

# A Study of a Health Enterprise Information System, Part 2 - Discussions with ED Directors: Are we on the right track?

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## Abstract

*Discussions were held with the Directors of 7 Emergency Departments in New South Wales (NSW) public hospitals assessing the impact of the introduction of the FirstNet information system into their Departments<sup>1</sup>. All but one of the Directors has found that the system has had a deleterious impact on their department's clinical work. The range of problems reported indicate that whilst the software is not fit-for-purpose, many of the problems are created or exacerbated by attitudes of the NSW Health IT support, Health Support Services (HSS). In most departments it was reported that staff have developed significant strategies for minimising and circumventing the use of the system. The Directors are frustrated by the lack of a reporting functionality that disables their ability to monitor their own department's performance. Most Directors report an increase in the time required to deal with patients and therefore a deterioration in access block times. This has been masked by changes in the way this time has been redefined by NSW Health. Overall, most perceive that in moving from their previous information system EDIS to FirstNet they and their patients have suffered. Most Directors are resigned to the fact that no improvements will be made to the current performance of the system due to its inherent inadequacies and the attitude of HSS. A consequence of the ED Directors critique leads inevitably to the debate on the merits of enterprise wide systems versus best-of-breed systems. Emerging from these issues are criteria for a new technology for creating clinical information systems.*

This essay consists of 3 sections beginning with a description and analysis of the discussions held with 7 ED Directors in and around the Sydney basin on improving the work processes within their departments and the impact the introduction of FirstNet has had on their operations. The second section arises from the contrasts a number of the Directors made between FirstNet and the information system they had prior to the introduction of FirstNet, that is, EDIS as provided by the iSoft corporation. This topic of conversation showed a sharp contrast between best-of-breed information systems and enterprise system so the merits and shortcomings of each are discussed. The third section deduces from the threads of information in the earlier sections a set of criteria for defining the functions of an information system that would satisfy a wider range of requirements than both the best-of-breed and enterprise architectures.

## 1. Discussions with ED Directors

The introduction of FirstNet into the NSW has been an on ongoing effort for the last 5 years. Its impact was analysed in a previous essay (Patrick, 2009)<sup>2</sup> and published as a more generic theme in an editorial<sup>3</sup>. This essay reports on a systematic study from a series of discussions with 7 Directors of Emergency Departments in and near the Sydney basin, New South Wales, Australia, and with two software providers, iSoft<sup>4</sup> and

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<sup>1</sup> The author thanks the Australasian College of Emergency Medicine for its support.

<sup>2</sup> A Critical Essay on the Deployment of an ED Clinical Information System - Systemic Failure or Bad Luck?  
[http://www.it.usyd.edu.au/~hitru/index.php?option=com\\_content&task=view&id=91&Itemid=146](http://www.it.usyd.edu.au/~hitru/index.php?option=com_content&task=view&id=91&Itemid=146)

<sup>3</sup> Patrick, J. 2010. The Validity of Personal Experiences in Evaluating HIT. Applied Clinical Informatics.1,4. 462-465. <http://aci.schattauer.de/en/contents/archive/issue/1124/manuscript/15463/show.html>

<sup>4</sup> iSoft provided their EDIS product manager for 3 hrs in their corporate offices Sydney to demonstrate EDIS software and answer questions related to its performance and the manner in which their software would solve the reported difficulties with FirstNet.

Cerner<sup>5</sup> who provide ED clinical information systems. All Directors manage departments in public hospitals that are publicly funded by the state government of NSW and participated in the discussions as part of their own quality improvement processes. Seven of the Directors use the State Based Build (SBB) Cerner software configuration of FirstNet with other components of the Cerner Millennium suite.

The specification of the configuration of the SBB is created by the Health Support Services (HSS) of the Department of Health, NSW, known as NSW Health. One director's department has a version of FirstNet that is different from the SBB and was developed by a software team within their own Area Health Service (AHS). This puts them in a far better position than the other six directors as they have access to their own programmers who can help them change configurations of their system far more easily than the other six directors using the SBB.

