UNIVERSITY OF SOUTHERN QUEENSLAND
Faculty of Engineering and Surveying

UTILISING SPATIAL TECHNOLOGY FOR HOSPITAL BED MANAGEMENT

A dissertation submitted by

Angela G. Nicholls
B. of Social Science (Geography)

In fulfillment of the requirements for the

Master of Geomatics

July 2010

ABSTRACT

This research utilised existing spatial geographic information system (GIS) technology to develop a data management system that was beneficial to health care practitioners and organisations. The research focused primarily on a public hospital environment by addressing the complexity of patient flow and/or patient allocation to a hospital bed and to provide an understanding of how to better manage the needs for future demands.

Current management systems are not fully integrated and do not have the capacity, or the development capability, to readily address current management deficiencies. Hospitals across the country are struggling to deal with issues such as access block, availability of beds and staff shortages.

A practical bed allocation management system tool, or eBeds, was developed as a prototype within the hospital environment to provide a patient management system that meets the protocols required by the health industry. It assists health care professionals to make informed and more accurate decisions for patient allocation to beds and provides further economical and beneficial patient care than current systems. The prototype also addressed the hospital management, community expectations and provides a flexible and dynamic advancement for the health industry. The application can also be expanded for future potential changes and will be discussed within this research (refer to Chapter 6).

The outcome of this research has demonstrated the beneficial role of GIS within the health care industry by providing efficient and effective decision-making tool to an existing organisation that is struggling to meet the demands of community expectations.

CERTIFICATION OF DISSERATION

I certify that the ideas, experimental work, results, analyses, software and conclusions reported in this dissertation are entirely my own effort, except where otherwise acknowledged. I also certify that the work is original and as not been previously submitted for any other award, except where otherwise acknowledged.

_____ _____

Angela G. Nicholls Date

ENDORSEMENT

_____ _____

Associate Professor Frank Young Date
Principal Supervisor

ACKNOWLEDGEMENTS

I wish to thank my Principal Supervisor, Associate Professor Frank Young, Faculty of Engineering and Surveying, University of Southern Queensland, for his enthusiasm, professionalism, dedication and, in particular, his patience throughout this process. I am eternally grateful to Frank's, and also to the University of Southern Queensland's, ongoing support and encouragement during this time whose invaluable experience and insights has helped me to achieve a far better expectation of my project.

I would also like to thank the staff at the Princess Alexandra Hospital, particularly the Mental Health Unit, for their time and knowledge in helping me to achieve the development of my application.

Finally, I would like to sincerely thank my husband, Victor, who has always encouraged me to achieve as many of my goals as possible and who has also demonstrated incredible patience and devotion throughout my studies. To my son Samuel - you make it all worthwhile.

TABLE OF CONTENTS

TABLE OF CONTENTS CON'T

5.6.1 Background and Environment ~~12~~477

TABLE OF CONTENTS ~~CON'T~~CON'T

TABLE OF CONTENTS CON'T

GLOSSARY AND ABBREVIATIONS

ADT	Admission/Discharge/Transfer.
Available Bed	A bed that is immediately available for use by the consumer.
BASAP	**B**usiness **A**pplication **S**ecurity **A**ssurance **P**rogram. A checklist used by Queensland Health to monitor risks associated with any new implementation of software applications.
Closed Bed	A bed that is either closed for cleaning by housekeeping or may be attended to by the maintenance department for repairs.
GIS	**G**eographic **I**nformation **S**ystems.
HBCIS	**H**ospital **B**ased **C**orporate **I**nformation **S**ystem (pronounced Hibiscus). This system is unique to Queensland Health public hospitals. It is a legacy database first developed in the early 1970s and is the main database that is used when entering patient information upon the admitting process.
HL7	**H**ealth **L**evel **7** is a programming language used to transfer health data and allows healthcare applications to share clinical data with each other.
KPIs	**K**ey **P**erformance **I**ndicators.
LAN	**L**ocal **A**rea **N**etwork. A LAN is a computer network and associated devices that share a common communications line or wireless link, ie. a home office, or a small group of buildings such as a campus.
LOS	**L**ength **O**f **S**tay
Occupied Bed	A bed that is occupied by a patient.

RAID 1	A hardware controller or software that generally allows duplication of data on two different drives.
UPS	**U**ninterruptible **P**ower **S**upply.
Vacant bed	A bed that has been cleaned by housekeeping staff and waiting to be occupied by a patient.
WAN	**W**ide **A**rea **N**etwork. A WAN is a computer network and associated devices that covers a large geographical area and links across metropolitan, regional and national boundaries. The most common example of a WAN is the Internet.

CHAPTER 1 – INTRODUCTION

Achieving a more effective delivery system also means ensuring a public health workforce which is fit for purpose.
(Liam Donaldson, 1999)

1.1 Outline of Study

The main focus of this study was to investigate how the application of Geographic Information Systems (GIS) can benefit the health care industry. The sophisticated GIS technology is not normally associated with health care management but has a potential to solve the very complex and difficult issue, long associated with both public and private hospitals, of patient allocation to available beds.

Utilising existing spatial technology knowledge in a hospital environment, a bed allocation system (eBeds) can provide an efficient management system tool to satisfy the relevant health industry protocols (refer to Chapter 3). Existing hospitals systems currently rely on a large number of diverse methods to gather and collate patient information. The eBeds system will be a practical and flexible tool that crystallises these existing systems to aid administrative and medical staff to make better informed and more accurate decisions for planning and managing bed allocation: thus providing greater economical, timely and beneficial patient care. It was apparent that the existing systems were not fully meeting the management needs of the hospital environment and did not have the capacity to be upgraded in an efficient and economical, or complete solution, to meet current and future management needs (refer to Chapter 2). Therefore, this research stems from the need to provide a bed management solution that can utilise existing systems within the hospital along with the ability to integrate seamlessly across the organisation.

Using the geographical format will allow the data to be displayed in a visual real-time layout with the exact location and current and future occupancy rate of each hospital bed within a room, ward or floor. Attached patient records for that particular bed can also be examined by those with the appropriate authorisation. eBeds will also be designed to:

- be expandable to encompass maintenance and other administrative information;
- be equally adaptable to both public and private hospital environments; and
- be applicable in regional health care organisations; and
- will function equally well in specific internal units as mental health, obstetrics and emergency departments.

1.2 Background Information

In the early 1970s, GIS technology was introduced to the market to enable the management of large spatial information databases and the reproduction and display of maps in a computer environment (Lang, 2003). The GIS was specifically designed: to visually display correlations between locations and their relations to each other; map information about where things are located spatially; and the events that may occur during a particular time period (Lang, 2003). GIS was primarily associated with physical geography representation, such as topographic mapping and associated metadata but eventually found applications in a variety of other industries, such as real estate, demography and medical geography.

The management of available beds has become an increasingly integral part of the economical and ethical management of health care within larger hospitals and through increasing public scrutiny. Better management of hospital beds is required but at a minimal cost that doesn't impact on the direct medical services. The direct medical services include the potential of taking trained medical staff away from their allocated duties to perform administrative duties. Consequently, the development of a bed allocation system needs to consider a minimum capital expenditure outlay with the major cost impact being from software costs and development time. Hence, this project will rely on existing computer hardware being available within the hospital system, and the existing bed information database which contains the patient records, for integration with the GIS development software.

To date, hospitals approach the bed allocation to patient's requirements at a very basic appraisal level. The decision to place a particular patient within a specialised ward generally takes place on either a daily basis (once a day) or on a reactive basis, requiring the time and skill of a variety of staff members and/or managers to complete this task. To achieve this task one or a number of data systems are also required helping the staff member/s to record this information. However, a hospital environment often has a varied and dynamic sequence of events in relation to the needs of patients throughout a 24-hour period. For example, emergency rated patients arrive at random times and must be admitted with minimum delay and with priority over elective patients. The decision-making process needs to be extremely quick as an emergency demand is likely to be time-dependent and thus bed requirements should be considered over a period of time. A patient's needs may also change during their stay and bed types will be dependent on their condition and the diagnosed treatment. Both public and private hospitals are presented daily with the challenge of finding appropriate available beds for inpatients and in managing other related medical resources.

1.3 The Problem

One of the major problems within a hospital environment is dealing with the bottleneck of patient allocation and the availability of beds (Ward, 2004). The management requirements are an integral part of the overall economical and ethical management of health care within the community. Inefficiencies and continuing management difficulties have not been overcome and continue to be a source of practical and management frustration within hospitals. The demand for hospitals beds is increasing rapidly, particularly in Queensland, by a number of factors such as an extraordinarily high population growth and an aging population.

At present, especially within the Queensland health system, the demand for available beds far exceeds the supply (Ward, 2004). Many emergency departments are overcrowded which results in elective surgery being cancelled along with other disruptions to patient care. Without increasing bed numbers or increasing staff numbers other ways need to be developed for increasing efficiencies within a hospital to enable patients needing attention to be put through the hospital process. Through developing a software application such as eBeds it is possible to manage the resources that are in place within the hospital (within different and incompatible systems) in a more efficient and effective manner.

This research will highlight the benefits and need for new technologies to assist in dealing with the process of allocating a patient to an available bed. It will also demonstrate that while current computer systems being used in the public hospitals are, in areas, quite beneficial in handling a wide variety of needs such as pathology, pharmaceuticals, radiology and casemix, they are inadequate and unable to focus on bed management and the associated problems (refer to Chapter 2).

Consequently, this research will focus on a new and suitable bed management structure that is compatible with the current disparate data management techniques, to prove a single system process to address the complex and varied facets of bed allocation that are faced by hospital staff and management on a daily basis.

1.4 Research Objectives

The objective of this research is to gain an understanding of how GIS can effectively and satisfactorily be applied to the health care industry. It will also discuss why this technology will be of benefit to allocating a patient to a particular bed through the use of visual aids such as floor plans of wards. Another objective is to demonstrate the solution of creating an automated workflow process addressing the elements of patient admission/transfer through to patient discharge management within a single computerised application.

The development of eBeds will be designed to improve bed usage efficiencies and to computerise the processes already in place within a hospital by:

- automating the 'white board' now in common use (this is the primary aim of the research);
- integrating the GIS with the hospital's current record system to provide real time information on patient admission, bed transfer and discharge status.
- tracking the status of beds across all acute care wards;
- displaying the floor plans of each ward;
- providing helpful tools for analysis of efficiencies in bed management.

To achieve the above, there are four stages involved:

Stage 1 – determine and examine the computerised systems currently being used in the Queensland public health system and to highlight the inefficiencies of such systems.
Stage 2 – research the needs of the medical staff whose primary role is to admit patients whether through planned admissions or emergency admissions.
Stage 3 – develop a new and innovative bed management application utilising GIS and highlight the benefits.
Stage 4 – test and evaluate the developed system (eBeds) through presentations to relevant medical staff and management to gain feedback in the functionality and capabilities of eBeds.

The eBeds system is to be primarily used as a practical and flexible tool that best supports administrative and medical staff with the planning and management of the allocation of beds for in-patients. The development of eBeds addresses some of the community concerns, such as, the availability of a bed upon admission without a lengthy wait time, and provides a flexible and dynamic advancement for the health industry (Queensland Health Systems Review, 2005). Existing hospitals systems rely on a large number of methods to gather and collate patient information. eBeds will crystallise those systems allowing health care professionals to make informed and more accurate decisions for patient allocation to beds, thus providing further economical and beneficial patient care.

1.5 Conclusion

What has been discussed so far establishes there are many issues that require resolving to enable the decision-making process of patient allocation to become better informed and achieve the results that are expected by patients and health care professionals; that is to lead to better patient outcomes.

What can be concluded from this research is that any solution, such as the application of eBeds, must have minimum impact on the health care environment as a whole. Therefore, it must be of minimum cost, redirect the least amount of

clinical human resources to its establishment and bring together the many disparate sources of data that currently reside within the hospital environment.
As previously discussed, the obvious challenge is to achieve all of the above while addressing the needs of those having to make the decisions in a timely manner. Those decisions are made under the enormous pressures of dealing with differing and changing patient needs that vary in time and frequency, while maintaining the compassion required when interacting with people who are often in very adverse circumstances. The demands on the healthcare system as a whole is also increasing due to an ageing population, interstate migration and normal population growth as well as an increase in the expectations that patients have of the health system (Queensland Health Systems Review, 2005).

This research will also highlight a very complex and difficult issue that most major hospitals tend to experience on a day-to-day basis, that is how and where best to place a patient into a hospital bed. Most hospitals are filled to capacity with patients, therefore, have vast amounts of information located in their existing computer systems. To have the right information at the right time to help support the highly trained professionals who are skilled in treating their patients in receiving the best care possible is extremely critical.

There has always been a need to better manage the allocation of patient flow to hospital beds. Hospitals, both public and private, are continually searching for more efficient ways of providing the continuum of patient care either through better accountability processes or through improved economic efficiencies. The current situation of having a number of different computerised software applications in place that deal with a variety of patient needs, such as mental health units, is certainly not working (King, 2006). There is a need to provide a new and innovative approach of dealing with such issues and highlights the need for such a system like eBeds.

The results of this research and as outlined in Chapter 2, will highlight and identify the number of existing systems located within a hospital environment and how those systems may or may not be meeting the requirements of the health care industry. Chapter 2 will also investigate the major health care companies in Australia and overseas that are providing computerised systems to the hospitals and whether or not the systems are meeting the needs of the health care industry.

Chapter 2 – Literature Review

"An overcrowded hospital should now be regarded as an unsafe hospital"
(Peter Cameron, 2006)

A Shakespearean actor slips on stage one night and breaks his wrist. He is rushed to the closest hospital, where he waits his turn in the crowded emergency department. As the charge nurse walks by and casts a disapproving eye at the ever-increasing backlog, she sees him dressed in his 16th century garb and does a double take.
"Just how long have YOU been waiting?"
(Sarah Norland, 2005)

2.1 Introduction

Chapter 1 outlined the potential benefits of applying an innovative technological approach to bed management that will address the needs for a single, efficient and universally usable system. One of the major benefits discussed was using a GIS to aid and assist in the decision-making of bed management. This chapter will establish the need for improved bed management, outline the existing computerised systems that are currently being used within the public and private hospitals and discuss whether or not these systems are meeting the needs of staff expectations. It will also outline the overall hospitals expectations, with the emphases on patient allocation to beds.

One of the major problems within a hospital environment is dealing with the bottleneck of patient allocation to, and the availability of, beds (Ward, 2004). Hospitals represent an essential infrastructure that is necessary for the community to function as a whole, hence the pressure for apparent and actual efficiency. Richardson (2003) discussed the issue that the public hospital system within Australia, particularly in Queensland, was running at peak capacity, which almost guarantees queuing in the emergency department when waiting for available beds and other critical inpatient services. In July 2009 Dr Malcolm Johnson-Lee, Director of Emergency Services at Toowoomba Hospital, discussed on ABC talk-back radio the term "Access Block" and how a patient admitted through the emergency department may have to wait for more than eight hours for a general ward bed. Access block is "*the inability to admit emergency patients to a ward bed in a timely fashion*" (Fatovich et al., 2009). It appears that the same issues discussed in 2009 are just as critical now as they were years ago. Through increased public scrutiny there is also a greater degree of accountability required from health care professionals with regard to facilities management and information administration.

There are a number of reasons why patients are queuing for available beds when admitted to the hospital system. The following are common to most public hospitals within Queensland:

- Staff shortages, such as not enough doctors or nurses;
- Decreasing available beds;
- Ward closures; and
- Population growth expanding rapidly within South East Queensland (Sommerfeld, 2005).

2.2 Management of Hospital Beds

One of the major challenges for public hospitals are managing the competing demands of emergency and booked patients while optimising bed utilisation. Managing the availability of beds has a certain degree of difficulty particularly when dealing with the individuality of the patient's needs. Long wait times have become a standard and all too common practice at major public hospitals. Patient expectations have resulted in an increase in the demand for better health care procedures, which have also taken its toll on staff as well (Norland, 2005). During an ABC Radio interview in August 2008, Eleanor Hall stated "*Doctors in Queensland are warning that their patients are dying because of the extreme shortage of hospital beds in the State*."

There are alternatives to improving the management of hospital beds but do not appear to be enough to provide a viable solution. Another alternative is to look at the processes and procedures within the hospital system itself and to utilise the current systems that are in place in a more efficient way. However, are the current systems meeting the needs of the hospital's requirements and protocols? Hospital in-house alternatives to improving patient allocation do not appear to be enough to provide a viable solution (refer to Chapter 3.3). Such research would determine if the current systems are meeting the needs of the hospital's requirements and protocols.

2.2.1 Management of Bed Deficiencies

Research has shown that overcrowding of the hospital system can actually be inefficient and is associated with an increased length of hospital stay (Cameron, 2006). Emergency departments are generally stretched to capacity at most major hospitals and having to wait for available beds increases the frustration not only of the patient but for professional staff also (Cameron, 2006). There has been an increasing amount of pressure put on governments from health care organisations to alleviate the overcrowding when it comes to hospital capacity. As stated by Capolingua (2007), the President for the Australian Medical Association (AMA), "*our public hospitals are dangerously underfunded and under-resourced*."

In late 2007, an Australian Federal election was called and one of the major issues at the forefront was the state of the public health system. By early 2008, the newly elected Prime Minster, Mr Kevin Rudd, publicly stated the he "*would work co-operatively to get our hospitals fixed*....". In 2008, the Prime Minister set

up a National Health and Hospitals Reform Commission to provide a common policy to address future challenges in the Australian health system. In June 2009, Prime Minister Rudd had discussed the possibility of a commonwealth takeover of state public hospitals after the State of the Australia's health system report was released. In April 2010, the Federal Government reached an historic agreement with all state governments, except Western Australia, to establish a National Health and Hospitals Network (Department of Health and Aging, 2010).

One of the main issues in relation to patient allocation being addressed within the health industry is Access Block (Cameron et al, 2003). The effect of Access Block can result in a number of concerns:

1. Transfer delays – patients may not be able to be transferred from one ward to another or from one hospital to another due to the time delay in being attended too. Doctors and staff may be busy dealing with emergencies and/or other patients with needs greater at that particular time. Therefore, there are delays not only in the Emergency Department (ED) but also delays in the bed allocation within the wards (Cameron et al, 2003)

2. Emergency departments go on divert – emergency departments are full to capacity and therefore cannot handle any additional influx of patients, resulting in ambulances being diverted to the next available or nearest hospital that is capable of taking on more patients. There needs to be a better knowledge of the hospital's, and also the surrounding hospital's bed situation, to help alleviate some of the bottlenecks that arise. In 2001 a study was commissioned by the Department of Humans Services, Victoria and as discussed by Dwyer et al (2001), "*it is high bed occupancy, rather than number of beds per se, which underlies acute access problems, with problems occurring when occupancy is above 85%*".

3. Surgeries may be cancelled – elective surgeries scheduled for a particular day may be cancelled due to the overcrowding of emergency departments, the unavailability of doctors and/or staff able to attend to the patient, and the unavailability, real or apparent, of beds.

4. Delay in patient discharges – the delay in patient discharge can contribute to the delay and gridlock of admitted patients waiting for an available bed (Queensland Health, 2006). As the patient is deemed medically fit to leave, the procedure of actually signing the patient out is delayed. For example, the nurse may be waiting for final discharge notice from the attending doctor or the patient may need to collect prescribed medication that may not have arrived from the hospital's internal pharmacy.

Overcrowding within an emergency department and hospital delays can be extremely costly and inefficient to the health care system. It can lead to a number of problems such as higher treatment costs, staffing difficulties and poor

patient satisfaction (Norland, 2005). In 2009, the current health minister announced Queensland's health budget with unprecedented levels of expenditure with an emphasis on upgrading emergency departments (Health Matters, 2009).

2.2.2 Bed Management Issues

There are a number of alternatives to achieving the gridlock of patient allocation to available beds. Norland (2005) suggested building more hospitals and creating space for more beds within an emergency department, however, this can be extremely expensive. To build more hospitals for example, such as the new hospital proposed for Southport on the Gold Coast will cost approximately $500M and will take years to build (Queensland Health, 2008). Building more hospitals may possibly be a solution in the long term, but again the resources within the new hospital still have to be managed efficiently for the whole system to function satisfactorily. The building of more hospital capacity is also a burden to the community in increased taxes and private hospital insurance costs.

Buying more hospital beds is also expensive (Norland, 2005). A "basic" bed generally found in the "non-specialised" wards costs approximately $8,000; a maternity bed can cost up to $30,000; and a special-needs bed (e.g. spinal bed or rehabilitation bed) can range up to $80,000. According to Cameron (2006), spending more money on increasing the number of hospital beds only alleviates the problem temporarily but does not solve the problem. The beds quickly fill and the bottleneck starts once again. While an increased needs capacity will always call for more staffed facilities, a more efficient use of existing facilities reduces the need for facilities, reduces costs and increases the number of patients able to access treatment. These issues remain applicable as has been highlighted by future changes forecast by both political parties during the 2009 State election.

2.2.3 Other Problems Encountered

When researching the hospital bed availability issues within a Brisbane hospital, the author discovered that a major problem also encountered by public hospitals was the "loss" of beds within the hospital itself. The loss of beds further contributed to the bottleneck of admitted patients waiting for an available bed. The cause of lost beds was varied but included the following:

- Beds wheeled (rather than the use of trolleys) from the ward to the operating theatre and not being returned to the originating place, reducing the expected available beds for patient admission in that location. Beds left in the corridor may have been picked up by orderly and taken to another ward type where there may be less call on bed vacancy.
- Beds wheeled to the ambulance station and being left at the entrance and again not returned to the originating place.

2.3 Current Administrative Systems Used

There are a number of health care companies in Australia that are providing a variety of health products and systems to both public and private hospitals. Through this research a number of health care vendors have been identified as providers of software applications (refer to Table 1).

Table 1 – Health Care Vendors within Australia

Vendor Name	Application	Functionality
Cerner	AusPAS	Electronic Patient Record solution and Patient Administration System.
iSOFT (also owned by IBA Health)	iPAS HBCIS (legacy system)	Patient Administration System **H**ospital **B**ased **C**orporate **I**nformation **S**ystem (Queensland Health only).
TrakHealth*	FastTrak	Web based Electronic Patient Record Administration System.
Accenture	OACIS	A State-wide clinical system implemented across South Australian public hospitals.
Meridian Health Informatics	Clinixian, eWard	Provides a base for clinicians to manage their data.
IBA Health	ibaPAS	Patient Administration System.

The companies listed in Table 1 appear to have very similar applications in relation to patient administrative systems (PAS). The applications are aimed at a number of solutions to assist medical and administrative staff with a variety of patient administration activities. Further investigation into the applications reveal that the software from each company does not generally address the administration of bed management but provides an entry point of managing patient admission and discharge along with a variety of other applications, such as radiology, pharmaceutical, lab results. There a number of smaller companies

that also provide health products to the public hospital system, however, the six listed above were chosen due to the provision that all or some of these products are installed within a hospital system within Australia, and particularly, in Queensland.

2.4 Who uses the hospital's health care systems?

A number of software applications (refer to Table 1), are specifically managed by a selected group of staff members, with particular specialisation, within the hospital environment. For example, the admission/discharge/transfer (ADT) process is handled by a small team (usually between four to five staff during a day shift and one to two staff members during a night shift) whose role is to specifically manage the entry and exit process of the patient. The primary role is to ensure the patient has been admitted through the appropriate channels and protocols of the hospitals admissions arrangement.

The appropriate software applications being utilised within a hospital environment are commonly web-based and the data are presented in a Windows©-based application. The windows-based application generally has an interface connecting to a group of other applications, for example, the application may also have access to the radiology or the pharmaceutical functionality of the software. From this interface various staff members have access to their particular functionality or data requirements, within security guidelines, and from there utilise the appropriate data selections. Through feedback, from the various staff at the hospital where the author was conducting the research, it was stated on a number of occasions that a more visual aspect of the applications being utilised throughout the hospital would be more useful rather than just a spreadsheet or text-based screens. For example, a visual display of the bed locations within a room, ward or floor would provide a quick and easy reference to gain an understanding of what beds were currently vacant, occupied or closed.

