horizon (2006/07 – 2014/15; Appendix A). We also allow for the recapitalisation of the WHFCDs and the laptop computers in operational year 4 (2010/11).

We employ discount rates of 4%, 7% and 10%, as recommended by NSW Treasury (Office of Financial Management, 1999). The evaluation is in real terms, using constant 2005/06 prices.

3.2 Costs

The costs of the project and their phasing are set out in the tables in Appendix A. We distinguish between the incremental cost of the project—what the hospital will have to spend to extend the wireless infrastructure to all departments and the cost of the total project—including the value to date of sponsors' contributions to the pilot project.

The incremental capital costs that would be incurred in Year 1 (2006/07) to extend the pilot elsewhere would be $4.05m (as detailed in section 1.3). There would also be recurrent costs of $100,000 a year for a 'licence fee' to use the WHFCDs and a further $275,000 every two years after Year 2 to cover the cost of replacement batteries for the MCDs (including for those initially donated to the pilot). The WHFCDs and the laptop component of the MCDs would be recapitalised (again including those initially donated) in Year 5 (2010/11) at an estimated combined cost of $843,000.

The capital costs of the whole project (part already spent) would amount to $4.8m incurred in Year 1. Recurrent and replacement capital costs would be the same for the incremental project.

3.3 Economic benefits

Hospitals are highly labour intensive organisations. Labour costs represented some 70% of the operating costs of the CHW in 2004/5 (CHW, 2005). Some 68% of labour costs in turn represent clinical labour costs (Appendix B). It is thus not surprising that technical innovation such as a wireless infrastructure in hospitals should constitute a significant source of savings

in labour cost. There may be other savings too, but labour savings are the most readily identifiable source of economic benefit and are easiest to measure.

In section 2.3 it was noted that the estimated labour savings of the incremental project were likely to amount to some 114,000 clinical hours per year and that labour savings from the total project would be some 122,000 clinical hours per year.

A monetary value for these savings can be obtained by multiplying the number of hours saved them by the weighted average hourly cost of clinical labour at CHW. During 2005/06 this was $60.65 per FTE clinical employee ordinary time hour worked—incorporating a loading for 'on costs' as well as for the average amount of overtime payment per FTE clinical employee in that year. This equals the total clinical staff cost in 2005/06 divided by the total number of FTE clinical staff (see Appendix B). The average hourly cost of each type of labour was obtained from CHW payroll data.

The estimated cost saving in clinical labour as a result of undertaking the incremental project would thus be some $6.9m per year at constant 2005/06 prices ($60.65 × 114,000 hours). The estimated clinical labour cost saving attributable to the total project would be some $7.4m per year at constant 2005/06 prices ($60.65 × 122,000 hours).

We have modelled the savings at a constant $7.4m per year as the size of the workforce at CHW is unlikely to change in the foreseeable future. In the Medicare environment, savings are likely to be applied to the care of a larger flow of patients with a given stock of labour (providing there are no other constraints such as bed capacity). Nevertheless, constant year-to-year savings are likely to be a conservative estimate because this ignores the learning curve associated with introduction of wireless infrastructure applications. The savings are likely to increase after the workforce has gained experience in the functionality of the applications and become more proficient in their use.

Aside from savings in labour costs, there are likely to be other benefits associated with the wireless infrastructure which it has not been feasible to measure and value in this evaluation. These are likely to include savings attributable to superior quality care related to access to data that are more timely, accurate and accessible. The source of such quality savings would likely include avoidance of double medication and duplicated tests, more comprehensive discharge summaries and avoidance of errors from deciphering hand-written entries.

3.4 Evaluation

The stream of monetary values for the total costs and the total benefit of CHW's prospective investment in the wireless infrastructure for the identified nine-year time horizon, both for the incremental project and for the total project, are summarised in Table 3.

The stream of costs is determined by the initial capital investment and ongoing operating costs and replacement capital costs. The stream of benefits represents the projected year-to-year constant savings in labour costs.

Net benefit is the difference between benefit and costs. In every year, other than Year 1—in which the project is gestating—estimated net benefit is substantially greater than the value of the initial capital investment, whether for the incremental or total project. The actual net benefit is the sum of the series of net benefit throughout the life of the project, discounted back to 2006/07, measured in constant 2005/06 prices.

Table 3: Summary of costs and benefit, Wireless Infrastructure, CHW, constant 2005/06 prices, $000s

	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Incremental project:									
Costs	4,050	*100*	100	375	943	375	100	375	100
Benefit	-	6,939	6,939	6,939	6,939	6,939	6,939	6,939	6,939
Net benefit	**-4,050**	**6,839**	**6,839**	**6,564**	**5,996**	**6,564**	**6,839**	**6,564**	**6,839**
Total project:									
Costs	4,815	100	100	375	943	375	100	375	100
Benefit	0	7,390	7,390	7,390	7,390	7,390	7,390	7,390	7,390
Net benefit	**-4,815**	**7,290**	**7,290**	**7,015**	**6,447**	**7,015**	**7,290**	**7,015**	**7,290**

Source: Appendix A

The estimated value of the project is given by the net present value (NPV) of the project. Using a central discount rate of 7%, the estimated NPV for the incremental project is $33.2m. Allowing for sensitivities at 4% and 10%, the estimated respective NPVs are $39.0m and $28.5m (Appendix A, Table A.1).

For the total project, at a central discount of 7%, the estimated NPV is $35.0m, and at 4% and 7%, the respective NPVs are $41.2m and $30.0m (Appendix A, Table A.2).

3.5 Project Risks and Sensitivity Analysis

In any project there are risks. In this case the major risk is that the benefits are overstated. Underestimation of costs is possible but, if it occurs, it is not likely to be a major underestimation.

Benefits could be overestimated because the estimated benefits in ED at CHW are overestimated or because the benefits in the rest of CHW would not be as great per full-time clinical staff employee as in ED. With regard to the former risk, each of the three survey approaches employed by NTF has some limitations. However, collectively they point in a similar direction and towards similar magnitudes of time savings and therefore potential cost savings. Also our estimates of benefits make no allowance for improvements in the quality of care. With regard to extrapolation of the benefits to the rest of CHW, the hospital advises that the ED is a good approximation of the experience of other Departments in the hospital.

Given that the present value of the estimated benefits is some eight times greater that then estimated present value of the costs, even if the benefits were only a half of the amount estimated in this report, the benefits of both the incremental project and the total project would be substantially higher than the costs.

References

Children's Hospital at Westmead (CHW) (2005) *Annual Report of the Royal Alexandra Hospital for Children*, Westmead.

Cisco (2006) *Connected Health @ The Children's Hospital, Westmead* (Extending network capacity and capability to put patients and clinicians at the centre of responsive networks of knowledge, service, trust and accountability), Sydney

NTF Group (2006), *Modelling the effect of the wireless infrastructure on ED waiting time*, working note, NTF Group, Sydney.

Office of Financial Management (1999) *Economic appraisal: principles and procedures simplified* (Policy and guidelines paper), NSW Treasury, Sydney.