## 1.1. Methodology

The meetings with the first 4 directors consisted of an open-ended discussion during the second half of 2010 and occurred in each Director's office. The Director and author discussed the history of the SBB and its effect on the operations of their department, and included open ended questions on topics defined by the earlier essay (Patrick, op cit). The discussions with the final 3 Directors were also held in their offices but consisted of two parts, the first as described above with the 4 Directors and then the discussions were completed using a process of working sequentially through a list of problems identified by the other Directors. This *Issues List* was initially compiled from complaints submitted to the author during 2009 and published in the original critical essay.

The principal discussion points of each meeting were prepared as a text document of notes and provided to the respective Directors for checking and approval. One director declined to correct or confirm their notes so their material has not been reported here. In a few meetings the Director was accompanied by colleagues. A compilation of the items of interest is presented in Appendix 1 in 17 themes. All the items of relevance gleaned from each of the discussions are presented in Appendix 2 organised into the same themes.

A report such as this can be organised in at least two different ways, thematically by general issues or according to clinical activity. Clinical staff tend to be more comfortable with the latter structure but we have used the former structure because it complements other analyses of the technology that will come later.

This report is organized around 17 themes that emerged from an analysis of the documents reviewed. Each point in each report has been allocated to at least one theme. The themes interact to some extent and so the decision as to which theme a point has been placed may be open to some debate. Some points contain multiple topics so they have been placed in the theme that seems the most dominant or in multiple themes. It is noticeable that not all the Directors make points about the same things. Some give more attention to how FirstNet impacts on their own department's operations, while others give greater attention to external issues such as the behaviour of the HSS. This should not be read as each director only having a small set of issues or some dichotomy of experience, but, rather as a record of the wide reaching effects the introduction of FirstNet has created. It also speaks to the limitations in covering a wide diversity of topics during the discussions.

The analysis of the contents of the *discussion reports* has followed these stages:

- The reports were compiled as a series of summary points written from notes taken down at the time of the discussions
- The discussion report was submitted to the director for correction and approval
- Each report was read to identify a set of themes that collected the comments together on common content. Each point in each report was assigned to a theme and then assigned to a characteristic within that theme.
- The characteristics were reviewed and aggregated to obtain some consolidation of the topics and to identify the most frequently described issues
- The points were reviewed again in an effort to identify statements that might illuminate issues within the software architecture and implementation of the SBB.

The *Issues List* was dealt with in the following manner in the first 5 discussions:

- Critical points were raised with the discussant and their response discussed.
- New points that emerged in their answers were later added to the list.
- The list size grew from an initial 45 points at the first discussion to 62 points on the final discussion.

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<sup>5</sup> Cerner provided one staff member for 30 minutes to demonstrate their PowerNotes product on their corporate stand at the HIC conference held in Melbourne, August 2010.

The issues List was used differently with the final three discussants who held a general conversation for the first half of the discussion and then each point was used as a question and they were asked to answer it. The answers were often elucidated and these have been placed in the *Appendix 3*.

The 17 themes are presented in Table 1 along with the frequency of issues and comments from the ED directors. There are a total of 116 issues emanating from the 17 themes, supported by 295 comments (an average of 2.5 comments per issue). The range of issues for each theme varies from 1 to 18 issues. On average there were 42.1 comments per ED director.