Access to health care is perceived as an individual right to all citizens living within a particular country. The Organisation for Economic Co-operation and Development (OECD) has listed the United States as one of the countries lagging behind in years in regards to the uptake of health information technology adoption. Of the software applications used within Australian hospitals (refer to Table 1), the majority of the applications are developed from within the U.S.. Millions of dollars are spent in the development and training of hospital staff by public and private hospitals that have invested tax-payer's or investor's money in purchasing these applications. Hence, these systems need to efficiently and fully meet all the management and administration needs within the hospital.

2.5 Other Software Applications

There are a number of software applications (refer to Table 1) and programming software that are available on the market that could aid and assist in bed management. For example, a software application such as a computer aided design (CAD) has been around for a number of decades and is a high end, complex application. CAD is basically used in the design of all types of drafting for buildings or can be used for the design of detailed engineering models of physical components. CAD can be used within the healthcare industry for designing the structure of a new hospital. This involves the drafting and design of the external structure of a hospital and also the internals, such as ward locations and floor plans. Usually this software application requires specialist staff with a high level of expertise in developing specific applications and may not be entirely suitable in a hospital administration and management environment.

Open source software is another alternative as it is provides free software to the end user and is seen as an inexpensive way of sharing information such as source code and certain other rights normally reserved for copyright holders. Most open source software is available within the public domain and is very often developed in a public and collaborative manner (IBM, 2010). However, during the research project is was determined to not use open source software due to the confidential nature of patient data and privacy rights within a hospital environment.

Both CAD and open source software applications are in use today and depend on specialist programmers/operators to write and develop the very complex code needed to solve the pre-determined application. Unless the hospital has a particular need to employ such programming skills to develop in-house applications, and continue with specialised maintenance issues, then these types of software applications will be of a benefit. It would also add another level of staffing complexity and cost that would further complicate the staffing situation as discussed in Section 2.1.

There are a number of issues with the above software applications, as opposed to using a GIS (refer to Section 3.3) in particular, the inability to display information in a graphical format.

2.6 Other Research Techniques

There is alternative research techniques that are being developed within the hospital environment to understand the problems associated with allocating a patient to a hospital bed. The software applications are used to support a number of systems such as:

- Decision-support model simulation developed by using complex numerical computation.

- Forecasting models or capacity planning, and
- **Cu**mulative **Sum**mary Analysis or "Cusum Analysis".

Much research has been conducted using the Cusum technique within the health industry (Ward, et al, 2005). This technique tracks the cumulative sum which is, according to Burns et al (2005), the "*consecutive differences, for both positive and negative results, between an individual measurement and a given standard or target*". It basically presents the analysis as a statistical and graphical format that examines trends for sequential events over time (Naik et al 2003). It is a tool that can also track the success and/or failure of a particular trend over a period of time. The use of Cusum Analysis can play an important part in monitoring trends such as admissions and discharges and infections acquired by the patient through the duration of a hospital stay. These trends can also highlight the "*negative results*" of a hospital performing poorly by demonstrating erroneous clinical procedures or behaviours.

A study was conducted at a major public hospital located in Brisbane where Cusum techniques were used for early detection of the management of hospital bed occupancy (Burns et al 2005). The main purpose of the study was to gain an understanding of how Cusum Analysis could be utilised in monitoring trends in hospital admissions, discharges and various other variables. The outcome of the study proved that Cusum Analysis was a useful tool in the area of bed management. According to Chang (2006), the use of this simple technique provides a rapid analysis and can help identify trends in a series of data.

However, there are also a number of limitations that are involved with Cusum Analysis technique. Firstly, the results need to be validated against other forms of measurements. The measurements could be in the form of direct observation of a particular process or technique via a procedural checklist, or against a global rating assessment from other hospitals using benchmarks (Burns et al 2005). Secondly, Cusum Analysis involves a number of specialists who clearly understand the process and the particular data being analysed. Data collection and validation requires an enormous amount of time and effort and in some instances may take years to collect the specific data being investigated (Ward et al, 2005)

One major acute care hospital within Queensland has been utilising Cusum Analysis for a number of years and has a long continuing investigation to discover how or if it can benefit the public health system.

2.6.1 Staff Surveys

At the start of the research, a staff survey was submitted to the participating hospital to all team members throughout a number of wards (see Appendix A and Chapter 4.2.3). The aim of the survey was to gain a baseline result on a variety of subjects including:

- Lack of available information from a variety of sources, such as Queensland Health, which caused time over-runs. This was part of the research as it had an impact on the work progressing.
- The working environment was a difficult one for a number of reasons which impact short term on the viability of the project due to a brief that it maybe not achievable and too high risk for the sponsor and long term as it produces an inherent risk for a developer as the culture and information available in the Qld Health environment is scattered and changing on an almost daily basis.
- No detailed Health Level 7 (HL7) programming information for the interface (refer to Glossary).
- Poor understanding of the HL7 data flow and HBCIS programming.
- Ambiguous understanding of what the client wanted to see and how they wanted to see it.
- Non availability of qualified human resources.
- Changing staff within the IT environment.
- Changing of policies and procedures within the IT environment.
- Poor communication of policies and procedures to the research team.
- Continuous changes to the developed application due to individual demands not being addressed by the hospital management team.
- Inability of process and cultural change to take place either at a management level or from a user level that caused the project to not reach its full capacity.
  This happened on a number of different levels and for a number of different reasons. In an actual commercial implementation change management would be budgeted for and become a high priority to the implementation team. Even though this was identified as a risk early on it was not addressed by the hospital for budgetary reasons.
- Staff changes caused a lack of stability throughout the research and caused a lack of focus.
- Lack of basic computing skills should have been addressed prior to the implementation.
- Poor communication of the reasons for the change to a software based system lead to fear of big brother among the staff.
- An ageing workforce at the beginning of the project promoted a lack or inability to change.

The staff perceives these limitations and challenges as inhibiting efficient and timely bed management and impact negatively on them and the hospital to achieve optimum patient care.

2.7 Why a Geographical Information System?

The decision to develop eBeds within a Geographical Information System (GIS) environment derived from the investigation of determining what other applications are on the market and how they could be improved to design a more in-depth application that focuses solely on bed management and patient flow. Through the investigative process it was also determined that most staff working within an extremely time-critical environment needed to obtain information quickly and accurately.

It has been estimated that more than 80% of all data collected has a spatial reference attached to the database (Hocking, 2009). For example, within the health industry patient records almost always have a street address or postcode attached so therefore, using these unique identifiers, it is possible to match the unique identifier against a spatial database containing an address code or postcode. Or in the example shown in Figure 1, it is also possible to display the location of general practices and overlay the location of public and private hospitals within a specified region.

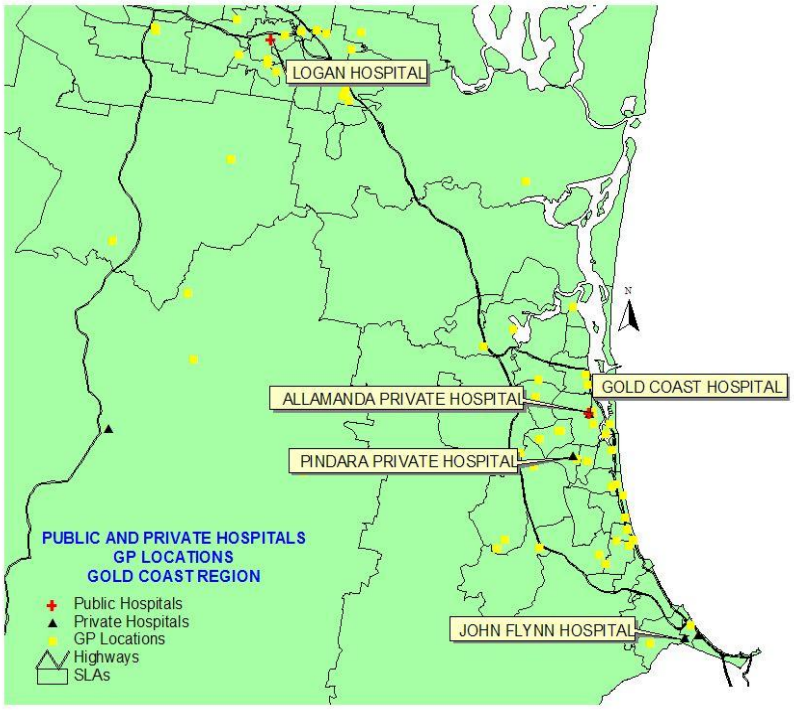


Figure 1 – Location of General Practitioners and Public/Private Hospitals

In the late part of the twentieth century, GIS was an extremely powerful tool and unfortunately was also extremely expensive. Now in the early part of the twenty-first century, GIS is starting to gain inroads into different professions such as real-estate and tourism, and in particular the health care industry. This is due to the awareness of its capabilities in these different applications, the decrease in cost and also the ability to utilise the internet to distribute an organisation's data.

2.8 Conclusion

Chapter 1 defined the need for and the potential benefits of a single, efficient and universally bed management system. This chapter also highlighted the complex and varied software applications and processes, and their shortcomings, that are utilised for bed management within a hospital environment to establish the need for a more comprehensive and efficient management of beds. Hospitals spend the vast amount of their budgets on software applications to help efficiently and effectively distribute data in relation to a patient, but are not necessarily meeting the needs in the best possible way (Ward, 2010).

From analysing the alternative software applications that are available to hospitals to manage their bed allocation, it is clear that the issue of managing bed capacity is a very complex and difficult task and hospital staff must cope with a variety of methods to assist in the bed management process.

It is also clear that the existing software applications do not address the core issues of bed management in detail due to them being built to generically handle all tasks that may occur within a hospital environment, from storing a radiology result to organising a special meal for a patient. Bed management becomes just one of the many tasks and not a core issue in its own right, hence not fully addressing the needs for the best management outcomes.

A GIS based software application seeks to address the majority of tasks associated with bed management issues by availing the staff of a visual, patient centric solution that delivers information to those who require it when and how they need to see it. Chapter 3 will discuss in detail the problems associated with the bed management processes currently in place in a major public hospital and the positive attributes of establishing a visual application in GIS. An improved system is perceived as addressing the need to provide timelier, easy to understand management information to reduce the access block and increase the efficiency and ability of admitting patients to a ward bed.

Chapter 3 – Research Design and Methodology

"We need more inpatient beds and better management of existing beds"
Daniel M Fatovich, (et al), 2009

3.1 Introduction

Chapter 2 detailed the significance of using a GIS platform in preference to the other applications being used in various hospitals throughout Australia and overseas. Despite a variety of bed management system applications within both public and private hospitals (refer to Chapter 2.3), these applications are not generally meeting the needs required by the hospitals to successfully aid in the placement of a patient to a hospital bed.

There is a real challenge in today's society to utilise spatial information in a more diverse way in delivering of health care (refer to Chapter 2.6), similar to the use of other business areas to meet a wide variety of management, information and access needs, such as real estate, tourism, transport, solutions from Google Earth and Google Maps. Significant gains can be achieved through a greater use of GIS technology across the health care spectrum and eBeds will demonstrate the utility and advantages of this method and technique.

This chapter will outline the methodology of developing eBeds and the risks and challenges associated with the different development stages and outcomes of the system. The development of eBeds was undertaken primarily within a public hospital environment at a Queensland Health location in Brisbane.

3.2 Displaying Health Data

One of the most notable examples of mapping within a spatial context was from the 19th century - Dr. Snow's famous cholera outbreak map (refer to Figure 2). Dr Snow was a physician who mapped a particular area of London in relation to an outbreak of cholera that struck in 1848, to track the progress of the disease to see if he could determine exactly how it was spread. Dr Snow argued the point that cholera was spread by contaminated water and the drinking water in certain areas was infected which was the primary means of contagion. He analysed data that had been collected in the epidemic of 1848-49 and showed that the patterns of disease could be linked with specific water supply locations.

Dr Snow gathered statistical evidence that showed a high incidence of cholera in homes and businesses within a short walking distance of the infected pump. This evidence was used to explain and highlight the certain number of deaths

and outbreaks, in a location sense, where these deaths and how many occurred. The format of the map was a dot map, which is a very simple but effective visualisation of displaying data and highlighted the efficient use of how maps played an important part in history in determining the cause and effect of such a disease (Johnson, 2006).

Figure 2 – Dr Snow's Cholera Map of 1848 (Tobler, W. 1994)

Dr. Snow's cholera map became a prime example of how the geographical visualisation of information could aid and assist in displaying the correlations between locations and the relationship to each other. Data visualisation is still recognised as a highly significant and useful method of understanding and evaluating a situation (Rosenberg, 2010).

3.3 Initial Research Drivers

The opportunity for developing the software application of eBeds followed an approach to a major public hospital that had identified inadequacies in their current information gathering processes. The author was employed within a public hospital to map patient demographics when she approached senior

management with the idea of developing a bed management system within a GIS environment. It was through interaction with a variety of staff who mentioned, on a continuous basis, how it was difficult to keep track of where their patients were located in the wards throughout the hospital when using a whiteboard (refer to Figure 3).

In day-to-day practice, a Microsoft (MS) Excel spreadsheet was utilised to review patient location and information within the wards was being utilised. The spreadsheet had a number of inherent flaws, such as it did not upload to the main hospitals database, namely the Hospital Based Corporate Information System (HBCIS) (refer to Glossary), and therefore a large amount of information was required to be entered manually into MS Excel or HBCIS. Nor was it possible to download any information from HBCIS into the spreadsheet. No pertinent historical data, other than that which could be saved as a MS Excel file, was able to be stored for future reference.

The hospital had a number of issues when dealing with the spreadsheet on a day to day basis, such as:

- The spreadsheet was frequently prone to corruption. This was either due to human error, such as, entering information incorrectly or through computer mishaps either through power loss or automatic shutdown.
- Once the corruption occurred, there was little chance of retrieving the information to access the previous accurate information as there was no backup of historical data due to the shortcomings of the current system.
- The current system could be edited only by certain staff with authorisation to do so and this lead to disruption in work practices and frustration amongst staff.
- The information could only be read at certain points within the hospital and therefore was only available to a minimum of staff resulting in a lack of information flow to many staff members
- No or little information flowed to the community care environment which impacted on the continuum of care outside the hospital
- There was no ability to gather extra information related to the patient stay other than what was entered on to the excel spreadsheet.
- There was no ability to combine data sets such as occupancy levels and acuity levels which hindered the ability of staff to gain an overall view of the current hospital environment. Also the information that was available was fragmented and difficult to extract and visualise from its current location. This led to time consuming gathering of data and a poor understanding of that data.

Also, all of the staff was using a whiteboard, which is common practice in most hospitals, to display the particular ward's information in an area that was visible for all staff to see. The information contains the number of beds occupied, vacant and closed, the patient's waiting to be discharged for that particular day

and how many admissions are due (refer to Figure 3). This information is considered extremely private and confidential and there is movement within the greater health community to stop this practice within hospital wards in relation to privacy laws.

However, this has not been effective and the whiteboards are still in operation displaying the confidential information. As yet, (in 2009), there are no other suitable visual alternatives to address and replace the whiteboard information.

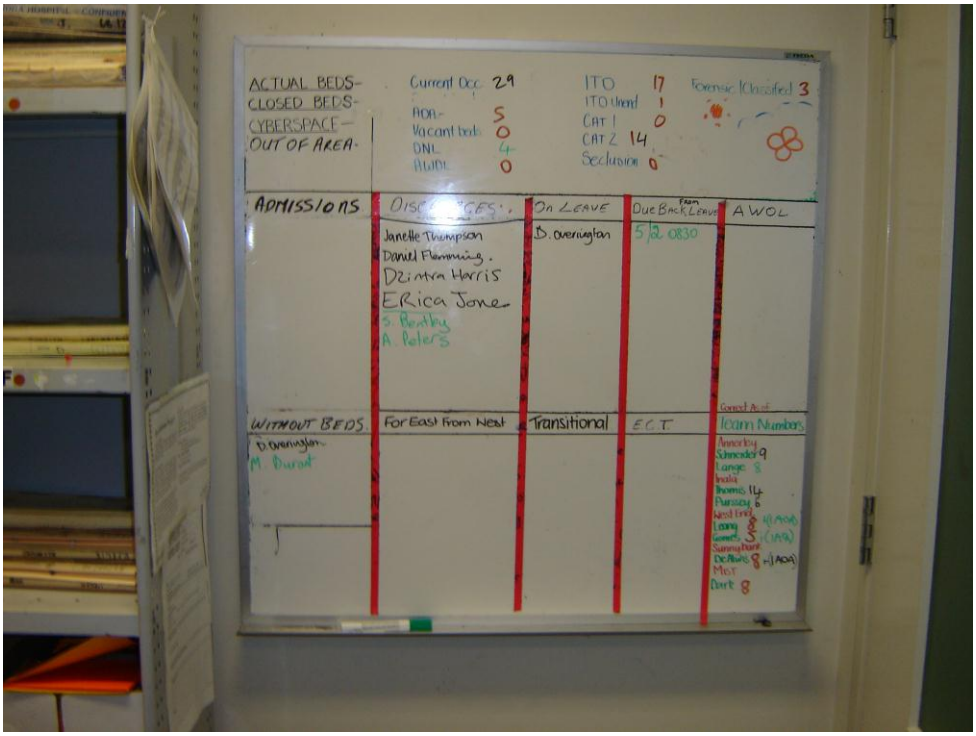


Figure 3 – The Whiteboard used commonly throughout a hospital ward.

There are a number of problems associated with this practice:

1. The information displayed on the whiteboard is clearly visible not only to staff but also to the patients located within the ward.
2. The information displayed was clearly visible to visiting members of the public, such as visiting relatives or external visitors moving around the ward for whatever purpose.
3. The transmission of this information to various users was not possible unless they physically viewed the white board.

Formatted: Indent: Hanging: 1.27

Formatted: Indent: Hanging: 1.27

One primary aim of the development of eBeds was to replace the whiteboard which continues in common use. Integral to this was to create a user friendly and patient centric software application that brings clear, concise and real time information in order to facilitate the decision-making processes (refer to Chapter 1.2).

3.4 Research Methodology

The eBeds concept methodology being discussed will disseminate the information and display that information in the most easily read format in relation to the task being performed. Data will then be delivered to the user with the necessary updates regarding patient information regardless of location, via the hospitals intranet and internet. It is also delivered via remote access to a specific user's remote location dependant on strict security guidelines. The data would not be on public display as it will be displayed from the user's allocated computer usually located behind the nurse's station or staff office. There are certain restrictions within the hospital to control the level of security and access to authorised information. These business rules and restrictions are structured as per existing hospital guidelines and will be assessed on a needs basis by hospital administrators. A sophisticated system of error trapping and internal auditing is envisioned in order to maintain data integrity and ensure reporting is as accurate as possible within the existing environment

At present, all these issues are a major factor contributing to the inadequate deficiencies in place with the current systems. These issues can be overcome with the proposed system of eBeds to help alleviate the protocols and policies and assist staff in the best practice for bed management.

3.5 Bed Management within Public Health

Beds are one significant and pivotal resource around which the function and management of the hospital section of public health environment relies upon. Beds within a hospital environment can be perceived differently to different hospitals depending on the context in which the word "bed" is used. The actual term 'bed' has a number of meanings. One definition of a bed is "a physical input, considered as a fixed asset" (Walsh, 1998). A bed can also be defined as "one of the most fundamental inputs in the provision of acute health care", (Walsh, 1998). Therefore, a bed can be perceived as one the most important parts of the health system infrastructure.

A 'bed', depending on the particular definition, can also be perceived as an indicator of how well a hospital may be functioning from a managerial point of view. Management may view ward closures as being wasteful and inefficient and therefore indicate that the hospital is underutilising its resources. Other viewpoints may be that the system is under resourced and can cause potential

bottlenecks, which in effect can lead to the rationing of beds and lengthy waiting lists.

There are approximately 82,000 public or acute beds available throughout Australia and about 1,290 hospitals (Australian Institute of Health and ~~Wealth~~Welfare, 2008). On an average day, there are around 20,000 Australians admitted to a hospital with about the same leaving or separating for a particular service provided (Australian Institute of Health and ~~Wealth~~Welfare, 2008). In Queensland, approximately 7880 people receive admitted care in acute care public hospitals every day (Queensland Health, 2009).

In Queensland, public hospitals there were 9,901 hospital beds available as of June 2007. By the year 2011, the goal of Queensland Health is to have an additional 750 beds made available (Queensland Health, 2007). The need for greater efficiencies and increasing bed numbers make improved management even more necessary.

3.5.1 The Bed Management Process

Bed management can be defined as the management of all hospital processes necessary to place a patient into an appropriate vacant bed. The processes taken into consideration are the admission of a patient, length of stay (LOS), type of specialist bed (if needed) and the pending discharge date (Commonwealth Department of Health and Aged Care, 1999). There are also a number of other factors to take into consideration, such as the availability of staff and resources and the general housekeeping and maintenance of the beds. Also, some patients change beds during a hospital stay, related to recovery or rehabilitation needs; (also known as an “episode of care”). These reallocations also need to be addressed with relation to bed management. Within the hospital, management and staff must find a balance between the demands for available beds placed on the organisation as a whole and the demands placed on them through the needs of continuum care of the patient.

The hospital system in general is renowned for being stretched to the limit in all areas of health care, whether it is in such areas of concern as:

- staff shortages;
- greater demand in providing a higher standard of continuum of care;
- more access to better facilities and services; or
- a growing demand in providing sufficient hospital beds (Kirby et al, 2003).

3.5.2 The Admission Process

The procedure of admitting a patient into a hospital bed is a very complex and involved process. The majority of hospitals have dedicated staff whose main occupation is to admit patients and manage the pre-admission to post-discharge procedure.

The journey begins for the patient on arrival to the hospital. Once the patient has been admitted and triaged, the admitting team need to determine the availability of beds for each patient. This generally consists of phoning individual wards on a daily basis to determine any pending discharges the ward may be having over the next coming days or within the next 24 hours. Once the bed occupancy is determined for each ward, is it then matched against the particular needs of the incoming patient. For example, a patient with a spinal condition would not be placed within a general ward due to the need for a specialist bed built specifically for spinal injuries and for the estimated length of stay (LOS) needed for the patient to recover.

The admitting process also involves the ward clinicians who manage the day to day care of each patient located within their allocated ward. Generally, each morning a staff meeting involving all the various ward managers is carried out to determine any patients being admitted that day or overnight, any pending discharges and any scheduled surgeries for the patient who will be leaving their allocated bed for a period of time and returning to possibly another ward or another bed location. All these variables are considered when first admitting a patient to a bed and the role of allocating patients to a bed is acknowledged throughout the health community as a very complex and involved process (refer to Sections 1.3 and 3.1).

All this information is then gathered and relayed to the admissions staff that is then aware of the bed occupancy for each ward within the hospital. It is then possible to determine the availability of potential bed allocation: however, this determinant is prone to a number of errors at any given time throughout the process. For example, during the research period, it was observed that if a particular ward became too busy due to lack of resources, such as unavailability of staff, certain wards would reduce the load of admitting patients. This occurred purely for the reason that adequate care could not be given to the individual patients; hence, a bed may remain unoccupied for a 24 hour period.

There are a number of issues pertaining to admitting a patient to a hospital bed and it is not necessarily the easiest process if not managed and monitored correctly. The application of eBeds will help alleviate such difficulties due to the application being web-based, therefore, the ability for staff to view across the intranet/internet. Also, one major benefit is the visual display of the floor plans outlining the individual wards and the location of the bed within each ward to help with negotiating the occupancy of beds within each ward.