Appendix A Economic Evaluation of Wireless System at CHW

Table A1: Economic Evaluation of Incremental Wireless System, at constant 2005/06 prices, $000

	1	2	3	4	5	6	7	8	9
YEAR	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
COSTS, $000s									
Incremental costs (ie cost of extending system beyond ED)									
Incremental capital cost:									
Wireless infrastructure	2,800	0	0	0	0	0	0	0	0
Mobile Computer Devices (MCDs) (100 units)		0	0	0	0	0	0	0	0
- trolleys and power supplies @ $5,000	500	0	0	0	0	0	0	0	0
- laptop computers @ $2,000	200	0	0	0	220	0	0	0	0
Wireless hands-free communication devices (WHFCDs) (300 units)	550	0	0	0	623	0	0	0	0
Sub Total, incremental capital cost	4,050	0	0	0	843	0	0	0	0
Incremental operating cost:									
Maintenance (replacement batteries, MCDs) @ $250	0	0	0	275	0	275	0	275	0
Annual Licence Fee (WHFCDs)	0	100	100	100	100	100	100	100	100
Sub total, incremental operating cost	0	100	100	375	100	375	100	375	100
TOTAL INCREMENTAL COSTS#	4,050	100	100	375	943	375	100	375	100
BENEFITS, $000s (see Appendix B, Table B.1)	0	6,939	6,939	6,939	6,939	6,939	6,939	6,939	6,939
INCREMENTAL NET BENEFIT	-4,050	6,839	6,839	6,564	5,996	6,564	6,839	6,564	6,839
	@ 4%	@ 7%	@ 10%						
NPV OF INCREMENTAL NET BENEFIT, $000s	$39,035	$33,228	$28,493						

Table A2: Economic Evaluation of Total Wireless System at constant 2005/06 prices, $000

	1	2	3	4	5	6	7	8	9
YEAR	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
COSTS, $000s									
Overall costs, including the cost of sponsors' contributions									
Overall capital cost:									
Wireless infrastructure	3,422	0	0	0	0	0	0	0	0
Mobile Computer Devices (MCDs) (110 units):									
- trolleys and power supplies @ $5,000	550	0	0	0	0	0	0	0	0
- laptop computers @ $2,000	220	0	0	0	220	0	0	0	0
Wireless hands-free communication devices (WHFCDs) (340 units)	623	0	0	0	623	0	0	0	0
Sub Total, overall capital cost	4,815	0	0	0	843	0	0	0	0.00
Overall operating cost:									
Maintenance (replacement batteries, MCDs) @ $250	0	0	0	275	0	275	0	275	0
Annual Licence Fee (WHFCDs)	0	100	100	100	100	100	100	100	100
Sub total, overall operating cost	0	100	100	375	100	375	100	375	100
TOTAL OVERALL COSTS#	4,815	100	100	375	943	375	100	375	100
TOTAL BENEFIT, $000s									
Savings in clinical labour costs (Appendix B, Table B.2)	0	7,390	7,390	7,390	7,390	7,390	7,390	7,390	7,390
TOTAL NET BENEFIT	-4,815	7,290	7,290	7,015	6,447	7,015	7,290	7,015	7,290
	@ 4%	@ 7%	@ 10%						
NPV OF TOTAL NET BENEFIT, $000s	$41,220	$35,031	$29,985						

Appendix B Data for Economic Evaluation

Table B.1 Data for Benefits of Incremental Wireless Application

All Departments, CHW, other than ED:	
1. No of FTE clinical staff employed in all Departments other than ED, CHW	
Registered Nurse	431.6
Staff specialists	136.5
Registrars	148.0
Registered nurse specialists	168.0
Allied health personnel	197.1
Nursing Unit Managers	53.4
VMOs (contracted)	10.0
Enrolled Nurse	56.0
Pharmacists & Assistants	34.7
Resident Medical Officers	22.0
Post Graduate Fellow	3.0
CMO & Medical Officer, other	3.0
2. Total hours worked 2005/06, Clincal staff other than ED, CHW:	
Registered Nurse	754,437
Staff specialists	262,080
Registrars	269,952
Registered nurse specialists	293,664
Allied health personnel	359,510
Nursing Unit Managers	97,402
VMOs (contracted)	19,200
Enrolled Nurse	97,888
Pharmacists & Assistants	63,293
Resident Medical Officers	40,128
Post Graduate Fellow	5,472

CMO & Medical Officer, other	5,472
Total	2,268,498
3. Total time saving in all Departments other than ED, 2005/06 (ex- NTF study), hours:	114,415
4. Weighted average hourly cost, Clinical labour, including overtime loading & on costs, CHW, $s:	60.65
5. Estimated cost saving in clinical labour in all departments other than ED, (3 × 4) 2005/06, $'000s:	6,939,259

Source: Information Services and Payroll, CHW; The NTF Group (2006).

Table B.2 Data for Benefits of Total Wireless Application

Emergency Department (ED), CHW:	
1. No of FTE clinical staff employed in ED, CHW	
Registered Nurse	40.4
Staff specialists	6.5
Registrars	16.0
Registered nurse specialists	12.0
Allied health personnel	0.9
Nursing Unit Managers	3.6
VMOs (contracted)	0.0
Enrolled Nurse	0.0
Pharmacists & Assistants	0.3
Resident Medical Officers	0.0
Post Graduate Fellow	2.0
CMO & Medical Officer, other	1.0
	82.7
2. Total hours worked 2005/06, Clincal staff ED, CHW (1 × 5):	
Registered Nurse	70,619
Staff specialists	12,480
Registrars	29,184

Registered nurse specialists	20,976
Allied health personnel	1,642
Nursing Unit Managers	6,566
VMOs (contracted)	0
Enrolled Nurse	0
Pharmacists & Assistants	547
Resident Medical Officers	0
Post Graduate Fellow	3,648
CMO & Medical Officer, other	1,824
Total	147,486
3. Total time saving in ED, CHW, 2005/06 (ex- NTF study), hours:	
	7,438.7
CHW, Overall:	
4. Total FTE clinical staff employed CHW	
Registered Nurse	472
Staff specialists	143
Registrars	164
Registered nurse specialists	180
Allied health personnel	198
Nursing Unit Managers	57
VMOs (contracted)	10
Enrolled Nurse	56
Pharmacists & Assistants	35
Resident Medical Officers	22
Post Graduate Fellow	5
CMO & Medical Officer, other	4
5. Ave ordinary time hours per year worked per FTE clinical worker:	
Registered Nurse	1,748
Staff specialists	1,920
Registrars	1,824

Registered nurse specialists	1,748
Allied health personnel	1,824
Nursing Unit Managers	1,824
VMOs (contracted)	1,920
Enrolled Nurse	1,748
Pharmacists & Assistants	1,824
Resident Medical Officers	1,824
Post Graduate Fellow	1,824
CMO & Medical Officer, other	1,824
6. Total ordinary time hours worked 2005/06, Clincal staff CHW (4 × 5):	
Registered Nurse	825,056
Staff specialists	274,560
Registrars	299,136
Registered nurse specialists	314,640
Allied health personnel	361,152
Nursing Unit Managers	103,968
VMOs (contracted)	19,200
Enrolled Nurse	97,888
Pharmacists & Assistants	63,840
Resident Medical Officers	40,128
Post Graduate Fellow	9,120
CMO & Medical Officer, other	7,296
Total	2,415,984
7. Estimated total time saving in CHW, 2005/06 (extrapolated from 3 to 6), hours:	
	121,854
8. Total cost of clinical labour, CHW, incl overtime loading & on costs, $000s	
Registered Nurse	42,727
Staff specialists	30,506
Registrars	20,250
Registered nurse specialists	17,279

Allied health personnel	15,624
Nursing Unit Managers	6,456
VMOs (contracted)	4,962
Enrolled Nurse	3,217
Pharmacists & Assistants	2,971
Resident Medical Officers	2,506
Post Graduate Fellow	708
CMO & Medical Officer, other	620
9. Average hourly wage / salary / sessional cost per FTE, incl overtime loading & on costs, 2005/06 (8 ÷ 6), $	
Registered Nurse	51.74
Staff specialists	111.44
Registrars	67.70
Registered nurse specialists	55.01
Allied health personnel	43.22
Nursing Unit Managers	62.32
VMOs (contracted)	258.46
Enrolled Nurse	32.87
Pharmacists & Assistants	46.54
Resident Medical Officers	62.45
Post Graduate Fellow	79.18
CMO & Medical Officer, other	84.93
10. Weighted average hourly cost, Clinical labour, including overtime loading & on costs, CHW (from 9 & 4), $s:	60.65
11. Estimated overall cost saving in clinical labour, CHW 2005/06 (7 × 10), $000s	7,390,415

Source: Information Services and Payroll, CHW; The NTF Group (2006).