No.	Theme	No of Issues	No of Comments	Comments per Issue	Average comments per ED
1	Implementation Process of HSS	8	16	2.0	2.3
2	Clinical Documentation	9	31	3.4	4.6
3	Usability – Staff Attitudes & Behaviour	7	55	7.9	7.9
4	Unusable/Useless Functions	10	14	1.4	2.0
5	Reporting Functionality	8	18	2.2	2.6
6	Ordering	12	33	2.6	4.7
7	Patient Record Retrieval	5	15	3.0	2.1
8	Tracking List	4	19	4.8	2.7
9	Data Management	5	7	1.4	1.0
10	Print Functions	4	6	1.5	0.9
11	Work Arounds	6	7	1.2	1.0
12	SNOMED CT Coding	5	8	1.6	1.1
13	Training	5	11	2.2	1.6
14	Clinical Policies/ Protocols	1	3	3.0	0.3
15	Downtime and Backups	6	15	2.5	2.1
16	Positives	3	6	2.0	0.9
17	General Observations	18	31	1.7	4.3
TOTAL		116	295	2.5	42.1

Table 1. The frequency of issues and comments for each of 17 Themes in discussions with ED Directors.

## 1.2. Analysis of Discussions

*“The system causes constant frustration and contempt which cannot die down or escape. You can't escape and can't accept it as it is so constant a reminder of its inefficiencies.”*

The general statements by the directors form a backdrop to their attitudes on specific topics. Six Directors had a negative attitude to the software while the one who had their own installation considered it a success. Generally, the complaints centred around:

- the unnecessary complexity of the system and the “knock-on” effects this has had, including diminished time with patients,
- the lack of Australia-relevant knowledge such as suitable workflows,
- an emphasis on enterprise data needs over ED data needs,
- internal inconsistencies in the way interfaces work differently,
- the behaviour of NSW Health HSS who are cited as being unresponsive to solving problems and to providing appropriate reporting information, and,
- the staff responded to this unsatisfactory situation by developing “workarounds” and disengaging in the use of the software.

One of the most important user criterion for a clinical information system is its efficiency and this means that any interface carries just the correct amount of information for the current decision making task. This is important to staff given the limited amount of time that can be spent on a patient. The time-critical aspect of completing all tasks in the ED is paramount in the clinical staff’s eyes, and they feel the FirstNet system wastes their time and adds a higher risk to the care of the patients without providing any gains. One Director reported the attitude of their staff as *“Staff try to enter the minimum amount of data and keep away from the irrelevant content.”*

The **implementation processes of the HSS** were criticised for refusing to acknowledge the validity of complaints, failing to fulfil promises, creating an ineffective change process, refusing to consult clinicians, using strategies to disenfranchise participation by clinical staff, and introducing a technology that doesn’t fit their needs. This is encapsulated by one Director in saying: *“NSWHealth have made sure that it serves their needs and they operate on a mental heuristic that the system couldn't be as bad as the clinicians report or they make counter claims.”*

In determining the **clinical documentation** needs of staff, the Directors claim that the HSS ignores the needs of staff. Directors report over-supply of irrelevant information and under-supply of needed information in the clinical interfaces. The environment consists of counter-intuitive interfaces where data is entered by one person in one part of the system so that it is not discoverable by another person. As one Director reported: *“However, problems still arise when the documents are saved but not signed. Documents may become difficult to find even for the experts. The First Net trainers state “Never use the save button”. Cerner was asked to remove the save button. However, the answer was that it could not be done.”* The interfaces have inappropriate sizing of objects, confusing functions, redundant steps, unused functions and cluttered interfaces. These difficulties have resulted in increased time usage on the system resulting in decreased time with patients for no gain in administrative or clinical outcomes. Staff minimise their use of the system to as little as possible with work arounds being constantly developed and improved. Staff morale has been clearly degraded with accompanying loss of respect for the HSS and more generally NSWHealth’s authority. One exasperated Director stated, *“The system causes constant frustration and contempt which cannot die down or escape. You can't escape and can't accept it as it is so constant a reminder of its inefficiencies.”* Even the ED Director who had a satisfactory installation has not adopted the Cerner software for clinical documentation because of its perceived deficiencies.

