Gathering and Designing a Multi-Disciplinary Surgical Clinical Ward Handover System at the SAN Hospital

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Surgical Clinical Ward Handover System

Abstract

Acknowledgements

Contents

Glossary

A Infection by Airbourne.

ACAT **A**ge **C**are **A**ssessment **T**eam.

AD **A**s **D**esired Diet (anything the patients wants to eat).

AIN **A**ssistant **i**n **N**ursing.

AMO **A**ccredited **M**edical **O**fficer.

Analgesia pain medication.

Anti-emetic medication against nausea.

Arthroplasty plastic surgery of a joint.

B **B**owels.

BD twice a day.

BGL **B**lood **G**lucose **L**evel.

Bolus a rounded mass of food or pharmaceutical preparation ready to swallow, or such a mass passing through the gastrointestinal tract.

BP **B**lood **P**ressure.

BSL **B**lood **S**ugar **L**evel.

C infection by contact.

CF **C**lear **F**luids.

CMO **C**areer **M**edical **O**fficer (doctor on call).

Comorbidity other illnesses that a patient has that are not part of the diagnosis but affect the health of the patient and possibly the treatment (ie. Diabetes, Hypertension).

Cont **C**ontinence (bowels).

CVC **C**entral **V**enus **C**atheter.

D infection by droplet.

DW **D**ry **W**eight (weight of patient before breakfast).

Dx diagnosis.

EDD **E**stimated **D**ate of **D**ischarge.

EEN **E**ndorsed **E**nrolled **N**urse. Have completed further medication endorsement. Allowed to administer Schedule 2,3, and 8 medications via all routes except intravenous, epidural, intraventriuclar and intrathecal. Any medication which requires checking prior to administration must be checked with a RN or Midwife. Excluded also from administering fluids or medications via CVC, PICC and femoral lines as well implanted devices or arterial lines.

EN **E**nrolled **N**urse. Nurses undertook 18/24 month course at TAFE or related health facilities). Even more restricted than EEN.

FF **F**ull **F**luids incl. milky drinks.

HITH **H**ospital **i**n **t**he **H**ome.

Hx history.

iCIMS **i**ntegrated **C**linical **I**nformation **M**anagement **S**ystem. A design application developed at the University of Sydney allowing the creation of information systems without the necessity of programming experience.

IDC **I**n-**D**welling **C**atheter.

IM **I**ntra**m**uscular (routed into muscle tissue).

IVC/F **I**ntravenous **C**annula (a catheter that is inserted into a vein for supplying medications or nutrients directly into the bloodstream) / **I**ntravenous **F**luids (fluids given through a vein inserted catheter.

L Light Diet.

LOS **L**ength **o**f **S**tay of a patient.

MO **M**edical **O**fficer.

MRN Medical Record Number.

MRO Methacilin Resistant Organism; an organism that shows resistance to Methicillin, a very strong antibiotic.

MRSA Multi Resistant Staphylococcus Aureus; any strain of Staphylococcus aureus that has developed resistance to beta-lactam antibiotics, which include the penicillins (methicillin, dicloxacillin, nafcillin, oxacillin, etc.).

N Neutropenic (very low white blood cell count). Caution must be taken by staff as they could pass something to a patient.

NBM Nil By Mouth.

NCR Nurse Care Record.

ND night shift.

NFR Not For Resuscitation. The patient does not want the clinical staff to use life saving measures.

NG Nasal-Gastric Tube.

NP Nurse Practitioner is a RN educated and authorised to function autonomously and collaboratively in an advanced and extended clinical role. Requires addition 1.5-2 years of study.

NUM Nursing Unit Manager.

OT Occupational Therapist.

PAC Pressure Area Care.

Palliative relieving or soothing the symptoms of a disease or disorder with effecting a cure.

Patient Handover List a printed list of all patients on the ward on which nurses note patient handover information. This list is referred to throughout the shift and also contains the nurses schedule. See Appendix B.3 for a scanned copy..

PEG Percutaneous Endoscopic Gastrostomy tube; tube that is inserted into the stomach to give nutrition.

PICC **P**eripherally **I**nserted **C**entral **C**atheter.

PRN as required medication; these are not part of the patients regular medications).

QID four times a day.

RN **R**egistered **N**urse. a graduate nurse who has been legally authorized (registered) to practice after examination by a state board of nurse examiners or similar regulatory authority, and who is legally entitled to use the designation RN..

Rx treatment pertaining to medication / subscriptions.

S strict precaution (Infection Risk).

SC **S**hower **C**omode (in chair).

SC Fluids **S**ub**c**utaneous Fluids; fluids administered just under the skin and not into a vein.

SH shower.

SP sponge bath in bed.

SPC **S**upra **P**ubic **C**atheter.

ST shower with trolley.

TB **T**owel **B**ath.

TDS three times a day.

TEDS brand of Anti-embolic Stockings that are used to prevent blood clots.

TKVO **T**o **K**eep **V**ein **O**pen.

TL **T**eam **L**eader.

TPN **T**otal **P**arenteral **N**utrition; all nutrition is given through a catheter.

Trainee Consultant/Registrar doctor learning his or her speciality.

U **U**rine **OR** MRO Risk (Unknown Status) mean a risk assumption has been made but not proven.

VTE **V**enous **T**hrombo**e**mbolism; i.e. blood clot in the vein.

Warfarin anticoagulant medicine; nurses need to be aware of patients receiving this due to higher risk of bleeding and in case of bleeds.

1. Introduction

1.1. Client Profile

Originally opened in Wahroonga on January 1 1903 as a 70 bed Sanitarium, the Sydney Adventist Hospital (SAH), known to the local residents as 'The San', is a not-for-profit hospital of the South Pacific Division of the Seventh-day Adventist Church. Today, the hospital is a private hospital offering acute care and currently has 358 licensed overnight beds. SAH is the largest single campus private hospital within NSW and was the first of its kid to be accredited by the Australian Council on Healthcare Standards. SAH is proud to have won the Australian Private Hospitals Association Award for Clinical Excellence in the category 70 beds and over in 2006.

The San prides itself on being the single biggest employer within the Hornsby-Kruing-gai area employing over 2,2200 staff and around 700 accredited medical pactitioners. Together, the SAN staff care for more than 50,000 inpatients and about 160,000 outpatients. The San is also known for its maternity wards and is proud to be bringing over 2,000 babies a year into the world. The SAN, being one of few private hospitals to offer emergency care, admits over 20,000 patients annualy making it NSW's largest and busiest emergency care department among private hospitals. The SAN offers medical services ranging from acute surgical, medical and obstetric care to complex cardiac and orthopaedic procedures. The SAN boasts cutting edge facilities that include a dozen operation theatre suites, 3 state-of-the-art Cardiac Catheterisation Laboratories and Australiaś first dual source CT scanner. The SAN is also responsible for operating the San Day Surgery Hornsby and Dalcross Adventist Hospital, located in Killara.

Having the mission statement "Christianity in Action", the SAN not only offers world class care to the patients within the hospital, but also to disadvantaged third world men, women and children as part of its HealthCare Outreach program. Since its inception in 1986, the HealthCare Outreach program has undertaken 100 trips to 13 different countries culminating in over 2,800 surgeries and lives saved.

1.2. Project Description and Scope

1.2.1. Project Description

The SAN Hospital Information System has to service many different clinical specialities and environments. This project will develop a prototype application in the form of a simulator of a novel HIT system for surgical patients. These patients typically have specific and predictable post-surgical outcomes and hospitalisation time-frames, as outlined in various surgical clinical pathways (e.g. Urology such as, Greenlight Laser Prostatectomy, Ear, Nose and Throat (ENT) and Plastics). Caring for these patients requires multidisciplinary nursing and allied health staff information systems. Constructing a requirements document will be a complex task but gives students the richest possible experience in understanding all the stages of requirements gathering, systems design and systems implementation. The project will use a research technology simulator that enables the process of requirements gathering and system design to be integrated as a single process and thereby enable validation of requirements by their implementation into a design simulator.

1.2.2. Scope

The project will commence with the gathering of requirements by meeting and interviewing various clinical staff fulfilling a variety of roles on the surgical ward, level 11. The student will also gather all paper based forms in use on the ward as references during the design process. Upon completion of the first phase of requirements gathering, a requirements document will be created and will represent the basis for design decisions. Throughout the rest of the semester, the student will update the requirements document as necessary. The student will design forms including the clinical handover in the simulator as well as obtain end user feedback during the majority of the semester. Towards the end of the semester, the student will undertake user acceptance testing as well as evaluations of the work done. The project will conclude with a first draft of the clinical handover form and a presentation to SAN staff. The project will finish at the end of the academic semester.

1.3. Project Objectives

- Collect the requirements for a Clinical Handover for use by nurses, allied health and medical staff in the care of surgical patients
- Produce an accurate record of the information each worker needs access to in the form of a requirements document including process flows
- Design and develop a prototype which simulates an electronic clinical information system with handover processes for nurses, doctors and other clinical staff

1.3.1. Risks

Ref #	Probability	Impact	Description	Mitigation
R.1	High	Medium	Reduced performance through use of new technology	Increase allotted tool usage time
R.2	Low	High	Unable to complete project objectives due to simulator issues	frequent communication with simulator developers
R.3	Medium	Medium	Scope creep	Clearly outline scope at outset of project

1.3.2. Assumptions

Ref #	Description
A.1	The simulator will not need to connect to existing SAN applications
A.2	We will have access to a simulator developer
A.3	A project manager will be available to use to assist us in our work at the hospital
A.4	We are not developing a system for actual use

1.3.3. Issues

Ref #	Priority	Description	Owner
I.1	High	Simulator bugs & issues	Simulator Developer
I.2	Medium	Exposed to immense amount of information	Student
I.3	Medium	Sporadic staff availability	Student & PM
I.4	Low	Time constraints due to university courses	Student

1.4. Anticipated Outcomes / Results for the Project

1.4.1. First Draft Computerised Handover Form

At the conclusion of this project, the student should have designed a first draft of a computerised handover form. This draft does not need to contain all information required but should focus on the most important pieces of information especially in regards to nurses. It should convey all relevant design decisions and be capable of representing patients with varying degrees of complexity, the degree to which a patient is ill.

1.4.2. Understanding of IT/IS within the Health Domain

The student will have gained a general understanding of not only the health domain but also the role of IT IS systems within a hospital setting. The student should see the advantages of using computerised information systems to support the clinical staff in their daily work.

1.4.3. Requirements Analysis Complete

By the end of the semester, the student should have completed the requirements analysis for the project. This should include all relevant requirements up to the end of the academic semester. As part of the requirements analysis, the student should have creating as-is and to-be process diagrams for the nurse to nurse handover.

1.5. Benefits of the Project

1.5.1. Technology Evangelisation

Through the project, the student will be able to show the advantages and abilities of computerised information systems to clinical staff in particular nursing staff. Although the clinical staff at the SAN are using applications to record information already, not all aspects of their daily work are digitised; this includes handover. By working with staff throughout the semester, the student will be able to generate end-user buy-in and support for a computerised clinical handover.

1.5.2. Pilot Project

This project constitutes a pilot project in the sense that future students can build upon the achievements of this project. The foundation, both in regards to system design as well as end-user exposure, will provide future students with a lower entry barrier into the clinical domain and into the SAN.

1.5.3. End-User Driven Development

Mention the use of the methodology here

1.5.4. Trialing Designer Tool

This project allowed the student to use a novice health information system application developed at the University of Sydney called iCIMS. The project can thus be seen as a trial for the designer tool enabling the student to not only use a new technology but also to document bugs and suggest enhancements to the system. In essence, the student ran the application through its paces and noted shortcomings as well as possible additional features allowing the application to go through a maturation process.

2. Process

2.1. Overview

In order to take full advantage of the tools employed in this project as well as the opportunity to work at the hospital, an iterative and incremental user driven development process was chosen. This allowed the student to take advantage of the tacit knowledge of clinical staff and allow the end-user to actively participate in the design of the system. The iterative and incremental nature of the process allowed the student to start with one form and then incrementally adding more forms as well as managing iterative changes in existing forms through user feedback. The ultimate goal of any project is to supply an outcome that will be accepted by the stakeholders, in this case the end users. User driven development enabled the student to ensure that during all steps in the project, the system met stakeholder needs and requirements. The active feedback gained from clinical staff enabled the student to shape and form the system to meet user needs. It is important to note that sitting down with clinical staff will was not always possible as their priority lies with patient care. In order to facilitate a continued design process throughout the semester a number of methods were employed. The student utilised participative observations, interviews as well as feedback notes to gain an adequate understanding of the user needs and requirements. The student's work at the SAN was supported by a project manager from the SAN, Hannah Chong, that facilitated first meetings with clinical staff as well as offering feedback on relevant project management aspects of the project.

2.1.1. Participative Observations

As this was the first time the student undertook a IT project within the health domain, it was important to learn how clinical staff worked. Participative observations facilitated this need through *shadowing* clinical staff during various points in their shift. This included sitting in on clinical handover, the process through which the nurse of the previous shift conveys patient information to the nurses of the oncoming shift. By sitting in on handover, the student was able to gain an understanding of the overall process of clinical handover as well as experience the shortcomings and inefficiencies first hand. This enabled the student to relate to the clinical staff when discussing the system design.