ATTACHMENT D – Financial Impact Statement

PROPOSAL: Funding Wireless Technology at CHW Beyond The Emergency Department – Incremental Costs at 2005/06 Prices

YEAR	Forward year 1 2006/07	Forward year 2 2007/08	Forward year 3 2008/09	Forward year 4 2009/10	Forward year 5 2010/11	Forward year 6 2011/12	Forward year 7 2012/13	Forward year 8 2013/14	Forward yr 9 2014/15
REVENUE $000s	0	6,939	6,939	6,939	6,939	6,939	6,939	6,939	6,939
EXPENDITURE $000s									
Incremental capital expenditure:									
Wireless infrastructure	2,800	0	0	0	0	0	0	0	0
Mobile Computer Devices (MCDs) (100 units)		0	0	0	0	0	0	0	0
- trolleys and power supplies @ $5,000	500	0	0	0	0	0	0	0	0
- laptop computers @ $2,000	200	0	0	0	220	0	0	0	0
Wireless hands-free communication devices (WHFCDs) (300 units)	550	0	0	0	623	0	0	0	0
Sub Total, incremental capital expenditure	4,050	0	0	0	843	0	0	0	0
Incremental operating expenditure:									
Maintenance (replacement batteries, MCDs) @ $250	0	0	0	275	0	275	0	275	0
Annual Licence Fee (WHFCDs)	0	100	100	100	100	100	100	100	100
Sub total, incremental operating expenditure	0	100	100	375	100	375	100	375	100
TOTAL EXPENDITURE $000s	4,050	100	100	375	943	375	100	375	100
NET REVENUE $000s	-4,050	6,839	6,839	6,564	5,996	6,564	6,839	6,564	6,839

ATTACHMENT E – Trial Evaluation Report

CHW Wireless Infrastructure
The NTF Group Research

25 September, 2006

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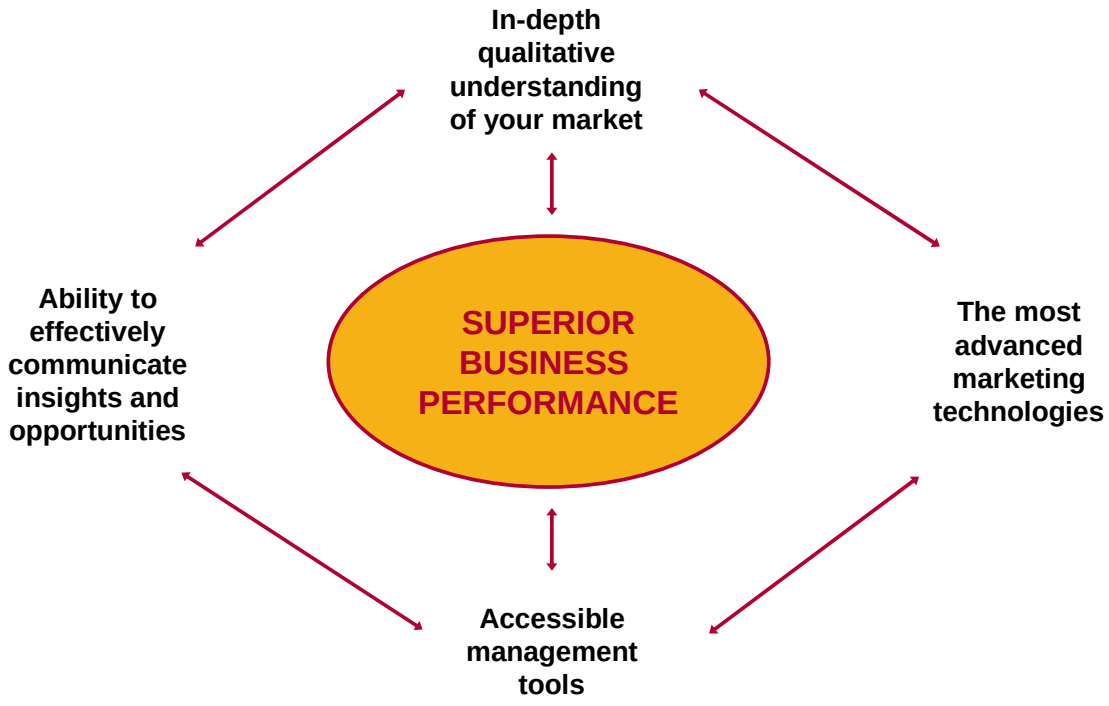
TABLE OF CONTENTS

1 THE NTF GROUP

The NTF Group was established in 1995 by Greg Taylor and Joan Nelson to fill the gap in high calibre management support required to improve the productivity of marketing and management activities.



The NTF Group is an analytic marketing consultancy and its strategy is to develop customised solutions for clients by integrating understanding of their business and qualitative insight into human behaviour, with:

- internal information systems,
- primary research and
- proprietary analytic techniques.

Further information on The NTF Group is available at www.ntf.com.au
.

2 OVERVIEW

2.1 Research Undertaken

The NTF Group were commissioned by Cisco Systems to undertake a range of research activities designed to assess the impact and effectiveness of installing wireless technology in the Children's Hospital at Westmead.

Specifically, the NTF Group:

- Undertook clinician-based observational research in June/July 2005, prior to wireless technology installation involving the following clinicians
    - Clinical Nurse Specialist – Surgical Unit
    - Staff Specialist -:Paediatric Intensive Care
    - Staff Specialist - Surgery
    - Clinical Coordinator – Surgical Unit
    - Medical Fellow
    - Medical Department Head of Emergency
    - Medical Registrar
    - Surgical Resident

  During this research, the following information was captured about each clinician
    - detailed information about the activities undertaken during a 'typical' day
    - the time taken to perform frequent activities and how often these were undertaken or attempted
    - bottlenecks in process that could potentially be improved by devices dependent on wireless technology

- Conducted two online surveys amongst nurses, fellows, consultants, registrars, and department heads. The first survey ran over the December '05/January '06 period (prior to deployment of wireless) and covered the following topics:
    - perceptions about the time taken to
        - obtain computer access
        - complete paperwork & do admin tasks
        - wait for a return page or trying to contact someone
        - retrieve patient records
        - file patient observations
        - locate pathology results
    - satisfaction ratings in a number of areas (eg amount of time spent with patients, time it takes to locate patient records)
    - efficiency ratings in a number of areas (eg daily handover process, bed allocation process etc)
    - staff frustration levels

  The second survey ran in April '06 (after deployment of wireless and use of communication devices and computers on wheels) and covered the following topics:

- perceptions about the time taken to
  - obtain computer access
  - wait for a return page or trying to contact someone
- satisfaction ratings in a number of areas (eg amount of time spent with patients, time it takes to locate patient records)
- perceptions about the time saved by the introduction of the Vocera device and the COWS

- Analysed admissions data for the Emergency Department (ED) for the 54 month period 1st January 2002 to 1st June 2006 to assess the impact (if any) of the devices dependent on the wireless infrastructure on the time taken to see a patient after he or she presented at ED.

2.2 Key Findings

2.2.1 Observational Research

It was found there were key areas of potential time saving which could be addressed by a communications device and by improved access to computers:

Communication

Difficulty locating the right person to speak to

Systems do not support all activities

Not able to view or source all patient information at point of care
Difficulty locating medical histories & charts
Continually logging on & off to check if test results had come back

Access to computers

Waiting to access
Speed of connection in some parts of the hospital
Positioning
Number of computers available

Subsequent measurement of waiting time data supported the view that the wireless network would assist in harvesting some of the potential time-saving.

2.2.2 Online Staff Surveys

Before-and-after measurement of staff attitudes showed that satisfaction had improved in important areas related to the time spent finding the right person for a consult or conversation, and in the ease of computer access. These improvements might reasonably be at least partly attributed to the introduction of the wireless network.

Open-ended comments in the survey supported the view that increased satisfaction resulted from the introduction of wireless-dependent devices.

The estimated time saving as a result of using the communication device was an average of 24.8 minutes per shift. The time saving in accessing a computer ranged between 12% and 25% per occasion of needing to access.