The lack of appropriate **reporting functionality** of the system has had a serious impact on the critical work of the Directors on process improvement. As one Director reported *“No reports were initially available with FirstNet and NSWHealth expressed the view ‘You don't need them!’. Nine reports are now available none of which support ED operations.”* This attitude is also presented in the Garling report<sup>6</sup>. It was evident in talking to the Directors that they have antennae highly tuned to the processes happening in their departments and the public health issues that emerge from their patients. On a daily, weekly and monthly basis they review single cases, collections of common cases, and variations in established disease profiles to understand the success of their work and to detect emerging new trends or potential new disease outbreaks. At an administrative level they are asked to review cases either because of the return of new test results or due to complaints or reviews from other bodies. The FirstNet installation has removed all the reporting functionality the directors had in their previous system EDIS while destroying their information sources for process improvement, and their mechanisms for creating and collaborating in research projects. This, in turn, has led to a loss of motivation to enter data further degrading the value of the data held within the system. As one Director stated: *“ they don't know how to get reports out of the system and haven't tried. Have heard from*

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<sup>6</sup> Garling Report. 2008. Final Report of the Special Commission of Inquiry Acute Care Services in NSW Public Hospitals. (<http://www.lawlink.nsw.gov.au/acsinquiry>)

*other's that they are not useful.*" Clearly, the HSS has given no credence to this important aspect of the Directors' work.

The disadvantages of the system for day to day operations is well demonstrated by the issues around the **ordering system**. It is stated to be overly complex and requires a large deal of repetitive information to be input for multiple orders on one sample, plus specialist data entry knowledge that requires every joint order to have exactly the same timestamp. Ordering was the first accession where staff recognised that information is sometimes sent to the wrong staff, both arriving where it shouldn't and not arriving where it should. *"Sometimes, the results have been sent to the wrong inbox or get lost."* Further mis-processing is seen with the cancellation of orders when a patient is transferred to a hospital ward from the ED. The results of orders, particularly radiology, often need to be checked by senior staff, but the system has no functionality to enable efficient processing of orders that have normal results, and thereby require no further attention. An outstanding deficiency in the implementation of the ordering system was the change in the presentation of some results. One ED director made the point that dealing with order results efficiently requires a pattern matching skill developed over years of experience. The HSS changed the organisation of some order results from non-standard layouts so that those pattern-matching skills were made redundant. Requests to revert to standard formats were rebuffed.

**Patient record retrieval** is an important aspect of the staff work with patients, therefore its efficiency and accuracy is of vital importance to the activities of the ED. Staff were particularly pointed about the deterioration of this functionality in FirstNet compared to the previous system EDIS. There were cases where records could not be found, confusion about where data was stored in the patient record with different staff writing the same information into different parts of the record, and the rewriting of records due to insertion of content into the wrong record. *"It took all day to retrieve the data using four staff members. Two of these staff members were experts in FirstNet seconded from Information Technology Services branch of NSWHealth."* There were cases of nurses who reduced their usage of the system because the tracking list interface made it too easy to insert information into the wrong patient record. Subsequently, extra time was required to rectify the mistake in the wrong record and retyping the content into the correct record. Further problems with the tracking list emerged from the extensive use of icons that were both semantically obscure and showed none of the needed dynamic changes in the status of information required for monitoring patient progress through the ED workflow.

General **data management** issues highlighted the generic nature of the problems with complaints such as: it doesn't match appropriate workflow, doesn't provide appropriate information at the right points of processing, and loss of functionality compared to the previous system, EDIS. *"The log of the system does not separate the writer of a document for a patient case from someone who views a record in the system. So it is difficult to identify who actually saw the patient."* The Tracking List theme and the Print Functions theme add to the issue of overly complex processes.

**Workarounds** in using the system are the most obvious tangible response of staff to the functions of the system they consider unsatisfactory. The key aspect of workarounds is that they constitute a subversion of the policy processes created by the software that the staff are not prepared to collaborate with. Some of these strategies may even compromise the legal status of the records in the system: such as not signing documents, unrecorded alterations to documents, and test results not attached to patient records. But other strategies are even more important, as with some hospitals who have reverted to using paper records for clinical documentation after many years of capturing this information electronically in their previous system. Another form of staff protest workaround is the strategy by staff to avoid using the system by either having other people do the work on the system, inserting minimal amounts of information thereby reducing the value of the information and passing information to other staff verbally. It has been said in the course of the discussions *"some staff just don't use the system"*.