The student did not actively participate in handover, that is to say that the student merely observed and did not give handover. Thus, the student acted like a 'fly on the wall', remaining in the background looking on. This method proved vital to the project as it provided a first

hand experience of the current situation. One disadvantage of using participative observations is that the student was overwhelmed at first by the sheer amount of information that he was exposed to. It took some time and effort on the part of the student to sift through, filter and understand the information in order to make the most efficient use of it. As the project progressed, this information overload continually decreased.

2.1.2. User Interviews

In order to supplement participative observation, user interviews were undertaken with various clinical staff fulfilling different roles within the hospital. This enabled the student to understand the viewpoints of various staff in regards to what they do as well as their view on clinical handover. The interviews lasted between ten and fifteen minutes and were held casually. During the interviews, the student asked specific questions about handover and the user's involvement. The interviews were held on the ward or in offices depending on the role of the staff being interviewed. The interviews also served the purpose of building a relationship with the clinical staff. The student's aim was to go back to the interviewed staff throughout the project and attain their feedback on the system design. This social component was very important in order to elicit staff support especially nursing staff as their time was extremely limited. Not undertaking this social component would have made the work of the student much more difficult.

2.1.3. Feedback Notes

During the course of the project, the student met with clinical staff at various times in order to show them the current status of the design as well as to get answers to open questions. During each of these encounters, notes were taken in order to preserve the exchange allowing the student to return to the notes at a later time to refresh his memory. In order to maximise the use of time with the clinical staff, the student was accompanied by another student who assisted with taking notes during the feedback sessions. This allowed the student to focus on the staff and not waste time trying to write down information as well as facilitating a smooth flow during the meetings with staff.

2.2. Tools and Skills

From the beginning of the project, one of the key aspects was the use of the iCIMS. Having been created at the University of Sydney recently, the project was meant to trial the tool in a real world scenario. The main ideology behind iCIMS is to use a graphic interface to build a system thus avoiding the necessity for programming skills. This means that end-users could actively participate in designing the system by creating the system together with the designer. iCIMS aims to be applicable in any clinical situation and thus utilises Ockham's Razor of Design (Budd [2011]), which states that :

"a design should use the minimal number of entities
with their maximal generalisations"

In conjunction with using iCIMS, the student utilised Trac, a bug and issue tracking system that also offers documentation functionality in form of a wiki. Two separate instances of Trac were used because the iCIMS project had an existing instance. All bugs and issues were documented in the iCIMS instance of Trac and all project documentation was created in a separate instance of Trac available for the project. All relevant project information, such as interview notes, process flows, etc., was documented on the Trac instance. Apart from playing a vital role in the completion of the project academically, the wiki will also serve as a starting point for future students continuing the project. This ensures that the student's efforts were not in vain and will allow future students to more easily find their way while undertaking future projects.

Apart from electronic tools, the student needed to use communication and people skills in order to successfully undertake this project. Communication and people skills played a vital role as the student was dealing with end-users that were very technology-adverse as well having a low computer-literacy. Inter-personal skills allowed the student to found common ground and terminology with which to communicate with end-user. It also allowed the student to quell most reservations that clinical staff had towards the project or its purpose.

2.3. Scope and Schedule

Although the project description outlines that the student undertake a design of the entire multi-disciplinary handover occurring at the SAN, this was deemed too big of a scope to handle within an academic semester. Below is a depiction that hints at the complexity and size of the entire clinical handover process.

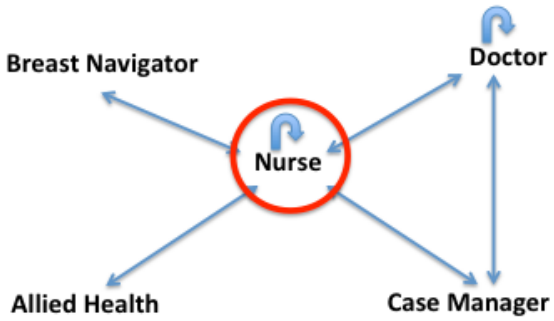

Figure 1: Clinical Handover Overview - All User Roles

As one can see, there are numerous roles involved in clinical handover each with their own needs and requirements. It was deemed unfeasible to undertake requirements analysis, system design and evaluation for all clinical staff involved. The sheer amount of information, communication complexity as well as immense design effort lead to the decision to focus on the nurse role for this project, denoted by the red circle in the figure above. Furthermore, the scope was defined as focusing on the clinical handover between nurses as this was deemed most important in discussions with staff. The nurse to nurse handover is also the most structured handover between clinical staff lending itself to be used in this project.

In regards to scheduling, the project was broken down into four major phases as depicted in the figure below. The week numbers are based on the academic semester timeframe.

Figure 2: Project Process and Schedule

Even though the project was broken down into four phases, all phases were undertaken at most times. The separation merely depicts where the focus lay at each point in time. The schedule of four weeks for requirements gathering was a good estimate and allowed the student to perform an adequate analysis allowing the student to proceed to the design phase. The design phase's projected timeframe of three weeks was too short and was actually the focus of the student's work until week twelve. This stems from the fact that the student had numerous issues with the designer in the form of bugs and it also took longer than expected to convert design ideas into reality within the designer. This was the case most notably because the student was not familiar with the designer or its components prior to commencing the project.

Due to the extensive design phase, the usability and acceptance testing phase was pushed back into the weeks twelve and thirteen after the student was at a point in the design that lent itself to such testing. Although the testing phase timeframe was reduced to two weeks and pushed to the very end of the academic semester, the student nevertheless managed to obtain testing data in coordination with staff. Due to availability issues with staff, not all clinical staff could undertake the usability and acceptance testing. It should be noted that these availability issues did not stem from bad time or appointment management on behalf of the student, but rather on issues surrounding staff being sick or having to take personal days.

The last phase, the reporting phase, was the focus of week thirteen of the project having been pushed back in order to allow for usability and acceptance testing. This did not pose a major issue as the majority of the reporting phase was in the form of the academic report. The other portion of the reporting phase where the weekly status meetings with Prof. Jon Patrick and the documentation of information in the wiki throughout the semester. At the centre of all phases and indeed of the project lay the communication with clinical staff as well as the project manager Hannah Chong and Prof. Jon Patrick.

3. System Design

This chapter will describe SANSURGIMS, "SAN Surgical Information Management System", which embodies the results of the project. The overarching goal of the project was to design a computer based handover prototype for clinical staff as outlined in 1.3. The prototype that was produced in the course of this project is the first attempt within the hospital to create a computerised handover and as such required the student to analyse the current processes as well as undertake a requirements analysis of the handover process. The requirements analysis was accompanied by the gathering of all paper based forms used on the ward. Together, these three aspects represented the design drivers for the project. Each of these aspects is described in more detail in the following pages.

3.1. Handover Overview

Before undertaking any kind of design work, it was necessary for the student to understand and analyse the current handover processes employed on the ward. The handover between nurses, in the formal sense, takes place three times a day, once for each shift. Handover is held at 7 am, 2 pm and 10 pm. The handover takes place in the staff lounge room on the ward. The purpose of the handover is to transfer information about the patients on the ward from one shift to the next. This is especially important in patient care because the handover process enables nurses to highlight important information about a patient that a nurse that is starting her shift **must** know in order to properly care for her assigned patients as well as to properly plan her shift. The information sources for any type of handover, not just the nurse to nurse handover, are diverse as are the communication channels employed as depicted by the figure below.

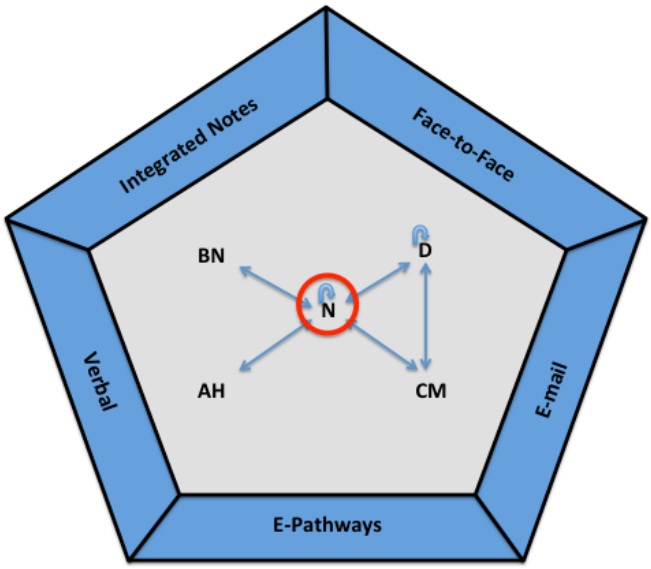

Figure 3: Clinical Handover Overview

As the figure shows, there are five information sources that are also utilised as communication channels. Face-to-Face and verbal communication is the quickest and most efficient way of relaying information in a clinical setting. This is emphasised by the fact that clinical staff have very little time during their shift that isn't devoted to patient care. Thus, communication usually occurs ad-hoc and spur of the moment whenever staff have a minute to spare. This includes communication with doctors, other wards and other nurses. Another advantage of using face-to-face and verbal communication is the fact that clinical staff can obtain immediate feedback to their questions or information exchange. This allows staff to quickly act on information instead of wasting time waiting. This is also one of the reason why handover is being done in a verbal, usually face-to-face, manner on the ward.

As stated, handover should focus on highlighting vital patient information and thus, the nurses and other clinical staff still need to go back to documented information sources to obtain a complete picture of the patient. Such documented information includes a patient's integrated notes or e-pathways as is the case on the surgical ward. A patient's integrated notes is a folder containing all the information in regard to the patient such as filled out paper based forms, doctors orders, medication orders, etc. The integrated notes thus represent everything that is known about a patient. While most wards at the SAN still use paper based integrated notes, the surgical ward has moved to an electronic system called e-Pathways, which stores all patient information electronically. In essence, e-Pathways is the electronic equivalent of a patient's integrated notes. It should also be mentioned that these integrated notes are used by all clini-

cal staff that are charged with the care of the patient including case managers and if relevant breast navigators. This leads to the natural conclusion that it is also used as a communication medium between staff albeit a slow one. This is especially the case for any non-nursing staff as they are not on the ward at all times and the nurse caring for a patient might not be around at the time so information is written into the notes that the nurse needs to read. This in turn leads to the necessity that the nurse go through the integrated notes or e-Pathways of her patients several times a day to check for new information, something that is rather tedious and time consuming and takes the nurse away from her primary duty of patient care.

The last communication channel and source of information is e-mail. This channel is not used in regard to handover information but was added for completeness sake. E-mail is usually used by doctors or breast navigators between each other. It also depends on personal preference whether or not e-mail is used.

As can be seen by the variety of communication channels and information sources, it is quite a difficult task to transform the current processes into an electronic form. Needless to say this would require a change, depending on each staff member this could be a drastic change, in how handover is done and how information is handled within the hospital. This will be discussed further in 5.1.

3.2. Current Handover Process

This section will outline and describe the current handover process for a nurse to nurse handover taking place during a shift change. There are two points of concern with the current handover process that needed to be addressed by the prototype. The first point of concern is the fact that currently, nurses will add “fluff” information to their handover. This “fluff” is any and all information that is not vital information about the patient. This fluff ranges from repeating information to mentioning things such as “the patient is moody”. This fluff is not only irrelevant information in regard to handover but it also consumes time during handover and forces the nurses of the oncoming shift to hear information that they must actively filter out.

The second aspect of concern is the fact that nurses on occasion only write down handover information for the patients they are responsible for. This means that the nurse is only aware of her own patients thus limiting her ability regarding other patients on the ward. A situation in which this limited knowledge of patients on the ward becomes an issue is for example when

family members of patient come onto the ward and request information about the person they want to see. If a nurse does not take down handover information for that patient then she cannot be the family members the information they seek and instead has to say "I don't know, let me get someone who does". This negatively represents the work of the nurses and that of the hospital. Another kind of situation in which the lack of patient knowledge causes problems is if emergency action must be taken for a patient. If the nurse that is responsible for the patient in distress is not available, another nurse must take her place and action the care necessary. This can only be done if the nurse is aware of the relevant patient information. While this situation is very rare it is nevertheless a possibility and should be handled appropriately.

Before describing the current handover process, it is necessary to describe the two main roles that partake in the handover. The two roles are the Team Leader (TL) and the Nurses. The roles have the following responsibilities:

Team Leader	**Nurse**
• looks after ward • checks to make sure registered nurses (RN) are fine • is also a nurse • calls out NFR status to all other nurses during handover • in contact with the Assistant Director of Nursing (ADON)	• primary carer of patients • handover to next shift • administer medication • fill out patient forms such as Observation Chart and Nursing Care Record • the night shift creates roster

When the TL comes on for duty, he or she will check each patient to see what their NFR status is. This is recorded in the patient's integrated notes, not on e-pathways. Before the start of each shift, the nurses of the on-coming shift meet in the staff room for handover. The handover usually last around 30 minutes. All of the nurses on the on-coming shift remain in the room during the entire handover.