2.2.3 Modelling ED Waiting Time Data

ED Waiting time data was modeled using data for the 54 months prior to installation, a one month training period and then subsequent months.
The variables that were available to explain the variability in waiting times were as follows:

- Public Holiday
- Day of Week
- Month of Year
- Hour of Day
- Count of patients being seen at time
- Description of illness
- Wireless status (coded as a three-level categorical variable to denote whether the admission happened during the pre-installation, training, or in-use period)

The following savings in waiting time were observed:

	In-Use Period A*	In-Use Period B**
Triage 3	7.0 ± 1.3 minutes	12.5 minutes
Triage 4	15.0 ± 2.3 minutes	24.9 minutes
Triage 5	13.6 ± 2.2 minutes	22.2 minutes

** These results are for the period 15/4/2006 to 31/5/2006 only*

** These results are for the period from 1/6/2006 to 30/6/2006 only*

3 OBSERVATIONAL RESEARCH

3.1 Objective and Scope

The aim of this component of the research was to understand how improved connectivity and communication could help clinicians and healthcare workers to be more effective in providing better care to patients by starting first with observing in fine detail what a day in their life is like and documenting areas that may be improved.

The clinicians observed were: Staff Specialist: Paediatric Intensive Care Unit (PICU), Staff Specialist Surgery, Medical Registrar, Surgical Resident, Medical Fellow, Clinical Coordinator Surgical ward, Clinical Nurse Specialist Surgical ward, Medical Department Head of Emergency.

3.2 Key Findings

The study determined that The Children's Hospital is a long way down the track in achieving the provision of 'information at the right place at the right time' for all clinicians and health care workers within the hospital. They have a project plan through to 2007 to achieve the majority of their initiatives if they are able to secure the financial backing.

There is an extremely collaborative approach between the IT department and all clinicians and departments within the hospital. All initiatives are integrated into service improvement committees and agendas. The IT department is seen as an integral facilitator of the initiatives, with the clinicians owning the content, presentation and functionality.

This was a very refreshing and positive environment that is delivering incremental benefits to all clinicians to ultimately provide better health care to their patients.

There were currently a number of areas for improvement experienced by all clinicians observed. These were:

Communication

Difficulty locating the right person to speak to

Systems do not support all activities

Not able to view or source all patient information at point of care
Difficulty locating medical histories & charts
Continually logging on & off to check if test results had come back

Access to computers

Waiting to access

Speed of connection in some parts of the hospital
Positioning
Number of computers available

Bed/Theatre/Staff & Equipment Management

No real time or integrated view of beds, theatre, staff and equipment availability, location or projected requirements.

Although The Children's Hospital is a long way towards achieving their ultimate goal of providing better health care to their patients through the provision of the right information at the right time, the observational research identified areas for opportunity that in most cases were planned to be addressed in future projects. The key areas are:

- The need for a campus-wide scheduling solution that effectively schedules the entire hospital's use of beds, staffing resources, theatre and supplies. e.g. pharmacy & equipment.
- A single point of access to all patient data requiring the integration of all programs, scheduling and paper information. This includes task allocation, pushing of data as it becomes available with assistance with decision making and plan of care for the patient
- Sufficient access points to obtain electronic data either via computers or Personal Computing devices
- Locating and contacting the right person
- Direct access to information in real time

The spreadsheet in the Appendix summarises observed bottlenecks for each clinician and identification of possible harvestable time and cost saving if they are fully addressed.

4 ONLINE SURVEYS

4.1 Objective and Scope

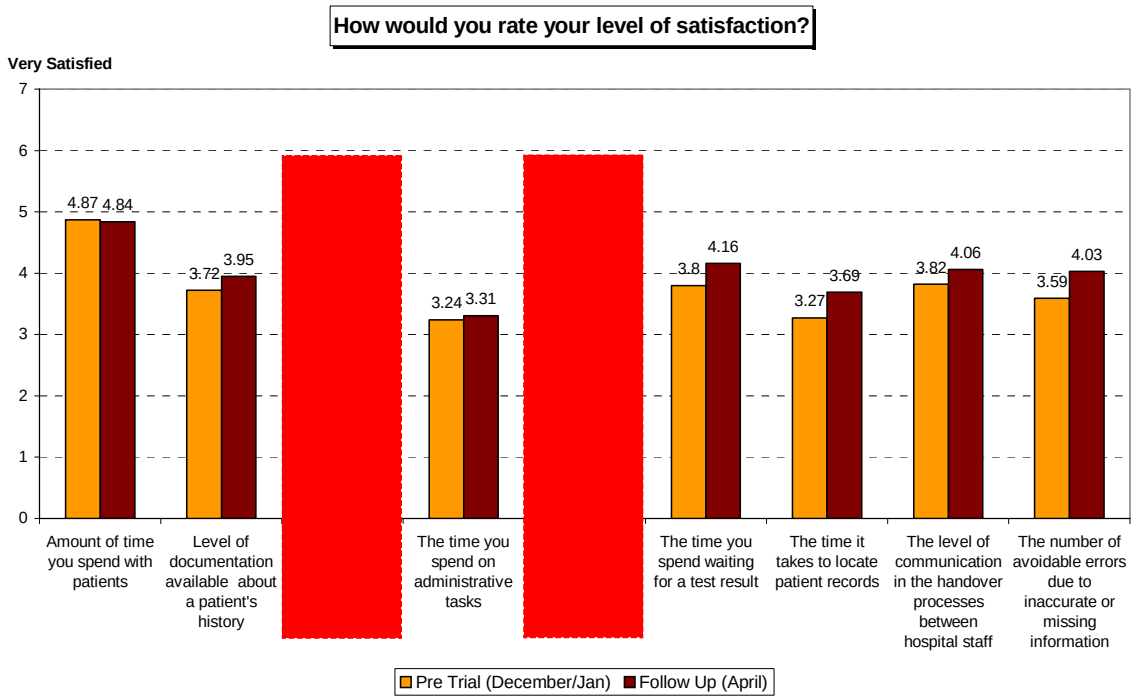
The aim of this component of the research was to identify and quantify specific improvements that might be attributed to the introduction of the wireless infrastructure.

To do this, an initial benchmarking survey was conducted in the December '05/January '06 timeframe and included 64 respondents, including Nurses, Registrars, Consultants, Fellows and Heads of Department.

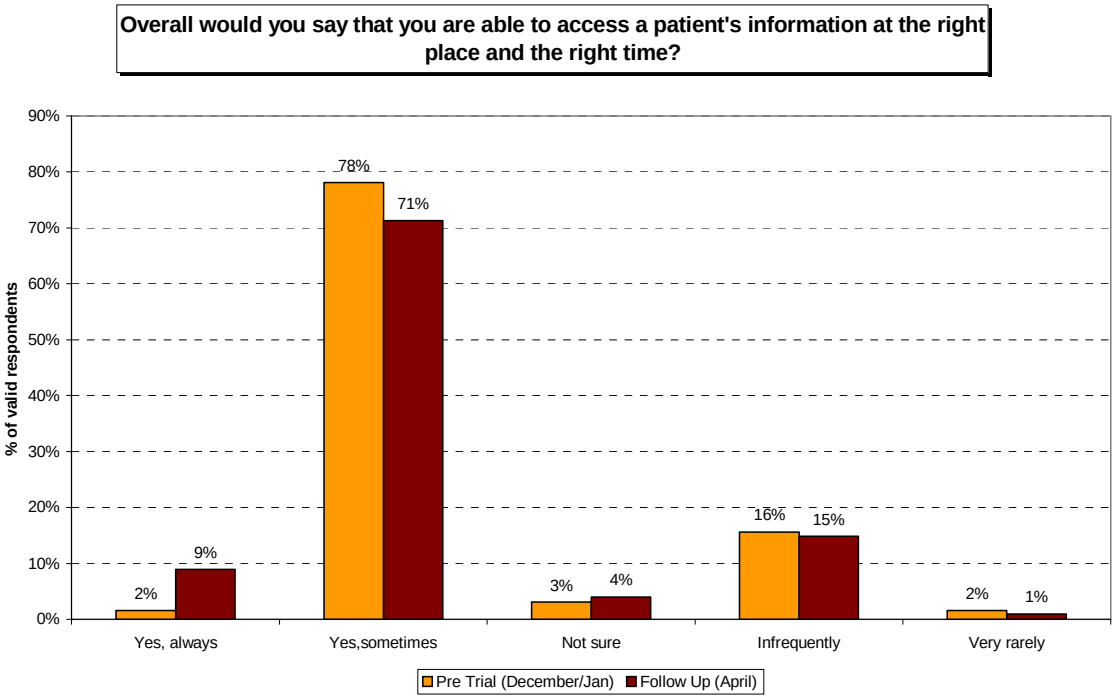
A follow up survey was then conducted in April '06 amongst clinicians from the same roles. For this survey there were 98 respondents.