A different technology problem within ED's identified by the Directors was the introduction of **SNOMED CT**. The Australian Government has determined that clinical records should be encoded using SNOMED CT and invested a great deal of money in securing its adoption in a long term on-going strategy. The introduction of SNOMED CT into the EDs could not have been done in a more disruptive manner. There clearly has been little consideration of the appropriate manner by which to introduce it. The current implementation is generally described as having inadequate functionality but more specifically staff have identified nonsensical information and irrelevant content that makes using the system time wasting. As one Director noted, *"There are many nonsensical categories, e.g. "vomiting and wasting disease of piglets"*. Generally the problem is that far too many codes are provided in the interface so that staff search until their patience

is exhausted and then choose the seemingly closest code discovered at that point in time, even though it is not the correct code.

**Training** is a most important aspect of the work of professional staff in most hospitals but especially the teaching hospitals included in this study. Medical staff typically have to train 20 new trainees on 10 week rotations, four times per year. This is considered as an important professional task by all the Directors and so they were concerned at the extent to which trainees were trained in the use of the system. In the discussions there was a tensioned dichotomy in the minds of the directors. Generally they considered the trainees did not have enough time to learn all the clinical knowledge they required so giving precious training time over to learning how to use FirstNet was undesirable. At the same time through their own training on FirstNet they realised that it needed very large amounts of time to learn properly. The Directors find this situation is further complicated by the fact that staff require continual re-training on the system as they either forget how some processing is done or the system is changed, not always in desired ways. *“Different trainers tell the staff different ways to use the system, which leads to inconsistent practice across the ED. This in turn increases the difficulty of using the system as different staff have stored information in different ways.”* An important part of training is for staff to learn the Clinical Protocols & Policies they are expected to follow in their work. With the introduction of FirstNet some hospitals lost access to their extant policies and were told to wait until NSW Health had approved new policies. A workaround was developed where the protocols were loaded onto an external server and delivered into the EDs from this privately funded source.

**Downtime and Backup** are of concern to the Directors as it effects the efficiency of the ED and ultimately flows through to their efficiency performance figures as well as making the work harder to complete. *“Scheduled downtime occurs on the weekend, and though a weekend is a good time as a downtime for other departments in the hospital, for ED it is possibly the worst time due to the high patient load.”* Difficulties arose from promises of a single terminal for maintaining basic processing during downtimes which never eventuated, and limited capacity, if any, to upload information about patients collected while the system was down. To overcome this problem, in one ED the staff maintained a small whiteboard with basic information about each patient. This process consumed time that was supposed to be saved by the use of FirstNet. Directors perceived that the downtime was greater than with their previous system. A more frequent issue that had a spasmodic effect on staff productivity was the freezes of the system in the course of their daily work. The Directors had no measurements on the frequency and extent of these freezes nor their ramifications but they had a sense of inconvenience and frustration to staff.

### 1.3. Issues Lists

The *Issues List* was aimed at bringing a more specific focus that was pertinent to evaluating the success or otherwise of the introduction of FirstNet. The *Issues List* is a straightforward alternative to ensuring there was a common set of topics discussed and recorded and it is not a fine grained instrument of measurement of attitude. Whilst it does not represent an independent triangulation on the views of each discussant it was seen as a method for validating the discussion transcripts in a review-like process.

The *Issues List* was also used in the meeting with iSoft to analyse the functions of EDIS and to identify its capacity to solve some of the problems with FirstNet. It also provided an opportunity to align the two competing software systems against each other, that is iSoft's EDIS and Cerner's FirstNet on the topics most pertinent to the Directors.