The first thing that happens is that the TL tells all the nurses which of the patients are NFR. Afterwards, the TL assigns each nurse a set of patients for that shift, which the nurses mark on their Patient Handover List (see Appendix B.3). Then the nurses from the off-going shift come in, usually one by one, and verbally tell everyone in the room about the patients they were responsible for. Each nurse does her handover a little differently even though there are guidelines for handover. They tell everyone the room number, patient name, short history, diagnosis, test results, medication changes, treatment changes, drug allergies as well as outstanding test results and tests/procedures that will occur that day. They report on any variances in vital signs, bowels, or any complications that the patient has. They also mention how the patient is feeling, if they are annoyed, sleepy, disoriented and other general information such as non-critical allergies, ie. shell fish allergy. If a patient is being discharged, the nurse will say where that patient is going and if the patient has left the hospital already, he or she is stricken from the list by the on-coming nurses.

The nurse who is responsible for that patient on the next shift writes down the important information on her Patient Handover List. The nurse will also create a small schedule of upcoming tests and procedures so that she can plan her shift accordingly and not be pressed for time during the shift. Any nurse can ask questions about the patient and the off-going nurse will try to answer them. If a patient is not assigned to a nurse, that nurse will not write down patient information. Should there be any doctor's notes or orders, then these are also mentioned during the handover process. When the off-going nurse is finished giving her handover she leaves the room and thus ends her shift. Should any information be missing then the on-coming nurse will check e-Pathways, the integrated notes or contact the relevant person in the hospital.

Below is a process diagram depicting how handover is currently undertaken based on the previous description.

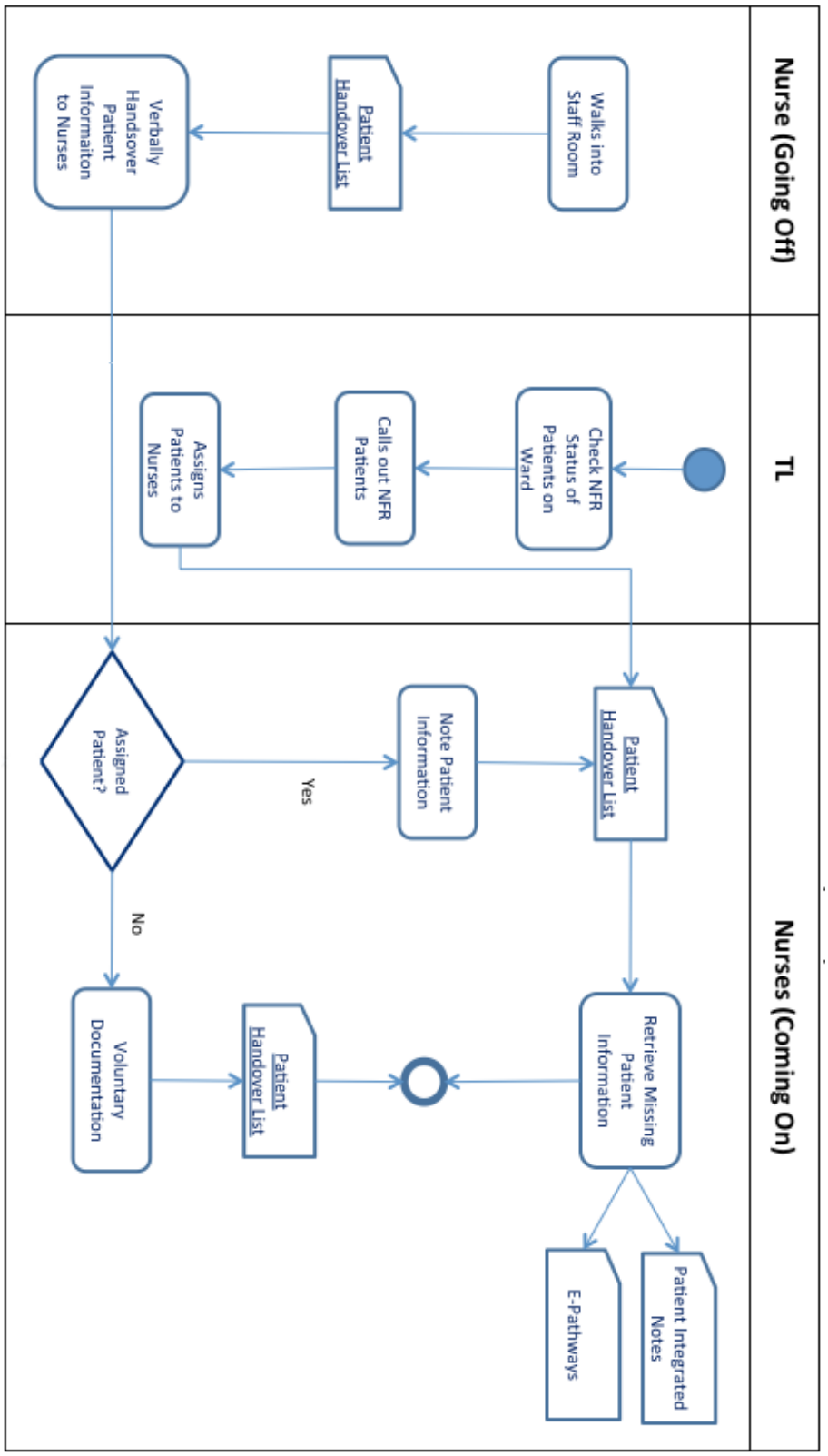

Figure 4: Current Nurse-to-Nurse Handover

3.3. Requirements Analysis

Concurrently to understanding the current handover process, the student undertook a requirements analysis for handover. The student interviewed various clinical staff fulfilling varying roles within the hospital. For a complete list of roles encountered during the requirements analysis see Appendix B.2. The interviews allowed the student to better understand the various roles within the hospital as well as obtaining the view on handover from the major roles involved in handover. After having undertaken the interviews, the student compiled a requirements document that was then verified by staff.

The student based his requirements model on that of the Business Analyst Body of Knowledge (IIBA [2009]). The requirements were split into business, stakeholder, pre-requisite requirements, functional and non-functional requirements. Pre-requisite requirements were requirements that must be fulfilled in order to design a clinical handover and refer to various paper based forms obtained throughout the project. The requirements are documented in Appendix B.1.

It should be noted that the requirements gathered and documented are an attempt to fully document handover requirements and thus are not limited to requirements that can be fulfilled by iCIMS. An example where this is the case is with printing the handover information. While iCIMS has a print function, it merely prints out the web page content and does not allow for print styling. Printing out the web page handover would not aid the nursing staff in their work as each patient would reside on a separate printed page. Nurses would have to carry around seven to fifteen pages worth of patient information, which is not something that is feasible. Instead, the information system containing the handover should be able to print a handover list such as the one currently employed by the nurses.

3.4. Form Gathering

As part of the requirements analysis the student collected all forms in use on the ward. All forms were collected in order to identify the sources of information that ultimately is handed over between shifts. The student collected over twenty forms during the requirements analysis. After collecting all of the forms, the student went through all the forms and identified the ten most important forms in regard to handover. This was done in order to keep within the scope of the project and to reduce the number of forms to a number that could be managed by the students in regard to analysis and digitisation. Of all the forms collected, the following

ten forms were deemed most important by the student in conjunction with clinical staff, in no specific order:

1. Nursing Care Record Form
2. Fluid Balance Chart Form
3. Intravenous Fluid Orders Form
4. Pain & Symptom Assessment Form
5. Patient History Form
6. Adult Observation Chart
7. Medication Chart Form
8. Temporary Transfer/Handover Form
9. Patient Handover List Form
10. Patient Mobility Form

Apart from forms 5 and 8, all forms are filled out at least once a day and thus hold the most up to date information on the patient. In order to better understand the forms and how the relevant information is documented, the student also gathered filled-in versions of these forms. A very important issue to raise here is the fact that because the forms are paper based, they are filled out by hand leading to issues with legibility. The student, on numerous occasions, encountered this problem and had to seek assistance from the relevant staff member to clarify noted information. The issue of legibility was also raised by clinical staff themselves, not only in regard to doctors but to all staff, and is something that they wished to be addressed. The filled-in forms also allowed the student to enter realistic data into the prototype in order to present the functionality to clinical staff.

Another issue that should be noted in regard to forms is the fact that most of the time, certain parts of forms were not filled out because they were not relevant for that patient. This presented the student with the problem that diverse variations of information was not available for all parts of forms. Unfortunately, it was unrealistic to ask clinical staff to provide such information for all possible situations because that would have required them to use a considerable amount of their time to generate the information, time that they did not have. Nevertheless, the student managed to adequately design the prototype based on the available information.

3.5. Design Process

As described in 2.1, the student utilised an incremental and iterative user driven development model. The realisation of the development model with iCIMS is depicted below.

Figure 5: Design Process

The first step undertaken was to digitise the paper forms within SANSURGIMS. This meant attempting to copy the form's design and layout one to one. The reason why the forms were copied one to one was so that the student did not influence the design of the system and that the clinical staff could partake in all design steps. The one to one copy of the form also allowed the clinical staff to more easily identify the form being displayed in the system. It also allowed the student to more easily elicit staff feedback because the staff were not confused by looking at something totally new. After seeing the digital copy of the form, the clinical staff could then identify shortcomings of the forms themselves and, together with the student, undertake changes to the forms. The digitised forms were displayed in the web browser and it was based on the web page display that the clinical staff gave feedback and suggestions.

This process allowed the student to incrementally add new forms into the designer and iteratively shape and mould these forms as desired with the help of the clinical staff. In order to make this more clear, Appendix B.4 depicts the design application. It begins by showing the paper form and then showing how the same form is represented in the designer and finally how it is shown in a web browser. It should be noted that the example form has been modified to meet clinical staff needs based on design choices.

While undertaken the design steps with the clinical staff during the semester, the student was confronted with several design decisions. This stemmed partly from the requirements gathered and partly from the necessity to create a handover that was relevant and usable by numerous nursing staff. The major design decisions are outlined below.

3.5.1. Handover by Exception

Due to the fact that staff were highlighting the fluff issue mentioned in 3.2 and the duration of handover being an issue, it was proposed that handover should be done by exception rather than by rule. This means that handover should focus on variances and abnormalities of a patient as well as information that directly affects the nurse's scheduling during her shift. This is opposed to handing over by rule in which all information about the patient is shared regardless of whether that information is critical or not. Clinical staff reasoned that a handover by exception would alleviate both the fluff issue as well as the lengthy handover issue. The student found the staff's reasoning logical and thus proceeded to create a handover by exception in which variances and abnormalities were at the centre.

While seaming reasonable and logical, the design decision had a major pitfall that was not discovered until user testing was undertaken. The pitfall pertains to the fact that not all nursing staff have equal experience. This means that junior nurses or student nurses will not necessarily know what is normal and what is abnormal for a patient whereas senior nurses and nursing management would, given their extensive experience. The system however must cater to both experienced and unexperienced nurses. A solution proposed by the clinical staff who noted this shortcoming was to create another handover form where all of the "normalities" of the patient were displayed, the information that was not out of the ordinary. This would enable the experienced staff to see what they wanted to see in the handover by exception and also allow less experienced nurses to retrieve normal information on the patient in the handover displaying normalities.

3.5.2. Viewing a Patient at a Glance

Clinical staff mentioned that they would like to view a patient at a glance meaning that they would see all relevant information without having to switch screens. The clinical staff wanted to move away from looking at disconnected patient information, in various screens, to seeing all of the patient information at once allowing for connections to be made between pieces of information. This design concept was raised by several clinical staff members and is reflected in the handover form creating during the course of this project.

3.5.3. Minimal Scrolling

Another design decision that affected the overall design of all forms within SANSURGIMS was the issue of scrolling. Because clinical staff were not computer literate, the situation could occur where staff would miss information simply because it was further down the screen and required scrolling down. In order to mitigate this risk, it was deemed necessary to create forms that required as little scrolling as possible. Unfortunately, scrolling could not always be avoided like it was the case with a ward patient list that was simply too long but was required to be displayed as a table. Wherever possible however, scrolling was eliminated leading to information being split into separate parts and only one part being visible at any given time. A perfect example of this design choice is reflected in the Nursing Care Record, (Appendix B.4). Instead of having a long scrollable form, the existing sections on the paper form were turned into separate forms within SANSURGIMS and each linked to with a button.

3.6. Digital Handover Process

The culmination of the system design were the patient tracking list, patient handover and all digital forms, a total of 52 forms, as well as a new handover process. The new handover process involving SANSURGIMS is described below and following are the digital forms. It should be noted that an assumption was made in regards to data entry. As the surgical ward is already employing a e-pathways, the digital equivalent to a patient's integrated notes, it is assumed that data entry and retrieval will occur through e-pathways and that SANSURGIMS takes that data and presents it in the form of the handover.

During the shift, the TL will check the patient's NFR status on the ward. While doing so, the TL will update the patient information in the system. Likewise, nurses undertaking their care of patients they are responsible for will update relevant forms and information in the computer system.

At the end of a shift, the nurse will go through his or her patients and ensure that all relevant information has been filled in. At the end of the shift, the TL will assign the patients on the ward to the nurses on the on-coming shift.

At the beginning of her shift, the on-coming nurse will log into the computer system and be presented with a list of the patients on the ward. He or she then filters that list to display only the patients that have been assigned to him or her. He or she then goes through the patient

handovers one by one by clicking on the handover button for each patient on the screen. The handover screen will then display all relevant information to the nurse allowing her to obtain a picture of the patient. The relevant information includes: drains, lines, tubes, fluid input, drain volume, voiding, removal of drains/catheters, relevant doctor orders, discharge plan, patient history summary, outstanding test results, test appointments, infection risk, NFR, procedures, allergies, medications (anticoagulant, antibiotics, analgesics), fall risk, vital sign variances.