4.2 Key Findings

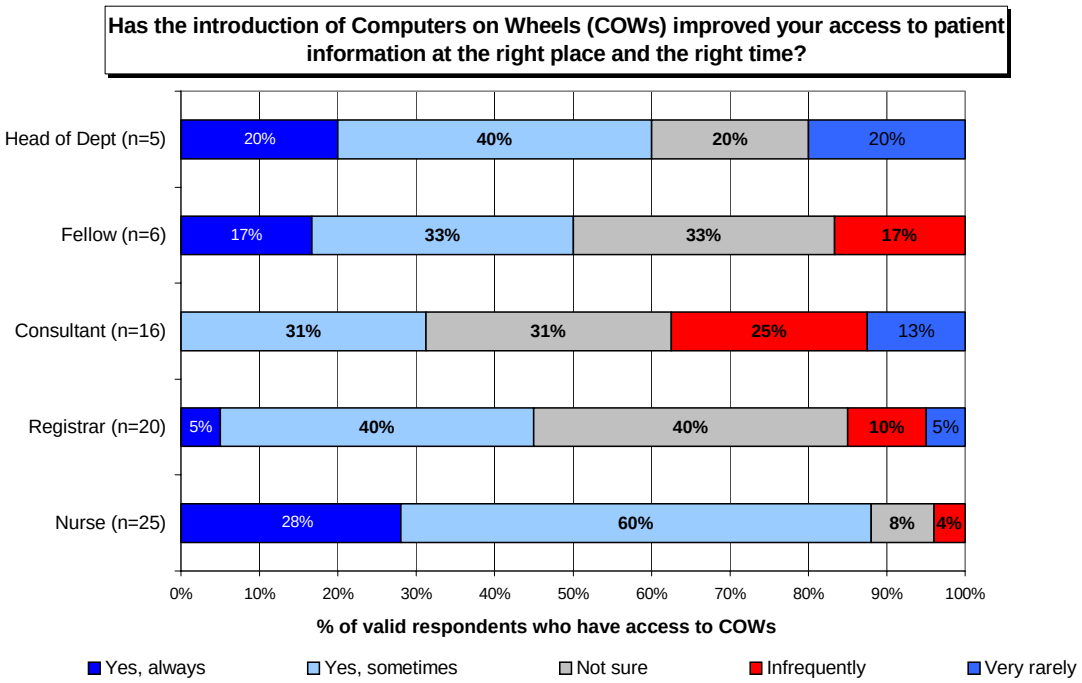
One of the areas in which it was hoped that improvement would be evident was in the satisfaction levels of staff. As the chart below shows, this was, indeed, generally the case. Particularly large improvements were seen in the satisfaction levels related to the time spent finding the right person for a consult or conversation, and in the ease of access to a computer, both of which might reasonably be at least partly attributed to the introduction of the wireless network.



On the specific issue of accessing patient information at the right place and time, a small improvement was recorded, with the proportion of people answering “Yes, always” rising from 2% to around 9%.

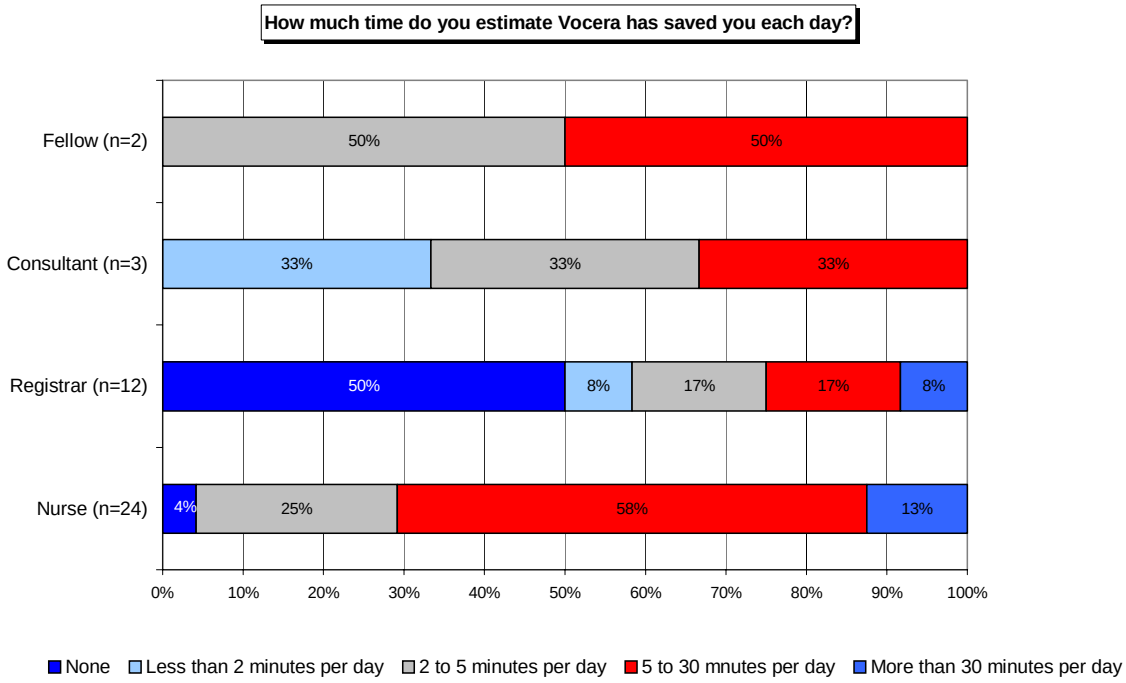


When asked a similar question specifically in the context of the Computers on Wheels (COWs), improvement was most strongly felt by nurses, amongst whom over a quarter claimed that the introduction of COWs had led to a consistent improvement in their timely access to patient information.



In the second (post wireless) survey, those respondents who had used a communication device were asked to estimate how much time they estimated it had saved them each day.

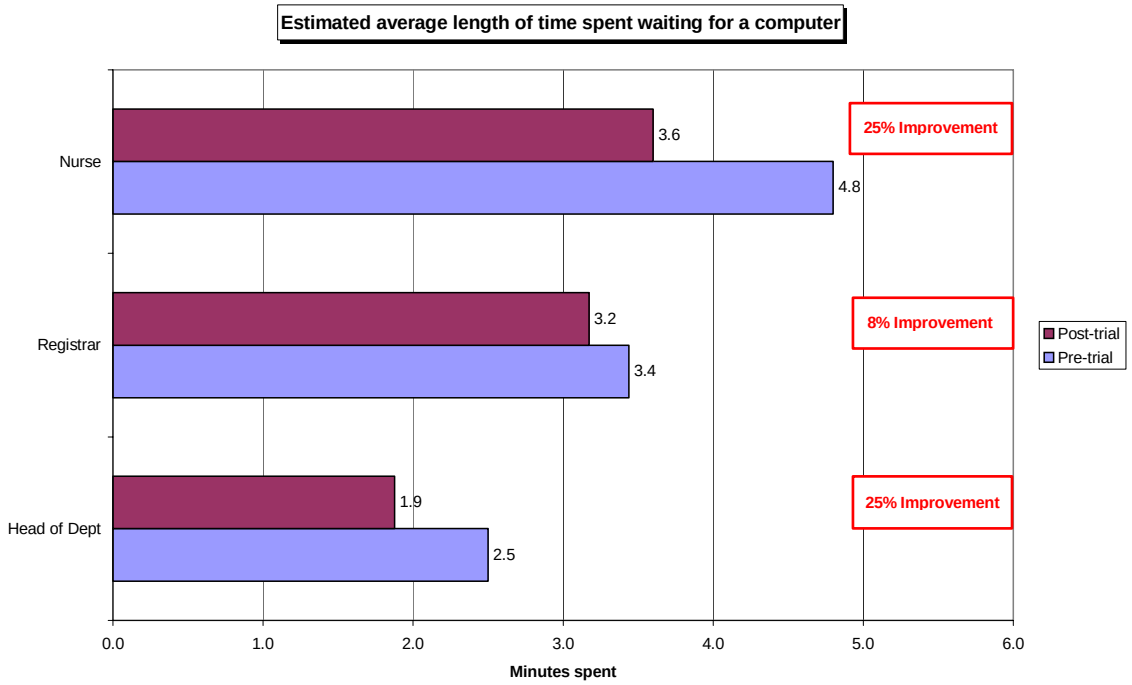
Most strikingly, over 70% of nurses felt that the device had saved them more than 5 minutes per day. Indeed, over 10% felt that it had saved them more than 30 minutes per day.