*Issues List* spreadsheet is to aggregate the qualitative content and give added focus on the more important and generalisable issues. It has added some extra perspectives on the overall topics by enabling more specificity about issues and detecting the commonality of the issues across various hospitals. It provides a contrast with the one hospital that is relatively satisfied with its own implementation of FirstNet as distinct from the SBB rolled out by the HSS.

The analysis groups the issues into a category scheme of 10 classes based on more generic descriptions of problems. The first five most important categories based on the frequency of the directors comments are: Unfulfilled Requirements, Non-parsimonious Design, Non-intuitive Design, Limitations of Training, and Poor Reliability. These classes provide 82% of the comments. Of those answers to the issues 65% agreed there was a problem, 6% disagreed there was a problem and 29% gave no specific answer (N=171) (See Table 2).

The differences in answers across hospitals was also insightful. Hospital H5 does not provide an answer to 59% of the issues. This is explained by the fact that H5 is the hospital with its own installation of FirstNet and other Cerner products which it operates independently of the SBB. This director is able to identify the differences between their own configuration and the SBB and the differences this causes in operations compared to other hospitals operations, and so chose not to comment on those issues.

Issue Classification	Issue Numbers on the accompanying spreadsheet	Frequency	Relative Frequency	Agree/Disagree from Directors		
				Yes	No	Null
Unfulfilled requirements	7, 14, 16, 19, 20, 22, 41, 42, 43, 44, 45, 53, 57, 58, 59, 60, 61, 62	18	0.26	33	5	16
Not Parsimonious	12, 13, 21, 22, 24, 25, 26, 28, 29, 31, 35, 39, 54	13	0.18	28	1	10
Lacks Intuitiveness	8, 15, 17, 23, 27, 30, 32, 40, 49, 54, 55	11	0.16	21	1	11
Limitations to training	12, 46, 47, 48, 49, 50, 51, 52	8	0.12	20	0	4
Poor Reliability	2, 4, 6, 18, 23, 63, 64	7	0.10	10	3	8
Poor Response Speed	33, 34, 36	3	0.04	7	0	2
Failure to generate awareness when needed	10, 11	2	0.03	0	5	1
Poorer system performance from prior CIS experience	5, 9	2	0.03	4	1	1
Inconsistent	37, 40	2	0.03	5	0	1
Poor data flow/continuity	38, 56	2	0.03	3	1	2
Lowers Productivity/efficiency	3	1	0.02	0	1	2
<b>TOTAL</b>		<b>69</b>	<b>1.00</b>	<b>131</b>	<b>18</b>	<b>58</b>

**Table 2.** A problem based classification of the issues list with the frequencies of responses from ED Directors in the form of Agreeing the issue existed for them (Yes), disagreeing (No), and no specific answer (Null). The numbering begins at 2.

On the other hand, the H6 and H8 both have a SBB and show a distinct similarity in having a common agreement on about 80% of the issues (Table 3). Given that the *Issues List* is constructed using about 80% of the items from one other hospital H2 and the remainder from hospitals H3, H4, H5, H7, then the commonality of issues is about 80% across the seven hospitals.

	H5			H6			H8		
	Yes	No	Null	Yes	No	Null	Yes	No	null
Frequencies	20	8	41	57	1	11	54	9	6
Relative Frequencies	0.29	0.12	0.59	0.83	0.02	0.16	0.78	0.13	0.09

**Table 3.** Frequencies of responses of ED Directors to the items in the *Issues List*

## 1.4. Analysis of *Issues List*

*“A lot of work is pattern recognition which we have learnt over years of experience, if you disrupt the patterns then it makes it harder to do our work and the quality must be effected.”*

A selection of 3 Directors' comments from the *Issues List* have been compiled according to the classification in Table 2 and presented in Appendix 3. The discussion and summary analysis of the comments arranged by class are presented below.