Should the nurse want more information she can navigate to relevant forms in the system that contain all of the information about the patient especially the information that was not displayed during handover. This kind of information includes any non-variance information as well as peripheral information about the patient. The nurse can re-visit the handover screen for a patient at any time allowing her access to a big picture depiction of the patient.

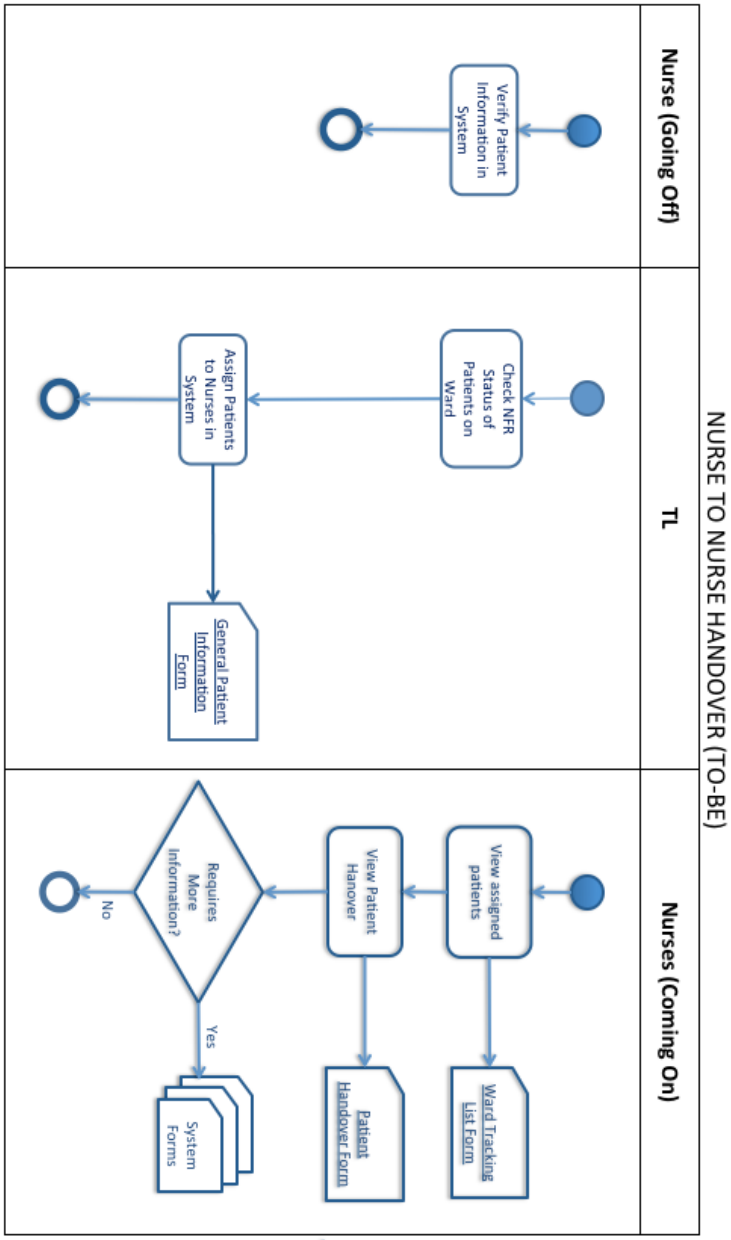

Figure 6: Updated Nurse-to-Nurse Handover

The process outlined above is what handover could like like once it is based solely on a paperless system. While being a rather utopian view of the future of the clinical domain, it does reflect what **can** be done. Obviously such a drastic change in any process will entail a quite substantial change in the way staff do things during their shift. This is quite an enormous undertaking especially with end-users that are considered computer illiterate due to the nature of such users to exhibit a greater barrier to change involving computer systems. In order to reduce the barrier to change acceptance, it would be necessary to be able to print the handover information during a shift. The paper printout would act as a bridging mechanism between the purely paper based handover and the paperless handover. Indeed, clinical staff repeatedly asked about whether it would be possible to print the handover out. The printed list is viewed as a life line for the nurses and as such would need to be retained until the last possible moment. Due to constraints within the project and iCIMS, a printable version of the handover was not designed but the student did realise the importance of this information medium and as such is reflected in Appendix B.1 as part of the handover requirements.

Having outlined the new process, a description of the SANSURGIMS forms and workflow follows. The initial screen within SANSURGIMS is the ward patient tracking list (Appendix B.5.1). This displays all patients currently residing on the ward and includes information such as the infection control (IC), bed number, full name, age, estimated date of discharge, attending and consulting doctors as well as the attending nurse. For each patient, there is a button that will go to that patient's handover, denoted by "Handover", and another button will take the user to the general patient information (Appendix B.5.5), denoted by "i", which is where the tracking list information among other things is stored. The tracking list serves as a ward overview as well as the starting point for any actions taken for a patient.

Clicking on the "Handover" button will lead the user to the handover associated with that patient. Depending on the complexity of the patient, various variances and abnormalities are displayed. Clinical staff are able to assess the complexity of the patient at a glance solely based on the amount of information displayed on the handover form. Appendix B.5.2 to B.5.4 provide example handovers for patients ranging form very uncomplex patients to very complex patients.

4. Evaluation

During the course of the project, feedback was repeatedly sought from clinical staff in regards to the progression of SANSURGIMS. This feedback was not only valuable to the student in regards to designing but also necessary in order to ensure continued alignment with requirements and staff needs. Towards the end of the project, this staff feedback was complimented with a questionnaire in order to attain quantifiable values that would lend themselves analysis. The student's view of SANSURGIMS was not included in any evaluation because end-users make much better judges when used in conjunction with measurement instruments as they, the end-users, tend to see things more in regards to strategic benefits for the organisation as opposed to the more system-benefit centric view of an IS professional (Mirani and Lederer [1998]). This leads to an overarching statement of IS Success and is said best by Seddon et al. [1999]:

> *"IS Success is [...] conceptualized as a value judgement made by an individual, from the point of some stakeholder."*

4.1. Testing Procedures

As mentioned above, the evaluation of the system was undertaken in two forms. The first form of evaluation, direct user feedback, was utilised during the majority of the project lifespan. The student met with clinical staff repeatedly and presented them with the current system. The student was accompanied by another student during these feedback sessions that was responsible for assisting in taking notes. This way, the student was able to give the clinical staff his full attention and facilitate a constructive session.

The second form of evaluation undertaken was the use of a questionnaire at the end of the project (Appendix B.6). The questionnaire first asked the clinical staff member to navigate to the handover for a specific patient and then answer specific questions about that patient. The task was used to determine how well the user could navigate the system and if he or she could find information in an acceptable time frame. After completing the small tasks, the clinical staff usually gave feedback in regards to the handover form on their own accord. After their feedback was noted, the clinical staff member was asked to answer the questions on the questionnaire. The objective of the questionnaire was to present the staff member with a small number of questions to which the he or she only needed to circle the statement that most corresponded with their view. It was very important that the questionnaire be short and easy to fill out

in order to not give the clinical staff the feeling that reviewing the system was a very time consuming matter. This plays an important role in regards to obtaining subsequent feedback. If staff feel that reviewing the system is too time consuming they might refrain from giving feedback.

4.2. Test Results

The continual feedback received from various clinical staff included a range of responses. These ranged from being very positive about the work being done to citing short comings of SANSURGIMS or even misconceptions introduced by the student. The feedback was always perceived as constructive and the student believes that these responses were earnest views of the system.

In regards to the questionnaire, the responses were mostly positive. There were some issues with navigating the system where clinical staff did not see the handover button on the right side of the table and instead opted to click on the row within the table. Others were uncertain when using the system and paused for one to two seconds before clicking the button. A third group of users were more confident in using the system and did not hesitate. The questions in the tasks were answered in a timely matter for the most part with only one user needed considerable longer to find the information. This stemmed from the fact that the user was taking longer to orientate themselves within the system than other users. The average rating in the questionnaire by question is displayed below:

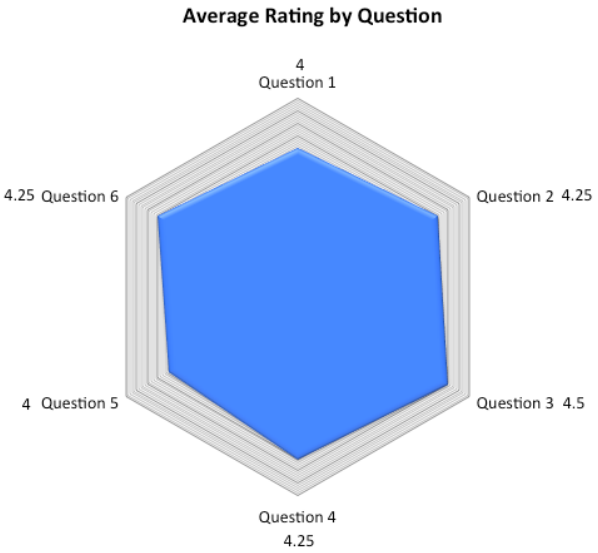

Figure 7: Questions Results - Averaged

4.3. Interpretation of Results

While staff feedback was viewed as earnest and constructive in regards to SANSURGIMS, it nevertheless needs to be taken with a grain of salt. This stems from the fact that there are numerous influences acting on a stakeholder and each will affect how the stakeholder views and acts during the project. In regards to the clinical staff, one could argue that time pressures and the fact that they were not consulted on whether to have such a project be undertaken on their ward or not lead to a lack of full support. The staff was very helpful but the amount of support might have been greater if staff were able to allocate for time to SANSURGIMS. This of course is quite to achieve given the nature of the staff's work. The feedback given still allowed the student to design a system that was received positively by the staff.

The positive reception by staff is further supported by the results of the questionnaire questions as depicted above. All questions, on average, were answered with a score of 4 and above. This means that there was no information overload, it was easy to find information, the information had a logical order, the colours were informative, SANSURGIMS would increase handover efficiency and the system was easy to navigate. There is one caveat to the positive results of the questionnaire; the student was only able to have four members of clinical staff fill out the questionnaire. This was due to time constraints on the part of the student as well as the staff and unforeseen personal circumstances ranging sick staff to staff not being available for an extended period of time due to their absences from the hospital. The small sample size greatly weakens the proposition of the results, that SANSURGIMS is meeting staff needs and requirements effectively. That is not to say that the opposite is true, but there is no objective proof to support that conclusion at this point in time.

Even though the testing and validation measures are lacking, the student still believes that a system was built that meets staff requirements and would serve the goals of a digital handover. SANSURGIMS can be viewed as a good pilot project into this domain and has potential that warrants a continuation of the work by other students.

The strengths of the work lie within building a relationship with the staff and introducing them to a digital information system in which they hold the power to make decisions. It allowed a good portion of the clinical staff to come to the realisation that a digital handover would make their work easier and cause them less headaches in terms of the quality of handover and the medium through which it is communicated.

The weakness of the system is that it focused on aggregating information into a handover form and thus neglected data entry. Forms were created for data entry but these were only created in a first draft and not continually updated. These forms were not directly shown to staff all the time, but all were shown at least once, but served merely as a way to adequately design the handover form. This also meant that no evaluation was undertaken on these forms due to the fact that they were first drafts and due to time constraints.

The reasoning behind this choice was that the data entry was more of a pre-requisite rather than an integral part of the actual handover, the main part of the project. Another reason why the data aggregation was favoured was because the surgical ward was already utilising another application for most of its work documentation. If implemented on the ward, SANSURGIMS would integrate with that application and pull the data from there rather than from forms created within SANSURGIMS. Thus the student chose to make a strategic long term decision during the design phase that would position SANSURGIMS in such a way as to mitigate redundant design should it ever be integrated into the ward.

5. Reflection

5.1. Difficulties

During the undertaken of the project, the student was faced with a number of difficulties which are described in detail in the following sections.

5.1.1. Design Thinking

One of the cornerstones of using iCIMS is a fundamental change in design thinking. Throughout university, student are taught a design approach that consists of requirements gathering, concept creation, development and testing. These are the main aspects of any design methodology and each is the focus at given point in any methodology. Designing with iCIMS changes that. iCIMS, in essence, melds all of these concepts into a single concept. While the user is designing he or she is also testing their design thinking and modifies the design on the fly based on requirements and needs. It was difficult to truly turn away from standard software practices and undertake "pure" designing by just creating forms and changing them based on feedback. Several times during the project, the student would catch themselves thinking about prototyping the forms or creating mockups or even how they would create said form *the old fashioned way*, through programming. This change in thinking caused some uneasiness or even doubt at times.

5.1.2. The Golden Middle

After having gathered the requirements for the project, it became evident that different stakeholders had different needs. These sometimes opposed each other forcing the student to attempt to find the golden middle, a compromise that would satisfy both sides. A very good example of this is the fact that senior staff wanted a handover by exception but junior staff required a handover that contained all of the information. These are two opposing views for which an adequate solution must be found. Finding that solution is not always easy and proved a challenge in some cases. This was also applicable to situations surrounding the project itself where hospital stakeholder views were at odds with academic views. These kinds of issues are especially challenging for a student because they require a great deal of attention in order to solve successfully.