3.5.3 The Patient Handover Process

Throughout Australian's hospitals there is a common practice of providing a handover process that occurs before and during staff shift changes. This

process enables staff members to become aware and more informed of the patient's well-being and condition.

As a general rule, within some public hospitals, there are only 30 minutes allocated for a patient information handover. Therefore, it is essential that staff is prepared and informed of exactly what is relevant to the particular patient being discussed at the time. The information, for a successful handover, includes the bed number, patient's name, and abnormal signs such as vital signs and/or blood sugar levels. Some other factors discussed in the handover process may include pain control and whether or not the patient is receiving IV antibiotics or fluids. The process is for an administrative purpose and is the responsibility of the attending nurse to inform the new shift staff member before their shift begins.

However, not all hospitals have a formal nursing clinical handover process as was the situation within the hospital in this research project. Despite the format structure, it was observed during the research process that the hospital had the following issues in relation to a handover process:

- The existing processes were somewhat ad-hoc; there was no formal procedure about what occurs and virtually a total absence of auditing the process.
- There was no record of what had been said or occurred as it was all verbal except for some handwritten notes. However, not all staff took notes and there was no requirement on those who did take notes to retain information for future reference. Although some staff notes where passed on at the end of a shift.
- If notes were taken by staff, they were usually carried around by the staff member, which became a privacy issue as the notes could be lost or misplaced.
- If notes were taken during the duration of a shift, they were not necessarily circulated to other staff members and not readily available other than if asked for. For example, the notes were not freely available to external staff members such as auxiliary care staff or community care staff.
- As the handover notes cannot be searched for historical data, trends in a patient condition can sometimes be missed especially due to the rotational nature of nursing shifts. Reliance is placed on the ability of clinicians to recall events and occurrences rather than having a clear searchable record of an episode of care.

3.5.4 Key elements of eBeds

The idea of eBeds was to create a timelier and accurate automated workflow process addressing the elements of patient admit/discharge management and patient tracking. These elements are:

- A modified pending admit/discharge function that captures workflow tracking elements for effective bed management and patient tracking.
- The creation of a management report to be used by admitting and nursing administration for early identification of problems in the admit/discharge/ transfer process.
- The creation of a management report of performance metrics to track the performance of the new bed management function.
- The creation of an electronic bed board to simulate the manual bed operation and allow visual access by nursing staff and admitting staff to the status of beds in the hospital utilising geographic information system (GIS) technology.
- The integration the GIS with the hospital's admit/discharge/transfer (ADT) information system to provide real time information on patient admission, bed transfer and discharge status.
- The integration of the GIS with the hospital's CAD electronic files to provide nursing floor views of the patient and bed status.

A trial of the eBeds system was to be used as a pilot to test and implement these concepts at a public hospital located within Brisbane, Queensland. The hospital would then implement a web based solution functioning on their Intranet web.

3.6 Limitations and Challenges

A challenge for health professionals is having timely access to health information for national, state-wide and local areas (refer to Chapter 2). The use of spatial technology allows integration of data from a variety of sources. When combined with an interactive web-reporting tool, the result is a set of tools that can bridge the divide between academic health scientists and clinicians/policy makers who rely on such information when making decisions in the field. These decisions also include determining the appropriateness of allocating a patient to available beds and their location relevant to the medical situation.

3.7 The Initial Scope of the Research

The aim of the development of eBeds is to create a user friendly and patient – centric software application that brings clear, concise and real time information to all the stakeholders in order to facilitate the decision-making processes. The application will disseminate and deliver information in the most easily read format in relation to the task being performed. The building of long-term business relationships along with continuous product improvement in conjunction with customers will facilitate the development process and promote eBeds in becoming the leader in bed management software.

When establishing the development methodology of eBeds, historical accountability was a critical factor in providing a system that was able to provide

both historical data and also define which team member actually made the change.
It is envisaged that the design of the application will focus firstly on the following business issues:

- Replicate the whiteboard in current use within the hospital with its conversion to a stable user environment to enable clear and accurate information flow.
- Enable an interface from HBCIS to reduce the rework of entering information a number of times.
- Enable historical data to be stored and retrieved by the use of the application's customised querying ability.
- Provide clear and real time information to all stakeholders in the project.
- Provide a stable and user friendly environment in which to store, retrieve and view information,
- Facilitate the flow of patients through the admission, continuum of care and the discharge process.
- Allow historical data (when it becomes available) to be analysed in order to become predictive for the hospitals environment.
- Be expandable to an enterprise level.

The functionality and scope proposed for the initial eBeds release are the:

- Ability to show in a graphical format the physical location of beds within a ward and room
- Ability to filter down through bed records to reveal patient demographic data.
- Ability to interface with HBCIS to download patient demographics from client hospitals database.
- Ability to allocate a Nurse and a Case Manager to a patient.
- Ability to input additional information such as staff allocation to a patient, risk categories and levels of risk, suburb, health act status, and overnight leave.
- Ability to monitor and highlight patient discharges and pending discharges.
- Ability to reserve beds for incoming patients Pre-Admits.
- Ability for community care areas in the health district to view certain information
- Ability to replicate the spreadsheet currently in use by the hospital.
- Ability to supply reports as outlined in a reporting document to develop jointly between the customer and the vendor.
- Ability to supply queries developed jointly between the customer and the researcher.
- Ability to develop crystal reports and MS Excel spreadsheets as required.
- Ability to email and fax selected reports to a third party (assuming the use of the customers fax server and depending on Qld Health Security Policies).
- Ability to audit inputs and changes.
- Ability to allocate and change security status.
- Ability to plan and manage bed availability.
- Ability to establish a process of benchmarking work flows.

- Ability to display information on a stable platform and with security protocols of the business and the greater Qld Health infrastructure, and
- Interface requirements to meet Qld Health specifications.

3.7.1 Selecting a suitable GIS

As discussed in Section 2.3, there are a number of health care companies providing software applications to assist medical and administrative staff. Of the venders listed (refer to Table 1) none of the applications specifically targeted bed management.

Part of the design of eBeds was to utilise the sophisticated technology of a GIS. There were a number of considerations when choosing the potential GIS before the development of the application began. One of the major considerations was related to the price of the software. The hospital involved in the research and development of eBeds had a limited budget set aside for the prototype. In was imperative to choose the correct GIS, not only based on price, but also on the functionality of the software.

On the market today there are two major GIS applications available, 1. ESRI suite of products and 2. Pitney Bowes MapInfo. These two products are extremely popular and are used extensively throughout all levels of governments and the private industry. Both software applications are price between $3,000 to $6,000 per licence for a standalone desktop computer. However, the prototype would eventually be based upon a web-based application, such as deploying across an Intranet or Internet over the World Wide Web. Both applications become even more expensive requiring more licences per the number of users within the organisation who would be utilising the software. The price then becomes even more expensive with prices ranging between $30,000 to $60,000. This price range is well beyond the budget of the development of eBeds.

From extensive research over the internet, and through discussions with various colleagues and professional advisors known to the author, another GIS package was eventually chosen. The GIS software package chosen was Manifold. Manifold is a very cost-effective and powerful application that has the same, if not more, functionality than the two major providers previously discussed. The cost of Manifold for unlimited users deployed over the World Wide Web is approximate $1,100.00.

This GIS package was well within budget and, after extensive investigation of thoroughly trailing Manifold over a 30 day trial period, it was determined that this application would certainly meet the needs of the hospital.

3.7.2 Operating Environment

During the design and development period of eBeds, the author was required to meet a mandatory list of operating functionality determined by the hospital. This was to ensure the design process could realistically deliver the requirements with no impact on the hospital's day-to-day protocols and procedures.

The application must operate in the environment as set out below:

- Accessibility 24/7, 365 days a year
- Minimum downtime with no data losses
- Maintenance scheduled in off-peak periods
- Aim for refresh rates of around 2 seconds allowing for limitations due to network traffic
- Security requirements as set out in Qld health documentation BASAP Individual security requirements will be set for users
- Some users are distributed geographically yet still require access
- Interface to HBCIS Qld Health data base
- Extreme confidentiality of Qld Health Patient records by adhering to the following:
    - Information Security Standard 6 Operational security Management V 1.3 (Queensland Government policy standard) Information Security Standard 1 Integration with Business Processes V 1.2
    - BASAP - Business Application Security Assurance Framework
- Historical data stored and backed up regularly
- Three tier environment Server/ database /Client.

The eBeds system of patient flow management will address all of the issues raised by the sponsor as having a detrimental impact on their ability to manage the allocation of patients to beds. It will do this by providing a real time database of information that can be accessed anywhere, by anyone with security access to view information in a format that is easily disseminated.

3.8 Development of eBeds

The research aimed to integrate the goals listed in Section 3.6 and support the end users' ability to optimise the business and practice of patient care within a constantly and rapidly changing environment. The healthcare industry is becoming increasingly pressured to increase effectiveness of their business while minimising costs (The Courier-Mail, ~~June~~ 2008 and Chapter 2.1). There is strong movement towards partnering, consolidation and mergers of organisations with government medical facilities a standard setup. This in turn creates pressure for healthcare organisations to streamline and re-evaluate business processes within their organisations and between themselves and external business partners.

One area that is being focused on by healthcare organisations is the creation and consolidation of electronic patient information. These organisations are increasingly focusing on ways of realising these savings through streamlining the admission and discharge processes to enable a reduction in the average length of stay for each patient.

For example, take into consideration this hypothetical scenario within the Queensland Health environment:
(Figures below are approximate and are based on the author's research valid at July 2009).

9000 beds in Qld Hospitals equals
9000 x 365 days equals
3,285,000 bed days
Average length of stay is 3.7 days
3,285,000 divided by 3.7 equals
887,837 episodes of care.

If the average length of stay is reduced to 3.6 days or by 2.5 hours, 912,500 episodes of care, or an extra 24,663 patients, can be cared for with the same resources. In the same way, ensuring there are no unnecessary vacant beds through poor management, more patients can receive more timely care.

Establishing an integrated information infrastructure is a crucial step for these developments and cannot be achieved in a vacuum. Likewise, to be successful in reaching the goal of eBeds, the subject hospital's current system infrastructure must be taken into account, just as future needs need to be assessed. It becomes necessary to connect both disparate internal departments and external business partners, for example, insurance and public agencies and ambulance and emergency services. Data from one department must be able to flow to another department as well as be consolidated into a single computerised patient record. Exchange of information between organisations must be achieved as well. The option of replacing all of these disparate systems is seen as very high risk by most healthcare organisations due to the complexity of the task and cost involved, sometimes hundreds of millions of dollars. Within the last few years attempts were made to deliver such an all-encompassing business application into Qld Health with the project failing after a number of years and multiple millions of dollars outlaid (refer to Chapter 2.2 and 2.3). For example, in 2003 Qld Health signed an $11.7 million computer contract with an Australian health care company to replace the legacy system of HBCIS to trial to a patient-orientated clinical computer system (Health Matters, 2003). By 2005, the health care company was suing Qld Health for breach of contract for $18 million (The Courier-Mail, December 2005).

The hospital was therefore left with an evolution of proprietary systems that may or may not connect to each other and contain varying data sets. Part of the design process is to ensure that the GIS based application will enable

interconnectivity of these applications, along with the integration and interrogation of data.

Once departments and business partners are connected, the first logical step is to consolidate all the patient information and make it available in a consumable fashion to care providers and healthcare professionals with a need together with the appropriate access rights. A second, and important step to completing the ubiquitousness of the system, is to give the providers and professionals the environment and the tools to actively integrate and increase their productivity. The tools and the technology exist to allow these steps to be achieved; eBeds using GIS is the core of that technology.

3.8.1 Study Limitations and Criteria

The success of the research will be defined as the delivering of the following elements. Staff surveys to be developed during the early stages of implementation and taken in the early stages of implementation are:

- Previous staff surveys taken six (6) monthly.
- Previous hard data taken from the HIMS application.
- Data on discharge times gathered during implementation.
- Staff surveys to be taken after implementation.
- Data on discharge times taken after implementation, and
- Hard data taken from the HIMS application.

3.9 Specifications and Requirements

The following elements will be determined and to be incorporated into eBeds while other components may be considered in the future. These are considered necessary and appropriate to enable eBeds to be efficient, effective and comprehensively evaluated.

Technical Specifications elements

- Number of Beds and Wards
- Number of Users
- Number of Concurrent Users
- Estimated Original Database Size
- Estimated Growth of Database
- Data Migration Requirements
- Number of Servers and Configuration (Failover etc)
- Service Level Agreement Requirements
- Wireless Connectivity Requirements
- Refresh Speeds Requirements
- What Sites are to be included (Community, GP’s Other Hospitals etc)
- Confirmation of the Preferred Platform

- Establish Bandwidth availability on the Network to support the Application (LAN and WAN)
- The requirement of 24/7 service or lessor service
- Expected downtime and when should it be scheduled
- Evaluate existing formal processes to manage application upgrades
- Requirement period in which archived information is obligated to be held in the database.

Security Requirements

- What levels of security are required for Individual Users
- Does the administrator require access to change security Requirements
- Is the standard BASS (Qld Health) level of application security sufficient?

Training Requirements

- How many users require training
- What level of training is required (User, Administrator, Tech Support)
- Is a Separate Server required for the Training Module
- Will the vendor be Training the Trainers or carrying out all of the Training
- Who is responsible for on-going training of new employees or is this done in-house.

Functionality

- Has a detailed list of required functionality been supplied
- At what stage of the Patient flow Study process has the Hospital Achieved
- How are you currently managing your patient-work flow
- Are we required to carry out detailed work flow study analysis to optimise results
- What is your ultimate goal you want to achieve (improved patient workflow, reduced ED diversions, save money, reduce overhead, facilitate communications)
- How are you currently managing your existing bed management (ie. White board, excel spreadsheets)
- What level of customisation is required in relation to
    - Reports
    - Queries
    - Application
- Is the Hospital database accessed as Read Only Or Read and Write and to what level?
- What historical information is required to be stored and retrieved?
- What analysis of historical data is required?

Administrative

- What expectations are there in regard to implementation times
- Who is responsible for Sign Off on the Project
- What is the Contract Process

  - Who draws up the contract
  - How long is the process from approval to Start of implementation
- Will a Project Manager be supplied by the Customer for the project implementation
- Will staff time be available for training
- Will a system administrator be appointed
- Is a Budget allocated for the Project and what does it include
  - Vendor Fees Vendor yearly support and maintenance
  - Project Manager (Including Laptop, Phone, Office, Internet Access)
  - Servers
  - Server Software (SQL server license or per concurrent user)
  - Listener
  - HL7 Interface from external vendor (implementation and yearly cost)
  - Service Level Agreement (Local IT Support)
  - Any WAN or LAN Upgrades if Necessary
  - Extra Desktop Computers
  - Large Plasma Screens if Required
  - Extra Data Outlets if Required
  - System Administrator.
- Is information freely available on the following
  - Staff Names, Positions, Novell Logons, Hierarchy, Location
  - CAD drawings for various floors and wards
  - HL7 Segments, Fields and Lookup Codes
- Who is responsible for the following
  - Project Risk Analysis
  - Development of the Project Plan
  - Project scope Document
  - Project Charter
  - Setting and evaluation of Key Performance Indicators.

Change Management

- Are processes in place for administration of process change
- Has a cultural change readiness study been undertaken
- Has a formal change management plan been undertaken and completed
- Who is responsible for managing and implementing any cultural change?

3.10 Conclusion

Chapter 2 discussed software applications currently being used within a hospital environment, while Chapter 3 discussed the problems and need for a more functional and ubiquitous system to enable better patient care processes.

It is extremely important for any hospital to take into consideration the continuum of care of their patients. The continuum of care commences with a patient's first

contact with the general practitioner via the admissions process and continues through the episode of care and hospitalisation, concluding with the transition into the community. Another component of the model is the management of bed resources. This includes all beds managed by the hospital irrespective of where the beds are located and their type or purpose.

The development of the eBeds application will definitely assist in the overall management and delivery of continuum of care for all patients on a day-to-day basis. One of the major benefits of eBeds is the ability to provide staff with current and accurate information to make informed decisions and predictions in a real time environment.

In Chapter 4, the results and pilot application of eBeds will be discussed and how the management and delivery of continuum of care for all patients will be explained outlining the innovative technology utilising GIS for an integrated bed management system.

Chapter 4 - Staff Survey and Discovery Process

4.1 Introduction

A key element of the research was the process of discovering the situation that existed at the start of the project, along with what was required of a bed management application. Without gaining a thorough understanding of the environment there was no adequate way of measuring success or the degree of success as there were no clear and concise deliverables to measure against. Only with this knowledge could the research start to examine how GIS technology could assist in the areas of visualisation of data, and collation and interrogation of that data.

The discovery of this information was a lengthy and complex task that was basically split into two areas: 1. a staff survey, and 2. individual interviews with the various stakeholders. The staff survey was conducted at the very start of the project, prior to any influence of the project itself, in order to obtain the clearest picture of the challenges and issues the staff were having within their individual roles. Further individual interviews were conducted throughout the project with various stakeholders involved, with some groups requiring extensive interviewing and some only one.

One of the many challenges in this process was firstly identifying who the actual stakeholders were, and secondly determining the right questions to ask to reveal the answers required to elucidate the needs of a management system.

For those reasons, it was chosen to offer the survey to all levels of staff that are exposed to either the decision making process or to the outcome of the decision making process. Further to this, the survey was kept anonymous to allow the staff to express their concern without fear of any repercussions from senior staff members should their opinions be contrary to what was expected. The questions themselves were designed to cover a wide range of the work that actually takes place by the staff members and followed extensive consultation with staff members at all levels.

The objective was to unveil the truth behind how each staff group was managing a difficult situation and the detail behind what the problems were at the most granular levels as possible. This was also the reason for splitting up the staff groups and age groups within those groupings as staff with different levels of experience may or may not experience the same levels of problem.

4.2 Background

A particular unit at a Queensland Health public hospital agreed to trail the eBeds bed management application to enable greater clarity of information to staff both inside and outside the hospital. In order to gauge the successes of the development, a survey (refer to Appendix A) was initiated to gain baseline results on a variety of subjects including access to information and the way that staff felt about their role. Further to this, the survey will be utilised to gain knowledge in the aspects of staff roles that caused the most irritation and the way that functionality could be built into the application to alleviate those issues.

4.2.1 Methodology

The survey was initially compiled by the researcher and reviewed by the Director of Nursing for the appropriateness of the questions prior to signing off and distribution to staff members.

The survey was distributed to approximately 100 staff members via their Team Leaders and the respondents were given a month before the completed survey was returned to the author again via their Team Leaders. A copy of the survey is attached in Appendix A.

The questionnaire also asked staff members to supply limited personal information such as:

- Age
- Role
- Time in their Role.

This information was used to further understand the answers by each group and the reason those answers may have been given. It also allowed any functionality that was built to be tailored to the particular role. Apart from this, anonymity was retained.

4.2.2 Question Results

Each question (excluding questions 2 and 3 in Work Flow Processes) had a common response format of:
Strongly Agree/ Agree/ Neutral/ Disagree/ Strongly Disagree.

Simple Analysis

A total number was calculated for each question by each category of response. This information is displayed as a graph showing any overall weighting toward one response by the whole survey group if it occurs. This is followed by a short explanation of the finding in each graph.

The graph does not take into account individual work groups or age groups of respondents. It does however provide a very quick insight in some cases into the severity of the thoughts within the whole group.

Detailed Analysis
To quantify the results a number was assigned to each of the responses.
Strongly Agree = -2/Agree = -1 / Neutral = 0 / Disagree = 1 / Strongly Disagree = 2

For each question and each staff category the results were progressively calculated starting with zero. An example is set out below.

Start of calculation	0
Respondent one Response Strongly Agree = -2	Calculation -2
Respondent two Response Disagree = 1	Calculation -1
Respondent three Response Strongly agree = -2	Calculation -3

(0 minus -2 = -2) (-2 plus 1=-1) (-1 plus -2 = -3)

The final response number for each category and each question reflects both the number of respondents and the severity of views of the respondents. The number of respondents for each question is listed at the top of each question results.

Questions 2 and 3 in Work Flow Processes - were to simply give respondents the ability to select from four alternatives or none at all. Therefore, for each question and category of staff a numeral 1 was assigned for each of the selected alternatives with the number of responses tallied up and given a category based on the number of responses:
O = No response / 0 to 4 Agree / 4 to 8 Strongly Agree / 8 to 12 Very Strongly Agree

By using this calculation, views were expressed not based on a high individual opinion but a general opinion across the target group, with higher responses indicating more like-minded opinion.

In all cases, any question response that was deemed to be not clearly indicating a specific response was discarded as if that question was not answered at all. The criteria for a Null response were:

- No response
- Response not clearly marked
- Multiple responses to a question
- Comments on a question.

The percentage of Null responses can be calculated by deducting the number of responses from the top of each question from the total number of responses, which were ~~51~~49.

4.2.3 Scope

The survey was offered to staff at all levels and in all roles with a comprehensive list of those roles listed in Table 2. The survey was offered to all levels of staff so that a comprehensive and unbiased baseline at the start of the research could be attained and that no assumptions could be made in relation to any roll being performed throughout the hospital.

Table 2 - Staff Roles

MEDICAL	
	Consultant
	JHO
	MO
	PHO
	Registrar
	Residents
	VMO
NURSING	
	ADON
	AIN
	CN
	CNC
	DON
	EE
	EEN-AP
	EN
	NUM
	RN
ALLIED HEALTH	
	Art Therapist
	Dietician
	~~Diversional~~Divisional Therapist
	Leisure Therapist
	Music therapist
	Occupational Therapist
	Pharmacist
	Psychologist
	Physiotherapist
	Recreational Officer
	Social Worker
	Social Worker Associate
ADMINISTRATION OFFICER	
	AO2
	AO3
	ESO
EXECUTIVE	
	Business Manager
	Clinical Director
	Community Co-ordinator
	Executive Manager
	Quality Information Officer

The list of roles was further condensed to four groups to simplify the data interrogation process and enable trends to be determined. These four roles were:

- Executive
- Administration
- Clinical Administration
- Clinicians.

The survey was also offered to staff in the community care teams, such as allied health staff, that are directly related to the hospital although the response numbers from this group were not measured individually. These community teams are:

- Community Care East
- Community Care West
- Community Care South
- Community Care North.

Surveys were distributed in electronic and hard copy format and a memo containing an explanation and authorisation confirmation was sent out to all Team Leaders. The memo aimed to highlight the benefits in having their staff complete the survey, such as having an input into their own role, and their ability to influence outcomes. Total respondents were ~~51~~ 49 with compliance being generally good. As stated above, compliance can be calculated for each question by deducting the number of responses at the top of each question from the total number of responses.

From comments written on some questions, the respondents identified those questions that were not applicable to them or, in a few cases, the question did not appear to be understood (approximately 1% of responses). In these cases, the question and any results were not included in the results of the survey. The methodology (refer to Chapter 4.2.1) contains a detailed report on this issue of how individual anomalies were handled.

4.2.4 Limitations

This survey was limited by the following:

- The number of responses compared to the number of staff may give a skewed view of responses as particular groups may respond more than others. For example, the number of clinicians in the hospital is far greater than clinical administrative staff so a larger percentage of answered questions by clinical administrative staff will be a rightful group answer, whereas, one by clinicians may not be so conclusive.
- The small number of individuals in each group who responded to some questions only permitted the interrogation of resulting information on those groups, not the whole hospital. So individual responses were grouped to

ascertain issues residing within that particular group. However, it may not be a representation of the entire group depending on the individuals that responded but gave an indicator or perception for analysis.