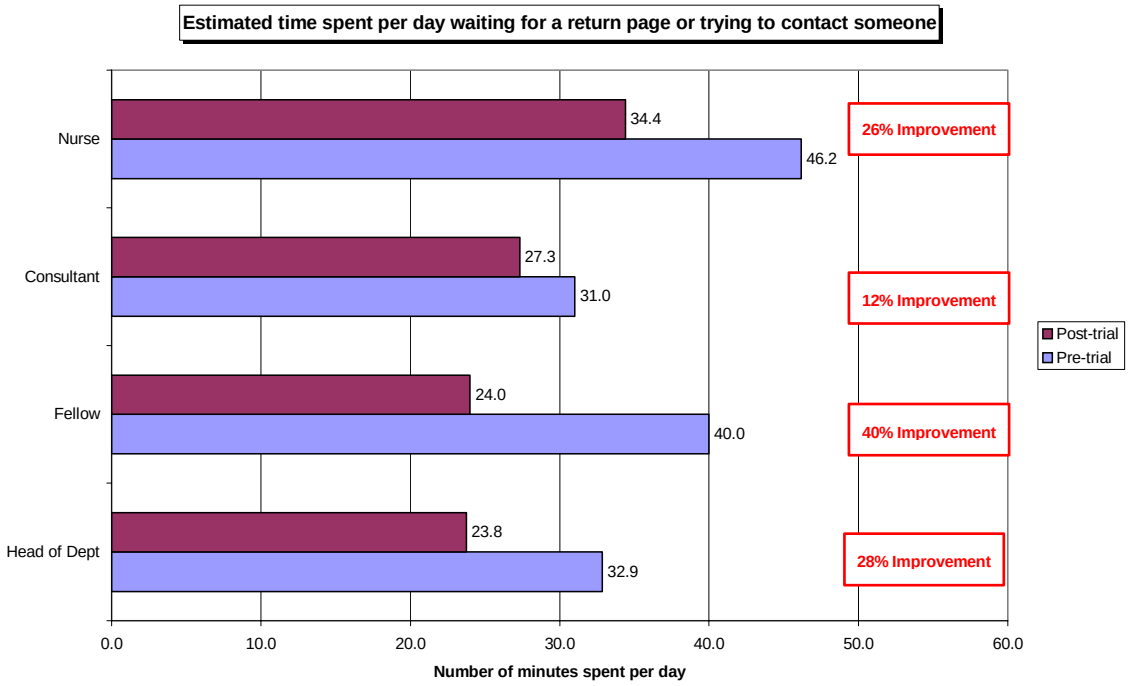
A follow-up question to those who had said they were saving time asked if they could estimate actual time saved. This showed that the average time saved was 24.8 minutes.

To assist in estimating the size of potential savings from introducing the wireless infrastructure, respondents were also asked how much time they spent, on average, waiting for a computer.

The results are summarised in the chart below, from which it can be seen that estimated savings ranged from 8% to 25% and were highest for nurses and heads of department.



For the same reason, respondents were also asked how much time they spent, on average, waiting for a return page or trying to contact someone. The results are summarised in the chart below, from which it can be seen that estimated improvement ranged from 12% to 25% and were highest for fellows, but also high once again for nurses and heads of department.



Open-ended comments

Comments by staff indicated that increased satisfaction and improvement in time saving were the result of devices dependent on the wireless technology:

- *I do not have to wait near a phone (and guard that phone with my life for others using it) endlessly for that other person to return my call. I can walk around and start seeing another patient, or do other tasks while waiting*
- *I can contact people more easily, don't miss call backs and am not limited by the phone system.*
- *Access to information without leaving the patient*
- *Easier access to computer where and when I need it*
- *Reduced time searching for nurses/AINs*

5 EMERGENCY DEPARTMENT DATA ANALYSIS

5.1 Objective and Scope

The aim of this component of the research was to build a statistical model to estimate the size of any reduction in waiting times due to the introduction of the wireless network for patients presenting at CHW's ED.

Data, provided by CHW's ED, was available for all patients entering ED during the period 1st January 2002 to the 1st June 2006 and, for the purposes of modelling, was split into three time periods:

- *Pre-installation period: 1st January 2002 to 14th March 2006*
- *Training period: 15th March 2006 to 14th April 2006*
- *In-use period: 15th April 2006 to 1st June 2006*

5.2 Modelling Approach

The data included, for each admission, three time stamps: the time that the patient presented at ED, the time that the patient was first seen by a clinician, and the time that the patient was discharged, for whatever reason, from ED.

For this phase of modelling the focus was on the first interval - that is, the interval between the patient presenting at ED and first being seen by a clinician. For simplicity, we call this the 'waiting time.

When patients arrive at ED they are assigned a triage category, which is a number ranging from 1 to 5 that reflects the urgency with which they must be seen. Since patients assessed at triage 1 or 2 are generally seen immediately, it was reasoned that little time saving could be expected from this group, so no model was fitted to the data for these patients.

Also excluded were obvious outliers, which were patients for whom waiting times greater than 6 hours were recorded. As these cases tended to come predominantly from the pre-installation period, the exclusion of them is likely to, if anything, understate the estimated impact of the introduction of the wireless technology.

The variables that were available to explain the variability in waiting times were as follows:

- Public Holiday (coded as a binary variable)
- Day of Week (coded as a seven-level categorical variable)
- Month of Year (coded as a twelve-level categorical variable)
- Hour of Day (coded as a twenty-four-level categorical variable)
- Count of patients being seen at time (a numeric variable created by NTF)

- Description of illness (coded as a thirty-one-level variable, with separate levels for each of the 30 most common descriptions and a single level, “Other”, for all other descriptions)
- Wireless status (coded as a three-level categorical variable to denote whether the admission happened during the pre-installation, training, or in-use period)

5.3 Key Findings

Initially, various linear models were fitted to the raw waiting time variable and to some standard transformations of it (log, square root, etc). However, the extremely long ‘tail’ of the waiting time variable – even after the outliers had been removed - made model-fitting problematic. Accordingly it was deemed to appropriate to discretise the waiting time variable.

Separately then, for each of triage categories 3, 4 and 5, approximate quintiles were calculated (rounded to the nearest minute since waiting times were calculated in minutes) and used to create a categorised waiting time variable for each observation.

Then, again separately for each triage category, an ordered logit was fitted with these quintiles as the dependent variable. Each fitted ordered logit was then used to predict the probabilities that a given admission from the pre-installation period would have fallen into each of the five waiting time categories, had the wireless infrastructure been in place.

These fitted probabilities were then averaged across all respondents and the mean category waiting times were then applied to these averages to produce predicted minutes saved. This was then compared to average actual waiting times for the period and produced the following improvements in waiting times (relative to the pre-installation period).

Improvement in Waiting Time

	In-Use Period A*	In-Use Period B**
Triage 3	7.0 ± 1.3 minutes[17]	12.5 minutes[18]
Triage 4	15.0 ± 2.3 minutes	24.9 minutes
Triage 5	13.6 ± 2.2 minutes	22.2 minutes

** These results are for the period 15/4/2006 to 31/5/2006 only*

** These results are for the period from 1/6/2006 to 30/6/2006 only*

[17] Boot-strapped 95% Confidence Interval
[18] Confidence Intervals not generated for Period B

5.4 Caveats

Whilst every care has been taken to control for factors whose variability might otherwise explain variability in waiting times, the possibility remains that the estimated reductions are not entirely the result of the introduction of the wireless infrastructure.