5.1.3. iCIMS

One of the major difficulties encountered during the project was the fact that the student was pushing iCIMS as far as it would go and was thus exposed to major growing pains of the tool. Several times during the semester, the student was faced with limitations on the part of the tool that required rethinking a design often causing a considerable loss of time. The growing pains of the tool also exposed numerous issues and bugs that slowed the student down and sometimes even brought the work to a grinding halt. Major issues included the tool's performance when viewing forms in the web browser as well as features not working as intended or even breaking as a result of bug fixes undertaken by the development team.

5.1.4. Time

Another issue rather than difficulty that arose during the project was the issue of time. Because of the type of work the nurses were doing during their shifts, they had little time to spare. Meetings could not be planned ahead of time and were undertaken in an ad-hoc manner; going up to the ward and seeing if the nurse was available. It is quite understandable that the nurses had little time but it nevertheless made the project more difficult. Time was also somewhat of an issue on the student side. It was not possible for the student to go to the hospital every day during the week because of other academic obligations. This limited the time the student had to accomplish tasks at the hospital.

5.2. Lessons Learned

Industry projects lend themselves very well to students learning valuable lessons for their future endeavours. This project was no different. Something that stood out especially was the fact that communication is key. The student had undertaken an industry project in a prior degree that also put emphasis on communication. Communication is key because both the student as well as the SAN staff come from two very different "worlds" but must work together to produce a successful outcome.

Another lesson learned is the fact that nothing is free. The student had to invest time and effort into introducing himself to staff and presenting the objectives of the project. Only after clinical staff were somewhat familiar with the student could the real design work begin because the staff became more comfortable around the student and were more willing to offer their time and feedback. The student was fortunate enough to guided by a very enthusiastic nurse at times that not only showed him around but also help introducing him to the staff. These social

relationships play a vital role in the success of a project.

A further valuable lesson learned is the fact that nothing great ever comes easy. Even though there were many difficulties with iCIMS and a great deal of time problems, the project was still successful and shows promise for the future. Having to deal with a domain as complex and information rich as a hospital has shown how much computer information systems can do to support and improve the work of staff. It is a stoney road that leads to a digital clinical handover but it is a road worth taking.

5.3. Future Suggestions

In the future, showing more presence while working at a client's site would allow for a better interaction with client users. By interacting more with the staff on a regular basis, it would form a bond that could be used to more effectively enlist the help of the users in designing a solution that meets their needs and requirements. Improving soft skills is vital to any successful undertaking and would thus be the focus of future improvements.

6. Conclusion

6.1. Strengths and Weaknesses

The strengths of the project lie in the fact that it has laid the foundation for continued development of the digital handover. The project has successfully shown the clinical staff that a digital handover would improve the way they work. As such, the project was successful as a pilot project. The handover design created has been received positively by the staff and allows for continued refinement that could lead to direct use on the ward.

The major weakness of the project is that it only delivered a first draft of the handover. It would have been better to have gone through two or three more major versions of the handover, including the handover form containing all of the patient information for junior nurses, in order to finish the project with a more mature handover. On some level, it came as a surprise that we were wrapping up the project after the first draft, not by choice but rather because the semester ended. Being able to show a more mature handover as well as having created the second version would have left the project in a stronger position to be continued next semester.

6.2. A Second Time

If the project would be undertaken a second time, the student would definitely spend more time on the ward building social relationships with the clinical staff. The student would also ask for access to iCIMS from the beginning in order to understand how it works. The requirements gathering could be done during the days at the hospital and the familiarisation with iCIMS could be done on the student's own time. This would allow for issues with the tool to be identified earlier as well as allowing for more design time. A bigger focus would be given to getting **all** relevant forms into the system and evenly working on data entry forms and the handover forms so that a complete system could be shown to staff, even if down the road the data entry forms are replaced with a connection to existing SAN applications. Documentation of the project and issue and bug tracking was done quite well and the student would not change anything in that regard.

6.3. Future Work

Future work on SANSURGIMS should include the creation of the normative handover, for use by junior staff, as well as the refining and adding of data entry forms. Future work should also include much more extensive usability and acceptance testing in order to adequately verify the success of the design. After having reached a significantly mature level of the nurse to nurse handover, future students could begin work on handovers including doctors, breast navigators, case managers and allied health. This work would culminate in a truly multi-disciplinary handover and reflect the overarching goal of the SAN in regards to improving handover. A further area of work that needs to be undertaken is change management in regards to handover. With the move to a computerised handover, the work processes for clinical staff would change drastically and thus must be managed. The clinical staff needs to be supported in the transition from the current paper based system to SANSURGIMS in order to ensure positive uptake and effective use of the new system. A last point of work that could be undertaken is the actual connection to current SAN applications in order to draw data from them to populate the handovers. Each of these tasks is quite an undertaking and would most likely result in them becoming sub-projects of their own.

6.4. Concluding Remarks

Overall, the project was a great experience. It allowed the student to work in a unique domain with great potential. It allowed the student to grow as a professional and to be part of what looks like a promising computer information system application. The student gained valuable knowledge in regards to inter-personal relationships, communication, requirements gathering and people skills in general. The project challenged the student in a way that only a real world project can. The student would do the project again, if asked, because for all its hardships it offered a unique and very valuable learning experience.

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B. Appendix

Include the following:

- Roles at SAN wiki page
- Scans of original questionnaires
- Screenshots of SANSURGIMS (Web and Designer)
- Scans of important forms (Nursing Care Record & Patient History)

B.1. Handover Requirements

Assumptions

- A1: The adding of patients to the ward list is automatic and will be undertaken by the admission system (this is out of scope)
- A2: Handover should be done by exception rather than the rule, this means that the handover should focus on variances
- A3: Resuscitation is not part of the clinical handover
- A4: We can make up data such as Doctor Names, etc
- A5: We can use abbreviations if they are standard abbreviations
- A6: In regards to the Discharge Plan, we can simply put the Discharge Destination and assume that all relevant information resides in another system that we are linking to
- A7: In regards to test results, we can assume that we are linking to a different system where all the relevant data is present and we merely have to show the status of the test

Business Requirements

- B1: Increase efficiency in conducting Clinical Handovers by reducing human errors
- B2: Increase productivity in conducting Clinical Handovers by reducing time in accessing patient information
- B3: Reduce redundancy in delivering Clinical Handover information for the staff on the next shift

- B4: Reduce time in doing handovers by providing nurses, doctors and allied health access to an electronic copy of patientÕs information
- B5: Create a uniform handover for clinical staff

Stakeholder Requirements

- S1: A user must be able to access patient information of any patient on the ward
- S2: A user must see the critical patient information first when accessing that patient's information in the system
- S3: The status of the patient in terms of current location, procedure or activity should be accessible by the user
- S4: A user has to be informed of changes in the patient's information for:
  - test results
  - variances in observations
  - change of medicine whether in dose or type
  - change in patient treatment
  - ward transfer
  - basic patient information
- S5: A patient must be displayed as a whole on a screen
- S6: Users have to know which Nurse/Doctor(s) is assigned to a patient
- S7: Users need to know, at all times, which patient they are looking at
- S8: Nurses and Doctors should see the patients they are responsible for first
- S9: Nurses and Doctors must be able to view a complete list of patients on a ward
- S10: Nurses and Doctors must be made aware of variance incidents of prior shift
- S11: The end users care about color so the forms need to be pleasing to the eye
- S12: In terms of handover, the nurses want to know the following:
  - Any tubes, lines, drains

- The rate of the IV (ml/hour)
- If the patient has voided or not
- If the patient has a catheter or not and whether the catheter has been removed
- What drains a patient has or what drains have been removed
- The volume that has drained
- How much blood is going (blood transfusion)
- Relevant Dr's orders
- Discharge plans & management
- Short summary of patient history
- Allergies
- Upcoming procedures
- Upcoming tests
- Outstanding test results
- Patient Mobility
- Patient Fall Risk
- Medications patient is on
- Whether the patient has NFR status
- Infection control

Pre-requisite Requirements

The following requirements are necessary in order to design a complete clinical handover:

- PR1: The system must contain the same information as the Resuscitation & Treatment Directive form
- PR2: The system must contain the same information as the Nursing Care Record form
- PR3: The system must contain the same information as the Fluid Balance Chart form
- PR4: The system must contain the same information as the Intravenous Fluid Orders form (Medication/Order by a Dr.)

- PR5: The system must contain the same information as the Initial Admission Assessment form
- PR6: The system must contain the same information as the Initial Pain & Symptom Assessment form
- PR7: The system must contain the same information as the Prescription & Observation Chart for Continuous Subcutaneous Infusions via Syringe Driver form (Medication)
- PR8: The system must contain the same information as the Patient History form
- PR9: The system must contain the same information as the Adult Observation Chart form
- PR10: The system must contain the same information as the Medication Chart form
- PR11: The system must contain the same information as the Temporary Transfer/Handover form
- PR12: The system must contain the same information as the Patient Handover List form
- PR13: The system must contain the same information as the Patient Mobility Assessment form
- PR14: The system must contain the same information as the Nursing Risk Screening & Assessment form

Functional Requirements

- F1: The system must display the patient's critical information on the handover screen
  - critical information is any and all of the following:
  - short concise patient history including comorbidities
  - patient age, name, MRN, POD and EDD
  - diagnosis
  - whether the patient is NFR or not
  - admitting and consulting DRs
  - medications that impact the care for the patient
  - outstanding procedures

  - outstanding test results
  - any and all variances in tests results or observations
  - important allergies such as those to medications or materials used in the hospital (eg. latex)

- F2: The system must be able to print out a "Handover List" with the critical patient information on it:
  - Bed/Room #
  - Patient Name
  - Age
  - MRN
  - POD
  - EDD
  - Admitting Doctor
  - Consulting Doctor
  - Diagnosis
  - Medications
    * Antibiotics
    * Anticoagulants
    * Antielgesic
  - Diet
  - IVs in patient and their rate
  - Drains in patient
  - Allergies
  - Medical History / Comorbidities
  - Small space for notes
  - Infection Status
  - NFR Status
  - Observation Frequency

  - Outstanding Test Results
  - Urine and Bowel voiding
  - Wounds
  - Operation Information (Theater, Time, NBM)
  - O2 Status
  - Fluid Restrictions
  - Blood Glucose Level
  - Discharge Information
  - Test result status

- F3: The system must be able to print out a filled schedule for the patients a nurse is responsible for
- F4: The system must be able to display a schedule of all procedures or time restrained actions the nurse must undertake for her patients
- F5: The system must allow a user to assign each nurse a set of patients for the shift
- F6: The system must log all user action for reference as well as auditing purposes
- F7: The system must allow the user the opportunity to add notes to a patient's information
- F8: The system must "highlight" variances for the user
- F9: The system must allow a user to enter information in regards to:
  - observations
  - transfers
  - notes
  - form data
- F10: The system should be able to qualify a user based on their role
- F11: The system must timestamp all printouts
- F12: The system should differentiate between allergies in regards to clinical treatment and other allergies (eg. latex allergy vs. shellfish allergy)

- F13: The system must be able to store multiple procedures for each patient with the varying operation dates and times
- F14: The system must be able to store complications that arose during a patient's operations
- F15: The system should inform the user of the status of test results at the following various stages
  - blood drawn
  - ready to be read (result available)
  - result acknowledged
- F16: The system must display a list of all patients on the ward
- F17: The system must allow the user to access handover information at any time during the shift
- F18: The system must visually differentiate between patients who are NFR and those who are not
- F19: The system must visually identify the infection control for each patient
- F20: The system must alert the user in the handover if infection control for the patient is necessary
- F21: The system must alert the user in the handover if there are vital sign variances for the patient
- F22: The system must provide a patient history summary in the handover
- F23: The system must provide the discharge destination of the patient to the user
- F24: The system must display the status of test results
- F25: The system must alert the user in the handover of any medically relevant allergies of the patient
- F26: The system must alert the user in the handover of any complications arising from surgery
- F27: The system must inform the user in the handover of the patient's dietary needs

- F28: The system must be able to store visual impairments of patients (eg. Glaucoma or Macular Degeneration)
- F29: The system must alert the user in the handover to any visual impairments the patient has

Non-Functional Requirements

- NF1: A clinical handover supported by the system cannot take longer than 30 minutes in regards to one nurse and her assigned patients
- NF2: The system must adhere to the Australian National Privacy Principles
- NF3: The system must adhere to the Federal Standard 6 "Clinical Handover"
- NF4: A user must be able to access a patient's information within 30 seconds
- NF5: Users with reduced vision must be able to use the system