- Participation was voluntary and, as respondents only replied if they wanted to, it which can be assumed that the responses were honest. However, a more complete comprehensive base for analysis could have been attained had responses been made by from all staff members in all roles.

4.3 Results

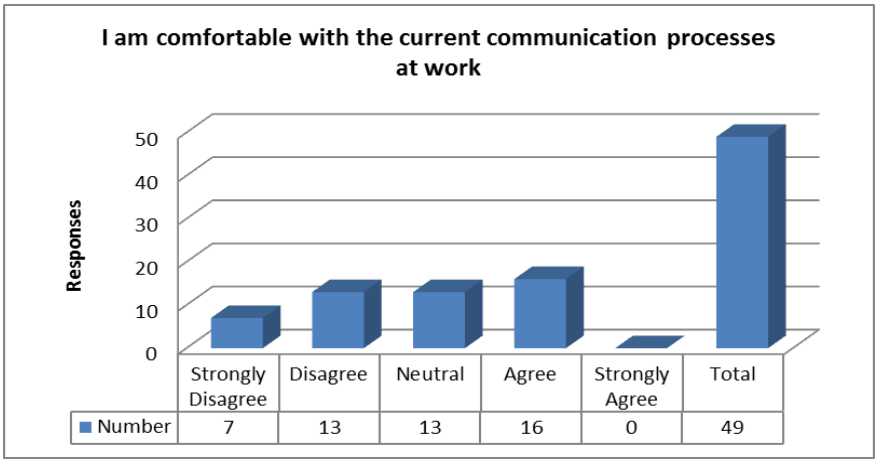
4.3.1 General Information

The following results have been expressed for each question and groups of staff colour coded to better understand the emerging groupings and trends. The 0-2 years refer to the length of time in each role and the total number of responses for each question is listed at the top under number of responses.

Communication

Question 1

I am comfortable with current communication processes at work



The above graph shows a reasonably even spread of responses around neutral with a weighting towards agreeing with the statement. To discern more, it is necessary to look at the responses from each work group and their responsibilities which are laid out below.

Detailed Analysis

0 = Neutral / Above 0 Disagree / Below 0 Agree

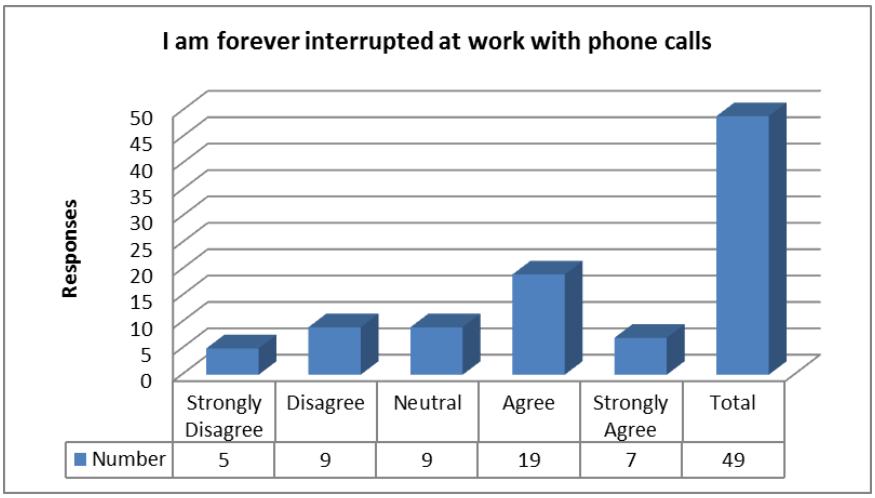
Number of respondents	49	
Results		
With no details	-1	Agree
Admin 2-5 years	-1	Agree
Clinical no details	-1	Agree
Clinical 0-2 years	-4	Strongly agree
Clinical 2-5 years	1	Disagree
Clinical 5-10 years	7	Very Strongly Disagree
Clinical 10 -20 years	3	Strongly Disagree
Clinical 20+ years	0	Neutral
Clinical admin 0-2 years	1	Disagree
Clinical admin 2-5 years	1	Disagree
Clinical admin 5 - 10 years	3	Strongly Disagree
Clinical admin 10-20 years	1	Disagree

The clinical administration team quite strongly disagree with this statement, with the staff members who have been in the role for between 5 to 10 years strongest in their belief. This indicates that their role in general had difficulty with the communication process rather than individuals.

The results from clinicians were interesting as the longer staff had been in a role (up to 10 years) the more they disagreed with the statement. This could either indicate dissatisfaction with the process or it could be that those people are in more senior roles that would encounter, and require a more immediate and detailed level of communication than those in a clinician role a short time.

The results from those who provided no details and Administration staff were that they mildly agreed with the statement. However, the sample was much smaller than the other groups at only 6 of the 49 respondents. It was difficult to interrogate this further as the roles of respondents were not available.

Communication
Question 2
I am forever interrupted at work with phone calls



The above graph clearly indicates the majority of respondents agree with the statement, strongly agree or are neutral, with only 14 of the 49 respondents disagreeing.

Detailed Analysis

0 = Neutral / Above 0 Disagree / Below 0 Agree		
Number of respondents	49	
Results		
With no details	-8	Very Strongly Agree
Admin 2-5 years	-1	Agree
Clinical no details	0	Neutral
Clinical 0-2 years	-5	Strongly agree
Clinical 2-5 years	2	Disagree
Clinical 5-10 years	4	Strongly Disagree
Clinical 10 -20 years	-4	Strongly agree
Clinical 20+ years	3	Disagree
Clinical admin 0-2 years	-1	Agree
Clinical admin 2-5 years	-1	Agree
Clinical admin 5 - 10 years	-3	Strongly Agree
Clinical admin 10-20 years	0	Neutral

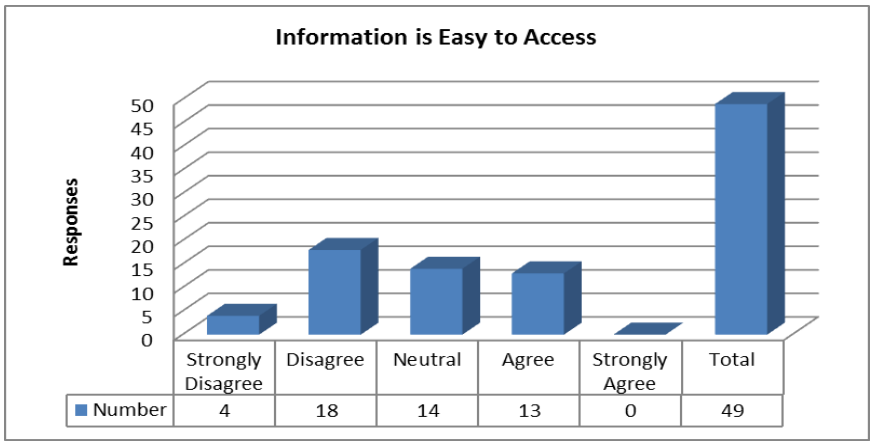
The Clinical Administration respondents agreed with this statement, with those in the role 5 to 10 years strongly agreeing indicating that there was a significant problem with phone call interruptions. In most cases, the phone call interruptions

were legitimate, however, for this question is was aimed at the unnecessary phone call interruptions in relation to bed availability.

The results for the Clinicians were confusing with 22 agreeing and 15 disagreeing and the responses not seeming to fit any pattern at all. This does leave, however, 22 clinicians saying that they were experiencing unwanted or unnecessary interruptions that impacted on their work.

The group who supplied no demographic details very strongly agreed with the statement, but because they did not supply those demographic details their results can only contribute to the overall result.

Access to Information
Question 1
Information is easy to access



The above graph shows an obvious weighting towards disagreeing with the statement that information is easy to access. There are, however, still a large number who agree that they can access information easily. The more detailed analysis below will reveal work groups and ages of respondents that agreed with the statement.

Detailed Analysis
0 = Neutral / Above 0 Disagree / Below 0 Agree

Number of respondents	49	
Results		
With no details	3	Strongly disagree
Admin 2-5 years	-1	Agree
Clinical no details	1	Disagree
Clinical 0-2 years	-4	Strongly agree

Clinical 2-5 years	0	Neutral
Clinical 5-10 years	5	Strongly Disagree
Clinical 10 -20 years	-2	Agree
Clinical 20+ years	4	Strongly disagree
Clinical admin 0-2 years	1	Disagree
Clinical admin 2-5 years	*1*	*Disagree*
Clinical admin 5 - 10 years	3	Strongly disagree
Clinical admin 10-20 years	1	Disagree

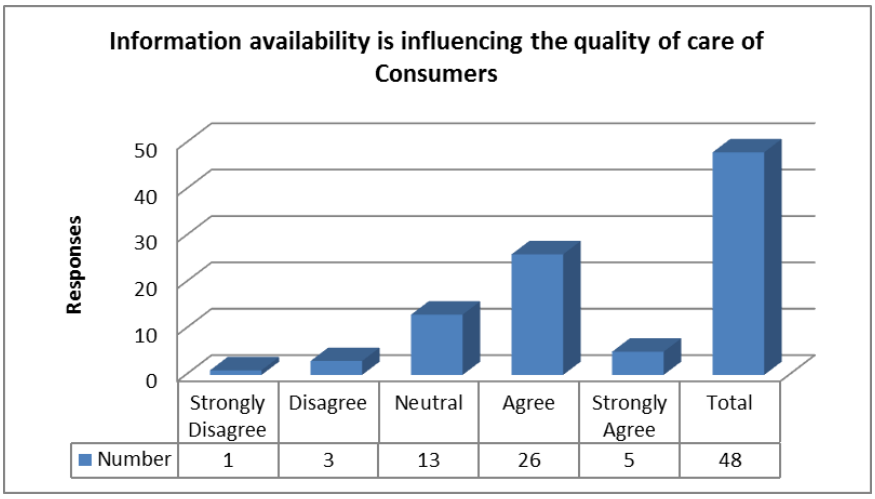
The Clinical Administration respondents were unanimous in disagreeing that information was easy to access, identifying the need for a system that provides easy and quick access to hospital information. The Clinical Admin 5-10 years as per question No.1 and 2 in communication had the strongest views – posing some interesting theories. It could be that a couple of respondents in the 5-10 year group were very strong in their views or it could be that the role of Clinical Administrator was very demanding as that information is very difficult to access and communication was also problematic.

The Clinicians responses were again very confusing. However, examining an individual's position could explain what problems those respondents with strong views were having. The clinicians' role could be anything from a doctor to a nurse to an allied health professional and that particular role could have an issue with access to information. Further discovery was required to determine this. Those with no demographic details strongly disagreed that information was easy to access, while those in administrative roles for only a short period of time agreed, which would indicate that the information an administrative person requires is available. However, the information that a clinical administrator requires was not available.

Access to Information

Question 2

Information availability is influencing quality of care of consumers



The above graph shows that 31 of the 48 respondents agreed with the statement with a large number neutral. There is a definite weighting towards agreeing with the statement.

Detailed Analysis

0 = Neutral / Above 0 Disagree / Below 0 Agree

Number of respondents	48	
Results		
With no details	-4	Strongly Agree
Admin 2-5 years	-1	Agree
Clinical no details	0	Neutral
Clinical 0-2 years	-12	Very Strongly agree
Clinical 2-5 years	-1	Agree
Clinical 5-10 years	-3	Strongly Agree
Clinical 10 -20 years	-4	Strongly Agree
Clinical 20+ years	2	Disagree
Clinical admin 0-2 years	-1	Agree
Clinical admin 2-5 years	-2	Agree
Clinical admin 5 - 10 years	-3	Strongly Agree
Clinical admin 10-20 years	-1	Agree

Ten of the 12 responding groups agreed with this statement with some groups (Clinicians 0-2 years/No Details/Clinical 10-20/Clinical 5-10/Clinical admin 5-10) having very strong views. The clinical administration team quite strongly disagreed with this statement; with staff members strongest in their belief having

been in the role for between 5 to 10 years). This indicates their role in general had difficulty with the communication process rather than individuals.

The results from clinicians were interesting as the longer staff have been in a role (up to 10 years) the more they disagreed with the statement. This could either indicate dissatisfaction with the process or it could be that those people are in more senior roles that would encounter, and require a more immediate and detailed level of communication, than those in a clinician role a short time.

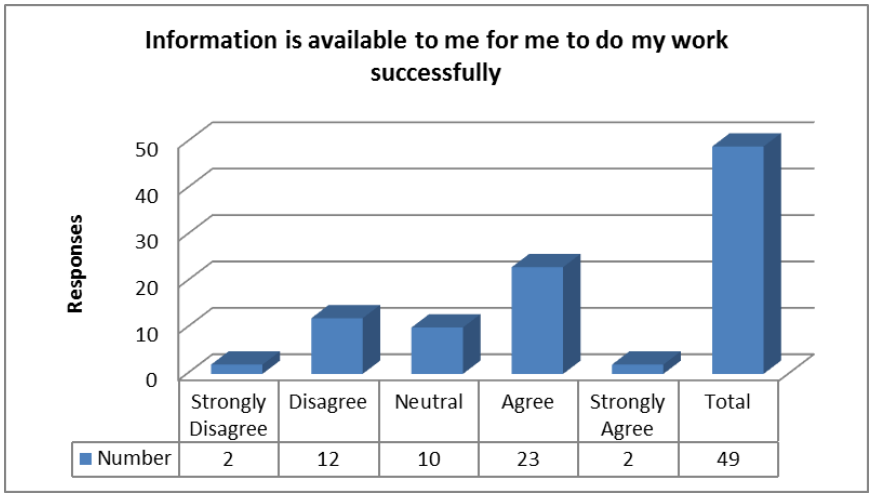
The results from the participants who provided no details and along with the Administration staff were that they mildly agreed with the statement, however, the sample was much smaller than the other groups at 7 of the 48 respondents. This probably indicated that the administrative staff did not have consumer contact and therefore could not comment. The only others were Clinical without details at neutral and Clinical with 20+ years' experience who disagreed.

This is an overwhelming result where the respondents believed that information availability was influencing quality of care.

Access to Information

Question 3

Information is available to me for me to do my work successfully



The above graph shows that almost double the respondents agreed with the statement that disagreed with it. The more detailed analysis below shows each group response.

Detailed Analysis

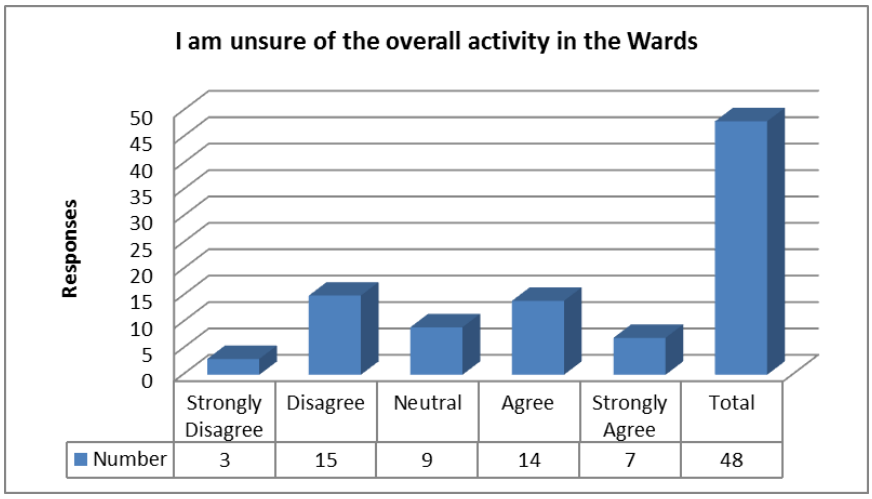
0 = Neutral / Above 0 Disagree / Below 0 Agree

Number of respondents	49	
Results		
With no details	0	Neutral
Admin 2-5 years	-1	Agree
Clinical no details	1	Disagree
Clinical 0-2 years	-10	Very Strongly agree
Clinical 2-5 years	-2	Agree
Clinical 5-10 years	1	Disagree
Clinical 10 -20 years	-5	Strongly Agree
Clinical 20+ years	0	Neutral
Clinical admin 0-2 years	1	Disagree
Clinical admin 2-5 years	0	Neutral
Clinical admin 5 - 10 years	3	Strongly Disagree
Clinical admin 10-20 years	1	Disagree

The results of this question were:
1. Clinical administration sector were at variance with the respondents with 5 to 10 years in the role.
2. Respondents with 5 to 10 years in the role had difficulty accessing information to allow them to carry out their duties

The results from the clinicians were very dependent on their time in the role with a very diverse and strong result both ways. This could be an indication of an individual's requirements and the level of a clinician's role as they occupied the job for a longer period. This made the results for this group inconclusive but there were still 14 individuals who believed access to information was available to them as required. The other categories were neutral and mildly agreeing indicating no strong views.

Access to Information
Question 4
I am unsure of the overall activity in the wards



The above graph shows that there is a very even spread of responses with almost an identical number agreeing with the statement as those disagreeing. This most possibly indicates that individual roles or age groups understand what is happening and others do not.

Formatted: Justified

Detailed Analysis

0 = Neutral / Above 0 Disagree / Below 0 Agree

Number of respondents	48	
Results		
With no details	3	Disagree
Admin 2-5 years	1	Disagree
Clinical no details	-2	Agree
Clinical 0-2 years	-2	Agree
Clinical 2-5 years	-3	Agree
Clinical 5-10 years	-5	Strongly Agree
Clinical 10 -20 years	4	Strongly Disagree
Clinical 20+ years	3	Disagree
Clinical admin 0-2 years	-1	Agree
Clinical admin 2-5 years	1	Disagree
Clinical admin 5 - 10 years	-1	Agree
Clinical admin 10-20 years	-4	Strongly Agree

Clinical administration agreed with this statement with the exception of respondents in the role for 2 to 5 years. The strong response was, however, in the group 10 to 20 years who strongly agreed they have an understanding of the

ward activity. This could be an issue of seniority of roles having more responsibility.

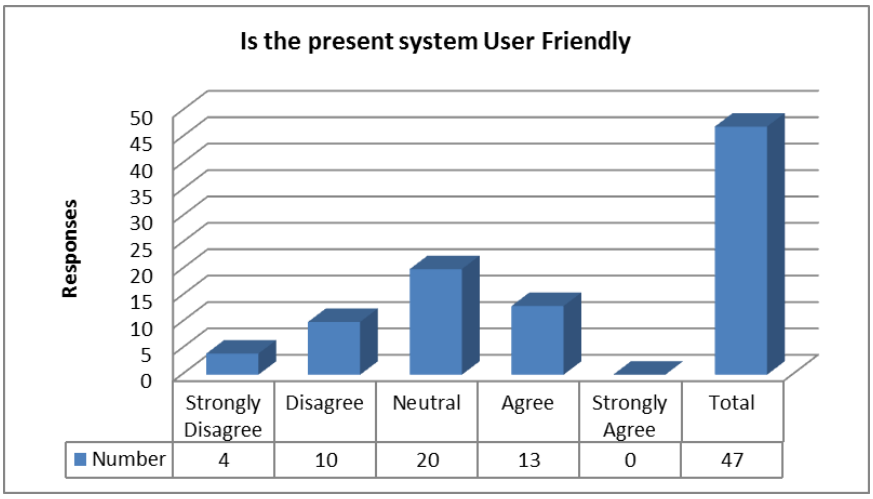
Clinicians also agreed with the statement up to a point when they have been in the role for more than 10 to 20 years. This suggests an indication of experience giving a clearer indication of ward activity. Alternatively, it may be that these clinicians believed they did have an understanding, but the perception and reality may be different.

Administration and those who supplied no details disagreed with the statement, however, without knowing who these respondents were and their role it was very difficult to make any assumptions for reasons for a particular point of view.

Access to Information

Question 5

Is the present system user friendly?



The above graph is interesting as it shows a very large number of neutral responses and a very similar number agreeing and disagreeing with the statement. The more detailed analysis will reveal the work groups and their responses.

Detailed Analysis

0 = Neutral / Above 0 Disagree / Below 0 Agree

Number of respondents	47	
Results		
With no details	3	Disagree
Admin 2-5 years	-1	Agree
Clinical no details	-1	Agree

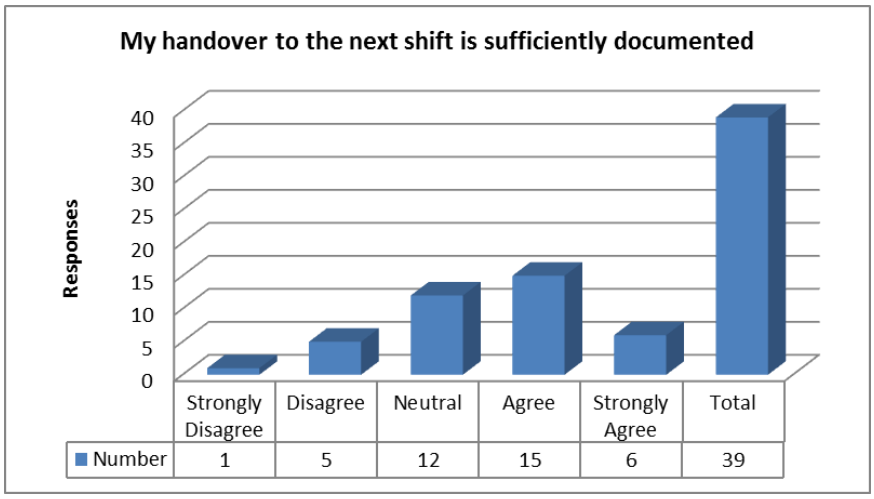
Clinical 0-2 years	-1	Agree
Clinical 2-5 years	2	Disagree
Clinical 5-10 years	0	Neutral
Clinical 10 -20 years	-1	Agree
Clinical 20+ years	4	Strongly Disagree
Clinical admin 0-2 years	1	Disagree
Clinical admin 2-5 years	-1	Agree
Clinical admin 5 - 10 years	3	Disagree
Clinical admin 10-20 years	0	Neutral

Unfortunately this question should have read "The present system is user friendly" to have a quantifiable response of agree or disagree. For this reason the question could have been interpreted different ways and this was shown in the responses. They were erratic and had no distinct pattern that can be evaluated. This was noted and adjustments made in any further survey.

Work Flow processes

Question 1

My handover to the next shift is sufficiently documented



The above graph shows that overall most respondents agreed that their handover process was documented well. Only 6 of the 39 respondents disagreed.

Detailed Analysis

0 = Neutral / Above 0 Disagree / Below 0 Agree

Number of respondents	39	
Results		
With no details	-2	Agree
Admin 2-5 years	0	Neutral

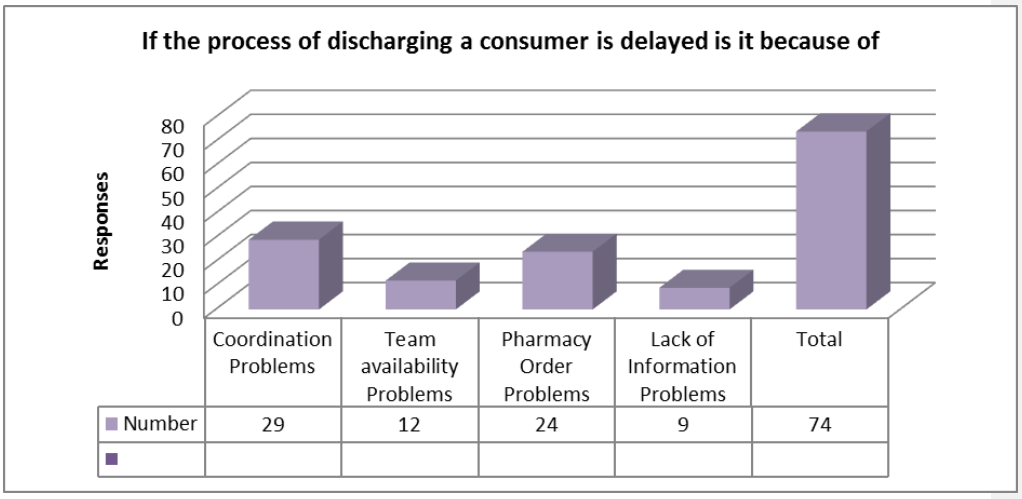
Clinical 0-2 years	-4	Strongly Agree
Clinical 2-5 years	-2	Agree
Clinical 5-10 years	-2	Agree
Clinical 10 -20 years	-4	Strongly Agree
Clinical 20+ years	-1	Agree
Clinical admin 2-5 years	0	Neutral
Clinical admin 5 - 10 years	2	Disagree
Clinical admin 10-20 years	1	Disagree

The Clinical administration group in general disagreed with this statement, indicating that from an administrative point of view in the clinical area a more documented handover should be considered. From this result we can determine the bed management functionality needed to address this issue, if possible, for this group. The Clinical group were unanimous in agreeing with the statement indicating they believed their clinical handover process was comprehensive. Those respondents with no details also agreed with the view that documentation was sufficient. Administration 2 to 5 years was neutral.