For example, it might be the case that the number of staff or their skill and experience level were unusually high during the period for which the wireless network was in place. Accordingly, some caution should be exercised in extrapolating the time estimated savings into the future.

Nevertheless, the size of the improvements is such that it seems reasonable to conclude that the wireless infrastructure has reduced patient waiting times.

6 APPENDIX

Observational Research of Clinicians

		Issue/Bottleneck		Total minutes
AH	1	No quick reference to key dates in chart or medical history such as theatre date (s) and return from ICU	1 x 2 mins	2
AH	2	Continually flipping through charts to remember what to complete next and insert gathered data e.g. BSL	23 x av. 1 min	23
AH	3	Duplicate entry of observations on Clinical observations chart & Pain management observations chart	8 x 1mins	8
AH	4	Difficulty locating equipment on the ward	3 x av. 3 mins	9
AH	5	Looking for another nurse to complete a medication check	3 x 1 min	3
AH	6	Time taken search for correct vial size and to mix medications when do not have the correct volumes on hand. e.g. 4 vials of an antibiotics when need a 2 gram dose.	1 x 4 mins	4
AH	7	Constantly searching for patient charts and medical histories	4 x av. 1.5 min	6
AH	8	Two professional wanting to access a patient's chart and or medical history at the same time	2 x 3 mins	6
AH	9	Finding out a patient has been reviewed by a doctor only when the nurse has time to read the medical history or the family inform the nurse	1	
AH	10	Manual calculation/update of fluid balance chart	6 x av.1.5 mins	9
AH	11	Difficulty remembering passwords when do not log into the system frequently	1 x 1 min	1
AH	12	Logging on to Power Chart when test results not back	2 x 1 min	2
AH	13	Needing to refer to a manual copy of roster to determine shifts for the next month.	1 x 4 mins	4
AH	14	Breakdown in communication of exactly what is requested by a consultant	1 x 4 mins	4
AH	15	Missing a request for tests.	1 x 2 mins	2

AH	16	Needing to manually check the tests have been completed	2 x 2 mins	4
			Total Minutes	87
		Salary based on $60/hour for a week day morning shift - $540 for day	**Cost impact for day observed**	**$87**
		-		
DP	1	Although have electronic medical records, staff specialists choose to have a paper summary of all patients which they hand on to the next staff specialist on clinical.	32 x 1 mins	32
DP	2	Bed management: Balancing admissions; elective, from emergency & wards with transfers via NATS and exit blocks	5 x av. 5 mins	25
DP	3	Misinterpretation, misunderstanding or forgotten instructions in the care of a patient. No direct allocation of responsibilities during ward rounds, there is a level of assumption.	6 x av. 7 mins	42
DP	4	Only able to view PACS from the flight deck and not at the patient's bedside.	1 x 10 mins	10
DP	5	No single way of informing all doctors/units caring for a patient when they are admitted to hospital other than multiple phone calls/emails	3 x 4 mins (consequential time)	12
DP	6	Finding out a consult has occurred some time after the event.	1	
DP	7	Description of tested site location of tested site insufficient to determine if line sepsis or generalized sepsis	1 x 5 mins (consequenctial time)	5
DP	8	Sometimes unclear who the responsible consultant is within a unit managing a patient	1 x 5 mins (consequential time)	5
DP	9	No way to confirm if request for a test has been hear/received, unable to confirm if tests back unless manually check	2 x av. 3 mins	6
DP	10	There is no single way of providing a quick single message to multiple people.	4 x 3 mins	12
DP	11	Not all medication orders within CCIS	2	
DP	12	Due to pace in ICU, prioritize to spend time with patients/family so sometimes have to forfeit some documentation	1	
DP	13	Staff specialists not able to view a patient from home to tell them what is going on, this could potentially minimize the Specialists need to come into the hospital.	comment	

			Total Minutes	149
		Salary based on $120 /hour for a week day,day consulting shift - $1,320 for day	**Cost impact for day observed**	**$298**
		-		
AS	1	No quick reference to key dates in CCIS	1 x 4 mins	4
AS	2	Inconsistencies between own theatre list and theatre's. No real time view of theatre list. Receiving multiple phone calls to prioritize, change theatre list	3 x av. 1.6 mins	4.8
AS	3	Need to search for medical histories on ward	2 x 3 mins	6
AS	4	Locating patients and their parents	2 x 5 mins	10
AS	5	Needing to leave a sensitive/ important meeting with parents to answer a page.	2 x 2 min	4
AS	6	Bed and theatre management an ongoing juggle	3 x 2 mins	6
AS	7	Have to wade through three medical history volumes to locate information looking for. (confirm that the patient did not have a left Kidney and this was where her transplant was going)	1 x 7 mins	7
AS	8	Did not remember all requests for consults	1 x 7 mins (consequencial time)	7
AS	9	Speed of computers, holds up workflow. (outpatients)	2 x av. 3 mins	6
AS	10	Unable to locate medical history , hard or scanned (Relied on a letter that the patient's mother has kept for 10 years)	1 x 3 mins	3
AS	11	Consultant needed to check address on stickers correct	2 x .5 min	1
AS	12	Hand delivery of day admission forms	3	
AS	13	Use of post-it note and another staff member to communication with a clinician	1	
AS	14	Layout of outpatients clinic not conducive to staff specialists keeping an eye on the registrars.	comment	
AS	15	Manual insertion of patients for theatre into PDA	2 x 1 min	2
AS	16	Unable to locate a Dictaphone in outpatients therefore had to take files back to office to dictate letters.	1 x 5 mins	5
			Total Minutes	66

		Salary based on $150 /hour for a week day, day shift -$1650 for day	**Cost impact for day observed**	**$165**
NC	1	Duplicate documentation of patient's name.	4 x 1 mins	4
NC	2	Two systems used to capture the nurse's details shift worked and hours worked. Need to work between the two programs to provide correct picture	4 x 2 mins	8
NC	3	Program does not provide smart assistance to increase the ease and speed of use. e.g. role/unit association when log on –"why do I have to enter that every time? It should just come up automatically what your unit is."	6 x 1 mins	6
NC	4	Slow acceptance of data requiring multiple insertion of the same information	6 x 1 mins	6
NC	5 & 11	No single way of informing nurses updates post medical rounds without walking around the ward and informing them face to face	4 x 2 mins	8
NC	7	Incredible use of highly skilled resources for staffing allocation.	1 hour	
NC	8	Theatre list cumbersome and not user friendly only able to print off limited information due to size.	1 x 4 mins	4
NC	6 & 15 & 19	Continually managing the roster as staffing changes at least every hour	8 x av. 4 mins	32
NC	9 & 10	Use of multiple lists/staffing allocation	12 x av. 2 mins	24
NC	12	Verbal request to stoma supplies	3 x 2 mins	6
NC	13	Waiting for return page	4 x 3 mins	12
NC	14	Phone messages on post-it notes on computer that could get lost, not reached until much later in the day	5 notes	
NC	16 & 20 & 25	Difficulty locating equipment on ward	3 x 6 mins	18
NC	18	Limited amount of time on the floor due to attendance to administration issues.	only half hour maximum with patients	
NC	17 & 21	Not a 'power user' of computers	average 30 mins extra taken per day	

NC	22	Duplicate entry of data into different programs/documents and to different staff members.	4 x 2 mins	8
NC	23	Lost patient paper work.	1 x 10 mins	10
NC	24	Unit dependent IT systems – inability to access system to obtain required information.	4 x 2 mins	8
			Total Minutes	154
		Salary based on $ 62 /hour for a week day morning shift - $558 for day	**Cost impact for day observed**	**$159**
WA	1 & 3	Time taken to log onto computer	4 x 1 min	4
WA	2	post-it notes	2 x 1 min	2
WA	4 & 6 & 7	Difficulty locating night resident's pager number.	2 x av. 3 mins	6
	5	Phone does not work	1 x 2 mins	2
WA	9 & 16	Difficult to secure 40 long and short cases for physician clinical exams. (reading records)	4 x 15 mins	
WA	10	Records dispersed between computer and physical notes	5 x 3 mins	15
WA	11	Difficulty locating a vacant computer	1 x 5 mins delay	5
WA	12	Waiting on hold	7 min	7
WA	13	Time taken to obtain information from external source	1 x 5 min	5
WA	14	checking information from one program to the other	3 x 3 min	9
WA	15	Scheduling is read only with no facility to change (requires chasing up)	1 x 5 min lapsed time	5
WA	17	Finding test results	5 x 3 mins	15
WA	18	Time taken to obtain leave form	20 mins	20
WA	19	Pagers are a continual source of interruption	12 x av. 1 mins	12
			Total Minutes	107
		Salary based on $110 /hour for a week day, day shift - $990 for day	**Cost impact for day observed**	**$196**