B.2. User Roles

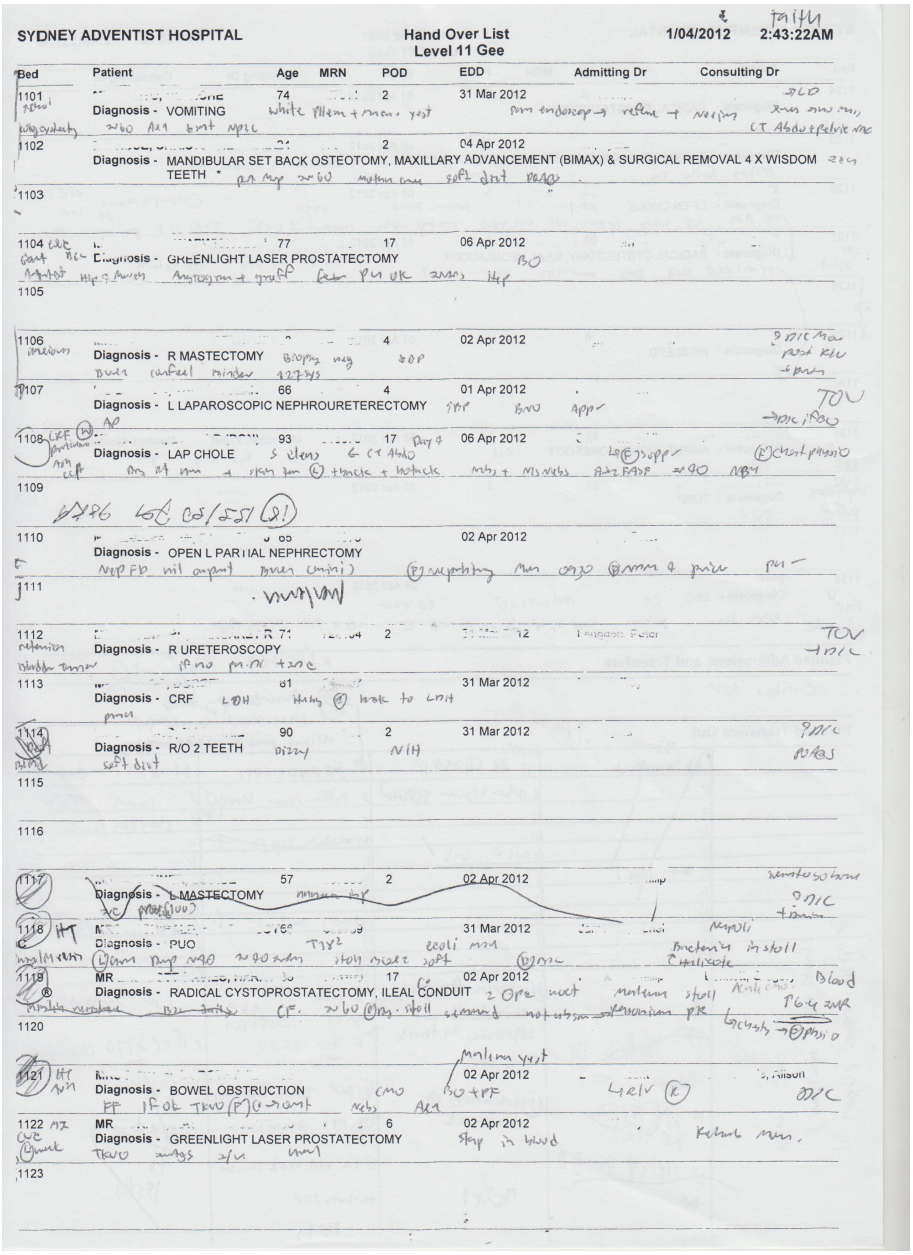
Roles	Responsibilities
Breast Navigator	• autonomous in their activities • regular communication with NUM/TL/Nurses • social care • documents social or emotional notes for nurses • share information between each other • reports directly to medical admin • undertakes follow ups with patients after treatments such as chemotherapy
Case Manager	• monitors patients length of stay • undertakes social activities with patients and their familiy • works towards a discharge plan with the patient • coordinates patient care with clinical staff • reports to Director of Medical Services • is in charge of patient's discharge plan • initiates referrals to RehabHospitals • ensures that the estimated date of discharge is met

Roles	Responsibilities
Career Medical Officer	• has 12 hour shifts • responsible for one of three areas: ICU, Acute Care or all Wards • fullfils doctor role • responsible for handling urgent matters that require review if responsible doctor is not reachable • checks ward book for routine tasks and problems written by nurses • arranges consultations with specialists • handover to each other as well as to specialists • verbal, face-to-face contact with TL, NUM and ADON
Doctor	• verbal, face-to-face commuication with all staff • sees patients • decides patient treatments • undertakes referrals to other parts of the hospital • checks in with only his/her patients • requisitions tests for patients • does handover whenever/wherever he/she finds the necessary people

Roles	Responsibilities
Nurse	• primary carer of patients • handover to next shift • administer medication • fill out patient forms such as Observation Chart and Nursing Care Record • the night shift creates roster
Nursing Unit Manager	• communicates with the TL • management role • oversees the entire ward • does not undertake any patient care • meets with staff in regards to patients/problems/how staff are doing • responsible for the staff roster and ward budget • handles patient complaints
Team Leader	• looks after ward • checks to make sure registered nurses (RN) are fine • is also a nurse • calls out NFR status to all other nurses during handover • in contact with the Assistant Director of Nursing (ADON)

Roles	Responsibilities
Volunteer	• in charge of putting flowers in rooms • undertakes light patient care for example bed baths
Ward Secretary	• manages inter-hospital transfers • manages calls into the ward and gives out information • manages a discharge board • handles patient pickup for external transport • handles communication with patient's family • ensures all paperwork is done • updates whiteboard for pharmacists, physios, cleaners and therapists • manages bedflow • information liaison on the ward
Wardsmen	• assist with transport of patients to other wards • assist with full care of patient • checks black clipboard on ward for information

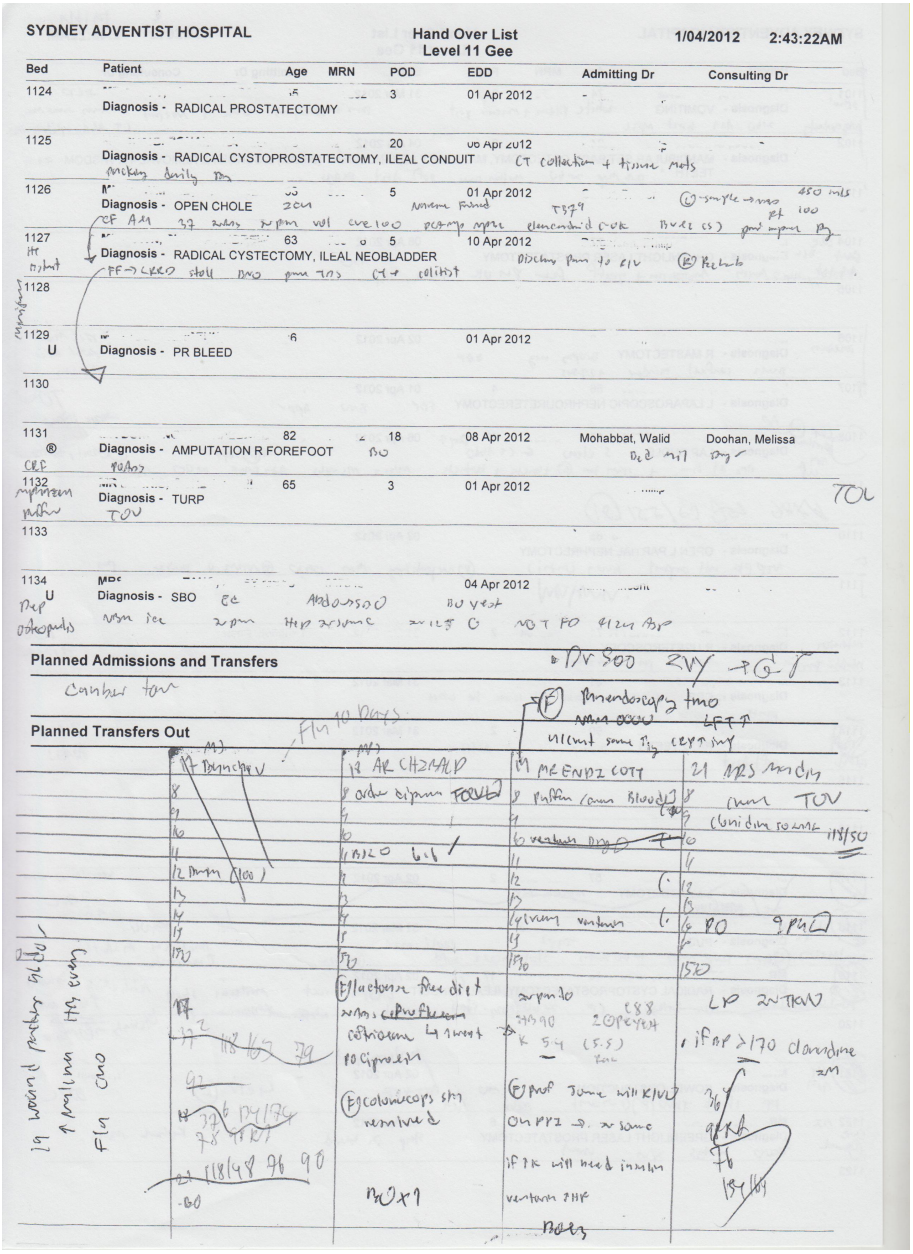
B.3. Patient Handover List



SYDNEY ADVENTIST HOSPITAL — Hand Over List, Level 11 Gee — 1/04/2012 2:43:22AM

Bed	Patient	Age	MRN	POD	EDD	Admitting Dr	Consulting Dr
1101	Diagnosis - VOMITING	74		2	31 Mar 2012		
1102	Diagnosis - MANDIBULAR SET BACK OSTEOTOMY, MAXILLARY ADVANCEMENT (BIMAX) & SURGICAL REMOVAL 4 X WISDOM TEETH *			2	04 Apr 2012		
1103							
1104	Diagnosis - GREENLIGHT LASER PROSTATECTOMY	77		17	06 Apr 2012		
1105							
1106	Diagnosis - R MASTECTOMY			4	02 Apr 2012		
1107	Diagnosis - L LAPAROSCOPIC NEPHROURETERECTOMY	66		4	01 Apr 2012		
1108	Diagnosis - LAP CHOLE	93		17	06 Apr 2012		
1109							
1110	Diagnosis - OPEN L PARTIAL NEPHRECTOMY				02 Apr 2012		
1111							
1112	Diagnosis - R URETEROSCOPY			2			
1113	Diagnosis - CRF	81			31 Mar 2012		
1114	Diagnosis - R/O 2 TEETH	90		2	31 Mar 2012		
1115							
1116							
1117	Diagnosis - L MASTECTOMY	57		2	02 Apr 2012		
1118	Diagnosis - PUO				31 Mar 2012		
1119	MR Diagnosis - RADICAL CYSTOPROSTATECTOMY, ILEAL CONDUIT			17	02 Apr 2012		
1120							
1121	Diagnosis - BOWEL OBSTRUCTION				02 Apr 2012		
1122	MR Diagnosis - GREENLIGHT LASER PROSTATECTOMY			6	02 Apr 2012		
1123							