Work Flow Processes

Question 2

If the process of discharging a consumer is delayed, is it because of



The above graph shows that coordination problems and pharmacy order problems are producing the most issues during the discharge process. There is also a significant number responding that team availability and lack of information are creating issues.

Detailed Analysis

Coordination problems

0 = No response / 0 – 4 Agree / 4-8 Strongly agree/ 8+ Very strongly agree

Number of respondents	29	
Results		
With no details	3	Agree
Admin 2-5 years	1	Agree
Clinical No Details	1	Agree
Clinical 0-2 years	8	Very Strongly Agree
Clinical 2-5 years	2	Agree
Clinical 5-10 years	5	Strongly Agree
Clinical 10 -20 years	6	Strongly Agree
Clinical 20+ years	1	Agree
Clinical admin 2-5 years	1	Agree
Clinical admin 5 - 10 years	1	Agree
Clinical admin 10-20 years	1	Agree

Team availability problems

0 = No response / 0 – 4 Agree / 4-8 Strongly agree/ 8+ Very strongly agree

Number of respondents	12	
Results		
With no details	1	Agree
Admin 2-5 years	0	No Response
Clinical No Details	1	Agree
Clinical 0-2 years	2	Agree
Clinical 2-5 years	3	Agree
Clinical 5-10 years	1	Agree
Clinical 10 -20 years	4	Agree
Clinical 20+ years	1	Agree
Clinical admin 2-5 years	0	No response
Clinical admin 5 - 10 years	1	Agree
Clinical admin 10-20 years	0	No Response

Pharmacy order problems

0 = No response / 0 – 4 Agree / 4-8 Strongly agree/ 8+ Very strongly agree

Number of respondents	24	
Results		
With no details	4	Agree
Admin 2-5 years	0	No Response
Clinical No Details	1	Agree
Clinical 0-2 years	6	Strongly Agree
Clinical 2-5 years	2	Agree
Clinical 5-10 years	2	Agree
Clinical 10 -20 years	6	Strongly Agree
Clinical 20+ years	1	Agree
Clinical admin 2-5 years	1	Agree
Clinical admin 5 - 10 years	1	Agree

Clinical admin 10-20 years	1	Agree

Lack of information problems

0 = No response / 0 – 4 Agree / 4-8 Strongly agree/ 8+ Very strongly agree

Number of respondents 9

Results

With no details	1	Agree
Admin 2-5 years	0	No Response
Clinical No Details	1	Agree
Clinical 0-2 years	2	Agree
Clinical 2-5 years	0	No Response
Clinical 5-10 years	2	Agree
Clinical 10 -20 years	3	Agree
Clinical 20+ years	0	No Response
Clinical admin 2-5 years	0	No Response
Clinical admin 5 - 10 years	1	Agree
Clinical admin 10-20 years	0	No Response

In these questions respondents were given an option of selecting one or more of four options to answer the question “If the process of discharging a consumer is delayed, is it because of:

Coordination Problems 29

The clinical group had the strongest views of all respondents.

Team availability Problems 12

Again, the clinical group had the strongest views but the overall response was much lower than the other 3 categories.

Pharmacy order problems

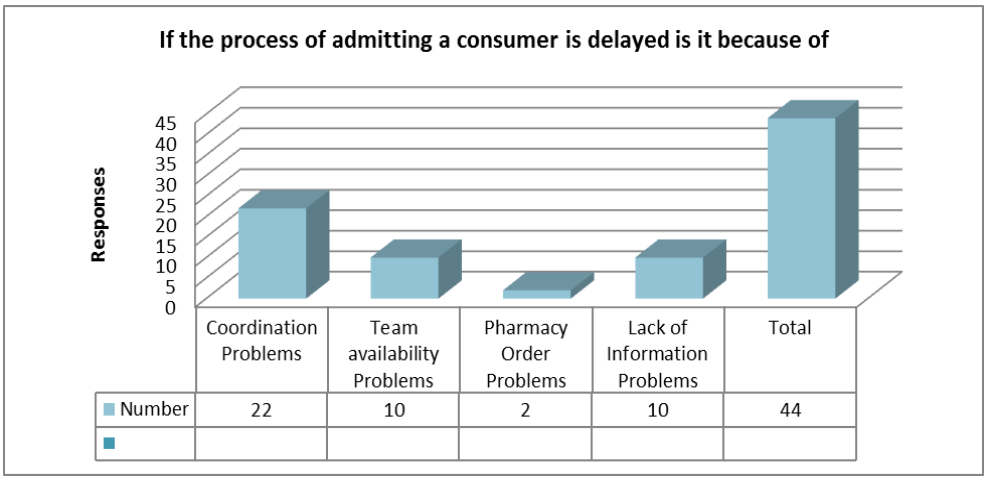
The clinical group had the strongest views that this was a cause of discharge problems.

Lack of information problems 9

The clinicians were the group who had the strongest views. However, the sample was the lowest of all four responses.

The result indicated that across the roles all participants believed that there were issues with discharging a patient that needed to be improved. This discharge process must be addressed in the resulting application functionality.

Work Flow Processes
Question 3
If the process of admitting a consumer is delayed, is it because of



The above graph shows that coordination issues are causing the greatest concern during the admission process; however, once again team availability and lack of Information also show a significant number of responses.

Detailed Analysis
Coordination problems
0 = No response / 0 – 4 Agree / 4-8 Strongly agree/ 8+ Very strongly agree

Number of respondents	22	
Results		
With no details	2	Agree
Admin 2-5 years	1	Agree
Clinical No Details	1	Agree
Clinical 0-2 years	6	Strongly agree
Clinical 2-5 years	3	Agree
Clinical 5-10 years	2	Agree
Clinical 10 -20 years	7	Strongly agree
Clinical 20+ years	1	Agree
Clinical admin 2-5 years	0	No Response
Clinical admin 5 - 10 years	0	No Response
Clinical admin 10-20 years	1	Agree

Team availability problems

0 = No response / 0 – 4 Agree / 4-8 Strongly agree/ 8+ Very strongly agree

Number of respondents	10	
Results		
With no details	1	Agree
Admin 2-5 years	0	No Response
Clinical No Details	0	No Response
Clinical 0-2 years	1	Agree
Clinical 2-5 years	0	No Response
Clinical 5-10 years	1	Agree
Clinical 10 -20 years	4	Agree
Clinical 20+ years	1	Agree
Clinical admin 2-5 years	1	Agree
Clinical admin 5 - 10 years	1	Agree
Clinical admin 10-20 years	1	Agree

Pharmacy order problems

0 = No response / 0 – 4 Agree / 4-8 Strongly agree/ 8+ Very strongly agree

Number of respondents	2	
Results		
With no details	1	Agree
Admin 2-5 years	0	No Response
Clinical No Details	0	No Response
Clinical 0-2 years	0	No Response
Clinical 2-5 years	0	No Response
Clinical 5-10 years	0	No Response
Clinical 10 -20 years	1	Agree
Clinical 20+ years	1	Agree
Clinical admin 2-5 years	0	No Response
Clinical admin 5 - 10 years	1	Agree
Clinical admin 10-20 years	0	No Response

Lack of information problems

0 = No response / 0 – 4 Agree / 4-8 Strongly agree/ 8+ Very strongly agree

Number of respondents	10	
Results		
With no details	1	Agree
Admin 2-5 years	0	No Response
Clinical No Details	0	No Response
Clinical 0-2 years	2	Agree
Clinical 2-5 years	1	Agree
Clinical 5-10 years	1	Agree
Clinical 10 -20 years	5	Strongly Agree
Clinical 20+ years	1	Agree

Clinical admin 2-5 years	0	No Response
Clinical admin 5 - 10 years	1	Agree
Clinical admin 10-20 years	0	No Response

In these questions respondents were given an option of selecting one or more of four options to answer the question “If the process of Admitting a consumer is delayed, is it because of.

Coordination Problems 22

The clinical group had the strongest views of all respondents.

Team availability Problems 10

Again the clinical group had the strongest views but the overall response was much lower.

Pharmacy order problems 2

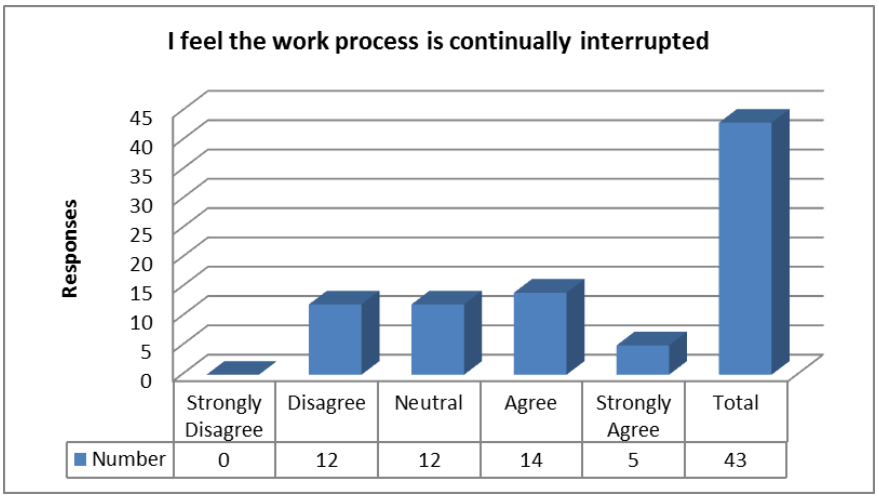
This response was extremely low as pharmacy was an issue during the discharge process.

Lack of information problems 10

Again the clinicians were the group who had the strongest views. However, the sample was quite low.

Once again there were obvious issues with the admission process from all roles. The pharmacy order result would be low due to no or little pharmacy interaction in the admission process.

Work Flow Processes
Question 4
I feel the work process is continually interrupted



The above graph shows a small weighting to respondents that agree with the statement and have problems with interruptions at work. This overall response could be different depending on work group.

Detailed Analysis

0 = Neutral / Above 0 Disagree / Below 0 Agree

Number of respondents	43	
Results		
With no details	-4	Strongly agree
Admin 2-5 years	-2	Agree
Clinical no details	1	Disagree
Clinical 0-2 years	2	Disagree
Clinical 2-5 years	-1	Agree
Clinical 5-10 years	0	Neutral
Clinical 10 -20 years	0	Neutral
Clinical 20+ years	-1	Agree
Clinical admin 0-2 years	-1	Agree
Clinical admin 2-5 years	-1	Agree
Clinical admin 5 - 10 years	-2	Agree
Clinical admin 10-20 years	-1	Agree

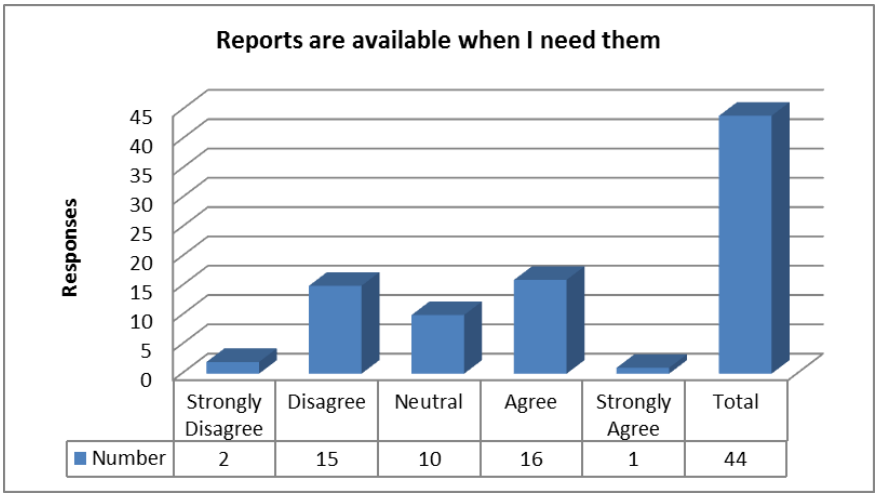
It appeared the clinicians with no details and 0 to 2 years were the only respondents that disagreed with this statement. However, the views were not as strong as with some other questions. Also, the response from the above could be an indication of the role the respondents were in which was not captured. The

difficulty was because as one small group gave no details it was impossible to drill further down and ask the question of why the response was opposite to the majority. This issue was outside the scope of this survey and would require compelling responses to demographic questions

Ability to Create Adequate Reports

Question 1

Reports are available when I need them



The overall response as shown in the above graph is extremely neutral showing almost no weighting at all either way. The more detailed analysis below will determine if separate work or age groups are weighted either way.

Detailed Analysis

0 = Neutral / Above 0 Disagree / Below 0 Agree

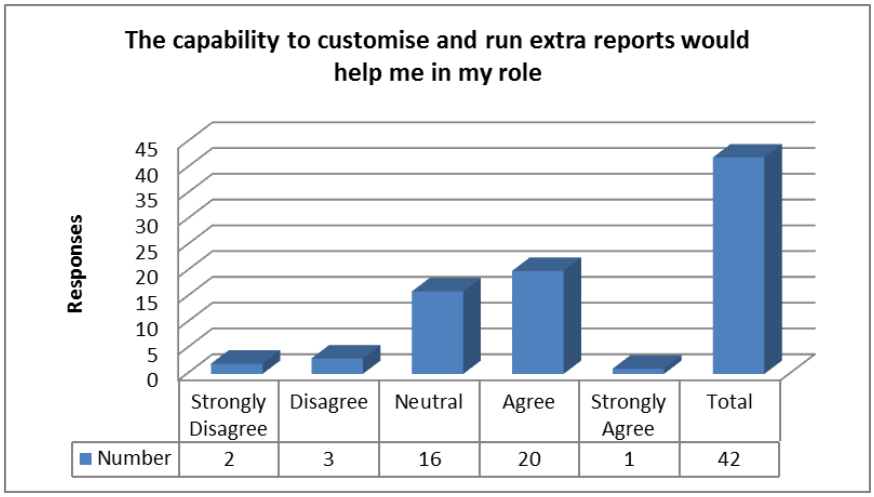
Number of respondents	44	
Results		
With no details	2	Disagree
Admin 2-5 years	0	Neutral
Clinical no details	2	Disagree
Clinical 0-2 years	1	Disagree
Clinical 2-5 years	0	Neutral
Clinical 5-10 years	-3	Agree
Clinical 10 -20 years	-3	Agree
Clinical 20+ years	-1	Agree
Clinical admin 0-2 years	1	Disagree
Clinical admin 2-5 years	1	Disagree
Clinical admin 5 - 10 years	2	Disagree
Clinical admin 10-20 years	1	Disagree

-The clinical group who had been in the role for more than 5 years agreed with the statement, but those with less experience disagreed with the statement. This can be summarised that this could be either due to the needs of the particular respondents to have access to reports or that with experience staff know where to go to get a report they need. Respondents who gave no details also disagreed with the statement.

Ability to create adequate reports

Question 2

The capability to customise and run extra reports would help me in my role



The above graph clearly shows a weighting towards agreeing with the statement with only 5 of the 42 respondents disagreeing.

Detailed Analysis

0 = Neutral / Above 0 Disagree / Below 0 Agree

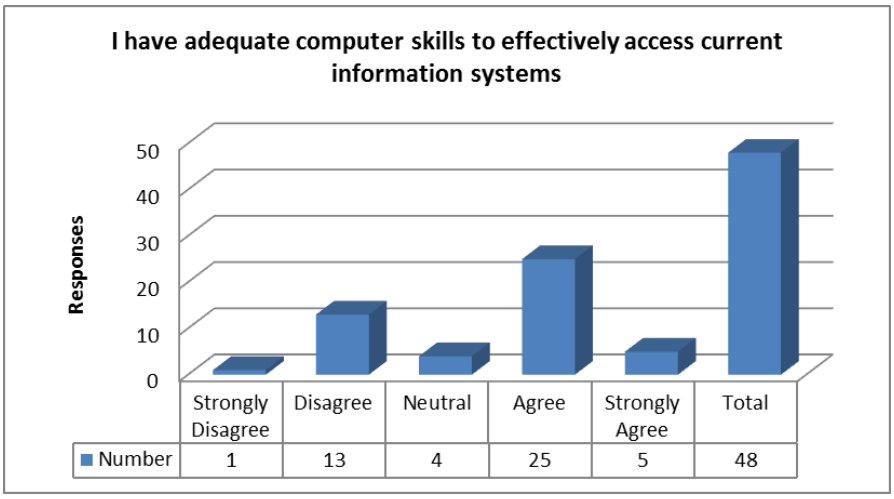
Number of respondents	42	
Results		
With no details	-3	Agree
Admin 2-5 years	0	Neutral
Clinical no details	-2	Agree
Clinical 0-2 years	-4	Strongly Agree
Clinical 2-5 years	0	Neutral
Clinical 5-10 years	-1	Agree
Clinical 10 -20 years	0	Agree
Clinical 20+ years	1	Disagree
Clinical admin 0-2 years	-1	Agree
Clinical admin 2-5 years	-1	Agree
Clinical admin 5 - 10 years	0	Neutral

Overall, the majority of respondents agreed with this statement. The only respondents that did not agree were either neutral or not strong in their views.

Ability to Run Adequate Queries

Question 1

I have adequate computer skills to effectively access current information systems



The above graph is interesting, firstly, as there are very few neutral responses and, secondly, as there is a strong response that adequate skills are available. There are, however, a group who disagree, and require more training to access information systems. The more detailed analysis below will reveal those groups.

Detailed Analysis

0 = Neutral / Above 0 Disagree / Below 0 Agree

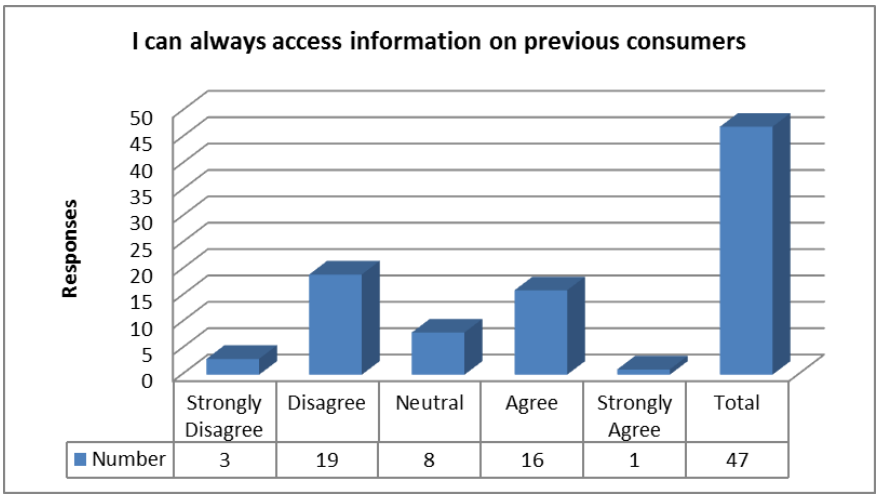
Number of respondents	48	
Results		
With no details	-1	Agree
Admin 2-5 years	-1	Agree
Clinical no details	-2	Agree
Clinical 0-2 years	-14	Very Strongly agree
Clinical 2-5 years	1	Disagree
Clinical 5-10 years	-4	Strongly agree
Clinical 10 -20 years	1	Disagree
Clinical 20+ years	0	Neutral
Clinical admin 0-2 years	1	Disagree
Clinical admin 2-5 years	-1	Agree
Clinical admin 5 - 10 years	0	Neutral

Clinical admin 10-20 years -1 Agree

The overall view of respondents was that computer skills were adequate for staff to access information. The only difference to this view was in the Clinical 2 to 5 years, clinical 10 to 20 years, and Clinical administration 0 to 2 years groupings.

Any further training of staff in computer skills should target these areas, however, as the responses were low it could be individuals who required training and not groups.

Ability to run adequate Queries
Question 2
I can always access information on previous consumers



The above graph shows a small weighting towards those respondents who have trouble accessing information on previous consumers. The more detailed analysis below will reveal those individual groups who are having the most issues.

Detailed Analysis
0 = Neutral / Above 0 Disagree / Below 0 Agree
Number of respondents 47
Results

With no details	1	Disagree
Admin 2-5 years	-1	Agree
Clinical no details	-1	Agree
Clinical 0-2 years	-1	Agree
Clinical 2-5 years	2	Disagree
Clinical 5-10 years	2	Disagree
Clinical 10 -20 years	4	Strongly Disagree

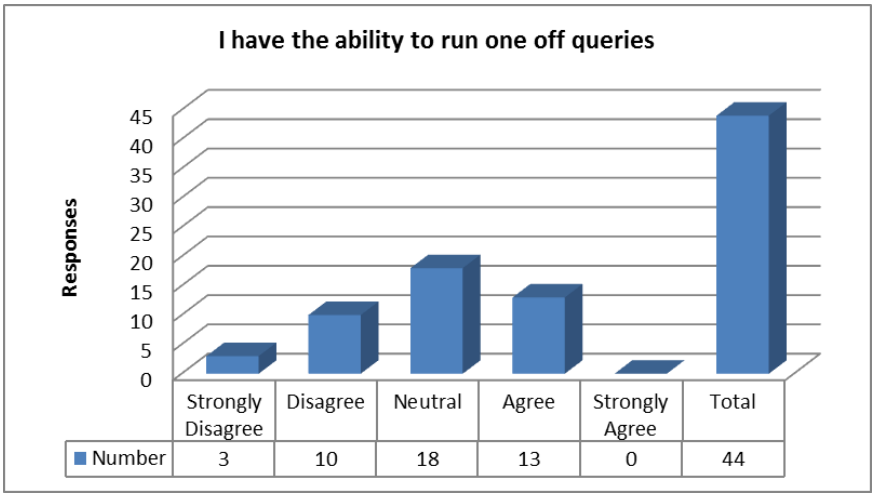
Clinical 20+ years	-2	Agree
Clinical admin 0-2 years	1	Disagree
Clinical admin 2-5 years	-1	Agree
Clinical admin 5 - 10 years	4	Strongly Disagree
Clinical admin 10-20 years	1	Disagree

The Clinical administration group disagreed with the statement apart from the respondents who had been in the role for 2 to 5 years. Clinicians were split with the statement with three groups agreeing and three disagreeing; the strongest views were in the 10 to 20 year group strongly disagreeing. Those supplying no details and Administration were also split; however, the views were not strong.

Ability to run adequate Queries

Question 3

I have the ability to run one off queries



The above graph shows a very neutral response overall with a high number of neutral responses and a very similar number either way. The more detailed analysis below will reveal which groups are having the most issues.