MM	1	Difficulty ordering test on computer.	6 x 1.5 mins	9
MM	2 & 3	Not knowing who is on for each team	6 x 1 min	6
MM	4	Needing to call switch to determine name and pager number of person who is on	4 x .5 mins	2
MM	5	Needing to keep going back to the nurses' station to write up notes and medication charts	10 x .5 mins	5
MM	6	Consultants can write in Health e Care or on notes	6 x 1 mins	6
MM	7	Consultants reviewing patients and not writing in the histories or Health e Care.	8	
MM	8	Not able to access notes for bedside	10 x .5 mins	5
MM	9	Computer becomes slow if left on. Needed to turn off and reboot to keep speed up	4 x 1.5 mins	5
MM	10	Needing to enter other teams review comments into the system.	3 x 1.5 mins	4.5
MM	11	Test ordering system did not provide a message that the test was already ordered.	2 x 2 mins	4
MM	12	Lack of computers, team needing to use emergency computers (tie up resource & ED staff have to wait)	4	
MM	13	Unable to take call on the phone and refer to computer information (write up later)	3 x 1 mins	3
MM	14	Duplicate documentation on paper and then transcribed in the computer.	10 x 1 mins	10
MM	15	No easy reference point for key information	4 x 2 mins	8
MM	16	No prompt when test results come back	10 x 1 mins	10
MM	17	Staff often leave the phone where they have paged someone as they can not wait for the return call	4 x .5 mins	2
MM	18	Needing to leave what doing to answer the phone (interruptions take time from other tasks)	10 x .5 mins	5
MM	19	Waiting over an hour for a return page.	1	
MM	20	Not getting patients onto wards	7	
MM	21	No easy reference to all the medical specialists caring for patient as outpatient	4 x 1 mins	4
MM	22	Lack of time to write up notes	6 x 2 mins	12
MM	24	Uncertain if correspondence to GPs is received via parents.	only 40% get through	
			Total Minutes	100.5

		Salary based on $145 /hour for a week day morning shift - $1305day	**Cost impact for day observed**	**$243**
DS	1	Ever changing roster	1	
DS	2	Unsure which extension to call to obtain the scan results	1 x 1 min	1
DS	3	Constantly being paged	10 x av. 1 mins	10
DS	4 & 6 & 25 & 38	Information not held in one central location, need to look through multiple sources to locate all required information.	7 x av. 3 mins	21
DS	5 & 11 & 12 & 35	Duplicate data entry	6 x av 2 mins	12
DS	7	Operating off a paper list of patients which also acts as a 'To Do' list	8 x av. .5 mins	4
DS	8	No key point of reference to remind staff of initial presentation	1 x 2 mins	2
DS	9	Difficulty determining who the consulting gastro registrar is for the day.	1 x 1 min	1
DS	10	Needing to access a computer while on the phone	1 x 2 mins	2
DS	13 & 14 & 26 & 28	Need to search nurses' station to locate medical chart.	7 x 1.5 mins	10.5
DS	15	No built in prompts for ordering of tests.	1 x 4 mins	4
DS	16	Disconnected communication within the unit/team	1 x 6 mins	6
DS	17	Requiring nursing staff assistance to navigate through CCIS	1 x .5 mins	0.5
DS	18	Needing to change computers as sat at computer designated for ward clerk.	1 x .5 mins	0.5
DS	19 & 22	Continual logging on/off to determine if tests results have come back.	8 x av. 1 min	8
DS	20	Missed communication between referring team and surgeon re underlying reason for admission, arguably the patient had developed far more complex problems since admission.	3 x av. 3 mins	9
DS	21	Carries around yesterday's patient list as a prompt and reference of important information, saves writing it down again on today's list.	2 x av. .5 mins	1
DS	23	Need to follow up on test results and slow return of test results when marked urgent.	2 x av 2 mins	4

DS	24	Waste of valuable time	1 x 5 mins	5
DS	27	Image report put on incorrect date in Power Chart	1 x 10 mins	10
DS	29	Need to manually check to see if a consult has occurred	2 x 3 mins	6
DS	30	No prompt as to what information is required to complete a discharge.	1 x 1 min	1
DS	31	No written documentation that the consultant had completed a discharge letter	1 x 3 mins	3
DS	32	Difficulty locating a vacant computer.	1 x 1 min	1
DS	33	Needing to restrict the use of a phone to ensure return page received.	1 x 5 mins	5
DS	34	Unable to hang around for colleagues to return calls when paged.	1 x 4 mins	4
DS	36	Not all wards manage their requests for on call doctors the same	1 x 1 mins	1
DS	37	Frustration when lists not maintained	1 x 3 mins	3
			Total Minutes	135.5
		Salary based on $55 /hour for a week day, day shift - $ 495 day	**Cost impact for day observed**	**$124**
AB	1 & 26	Wait for computers	4 x av. 3 mins	12
AB	2	Customize patient list	1 X 2 mins	2
AB	4	Difficulty locating right person	8 x av. 1 mins	8
AB	5 & 6 & 15	Duplication of data entry	6 x 1 mins	6
AB	7	Locating calculator	1 x 4 mins	4
AB	8	Documentation onto pieces of paper where there is a risk of losing	shuffling lots of pieces - numerous times - some disappear	
AB	9	Feel may not be able to take notes on PDA as too small	difficulty of typing or entering using a tool	
AB	10	Switch intranet service does not note who is on or who is taking consults etc today.	6 x 1 mins	6
AB	11	Only able to send short text messages	3 x 1 mins	3
AB	12	Wait by phone for return page	5 x av. 3 mins	15

AB	13	Request consult	4 x av. 4 mins	16
AB	14	Difficulty accessing magic web	2 x 2 mins	4
AB	16	Multiple sources to obtain all patient information	4 x av. 3 mins	12
AB	17	Uncertain if all consult request forms make it into the patient's medical history.	3 x av. 5 mins (consequential time)	15
AB	18	X-ray requests	4 x 2 min	8
AB	19	Not able to connect to Magic Web in conference room	1 x 15 mins	15
AB	20	Feel impractical to ask IT for simple directives/advice.	2 x av.3 mins	6
AB	21	Logging on to check if test results in	6 x .45 mins	2.7
AB	22	Not able to view all staff's schedule on line, including VMOs	3 x 2 mins	4
AB	23	Difficulty contacting/tracking down VMO	3 x 5 mins (on-going)	15
AB	24	Mistake with the medication route documented.	1 x 4 mins	4
AB	25	Difficulty deciphering colleague's hand writing	2 x 2 mins	4
AB	27	Chasing up X-ray results	2 x 3 mins	6
AB	28	No clear protocol for patient management	1 x 10 mins	10
AB	29	Difficulty accessing emails from home	mentions – not observed	
			Total Minutes	177.7
		Salary based on $70 /hour for a week day, day shift - $630 for day	**Cost impact for day observed**	**$208**

Key

	represents an occurrence or a comment by the clinician
	time saving currently possible with COWs and communication device
	time saving currently possible with communication device

Note Cost is based on %%%% Salary for the shift observed. No on costs have been factored in

AH Clinical Nurse Specialist – Surgical Unit

DP Staff Specialist – Paediatric Intensive Care

AS Staff Specialist - Surgery

NC	Clinical Coordinator – Surgical Unit
WA	Medical Fellow
MM	Medical Department Head of Emergency
DS	Surgical Resident
AB	Medical Registrar