Figure 8: Patient Handover List - Front Page



SYDNEY ADVENTIST HOSPITAL — Hand Over List, Level 11 Gee — 1/04/2012 2:43:22AM

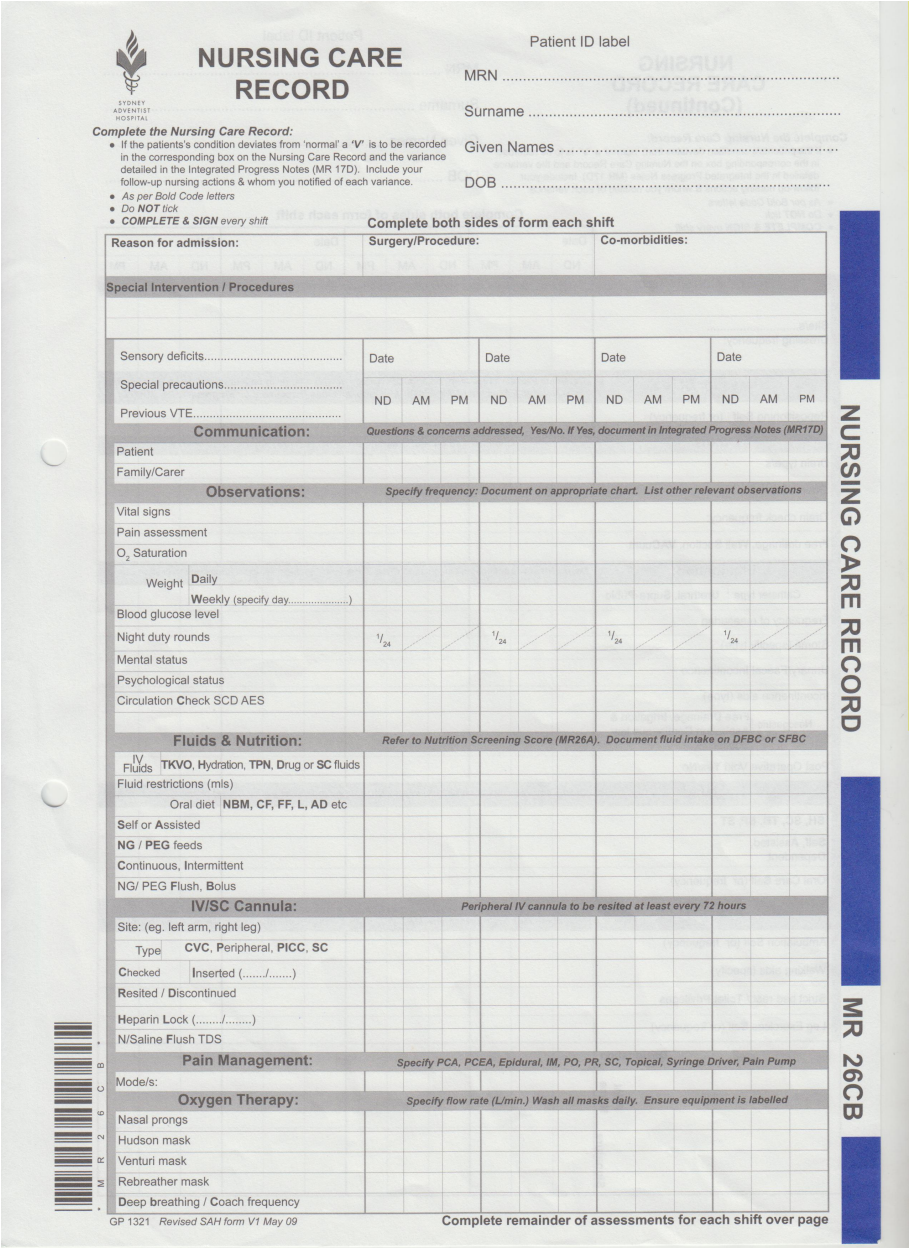
Bed	Patient	Age	MRN	POD	EDD	Admitting Dr	Consulting Dr
1124	Diagnosis - RADICAL PROSTATECTOMY			3	01 Apr 2012		
1125	Diagnosis - RADICAL CYSTOPROSTATECTOMY, ILEAL CONDUIT			20	01 Apr 2012		
1126	Diagnosis - OPEN CHOLE			5	01 Apr 2012		
1127	Diagnosis - RADICAL CYSTECTOMY, ILEAL NEOBLADDER	63		5	10 Apr 2012		
1128							
1129 U	Diagnosis - PR BLEED				01 Apr 2012		
1130							
1131 ®	Diagnosis - AMPUTATION R FOREFOOT	82		18	08 Apr 2012	Mohabbat, Walid	Doohan, Melissa
1132	Diagnosis - TURP	65		3	01 Apr 2012		
1133							
1134 U	Diagnosis - SBO				04 Apr 2012		

Planned Admissions and Transfers

Planned Transfers Out

Figure 9: Patient Handover List - Back Page

B.4. Nursing Care Record Transformation



SYDNEY ADVENTIST HOSPITAL

NURSING CARE RECORD

Patient ID label

MRN .....

Surname .....

Given Names .....

DOB .....

Complete the Nursing Care Record:

- If the patients's condition deviates from 'normal' a **'V'** is to be recorded in the corresponding box on the Nursing Care Record and the variance detailed in the Integrated Progress Notes (MR 17D). Include your follow-up nursing actions & whom you notified of each variance.
- *As per Bold Code letters*
- *Do* ***NOT*** *tick*
- ***COMPLETE & SIGN*** *every shift*

Complete both sides of form each shift

Reason for admission:	**Surgery/Procedure:**	**Co-morbidities:**

Special Intervention / Procedures

Sensory deficits..... / Special precautions..... / Previous VTE.....	Date			Date			Date			Date		
	ND	AM	PM	ND	AM	PM	ND	AM	PM	ND	AM	PM
Communication:	*Questions & concerns addressed, Yes/No. If Yes, document in Integrated Progress Notes (MR17D)*											
Patient												
Family/Carer												
Observations:	*Specify frequency: Document on appropriate chart. List other relevant observations*											
Vital signs												
Pain assessment												
O_2 Saturation												
Weight – Daily												
Weight – Weekly (specify day.....)												
Blood glucose level												
Night duty rounds	1/24			1/24			1/24			1/24		
Mental status												
Psychological status												
Circulation **C**heck SCD AES												
Fluids & Nutrition:	*Refer to Nutrition Screening Score (MR26A). Document fluid intake on DFBC or SFBC*											
IV Fluids **TKVO**, **H**ydration, **TPN**, **D**rug or **SC** fluids												
Fluid restrictions (mls)												
Oral diet **NBM, CF, FF, L, AD** etc												
Self or **A**ssisted												
NG / PEG feeds												
Continuous, **I**ntermittent												
NG/ PEG **F**lush, **B**olus												
IV/SC Cannula:	*Peripheral IV cannula to be resited at least every 72 hours*											
Site: (eg. left arm, right leg)												
Type **CVC**, **P**eripheral, **PICC**, **SC**												
Checked – **I**nserted (...../.....)												
Resited / **D**iscontinued												
Heparin **L**ock (...../.....)												
N/Saline **F**lush TDS												
Pain Management:	*Specify PCA, PCEA, Epidural, IM, PO, PR, SC, Topical, Syringe Driver, Pain Pump*											
Mode/s:												
Oxygen Therapy:	*Specify flow rate (L/min.) Wash all masks daily. Ensure equipment is labelled*											
Nasal prongs												
Hudson mask												
Venturi mask												
Rebreather mask												
Deep **b**reathing / **C**oach frequency												

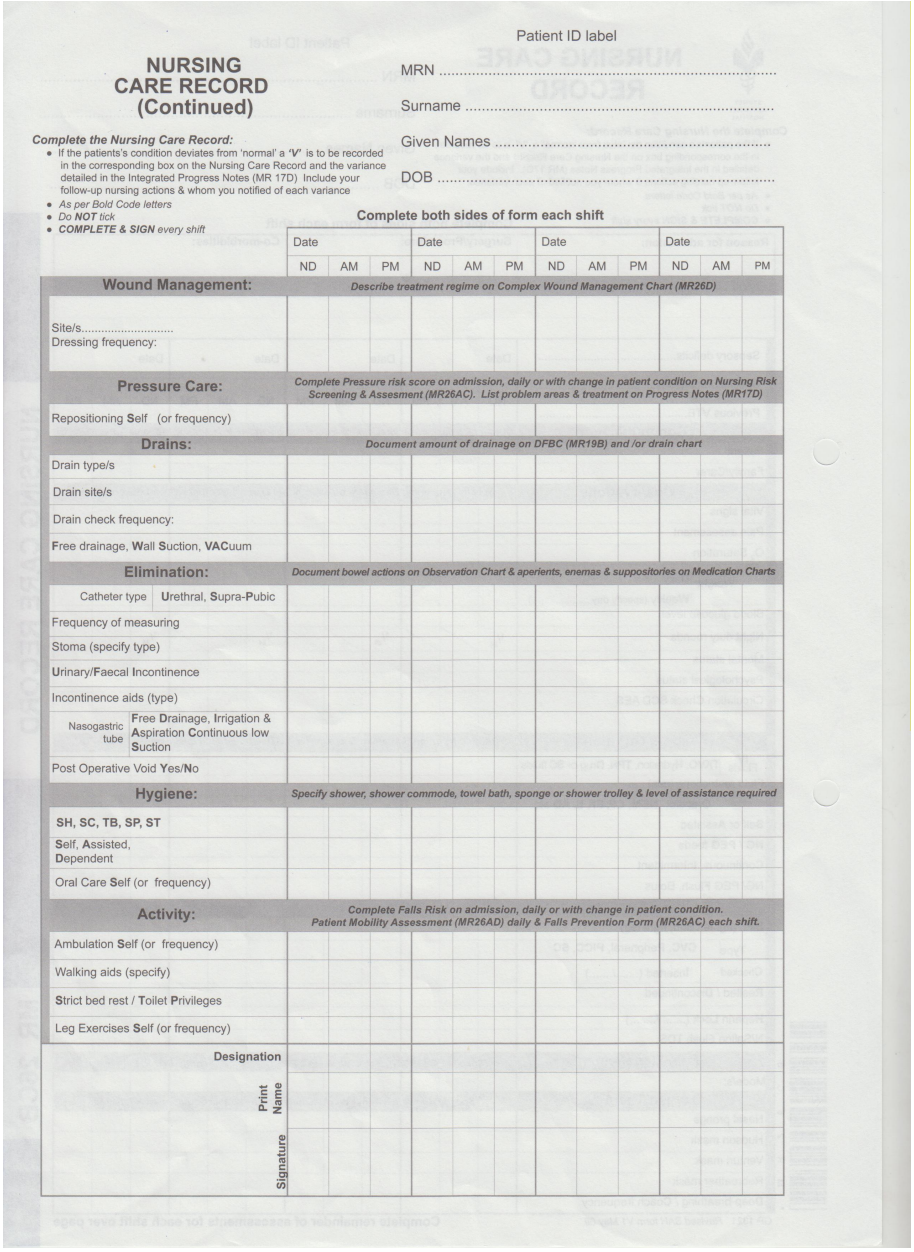
GP 1321 *Revised SAH form V1 May 09*

Complete remainder of assessments for each shift over page

NURSING CARE RECORD

MR 26CB

Figure 10: Paper based Nursing Care Record - Front Page



Patient ID label

NURSING CARE RECORD (Continued)

MRN .....

Surname .....

Given Names .....

DOB .....

Complete the Nursing Care Record:

- If the patients's condition deviates from 'normal' a *'V'* is to be recorded in the corresponding box on the Nursing Care Record and the variance detailed in the Integrated Progress Notes (MR 17D) Include your follow-up nursing actions & whom you notified of each variance
- *As per Bold Code letters*
- *Do **NOT** tick*
- ***COMPLETE & SIGN** every shift*

Complete both sides of form each shift

	Date			Date			Date			Date		
	ND	AM	PM	ND	AM	PM	ND	AM	PM	ND	AM	PM
Wound Management:	*Describe treatment regime on Complex Wound Management Chart (MR26D)*											
Site/s..... Dressing frequency:												
Pressure Care:	*Complete Pressure risk score on admission, daily or with change in patient condition on Nursing Risk Screening & Assesment (MR26AC). List problem areas & treatment on Progress Notes (MR17D)*											
Repositioning **S**elf (or frequency)												
Drains:	*Document amount of drainage on DFBC (MR19B) and /or drain chart*											
Drain type/s												
Drain site/s												
Drain check frequency:												
Free drainage, **W**all **S**uction, **VAC**uum												
Elimination:	*Document bowel actions on Observation Chart & aperients, enemas & suppositories on Medication Charts*											
Catheter type **U**rethral, **S**upra-**P**ubic												
Frequency of measuring												
Stoma (specify type)												
Urinary/**F**aecal **I**ncontinence												
Incontinence aids (type)												
Nasogastric tube **F**ree **D**rainage, **I**rrigation & **A**spiration **C**ontinuous low **S**uction												
Post Operative Void **Y**es/**N**o												
Hygiene:	*Specify shower, shower commode, towel bath, sponge or shower trolley & level of assistance required*											
SH, SC, TB, SP, ST												
Self, **A**ssisted, **D**ependent												
Oral Care **S**elf (or frequency)												
Activity:	*Complete Falls Risk on admission, daily or with change in patient condition. Patient Mobility Assessment (MR26AD) daily & Falls Prevention Form (MR26AC) each shift.*											
Ambulation **S**elf (or frequency)												
Walking aids (specify)												
Strict bed rest / **T**oilet **P**rivileges												
Leg Exercises **S**elf (or frequency)												
Designation												
Print Name												
Signature												

Figure 11: Paper based Nursing Care Record - Back Page

Figure 12: Designer based Nursing Care Record

The yellow section in the middle will be replaced by form content to which the buttons link. The user clicks on a button on the left and the relevant form section is displayed in the yellow section.