Detailed Analysis

0 = Neutral / Above 0 Disagree / Below 0 Agree

Number of respondents 44

Results

With no details	-3	Agree
Admin 2-5 years	0	Neutral
Clinical no details	-1	Agree
Clinical 0-2 years	-5	Strongly agree
Clinical 2-5 years	1	Disagree
Clinical 5-10 years	3	Disagree

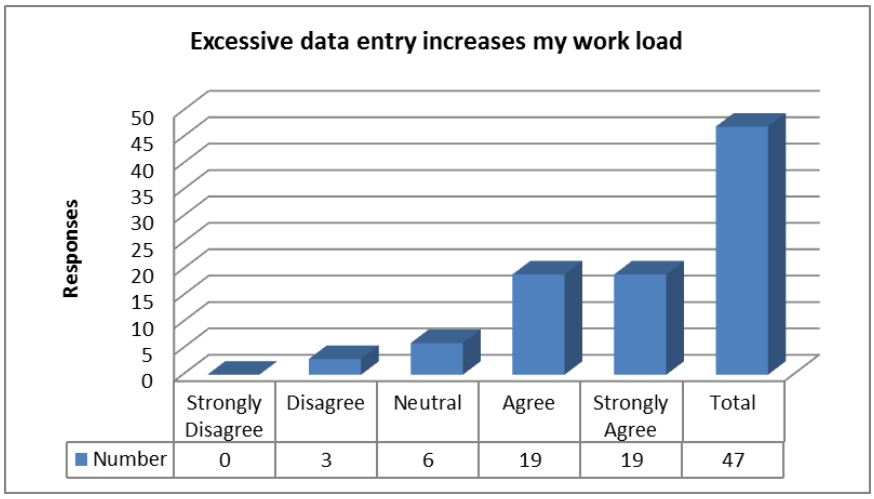
Clinical 10 -20 years	3	Disagree
Clinical 20+ years	0	Neutral
Clinical admin 0-2 years	1	Disagree
Clinical admin 2-5 years	1	Disagree
Clinical admin 5 - 10 years	4	Strongly Disagree
Clinical admin 10-20 years	-1	Agree

The responses to this statement were not as strong as other questions, however, the group who strongly agreed were Clinical 0 to 2 years and the group who strongly disagreed were Clinical administration 5 to 10 years. This most likely reflects the information that was being requested by the groups and being available in one case and unavailable in the other.

Feelings about Your Role

Question 1

Excessive data entry increases my work load



The above graph shows a very strong indication that excessive data entry is increasing work load and all efforts should be made to decrease data entry requirement and therefore increase consumer contact time.

Detailed Analysis

0 = Neutral / Above 0 Disagree / Below 0 Agree

Number of respondents 47

Results

With no details	-5	Strongly agree
Admin 2-5 years	-1	Agree
Clinical no details	-3	Agree
Clinical 0-2 years	-12	Very Strongly agree
Clinical 2-5 years	-3	Agree

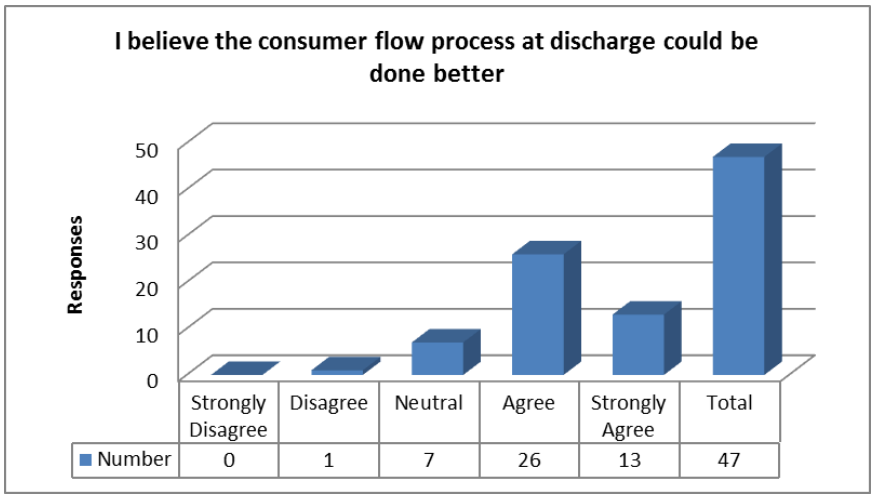
Clinical 5-10 years	-13	Very Strongly agree
Clinical 10 -20 years	-7	Strongly agree
Clinical 20+ years	-3	Agree
Clinical admin 0-2 years	-2	Agree
Clinical admin 2-5 years	-1	Agree
Clinical admin 5 - 10 years	-2	Agree
Clinical admin 10-20 years	-1	Agree

The responses to this statement were both unanimous and very strong with clinicians having extremely strong views that data entry was excessively adding to workload.

Feelings about your Role

Question 2

I believe the consumer work flow process at discharge could be done better



The above graph shows a definite weighting towards a feeling that the discharge process could be handled better. Only one respondent disagreeing and seven neutral is a very strong response.

Detailed Analysis

0 = Neutral / Above 0 Disagree / Below 0 Agree

Number of respondents 47

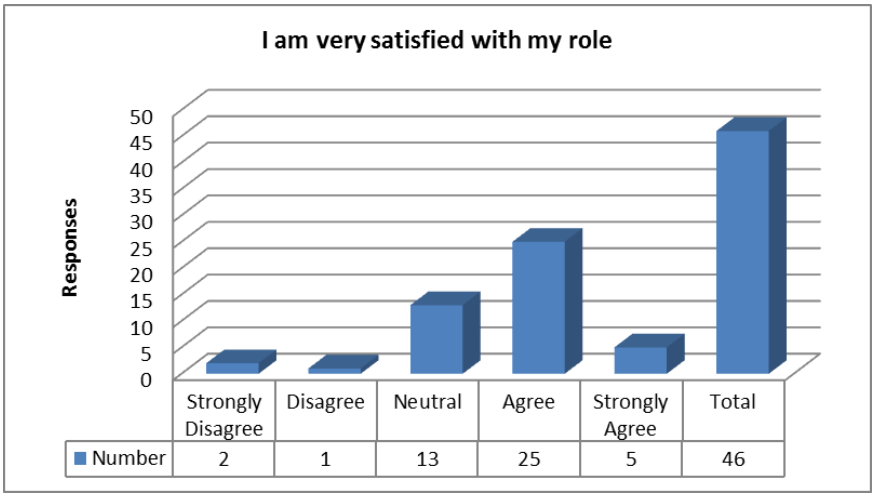
Results

With no details	-8	Strongly agree
Admin 2-5 years	1	Disagree
Clinical no details	-1	Agree
Clinical 0-2 years	-14	Very Strongly agree
Clinical 2-5 years	-3	Agree

Clinical 5-10 years	-9	Very Strongly agree
Clinical 10 -20 years	-9	Very Strongly agree
Clinical 20+ years	-3	Agree
Clinical admin 0-2 years	-2	Agree
Clinical admin 2-5 years	-1	Agree
Clinical admin 5 - 10 years	-2	Agree
Clinical admin 10-20 years	-2	Agree

Once again the response to this statement was both unanimous and very strong with clinicians agreeing very strongly.

Feelings about your Role
Question 3
I am very satisfied with my role



The above graph shows that only 3 of the 46 respondents were dissatisfied with their role which is a very strong response that most respondents were either satisfied or very satisfied with their role.

Detailed Analysis
0 = Neutral / Above 0 Disagree / Below 0 Agree
Number of respondents 46
Results

With no details	-1	Agree
Admin 2-5 years	-1	Agree
Clinical no details	-2	Agree
Clinical 0-2 years	-13	Very Strongly agree
Clinical 2-5 years	-3	Agree
Clinical 5-10 years	-1	Agree
Clinical 10 -20 years	-5	Strongly agree

Clinical 20+ years	-2	Agree
Clinical admin 2-5 years	-1	Agree
Clinical admin 5 - 10 years	1	Disagree
Clinical admin 10-20 years	-1	Agree

This response was nearly unanimous with all groups except for Clinical Administration agreeing they were very satisfied with their role. The clinicians were once again the strongest in their views.

4.4 Summary of Survey Results

It was important when analysing the information and responses to this survey to acknowledge that each group of respondents, while working in a similar environment, will be looking for different information based on their role in that environment. Therefore, questions on access to information and communication responses were analysed by group to discern particular needs within that group which would form part of the eBeds function criteria. Also, each group interacts in a different way with others and this can lead to differences in responses.

The time in a particular role can also vary responses as more junior roles will have different needs and less opportunity to experience all aspects., This was reflected in results as trends showed changes in opinion based on the length of time in a role rather than a particular role.

One interesting point was the lack of responses from those in executive positions, unless they responded with no details to ensure complete anonymity. They could have believed the survey was more for clinical staff even though it was distributed to all staff members and tended to be out of touch with day-to-day operational functions/needs.

In general, it appears improvements need to be made particularly in the areas listed below and that an electronic information system would deliver these improvements:

- Communication needs to be improved for Clinical Administrative staff and Clinicians in senior roles.
- Access to information needs to be improved across the board for all staff and roles with again an emphasis on Clinical Administrators and Clinicians.
- Work Flow Processes questions identified the need to provide more information, solve pharmacy order problems, improve team availability and coordination for all groups for both admission and discharge processes.. Further to these, interruptions to work were most common in the clinical administrative area and require new strategies to minimise interruptions. The question of handover was interesting as all agreed that the current situation was adequate except for the senior clinicians who had an opposite perception. This may be due to some groups not wanting their

work load increased; or that senior clinicians see a need for more clarity as they have an overview of the process: a more transparent process could solve this dilemma?

- Availability of reports were an issue in all roles when looking for customised reports but the Clinical Administrators had a general issue with all reports being available when required.
- Queries questions targeted a need for extra computer training in certain roles such as Clinical 2 to 5 years and 5 to 10 years as well as Clinical Administrators 0 to 2 years.
- Staff felt their role was generally satisfying, however, they felt that both admissions and discharges could be handled better and that excessive data entry was a burden. This was taken into account when developing the application to ensure that data entry was kept to a minimum.

The survey undertaken must be seen as a guide to facilitate further research and discovery processes within the groups and areas highlighted, rather than a definitive study of what functionality to build into an application. If this discovery targets the areas already highlighted, then the best chance of addressing the core issues will be achieved.

4.5 The individual interviews

4.5.1 The Interface to HBCIS

Queensland Health has established a separate unit called “Interfaces R Us” to work with vendors in the establishment of any interface between HBCIS and another application. This was done to centralise and monitor all activity from HBCIS to ensure quality and integrity of information flow.

Extensive discovery took place with the interface team to establish and reveal the information required to build the interface. One of the main issues for all concerned was that this type of interface in real time had never been achieved before within Queensland Health and, although technically possible, would require extensive analysis of not only what was required but what type and form of messages that HBCIS sent out under every circumstance. This resulted in a complex process of testing at each stage to ensure each transaction was working prior to moving on to the next. A clear understanding of the HBCIS policies and procedures were also required and involved communication with the HBCIS trainers as well as clinical administrative staff.

4.5.2 Procedures

Queensland Health is a very large organisation and everything that is undertaken, whether it is internally or with an external provider, must follow the guidelines contained within those procedures. Discussions took place with the

following groups, such as the information technology (IT) staff and clinical administration, to discover what procedures need to be followed.

Within the information technology group, procedures were found for basically any interaction from installing software to testing and upgrades, as well as backing up data. The discovery of these procedures was sometimes difficult and resulted in some delays for certain undertakings.

Clinical Administrators were tasked with the entry of data into HBCIS and were a good source of information when troubleshooting interface issues and procedural issues with entering information.

Within the clinical group it was important to talk with clinicians and obtain an intimate understanding of the way they carried out their roles in order to understand how eBeds could help make their work load easier. These roles differ within hospitals and from one hospital to the next even though the job title may be the same, so having a granular understanding of each person's responsibilities was very important.

In order to understand how the business operates, interviews took place with management from both the clinical and administrative sides which revealed not only present policy but also future direction for the hospital. eBeds had to fit this direction and obtain the information they required in order to be useful to this group.

4.5.3 Existing MS Excel Spreadsheet

Print outs were obtained of the existing MS Excel spreadsheet to determine what information was presently gathered. Interviews also took place with the existing bed manager to determine what information they required, both in real time and historically, to increase their effectiveness in the role. This resulted in a clear understanding of what their role was and how they interacted with other roles in the organisation, which gave a vital insight into how they wanted to operate in the future.

4.5.4 Data gathering requirements

It was discovered that one of the key objectives from the staff for eBeds was the ability to gather more data pertaining to patients and query that data along with data from other external and internal sources. This gathering of data had to meet management objectives and at the same time alleviate the doubts of staff that were fearful of being overburdened with data entry tasks. The following data were to be collected in the eBeds application:

- Consumer Notes
- External Programs
- Nurse and Case Manager Assignment

- Mental Health Status
- Risk
- Observation status.

It was noted that to obtain this amount of information without increasing the data entry requirements of the staff was going to be a challenge and further interviews took place to determine in each category exactly what information was required to simplify the data entry process.

4.5.5 Internal security requirements

From information obtained from the IT group, it became clear that certain security standards must be met for external access into the application. However, once logged on to the application, a separate set of security levels was required within the business to allocate access based one a user's role and requirements. The determining of these roles was achieved with consultation with the clinical management team with advice from the researcher as to how best to split the access and to whom.

4.5.6 Layout of wards and operational activities

In order to give the users a visual layout of the wards and the beds as well as the patients in those beds, the computer aided drawings of the hospital were sourced and verified against actual layout to determine if any changes had occurred. This layout could then form the many visual layers that are built into the application. It was also important to understand how the ward staff functioned in their day to day activities as well as the organisational structure of who was responsible for what on each ward within the hospital. It was also important to understand what the admission and discharge process was to ensure that the eBeds functionality meshed with the actual events as they occurred and this process occurred through interviews with senior clinicians.

4.5.7 The LAN and WAN

In order for the multi-tiered architecture to operate, the application must be deployed across the Local Area Network (LAN) and to be accessible to Community Care Teams across the Wide Area Network (WAN). The significance of using such infrastructure such as a LAN or WAN is that a LAN can connect a group of computers contained within a building or group of buildings. This type of setup is ideal for a hospital environment where users can share expensive devices such as printers and data. A WAN can connect a computer network such as a LAN over a relatively large geographical area, therefore, connecting staff who may work in remote areas to the same data used within the LAN.

This dependence on existing infrastructure meant an investigation into the impact of the application on the network, and particularly on the WAN, as

network speeds in these areas were already slow. Fortunately, during those investigations, it was ascertained that upgrades were scheduled to the network in the areas being deployed to and those upgrades were in place prior to any Go Live of the eBeds application. WAN testing by the Queensland Health WAN testing group confirmed that the eBeds application was deployable.

4.5.8 Interaction with other units of the hospital

It was determined through numerous interviews, such as the on-going face to face sessions, that staff often interacted with others from various other units within the hospital. It was important to be sure, for eBeds, just how this interaction occurred. For example, admissions mainly came in through the emergency department. However, sometimes after hours admissions occurred directly to the hospital and research questioning discovered who handled these and why. This aided in the development of the interface as did a thorough understanding of the transfers of acute care procedures. All of this post survey information came from interviews and meetings with key stakeholders in each area throughout the development period.

4.5.9 Interaction with external stakeholders

It became very clear through meetings with staff that a continuum of care was particularly vital in the area of acute care. Therefore, with the continual communication between the hospital and external stakeholders, such as allied health staff located outside of the hospital, it was also vital in ensuring that the continuum of care becomes known. How could eBeds facilitate the care that the external providers were striving to achieve was the main question asked of the clinicians in these areas.

It was clear that access to information, particularly in real time, was the key solution as it was vital in these areas to know the status of patients that were currently being case managed. Currently, at any time when information is needed, the case managers would need to phone for this information and try and locate the staff member who was looking after their patient. A free flow of current information would also benefit the many funded and volunteer external care programs by providing the information quickly and accurately.

4.6 Conclusion

Chapter 4 outlined the process undertaken to obtain a very clear understanding of what various levels of staff need to function efficiently and the subsequent processes requirements for the success of the development of eBeds.

The main requirements evolving from the analysis of the survey was that eBeds needed to address the core issues of enhancing information flow and

accessibility as well as creating a visual interface to enable the user to view that data efficiently.

After extensive discovery the core issues had been identified and are discussed in detail in Chapter 5 along with the functionality that eBeds will be employing to resolve those issues.

Chapter 5 – Functionality and Outcomes

'It is my experience that people (i.e. organisations) that are interested in GIS ask all the wrong questions – they want to know what's the best software, what's the best platform, etc.. When I ask, "what is it you want to do?" the response is usually a lot of head scratching followed by "make maps" (or some other really vague remark). So, it is no surprise that determining user requirements can be a long (and sometimes painful) process – kind of reminds me of my kids who never want to do their homework either…"

Scott Freundschuh 1993.

5.1 Introduction

The research process and development of eBeds in Chapter 3 outlined the need to replace the existing whiteboard system within a Queensland public hospital due to the inadequateness and inefficiencies. There were four stages involved in researching and developing the bed management application (refer to Chapter 1). This chapter will discuss and analyse the third stage, viz. to develop a new and innovative bed management application utilising GIS and highlight the benefits.

5.2 Business Requirements and Expectations

During the research period the basic MS Excel spreadsheet being used within the hospital did not upload to the main hospital's database and a large amount of information was required to be entered manually to the database (refer to Section 3.3). Therefore, it was imperative to replicate the information contained within the spreadsheet to a more manageable and easy to use application that was accessible by all level of relevant employees. There were a number of business requirements and expectations needed to achieve the successful implementation of eBeds into the hospital wards, namely:

- Provide a stable platform for replicating the patient whiteboard in a spreadsheet type of environment.
- Provide for the retrieval of historical data from within the application.
- Track the flow of patients through the admission, continuum of care and the discharge process.
- Provide the ability to be expandable to an enterprise level.
- Allow the linkage of nurse and case managers to individual patients.
- Provide access to patient information from outside the hospital such as community care and aged care.

- Provide an instant view of bed status (vacant, closed or occupied).
- Provide the ability to generate a patient waiting list.
- Provide the ability to run scheduled and customised reports.
- Provide levels of security and accountability.
- Provide a real time display of patient information to enable timely and informed decision making by clinicians and managers.

The vision in the development of eBeds was to create a user friendly and patient-centric software application that brings clear, concise and real time information to the stakeholders in order to facilitate the decision-making processes (refer Chapter 1). The application should disseminate and deliver information in the most easily viewed and read format in relation to the task being performed. The building of long-term business relationships along with continuous product improvement in conjunction with customers will facilitate the development process and promote eBeds within the hospital environment.

5.2.1 Limitations and Exclusions

There are a number of limitations and exclusions determined at the start of the research period regarding the participating hospital's environment:

- Access to the application will be limited by access to the server based at the hospital and the ability of Queensland Health IT department to organise the access for the various geographical locations.
- Response times for data retrieval and querying will be limited by the operation of the Queensland Health Intranet and the infrastructure it was built on as well as the number of users on line at any particular time.
- Uptime could be limited to business decisions made by the customer such as server redundancy and Uninterruptible Power Supply (UPS) requirements.
- The application is limited to the information available at the time of release both from HBCIS and from user input functions.
- The application was limited to the ability of the organisation to accept process and cultural change, in particular, in relation to inputs to HBCIS and discharge processes.
- As eBeds uploads information from HBCIS it was imperative that HBCIS was updated in a timely manner in order for eBeds information to be current and correct.

5.3 eBeds and GIS

eBeds was designed to take advantage of the sophisticated technology of a Geographic Information System (GIS) with the ability to be displayed across the world wide web. However, for research purposes eBeds was only deployed across the clients Intranet.

There are a number of GIS applications on the market (refer to Section 3.7.1), in particular, the two world leaders in the field:

1. Environmental Science and Research Institute (ESRI), and
2. Pitney Bowes MapInfo.

Both companies have extremely powerful and comprehensive functionality in regards to software products and are priced accordingly. However, one of the major limitations when developing the application for eBeds was budgetary constraints for the project. Both GIS products from ESRI and Pitney Bowes MapInfo were too expensive to utilise and further research was needed to find an alternative GIS that would fit within the budget of the hospital (refer to Section 3.7.1). The GIS that was eventually selected for the development was obtainable at a fraction of the cost, while still encompassing all the functionality of the more expensive geographical information systems. More importantly, it was within keeping of the hospital's project budget.

Open source software was not an option due to the privacy issues when dealing with patient information and, therefore, the hospital requested to not use that software at all.

The author's role in the development of the eBeds application was significant. The author has many years' experience in the field of GIS including programming and developing a variety of GIS applications and projects. It was through this experience the author was able to initiate the idea of eBeds and develop the application further within a hospital environment. The majority of the programming of eBeds was completed by the author unless something proved to be much more difficult than expected and then other expertise was sort.

5.4 The Functionality of eBeds

The functionality of eBeds addresses the core issues as outlined in the business requirements and business expectations that have been highlighted in Section 5.2. At the same time, these issues were addressed by incorporating a high level of visualisation and data collection as was delivered through GIS technology. This is combined with the various areas of data availability aimed at those who will be accessing the data the most. This information was acquired through the staff survey process and extensive interview and discovery (refer to Chapter 4).

5.5 Replication of the Whiteboard

There was a need to replicate the whiteboard in current use within the hospital with conversion to a stable user environment in order to enable clear and accurate information flow (refer to Figure 3, Chapter 3).

5.5.1 Background and Environment

HBCIS is the master database that all patient information resides on within Queensland Health hospitals and contains such information as a patient's episode of care as well as demographic and billing information. HBCIS handles a number of Admission/Discharge/Transfer (ADT) message transactions and conveys these messages via an interface engine in an HL7 format to each of the applications that are listening on the network. The interface engine allows the messages to be changed in form to match the business rules of the destination customer. For example, a transfer message would need to be changed from a patient admission (A01) to a discharge (A03) once the patient had completed an episode of care. Also through the interface engine, all messages can be tracked for quality assurance and auditing purposes. HL7 is the programming language used to transfer health data and is recognised worldwide as the most appropriate form of message transactions as there is acknowledgement of messages at source and destination.

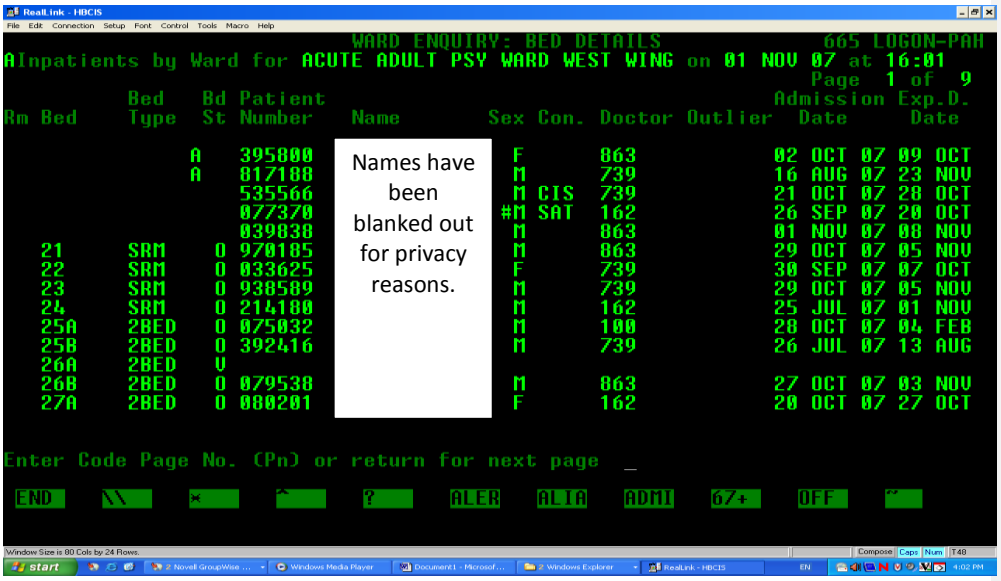


Figure 4 – HBCIS admissions screenshot

5.5.2 User Requirements

Prior to the eBeds interface, information was entered manually into an MS Excel spreadsheet necessitating rework in data entry (refer to Chapters 3.3 and 4.5.1). Reduction in data entry was not only a requirement of the business model but was identified as one of the core issues that the users wanted addressed to enable them to spend more time in the clinical role.