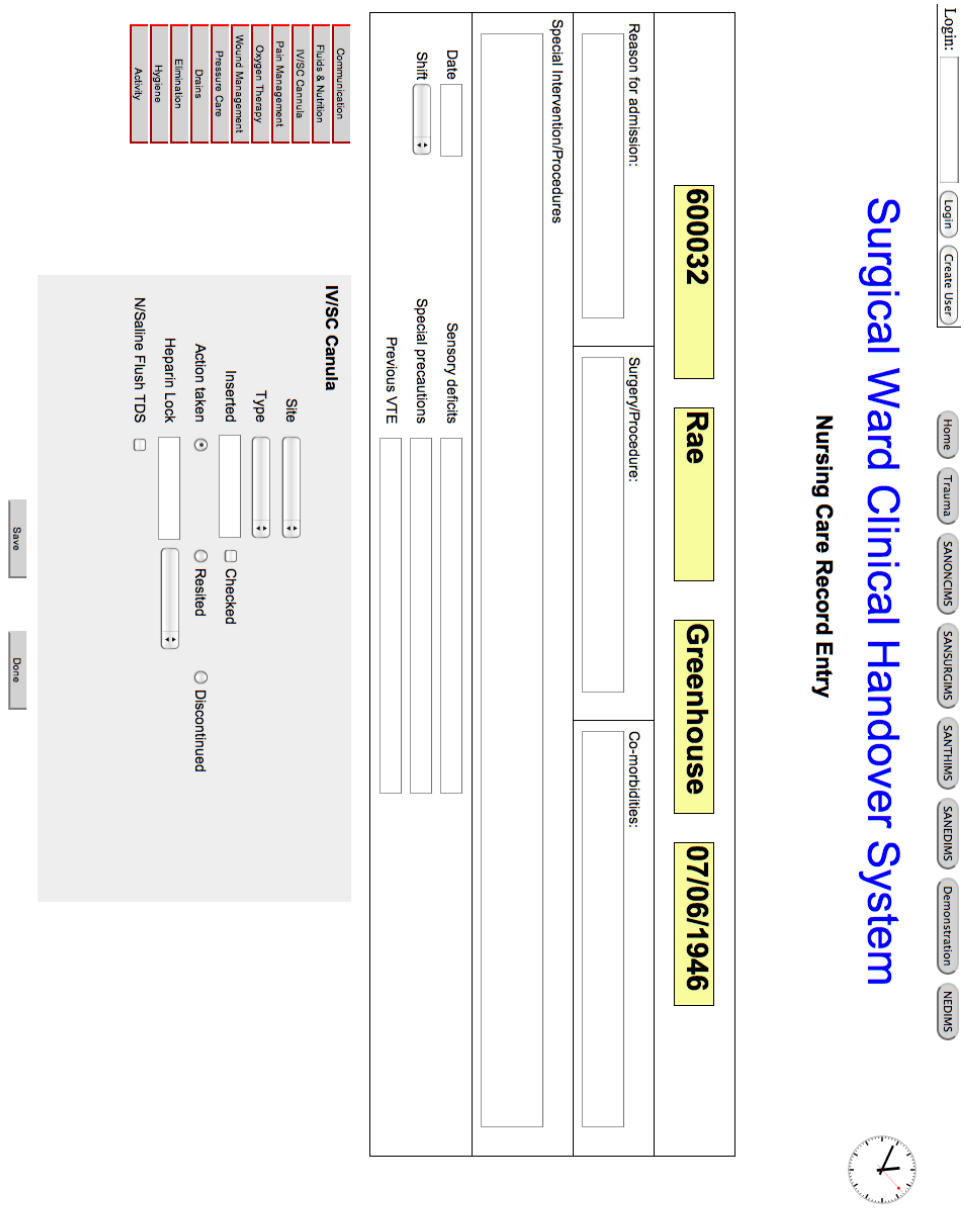


Figure 13: Web based Nursing Care Record

B.5. SANSURGIMS Screenshots

B.5.1. Patient Tracking List

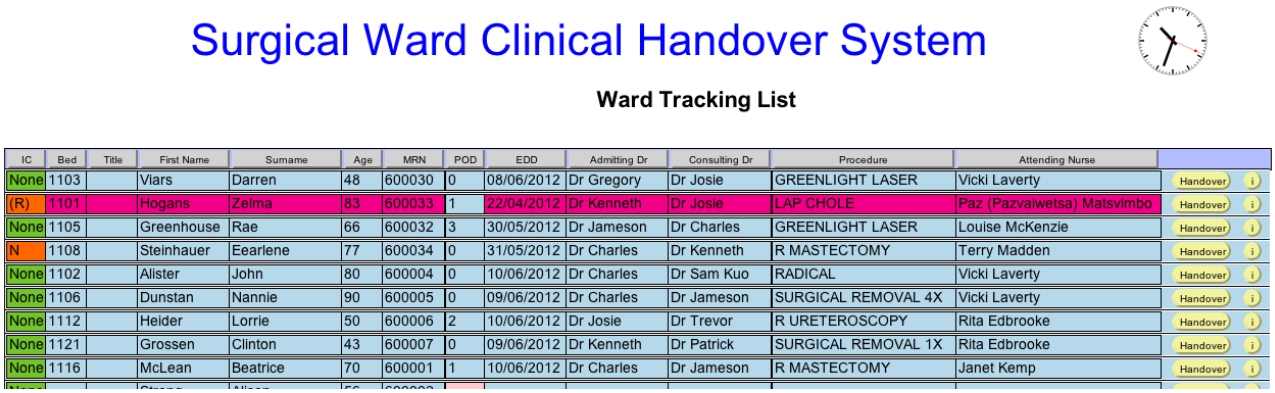


Figure 14: Patient Tracking List

B.5.2. Very Uncomplex Patient Handover

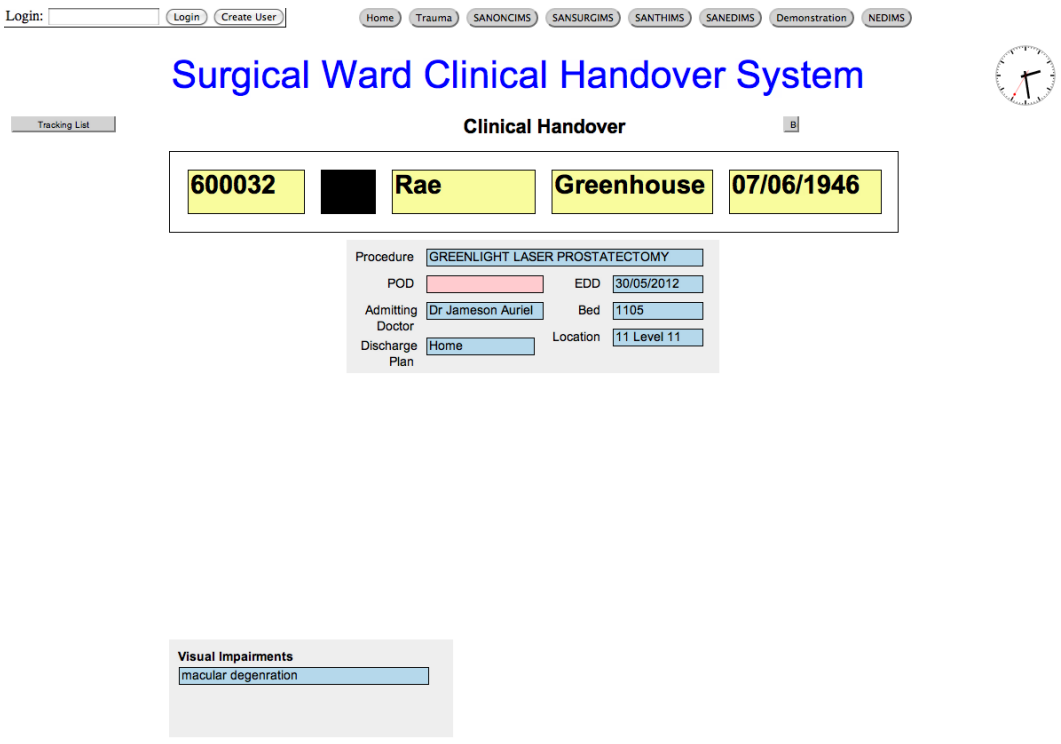


Figure 15: Patient Tracking List

B.5.3. Somewhat Complex Patient Hanover

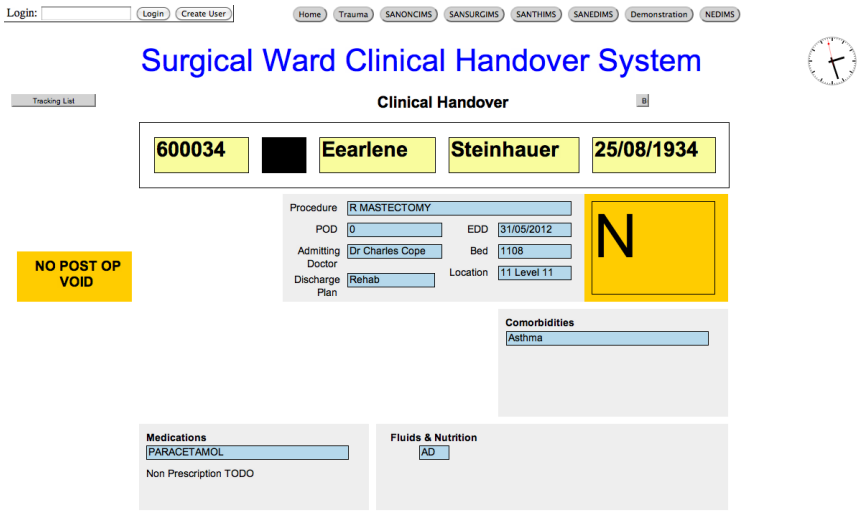


Figure 16: Patient Tracking List

B.5.4. Very Complex Patient Handover

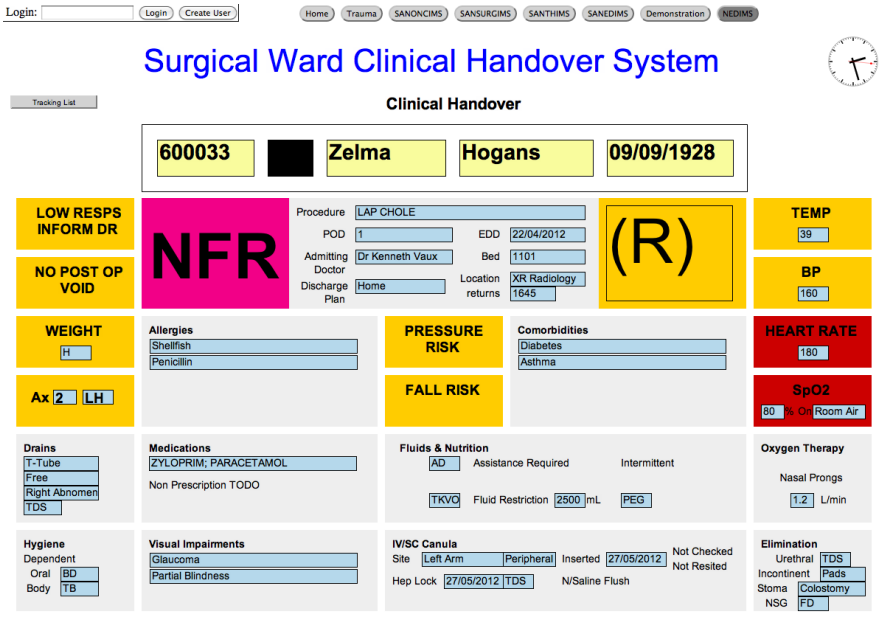


Figure 17: Patient Tracking List

B.5.5. General Patient Information Form

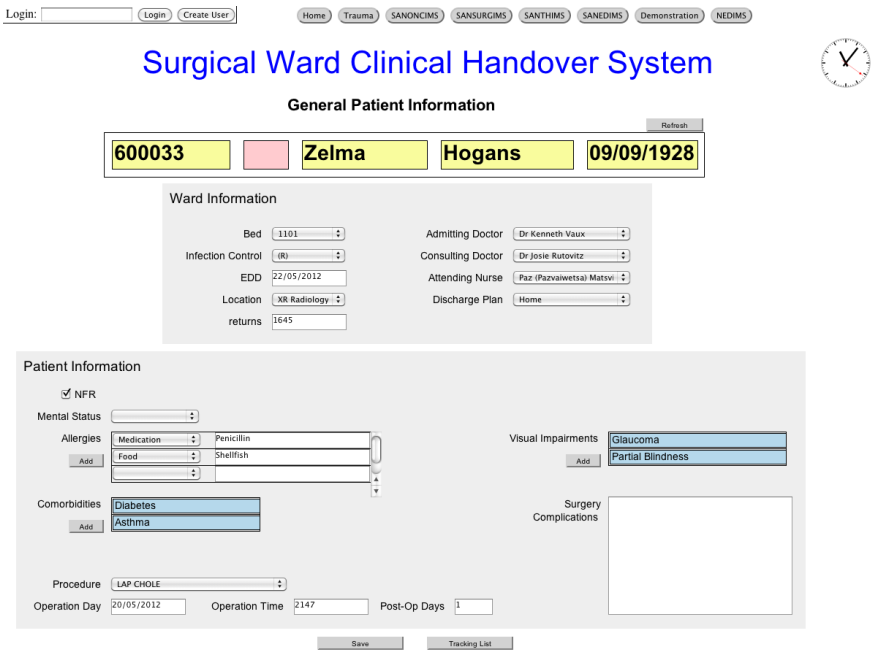


Figure 18: Patient Tracking List

B.6. Clinical Handover Questionnaire

Tasks

Level 6

1. Go to the SANONCIMS system
2. View the Handover of Mauricio Patricia (Patient)
    1. What medications is the patient on?
    2. What is the patient's O2 Saturation (SpO2)?

Level 11

1. Go to the SANSURGIMS system
2. View the Handover of Hogans Zelma (Patient)
    1. What medications is the patient on?
    2. Does the patient require assistance?

Questions

1. Is it too much information?
    1. too much information
    2. alot of information
    3. contains unneeded information
    4. contains the right information but needs improvement
    5. just the right amount of information
2. Is it easy to find information?
    1. cannot find information
    2. very difficult to find information
    3. can find information but take a long time
    4. can find information
    5. very easy to find information

3. Is the information logical to you?
    1. very unordered
    2. very cluttered
    3. somewhat cluttered
    4. mostly ordered
    5. very ordered
4. Are the colours informative?
    1. distracts from information
    2. does not give any extra information
    3. highlighting useful
    4. adds extra information
    5. highlights vital information
5. Does this form make handover more efficient for you?
    1. does not help at all
    2. as efficient as current handover process
    3. not sure
    4. improves efficiency
    5. greatly improves efficiency
6. Is it easy to navigate?
    1. unable to navigate
    2. confusing to navigate
    3. navigate with problems
    4. able to navigate
    5. very intuitive