The amount of information that was interfaced from HBCIS was scoped from the user requirements and signed off by the Director of Nursing prior to instigating the interface build process. Through business analysis during the discovery stage it was determined that the following set of message transactions would need to be received from HBCIS in order for the eBeds application to remain synchronised with HBCIS:

AO1 Admission
AO2 Transfer
AO3 Discharge
AO8 Update Patient Information
A11 Cancel Admission
A12 Cancel Transfer
A13 Cancel Discharge
A17 Swap Patient Beds
A21 Place Patient on leave
A22 Patient returns from Leave

5.5.3 Interface build

The interface build started with a process of discovery of information and detailed analysis of the Queensland Health environment to enable the programming of the interface to take place. This included the review of the specification of ADT HL7 messages, in itself a 90 page document detailing all of the possible message segments. This, when compared to the data dictionary, gave an insight into the interface environment that required programming.

Further to this, in addition, the business requirements were analysed to ascertain all interactions of patients both inside and outside the hospital and logic determined to ensure that whatever transpired as far as a patient movement it would be captured by the interface model.

Once this was completed, programming and testing of the system was done firstly with sample data and then with live data to ensure that synchronicity of data was maintained with HBCIS. The prototype was designed and developed by the author researching the best GIS to employ for the project (refer to Chapters 3.7.1 and 5.3).

5.5.4 Outcomes

The outcome for the users was an application that remained synchronised with HBCIS under all circumstances of message transactions. Whenever an event occurred to a patient, such as an admission or discharge, the information was entered into the hospital database as per procedures and this immediately generated a message through to eBeds passing on that information. In short,

eBeds sees what HBCIS sees. This has met the objective of transfer of data while reducing data entry for the users.

5.6 Retrieval of historical data and querying ability

It was necessary for the users to be able to retrieve historical data through the functionality of being able to query the patient information. It was also important that different levels of management had the ability to provide "snapshots" over specified time periods to gain an understanding of how their hospital was handling bed management and occupancy rates.

5.6.1 Background and Environment

Existing systems prior to eBeds consisted of HBCIS as the main database and an MS Excel spreadsheet that was populated by manual entry of data with no ability to store or retrieve information. Both systems were not user friendly and MS Excel spreadsheet was prone to corruption of data through mistaken entries, deletions and system crashes. Also, no information could be easily retrieved as information was not stored for historical purposes nor could it be queried for detailed reporting analysis.

5.6.2 User Requirements

It was clear during the discovery process and through information obtained from the staff survey (refer to Chapter 4) that the application must be designed with a intuitive interface that requires minimal training and retraining to utilise. The user interface must also create an environment that minimised mistakes in entries and was simple to navigate through. The application must also be stable in performance with minimal downtime and have redundancy in data storage to ensure no data loss occurs. Also, processing time for queries should be kept to a minimum to ensure that page refresh rates are within an acceptable time period so not to discourage users and to minimise time away from the work function.

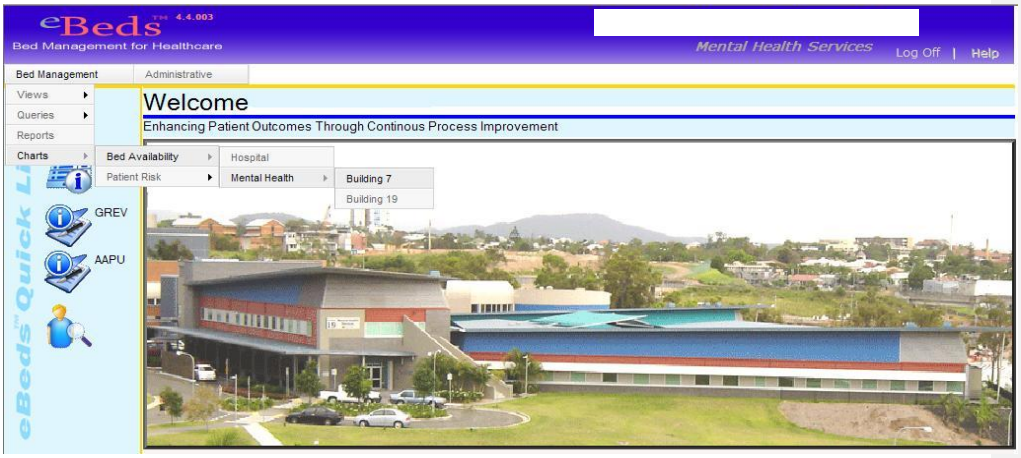


Figure 5 – eBeds User Interface

5.6.3 Function Build

Extensive discovery with the users enabled a pre-determination of data entry selections that not only reduced the amount of time for users to make selections when entering data but also ensured that a high level of data quality was maintained (refer to Section 4). The user interface was built around this information so each user simply had to make a selection from a specified query group when entering consumer information rather than typing separate information on each occasion.

The Manifold GIS, was selected because it was both stable in operation and possessed all of the functionality necessary to meet the requirements of the customer. The application was then loaded on to a separate server dedicated to the eBeds application. The server was over-specified for the intended eBeds use and had a Raid 1 configuration to provide redundancy in hard drives. This was all housed at the hospital's own site along with many other applications servers, in a purpose built server environment and protected by an UPS. A service level agreement was instituted between the customer and their own IT support which enabled regular backups of data and software updates as required.

5.6.4 Outcomes

The outcomes for the user were a stable and secure bed management system that had minimal downtime; an intuitive user interface that had multiple navigation methods and required minimal training to operate. Data entry time was kept to a minimum and a high level of data quality was ensured resulting in a high quality of reports and queries. The queries and reports were able to be exported into a number of formats such as MS Excel spreadsheets or could be inserted into MS Word documents.

5.7 Tracking the flow of patients

It was extremely important in the health care environment that continuum of care be maintained outside the acute care hospital and to achieve this, information flow also had to occur outside of the hospital boundaries. These external locations can be geographically diverse across the hospital district, as clinicians may sometimes also want to access information outside the district.

5.7.1 Background and Environment

There were great difficulties in understanding what the current occupancy levels were as the only way to access this information was through the cumbersome HBCIS. Retrieving historical information in this way was even more difficult and involved a lengthy process of requesting reports. This also relied on each individual having knowledge of HBCIS and its functionality, which varied depending on each staff member's exposure to the application. There were also difficulties in tracking each event that occurred in a patient's episode of care, such as time spent waiting for a bed and the number of bed transfers that had occurred. This event tracking lead to a lack of understanding of the actual work load of each staff member. The majority of admissions were directed through the Emergency Department (ED) and there were also difficulties in access to the information of who was waiting for a bed and for how long.

5.7.2 User requirements

It was clear from the staff survey (refer to Chapter 4) that there were certain staff members that did not have a clear understanding of the status on the wards at any particular time. This was particularly the case with clinical and clinical administrative staff that had a requirement to know this status.

The users required functionality that tracked each event in a patient's episode of care in real time and provided the ability to report on those events, including the times that events occurred and the duration of events. The users also wanted this to occur without any extra data entry and result in the display of the information in a format that was easy to understand and facilitated the decision-making process.

5.7.3 Function Build

The building of the functionality required to enable the above started with capturing all of the events that took place, such as admission to the ED, waiting for an inpatient bed and admission to that bed. These events also included any movement during the length of stay of the inpatient, such as going on or returning from leave or any transfer from one bed to another or ward to another. Also

captured were the events during discharge such as formal doctor discharge, actual time of discharge, pharmacy orders and housekeeping times. Virtually all of this information was captured to eBeds from interface transactions without any significant increase in data entry. Formerly, very few of these occurrences were being captured by any other means within the hospital. The current ward status information was then displayed in a number of formats including the whiteboard and the floor plans (refer to Chapter 5.5 and 5.11). Reports were then developed to display these times and events for the users.

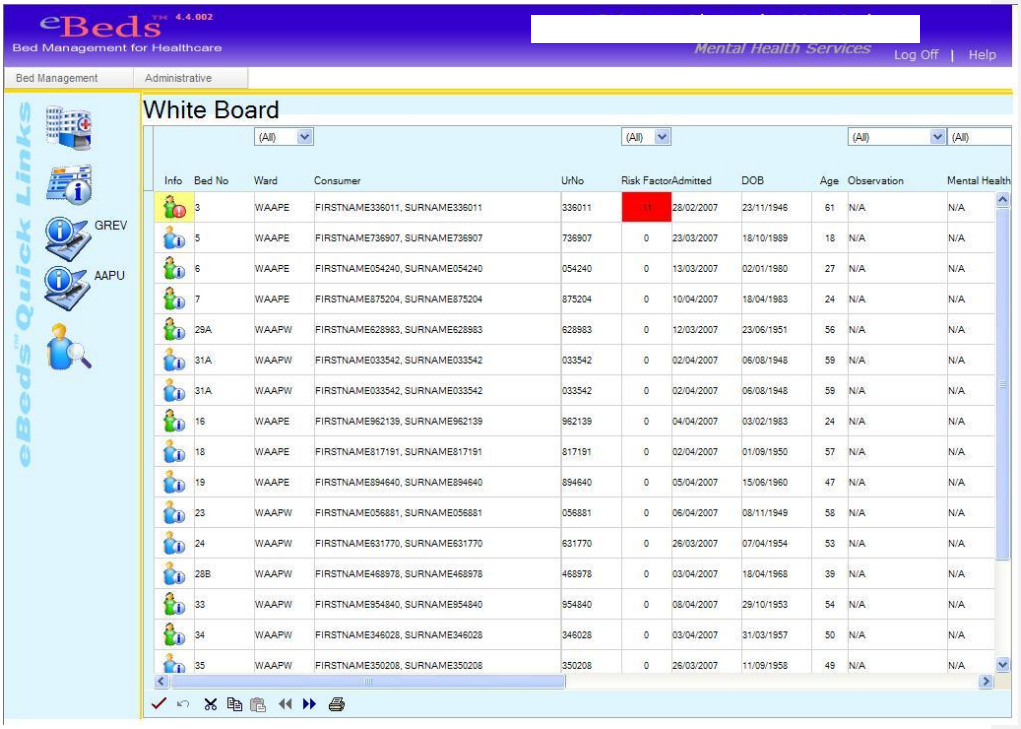


Figure 6 – Screenshot of eBeds Whiteboard

5.7.4 Outcomes

The outcome was the capturing and display of data that enabled the ward staff to have a clear understanding of the activity within the wards in real time without the need for any significant increase in data entry. Patient movements through their episode of care were captured and that information stored historically for future reference and interrogation. This was seen as a significant step forward in the continuous patient improvement process.

5.8 Enterprise-wide capability

When installing a new application into Queensland Health it is a requirement that it be expandable to have enterprise-wide capability.

5.8.1 Background and Environment

At the present time, the information available to health management at an enterprise level was limited and the functionality out of date as it was mostly retrieved from the legacy database of HBCIS. There was no intercommunication between hospital databases and the information flow on a daily basis took place by phone to ascertain whether each hospital could accept inter-hospital transfers. This was a complicated process and one that had been identified by staff surveys and discovery as having issues relating to the clarity of information and the number of communications that were required (refer to Chapter 4).

5.8.2 User requirements

While not actually stipulating in the current scope of work that enterprise functionality be installed in the application, it was a requirement that any system architecture that was implemented within Queensland Health would lend itself to an enterprise model in the future. The anticipated functions within an enterprise model would include such requirements as an overview of state-wide bed loads and waiting list loads as well as waiting list times. The ability to drill down to each individual hospital's detailed information was certainly possible using a GIS as the system had the geographic functionally to map these locations. Also, because eBeds was to be connected to Queensland Health's intranet via the LAN it would also be possible to connect to the Internet via the WAN.

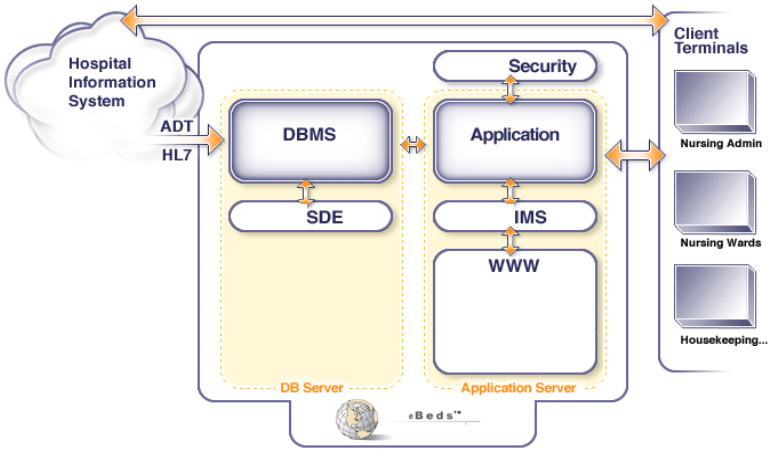


Figure 7 – eBeds System Architecture

5.8.3 Function Build

As stated in Section 5.8.2, there was no actual need to build this functionality within the application as yet; however, the system architecture was established to conform to an enterprise wide application as were application security standards. The application was also structured to allow for the possible future intermeshing of an enterprise application.

5.8.4 Outcomes

The outcome for the customer was a software application that would easily be enterprise enabled. This outcome would encompass the building of added functionality; however, this would simply interact with the current software.

5.9 Nurse and Case Managers linkage to patients

It was a requirement within eBeds for nurse and case managers during a rostered shift to have easy access to the information of individual patient who was assigned to them. This ensured the flow of information between the nurse and case manager in the event that it was not possible for face-to-face discussions or meetings.

5.9.1 Background and Environment

One of the issues with prior systems (refer to Chapter 2) was the inability to gather and store extra information related to a patient's activity and episode of care. If the data was collected, it was not in a format that could be queried and/or interrogated along with other datasets. For example, a nurse was unable to search for historical information relating to a particular patient as the clinical notes were either not available due to lost information or in hard copy form. The business goal was to be able to gather, display, store and retrieve information relating to each patient's nurse and case manager. At the start of a rostered shift, each patient had a nurse assigned for the duration of their stay in hospital, along with a case manager assigned if a longer stay was required. The business saw great benefits in being able to process this information within eBeds.

5.9.2 User Requirements

The hospital's business goal was to be able to assign a nurse to each patient before the start of each shift (refer to Section 3.5.3) , have that information displayed prominently in the application for all secure users to view, store the information historically and allow the information to be searched for at a later date. The case managers were assigned on a longer term basis as they were responsible for the patient's continuum of care outside the hospital. This information was handled in the same way as the nurse assignment. The

reasoning behind this display of information was to give the case manager access to their allocated patient at all times, as well as search historically if an incident should occur.

5.9.3 Interface Build

Once the function criteria were established, the build process could commence with an emphasis on simplicity of use. Each patient had a detailed information screen where all external information was entered and viewed and demographic information from the HBCIS was contained also. Each user simply scrolls through a list of nurses for the unit and selects that particular nurse to assign by a point and click function. A similar process takes place for the case managers. The nurse and case manager table is populated from the user security requirements and are updated automatically.

5.9.4 Outcomes

The outcome for the user was a simple user interface that allowed the gathering of the data with the minimum effort of entering information through a series of drop down menus of predefined queries. Along with the display of the data that were clear and precise for all staff, this was a particular section of the business requirements which achieved one of the hospital's goals. The data can also be searched historically as required.

5.10 External accessibility of information

It was a requirement for eBeds to be able to provide external access to a number of stakeholders who needed to view or retrieve information regarding patient information from different geographic locations, such as or remote access.

5.10.1 Background and Environment

Prior to the eBeds project, patient information was available from numerous sources including HBCIS, which was difficult to use and extract information from. The existing MS Excel spreadsheet that relied on manual entry and was only viewable from a stand-alone software application located on two computers throughout the hospital.

5.10.2 User Requirements

The users required access to the application from any computer within the hospital and accessed from the Queensland Health network via the hospital's Intranet. The application could also be accessed by certain individuals who were granted a recommended level of security access the through Queensland Health's remote access protocols to the network via the Internet.

5.10.3 Interface Build

Modern GIS applications are web deployable and therefore meet the necessary requirements of the hospital's business goals to achieve the above (refer to Section 5.3). The simple solution was a client server architecture that allowed the application to be stored on a central server located at the hospital and accessed via the LAN internally through the hospital and the WAN externally. Initial testing of the application took place on the LAN with WAN testing carried out by the Queensland Health WAN testing team prior to sign off that the application was capable of being served over the WAN (refer to Chapter 4.5.7). This testing took into account the effect the application had on network latency when queried under various circumstances and conditions to ensure no detrimental effects were encountered.

5.10.4 Outcomes

Business objectives were met with all staff being able to access the application regardless of geographical location provided they had the required level of security to access the Queensland Health network. Also provided was access for multiple users able to view the application simultaneously. At the same time, Queensland Health remained as the guardian of access to the application through their own network and, therefore, controlled who accessed the application and from where. Security within the application further controlled access and the type of access as required by the business model.

5.11 Graphic display of bed availability

One of the features of eBeds is the ability to visually display the geographical location of a particular bed by room, ward or floor. The client indicated the importance of being able to view such information in a graphical format.

5.11.1 Background and Environment

One main objective for eBeds was to not only replicate the MS Excel spreadsheet but to incorporate the ability to visually display the geographical location of a particular bed by room, ward or floor. As discussed in Chapter 3, the spreadsheet was prone to errors and the hospital wanted to replace this system with a more reliable and user friendly application.

5.11.2 User Requirements

A user requirement in regards to displaying the bed location graphically was the ease of use. As some staff members were not necessarily "computer-savvy" (refer to Chapter 4) and familiar with using a mapping tool it was necessary to design the floor display as a point and click function. This very sophisticated

mapping application allowed the user to quickly and easily display the location of a particular patient via the bed number.

5.11.3 Interface build

This particular functionality within eBeds displayed the beds in a geographical format allowing easy identification of the location of beds and patients. The user was able to click on a bed icon where pre-defined patient information was displayed on the screen using a simple layering functionality. It has a drill down functionality allowing users to navigate to patient information. There was also the ability to zoom in to various sections of the floor plans and show extra detail with the ability to navigate directly to patient information.

Figure 8 - Layout of floor plan displaying bed locations.

The functionality discussed in Figure 9 highlights the advantages of using a GIS for a bed management application. At first glance, the user is able to determine what beds are vacant, occupied or closed as the beds are colour-coded appropriately. This functionality can also be used by housekeeping to determine what beds are closed and need to be either cleaned or repaired by the maintenance department.

It was determined by the participating hospital that all level of staff have security access to view the layout of the floor plan and to also click on the bed location to gain access to the patient's information. It is also possible to change the patient's information contained within eBeds rather than retrieving the data from HBCIS again.

Once the user had zoomed into a particular location of the floor plan, another level of information is displayed on the screen (refer to Figure 6). For example, the user is able to identify what gender is situated in a particular room; whether the room is two-bed or one-bed accommodation; identify a patient who had overstayed their expected discharged date by a certain amount of days and identify a patient who had a discharge ordered by their attending doctor. There is also a legend located on the right hand side of the screen to identify this information using different symbols and colour-coding. One of the areas of interest for the users was the easy identification of which patients had overstayed their expected discharge date and by how many days, such as number of days less than five days, between five to nine days and greater than nine days. The visual display allows staff to quickly and easily identify what patients had overstayed their length of stay but more importantly alert staff to investigate further as to the reasons why.

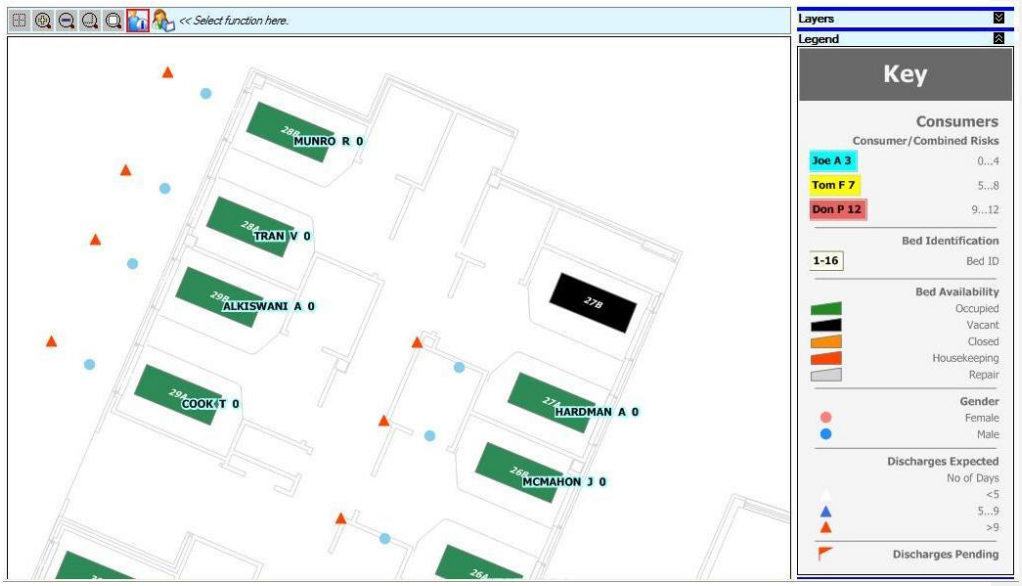


Figure 9 - Displays a close up of the floor plans.

5.11.4 Outcomes

The visual display of the bed location has a number of applications for different levels of staff. During the research period there had been verbal feedback from various staff acknowledging the usefulness of the visualisation. The staff whose main role was to admit patients, had commented on a number of occasions, when determining bed availability within wards, the convenience of gaining an overall representation of which beds by the visual display of the floor plans. This in turn allowed the staff to plan in advance how many patients may be scheduled

for elective surgery and determine how many emergency admissions may be permitted from the bed availability. On many occasions it had negated the need to make numerous phone calls to nursing staff on the wards on a continual basis and possibly having to wait for anywhere between one to two hours for an answer on bed availability. As the application runs in real time and is constantly updated every time 30 seconds, the user was ensured of receiving correct data in relation to admission information.

5.12 Ability to generate a waiting list

It was important to the client to be able to generate a waiting list of all patients that have been pre-admitted and/or were currently awaiting a bed allocation.

5.12.1 Background and Environment

The existing environment prior to the implementation of eBeds provided no evidence of tracking and triaging patients on the waiting list for a bed other than on a whiteboard that was maintained and had been updated by the admission team (refer to Chapter 3.3). There were a number of issues relating to this method of managing the information. These were:

- Once a patient is admitted the information is removed from the whiteboard and lost with no further historical record being taken.
- The possibility of information been removed in error.
- No statistical information is gathered such as admit/discharge times and numbers of patients.
- Only staff with access to the waiting list can see the information.
- No system of maintaining privacy for patients was employed.

5.12.2 User Requirements

From the staff survey and the discovery process (refer to Chapter 4), it was evident that any changes in business operation would need to reduce data entry particularly for clinical administrators and the waiting list was one area where this could be achieved. The clinical administrators in this area were continually in communication with stakeholders wanting to know when their patient would be admitted to a bed as there was no other way of acquiring this information. The electronic list also had to track the number of patients on the list at any given time and how long the patient was waiting for an actual bed to audit compliance and measure against key performance indicators (KPIs).

The waiting list must also allow the same business rules to apply regardless of who triages the list and to track these changes. The final task was to gather

information on patients and store the information in order to recall and scrutinise the data at a later date with the eventual vision to be able to become predictive of patient loads by analysing historical data.

5.12.3 Function Build

The challenge was to create a user friendly functionality that engaged with HBCIS to enable patients to be admitted through HBCIS messages to virtual beds which contained the patients that were waiting for an actual inpatient bed. This list was then displayed in a user friendly format with functionality built to enable the patients to be changed by order of preference on the list. For example, if patient C was third on the waiting list but became a priority for a bed due to been triaged into another category then it was possible to move from third position to the top of the waiting list by a drag and drop function. A separate security level was enabled also to only allow a small number of users to change this order. Reports were also built to express the time and number of patients waiting at any given time.

5.12.4 Outcomes

The outcome for the users was a user friendly interface that mimics the old whiteboard yet provides all of the features that enable tracking of patients and retrieval of historical data (refer to Figure 6). The business operates the same way that it did previously without the cumbersome need for information to be entered on to a physical whiteboard and at the same time provides this information to all users with the appropriate authority level.

5.13 Scheduled and customised reports capability

Previously the client did not have the capability of providing schedule and customised reports. A business requirement was to be able provide the user with the functionality of displaying a variety of reports either by pre-defined reports already set up within eBeds or printing their own reports in a number of formats, such as Crystal Reports, an MS Excel spreadsheet, or inserted into a MS Word document.

5.13.1 Background and Environment

The reporting environment prior to eBeds revolved around the individual level of skill and knowledge about where and how to access reports, as well as having a high level of patience in some cases to wait for those reports to come in from third parties within the organisation. A great deal of information was not available simply because the data was not gathered. Further to this, the opportunity, to combine datasets was not available as applications did not interface with each other.

5.13.2 User requirements

The users firstly established and, through the ongoing discovery process, confirmed that this data would have a bearing on a patient's episode of care, safety and quality of patient care. Also required was the collation of the datasets to enable the querying of a variety of information, and the compilation of these data into reports.

Reports were required to be available whenever the user requested them to facilitate an immediate decision making process. The reports had to be designed to focus on a particular date and time or date range, or consumer if required. The report function would also be incorporated to enable the exporting of data to either Word or Excel formats.

5.13.3 Interface Build

Extra data that was identified as important to the consumer episode of care by the users was gathered through the customised consumer information screen and combined with the various datasets available to form a pool of data available to the reporting menu. The reports were then customised using Crystal Reports to build the information that the users required. A reporting interface was then built to allow the users to select which report was required and further drill down to date ranges and specific areas required.

5.13.4 Outcomes

The outcome for the users was a set of reports that had been customised to their requirements and that could be accessed easily at any time through the simple user interface in the application. The reports are generated in Crystal Reports; however, they can easily be exported to MS Excel or MS Word or stored in a file format on the user's hard drive.

5.14 Security and Accountability

A major business requirement was to ensure the security functionality was extremely safe and stable and there was an audit or accountability procedure in place within the eBeds application

5.14.1 Background and Environment

The business was using an MS Excel spreadsheet to enter daily information relating to patients that were inpatients. There was basically no security on these entries and no auditing of quality of information or on who was entering information. This current system bypassed some of the strict protocols due to the fact that it was being used as a stand-alone system and existed only on the

one computer, however, the system security and auditing was not sustainable long term. The Queensland Health IT environment calls for strict procedures and protocols when application security is concerned and these had to be incorporated into any new application that were installed on the Queensland Health network.

5.14.2. User Requirements

The challenge when building the application was installing levels of security that met the strict Queensland Health standards whilst still ensuring that the business was able to set levels of security for each individual user. The business also required an audit trail of each user's activity to track whom was doing what and when and for how long. The sensitivity of health data cannot be underestimated and it was essential that there was a clear logging of entries made under each user. In addition, no entries could be deleted or staff removed as users, to ensure that the audit trail was maintained historically.

5.14.3 Function Build

Essentially the application was built integrating security standards as per the Queensland Health requirements which allowed each user to access the application. Within the application varying levels of access were set which allowed each individual user to access the application to varying degrees depending on the users designated requirements. The security levels were then allocated by the Administrators of the application when each user was activated. This gives the business control over who accesses what and when without any external changes being made to the application. Audit trails had also been built to enable tracking of each transaction taking place by each user and an ability to search for these activities to audit the user's activity.

5.14.4 Outcomes

The outcome for the business was an application that met all of the external requirements set out by Queensland Health as an overseer of IT infrastructure whilst allowing the business to manage the day to day activity and access by each user.

5.15 Conclusion

It has been established that bed management and the utilisation of available resources should be seen as an integral part of any major healthcare providers business focus. With the development of eBeds along with the guidance of the sponsor hospital it has been possible to meet the majority of the business requirements as specified within the initial scoping documentation. eBeds has also been developed within the guidelines to meet a number of user

requirements and along with the requirements of corporate and management specifications.

By using a geographical format, the data is displayed in a visual layout, in real-time, of the exact location of each bed within a room, ward or floor. It also has the capability to permit examination of a bed's attached patient records as existing hospital software applications can be efficiently and seamlessly integrated into eBeds. This was one of the major requirements that needed to be achieved by the author to ensure the success of the project of developing eBeds. This was certainly achieved and feedback from the sponsor hospital has been extremely positive. The other objective to achieve was the replication of the whiteboard and ensuring a more stable and secure environment was provided. This was also achieved by providing an application such as a GIS capability eBeds system, which is a practical, flexible and dynamic tool that aids planning and management of bed numbers, types and location for the allocation of in-patients.

The final chapter, Chapter 6, will demonstrate the uniqueness of eBeds and how it help to increase the ability of the user to make informed and timely decisions in regards to the efficiencies of management. It will also discuss what has been achieved through the development of eBeds and the outcomes and success that were accomplished.

Chapter 6 – Conclusions

6.1 Introduction

Visualisation of data has been demonstrated to increase the ability of the user to make informed and timely decisions, enabling more efficient and timely management. This chapter discusses the benefits and implications of eBeds compared with current system and future enhancements. While developed as a trial model, eBeds has met the research objectives and majority of assessment criteria developed for the research project to test the outcomes.

The aim of the literature review was to establish the need for a management system to overcome the inadequacies of the current hospital systems and provide accurate and timely information that meets the needs of the nurses, administrators and professional medical staff. Chapters 2 and 3 also highlighted the societal and government needs for a more efficient hospital system and better use of the current bed capacity.

The staff survey established the needs of the staff and assisted in a set of parameters to work within to facilitate a successful outcome in the application build process. These parameters, along with business requirements of the hospital in general, created an environment in which the outcomes can be tested, which is discussed in detail in Chapter 4.

This research has determined that GIS based eBeds has provided a better and more meaningful management tool that is more user-friendly and acceptable by the hospital staff. This chapter will discuss the complexities of what has been

achieved, how the fundamental research questions have been answered, and to what degree they have been answered.

Further validation of the outcomes has been demonstrated by the Government department contracting the research to establish a fully functional system within one section of a hospital.

6.2 Bed management outcomes

It has been established that bed management and the utilisation of available resources should be seen as an integral part of any major healthcare providers business focus. The mere acceptance of a research project such as the one undertaken is testament to the priority that the health care organisation place on the efficient use of resources.

The championing of this project by the participating hospital cannot be underestimated and the trial of an unproven concept, although theoretically sound in nature, is an indication of the lengths and risks that the usually risk averse health care sector will embark on to solve inherent issues that exist in their business.

The question of whether current software applications are addressing the issues is somewhat one of perspective. Certainly the research has shown that an organisation was willing to try something new and ground-breaking and that itself would indicate to some degree that what exists on the market presently is not addressing the issues, otherwise that application would have been adopted. The perspective issue is more about what can be done as against what is been done in the past with other software applications. Users do not know what to ask for in an application until they are shown what is achievable and merging technologies such as a GIS into their environment has achieved an unprecedented level of information flow to the user from the application. The verbal feedback to the author from the users has been extremely positive in relation to the many interfaces and its ability to convey data as required.

The major research hypothesis was:
"Can a GIS based application provide a solution to the complex issue of Bed Management?" (refer to Chapter 1).

This hypothesis can be fully addressed from the answers of the following four questions. The questions can relate to collation of data, interrogation of that data, display and visualisation of the data and user adoption of the application itself.

Question 1

.Has the application been able to collate information from many sources within the hospital environment?

This has been achieved by allowing multiple points of information entry into the application itself both from a geographical point of view and from separate data sources. The integration of an HL7 interface between the main hospital database and eBeds was an integral part of the development and was at its time a Queensland Health first in achieving real time information flow in a HL7 format. This alone has reduced user input by halving data entry as well as increasing information available in the central bed management module as more data could be interfaced from the main database.

The application also allows for the collection of data by users via a preconfigured user interface. By achieving this, users are able to utilise "point and click" drop down menus to collect consumer data on a range of topics relevant to their daily tasks and the quality and safety of the consumer's episode of care.

The ability to input this information from varied geographical locations also allows for information flow between such areas as pharmacy, community care and other allied health care professionals.

Question 2
Have these sets of data been combined within the application to provide meaningful information to the user?

The concept of combining data into one location has many benefits provided the software located at the central location has the capacity to interface and be queried to provide meaningful information. GIS software has the inbuilt ability to achieve this through having capacity to process large and varied data sets. eBeds has proven itself to be capable of this task. The data collected was stored and formatted in such a way as it can be retrieved and displayed to achieve the clearest understanding of the information. For example, by displaying the bed location on a floor plan allows staff to quickly determine what beds are available, occupied or closed.

Question 3
Can the data sets be interrogated as required in order to display the data in a format that is most easily understood by the user for each particular task, and enable access to information from varied geographical locations and under various levels of security?

Modern GIS applications are capable of web deployment across the internet and across a customer's Intranet. The eBeds application utilises this web deployment capability and a multi-tiered architecture to allow the user to access

and input information from many geographical locations either within the hospital or external at community care locations.

Combined with this is the ability to set security standards for each individual user based on his or her access requirements and role within the organisation. The application provides the tools for the system administrators to allocate security levels that enable each administrator the ability to assign appropriate levels based on their own business rules and procedures. This allows for changes to take place within the organisation without the need for major changes to the application itself.

The information available at the user interface is in varied forms that have been customised to the user requirements established during the discovery phase of the development (refer to Chapter 4). One of the most utilised of these was the floor plan views, which turn GIS inwardly to map not topography, as normally associated with GIS, but floor plans of wards. This view gives users the information in a format that enables them to make informed decisions about consumers and their care. A zoom in/zoom out ability reveals more detailed information as it is requested while drill down functionality on actual beds reveals all of the information pertaining to the consumer in that bed in real time. This multi-layered approach allows for views pertaining to users requirements such as an overview, a small amount of detail, to all of the information, while all the time retaining the geographical layout that users can visualise and process.

Question 4
Can the difficulties of change management and establishing new practices be overcome in a health care environment?

The core issue is that the management of changes within an organisation must be proactively addressed by the management team, become a central part of the implementation process and be planned and managed. There were many issues that arose during implementation that threatened to destabilise the implementation such as staffing changes, restructuring of roles and continual changes to the project scope. One of the major factors was the lack of knowledge in how to communicate changes to staff, which lead to staff apprehension of the impending change.

Ultimately, the acceptance of the application and alleviation of staff uncertainties has taken place in addressing the following issues rather than by the instigation of a formal change management process. Those issues were:

- Changes in management style
- Increase in computer literate staffing
- Increased communication.

The positive achievements that were realised came from these issues being addressed, even though this is a sector of the workforce that has a history of resistance to change, when staff overcomes its reservations and grasped new technology. Indeed, the more users come into contact with eBeds, the more the change was accepted and, with greater realisation of the benefits, the apprehension of change continued to diminish.

6.3 Future research and development opportunities

One of the biggest advantages of utilising a GIS in healthcare was the ability to map data pertaining to a patient's home geographical location and interface that with such information as diagnosis, number of visits to hospital and which hospital, and episodes of care. Investigation of this data can reveal trends that can be planned for and managed at various levels of the health care community, such as tracking of infectious diseases.

It was one of the ultimate goals of eBeds to progress to this mapping of external data in combination with information from within the application. However, due to time constraints and change management issues, progression to this level had not been achieved. As this was an already proven mapping technique, it could be reasonably assumed that it would be achievable and lead to advantages in data interrogation.

One of the most challenging issues faced by large health care organisations such as Queensland Health was that of surge capacity, or the ability to utilise excess capacity at an adjacent hospital when one hospital attains 100% occupancy. The flow of patients from one hospital to another occurs continuously and is part of the day to day operational duties of bed managers as they endeavour to meet the expectations of consumers and clinicians.

However, the flow of information between hospitals was not so clear with bed managers often relying on continuous telephone calls to arrange consumer transfers. Unfortunately, the capacity of eBeds to alleviate this issue by being installed at multiple hospitals has not yet been measured due to time and funding constraints as well as the risk adverse nature of the health sector.

Whilst acceptance of the technology and approach to bed management has been received well within the sponsor hospital, it is yet to be proven that this change would be accepted by both health care management and users in the wider health care sector.

There are many areas identified as possible future research and development opportunities flowing on from the research achieved to date, all of which would enhance the usability and information flow from the application. Some of these are identified below:

Consumer Flow Management

- Data modelling to predict future bed loads based on historical data
- Collection of additional information on consumers by the clinicians
- Connection to additional data sets and applications such as clinical systems enabling reduced data entry
- Write back from eBeds to the master hospital database to reduce data entry even further.

Demographic Mapping

The ability to map general population demographic data in combination with health data would form a powerful tool for clinicians and planners in the health care community.

Surge Capacity

Explained previously, the surge capacity would provide information flow across multiple hospitals and include benefits such as:

- Better planning of staff resources
- Reduced time spent through communication
- The right consumer being allocated to a bed on a needs driven basis
- Reduced waiting times for beds
- Reduced Ambulance bypass.

RFID (Radio Frequency Identification)

Providing location based information on assets, consumers and staff will provide efficiencies in the following areas:

- Real time location of any tagged person or asset
- Alerts staff of consumers roving beyond boundaries
- Manages the consumer discharge process with better communications
- Improves bed availability to decrease emergency diversions
- Sends alerts for certain staff-consumer-equipment interactions
- Provides medication delivery confirmation and safety
- Reduces housekeeping bed turnover time
- Eliminates food service delivery errors
- Reduces ‘lost’ equipment problems
- Reduces consumer waiting times
- Improves employee morale and satisfaction by reducing time searching for equipment.
- Provides historical movement tracks for efficiency and safety analyses.

Demand Driven Workforce

The ability to track workload on staff within a hospital and match skill sets to daily requirements is a complex concept that will require extensive research.

However, the ability of a GIS Bed Management system to track such items as patient transfers, admissions and discharges would form an integral part of the analysis and these tasks make up a large percentage of the workload on hospital staff.

Wider health care community
The utilisation of data sets from external sources would provide an opportunity to widen the scope of data interrogation from such areas as General Practitioner Data as well as medical associations and private hospitals.

6.4 Conclusion

eBeds has delivered tangible results to real users in their existing environment and proven the use of GIS in bed management was not only possible but can provide real benefits to the users through increased visualisation of data and collation of data sets. Through more efficient and comprehensive bed management practices there is increase opportunity for caring for more patients and increasing financial efficiency.

In achieving this, many “firsts” had been accomplished by the researcher and Queensland Health combined, some that were not thought possible. These breakthroughs have implication not just for the current research project but also for the wider health care community in providing access to data and clarifying the communication of information.

This project has delivered a working solution into a real hospital environment that is utilised daily to improve the outcomes for consumers and staff alike.

References

Australian Institute of Health and Welfare (2003). *Australian Hospital Statistics 2003-04*. Australian Institute of Health and Welfare (2003), Health Services Series No. 23.

Australian Institute of Health and Wealth (2008). *Australia's health 2008*. Cat. No. AUS 99. Canberra: AIHW.

Burns, Claire M., Bennett, Cameron J., Myers, Colin T. and Ward, Michael (2005). *The use of cusum analysis in the early detection and management of hospital bed occupancy crises.* Medical Journal Australia, Volume 183, Number 6.

Cameron, Peter A. (2006). *Hospital overcrowding: a threat to patient safety?* The Medical Journal of Australia, 184 (5): 203-204.

Cameron, Peter A and Campbell, Donald A. (2003). *Access block: problems and progress*, The Medical Journal of Australia, 178 (3): 99-100

Capolingua, R. (2007). A *mandate to strengthen the health system*. Medical Journal of Australia. Volume 187 Number 9: 498.

Chang, Winston R. and McLean Ian P. (2006). *CUSUM: A tool for early feedback about performance?* BMC Medical Research Methodology, Volume 6, p8.

Commonwealth Department of Health and Aged Care (1999). *An overview of Health Status, Health Care and Public Health in Australia*, Occasional Papers Series No. 5

Department of Health and Aging (2010). *Health Reform: for better healthcare and better hospitals.* Australian Government

Donaldson , L. (1999). *Strengthening public health*. National Public Health Conference, Birmingham, UK.

Dwyer, Associate Professor Judith and Jackson, Dr. Terri (2001). *Literature Review: Integrated Bed and Patient Management*. Prepared for the Department of Human Services. La Trobe University, School of Public Health.

Fatovich, Daniel M., Hughes, Geoff and McCarthy, Sally M. (2009). *Access block: it's all about available beds.* Medical Journal of Australia, 190 (7): 362-363.

Freundschuh, Scott (1993). GIS Systems Development Methodology, e-mail, GIS-L. Quote from Chapter 3, page 45

Hall, Eleanor (2008). *ABC Radio Interview*, Thursday 28th August 2008.

Haraden, C and Resar, R. (2004). *Patient flow in hospitals: understanding and controlling it better.* The Institute for Healthcare Improvement, Boston USA 20(4):3-15.

Haux, R., Winter, A., Ammenwerth, E., Brigl. B. (2004). *Strategic Information Management in Hospitals – An introduction to Hospital Information Systems*. Health Informatics Series. XXIII

Hocking, David (2009). *Digital Economy Future Directions Consultation Paper*, Australian Spatial Information Business Association Response:5.

IBM (2010). *Rational Open Access RPG Edition*. IBM 2010

Indiana University (2009) http://www.indian.edu, July 2009

Johnson, Steven (2006). *The Ghost Map: The Story of London's Most Terrifying Epidemic – and how it changed science, cities and the Modern World*, Riverhead, 2006.

Johnson-Lee, Dr. M (2009). ABC Radio Interview, July 2009

King, A. (2006). *Funding issue plagues e-health*, Australian Financial Review,

p.48

Kirby, A., and Kiesbo, A. (2003). *Tapping into hidden hospital bed capacity – Business*. Healthcare Financial Management, Volume 11, 38-41.

Lang L., (2003). *GIS for Health Organizations*. ESRI Press

Naik, Viren N. Devito, I and Halpern, S. H. (2003) *Cusum analysis is a useful tool to assess resident proficiency at insertion of labour epidurals*. Canadian Journal of Anesthesia 50:694-698.

Norland, S. (2005). *Containing costs in the ED*. Healthcare Financial Management, 65, 66-73.

Organisation for Economic Co-operation and Development http://www.oecd.org/document, July 2009

Queensland Government (2007). *Moving ahead. Queensland public hospitals performance report 2006-2007*, Queensland Health. Brisbane 2007.

Queensland Health (2003). *Health Matters – $11.7m computer contract signed*. March Edition, Volume 8 Number 2: 7.

Queensland Health (2009). *Health Matters – News and information from Queensland Health*. June Edition, Volume 14 Number 5: 3.

Queensland Health (2005). *Queensland Health Systems Review Final Report*.
Queensland Health (2006). *Queensland Health State-wide Patient Satisfaction Survery*, Prepared by Roy Morgan Research, February 2006.

Queensland Health (2008). *Building a new hospital*. Gold Coast Health Projects.

Richardson, Drew B. (2003). *Reducing patient in the emergency department*. The Medical Journal of Australia, 170 (10), 516-517

Rosenberg, Matt (2010). *John Snow's Map of London*, About.com Guide

Shaw, P.K (2009). Quote from. http://www4.tpgi.com.au/users/schleter/res_pksh.htm

Sommerfeld, Jeff (2005). *Hospital closes mental health beds*. The Courier-Mail, January 19, 2005.

Stevenson, Dr. M. (2009). *Queensland hospital waiting times still too long: AMA*. ABC News interview.

The Canberra Times (2009). *Rudd canvasses hospital takeover*. 30 June 2009

The Courier-Mail (2005). *Health IT firm sues for $18m.* 16 December 2005.

Tobler, W. (1994). National Center for Geographic Information and Analysis, University of California.

Walsh, Michael (1998). *What is a Bed? – Beds as a Measure of Resource Usage and Demand.* Better Outcomes Health Newsletter, V4 N3.

Ward, Michael (2004). *Bed Management Collaborative*. Queensland Health Quality and Safety Improvement Program, Queensland.

Ward, Michael (2010). *Why a detailed IT plan should be part of your organization's strategy: a hospital's IT capability can have significant clinical and business implications.* Healthcare Financial Management. April 2010.

Appendix A

Staff Survey

eBeds® Bed Management

"Enhancing Patient Outcomes Through Continuous Process Improvement"

Background

A staff survey will be distributed to all staff members to gain an understanding of what requirements are needed to assist in replacing the existing electronic whiteboard with eBeds - Bed Management application. This replacement will take approximately three (3) months with the majority of time taken to investigate workflow processes, areas for improvement and build an interface to the existing HBCIS database.

The result will be a stable and customised application built around consumer and staff needs with a HBCIS interface and far improved capability and functionality particularly in the area of reporting, querying and historical data retrieval. The system will be available to all users via the Qld Health Intranet.

Why

To ensure we build the best system that suits the needs of all of the stakeholders and prove its capability by measuring its success, we need information from YOU the users and operators of the system, both before and after implementation.

Confidentiality
All answers will be held in confidence. Information will be made available to staff on request.

About You
None of the fields below are mandatory.
Please tick the answer most appropriate for your circumstances.

Job Function		**Time in Position**		**Age**	
Administration	☐	0 to 2 years	☐	18 to 25	☐
Executive Team	☐	2 to 5 years	☐	25 to 35	☐
Clinical	☐	5 to 10 years	☐	35 to 45	☐
Clinical Administration	☐	10 to 20 years	☐	45 to 55	☐
		Over 20 Years	☐	Over 55	☐

Communication

I am comfortable with current communication processes at work.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

I am forever interrupted at work with phone calls.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Access to Information

Information is easy to access.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Information availability is influencing Quality of Care of Consumers.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Information is available to me for me to do my work successfully.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

I am unsure of the overall activity in the wards.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Is the present system user friendly?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

☐ ☐ ☐ ☐ ☐

Work Flow Processes

My handover to the next shift is sufficiently documented.

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

If the process of discharging a Consumer is delayed, is it because of (tick more than one if appropriate)

Coordination Problems ☐
Team availability problems ☐
Pharmacy order problems ☐
Lack of information problems ☐

If the process of admitting a consumer is delayed, is it because of (Tick more than one if appropriate)

Coordination problems ☐
Team availability problems ☐
Pharmacy order problems ☐
Lack of information problems ☐

I feel the work process is continually interrupted.

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

Ability to Create Adequate Reports

Reports are available when I need them.

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

The capability to customise and run extra reports would help me in my role.

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

Ability to Run Adequate Queries

I have adequate computer skills to effectively access current information systems

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

I can always access information on previous consumers.

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

I have the ability to run one-off queries.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Feelings about Your Role

Excessive data entry increases my work load.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

I believe the consumer flow process at discharge could be done better.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

I am very satisfied with my role.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

You have completed the Survey

"What Now"

1. **Return your completed forms to your Nurse Unit Manager who will pass them to the Project Manager.**