### 1.4.1. Unfulfilled Requirements

*“a case where a patient attended the hospital on two consecutive days they could not find the pervious days notes and it took an IT staff member all day to find the patient record.”*

The directors have a range of issues concerning aspects of the system that they would have expected within a well-designed system that is fit for their purposes. These functionalities include: effective backup procedures, a list of presenting problems designed by an expert clinical team, direct recovery of records of patients from the past few days or weeks, well engineered presentation interfaces with critical information being clearly designated, appropriate and required content on the screens, removal of irrelevant information, flexibility and recognition of established workflows for orders and patient document distribution, a clinically sound list of diagnoses and medical codes, and an ability to use standard keyboard functions available with commonly used web browsers.

### 1.4.2. Not Parsimonious

*“Now as they have gotten used to the system, they have gotten faster, however they would be much faster if they didn't have it at all.”*

The staff in the ED are now generally experienced at using some form of clinical information system, many for over 10 years. This experience gives them a keen sense of what is possible with technology as well as the deficiencies in the existing systems. Combining this experience and knowledge with a sense of professional responsibility for process improvement enables them to judge quite acutely when a system is well designed or not. Hence their observations about elements of systems that are not parsimonious enough for optimal clinical efficiency deserve to be respected. Observations from the FirstNet implementation are: many functions in the system are not used, unneeded information has to be collected, ambiguity as to the locations in the system where certain information should be lodged, an hierarchical screen structure that is confusing, unneeded pathways in the workflow, non-utilitarian icons, and useless function buttons. All these factors contribute to a general perception that the system creates delays in getting the work done due to the increased number of steps required to complete the work.

### 1.4.3. Lacks Intuitiveness

On icons on the tracking list: *“H2: No correlation between an icon and its purpose. H8: Agree. I don't use them and don't know what they mean.”*

The clinical staff are trained in the methods of their discipline and the institution they work in. After many years of practice of Emergency Medicine the directors and their senior staff have responsibility not only for the operation of their department but for the training of young doctors in their discipline. Whilst within one department the topology of the rooms, beds and access ways changes the nature of the workflow, they all have an intuitive way of doing their job. This was no better expressed than by one director who said *“a lot of work is pattern recognition which we have learnt over years of experience, if you disrupt the patterns then it makes it harder to do our work and the quality must be effected”*. The notion of intuitiveness is established by the experience of working continuously in a job and having honed the workflow to an optimum efficiency. The directors were clear about the non-intuitive aspects of the FirstNet suite in that: the sub-systems appear to have been designed by different teams due to their inconsistency, failure to separate two episodes for the one patient on the same day, triage benchmarks can't be modified, icons don't correlate with their representation, misleading and incomplete results, inability to track patients after discharge, results sent to the wrong person, and nursing and clinical notes kept separately.

### 1.4.5. Limitations to Training

*“It is far too complicated so it is hard to get ED staff to do anything with it.”*

Training can be seen in two different ways. It can be seen as a distraction that takes time away from doing more important things, or as a necessity for being able to use the system correctly and comprehensively. Whilst most directors took the first position one of the directors took the second position.

We also see other directors point to the HSS demand that clinical staff are required to take an inordinate amount of training to develop data entry skills. The length of training required for a system is a statement about its intuitiveness. A system that requires more training time than the users can make available cannot be utilised in the way it was designed and would seem to be particularly inappropriate in a hospital setting. The Directors made these observations about the limitations of the training: it is too complicated for staff to want to be trained, training staff said different things to people, nor did they train clinicians to use best practice, staff can't be trained to logoff yet the trainers insist on it, and the interface didn't conform to standard usages learnt on other systems (e.g. Microsoft software).

#### **1.4.6. Poor Reliability**

*"Yes, if it hasn't been signed, it will get lost. It frequently happens when you are in the middle of doing something."*

The reliability of a system is the extent to which it delivers the processing that users request. In the ED by far the predominant processing is retrieving information about a patient. Sending messages to other departments is important, but is a smaller part of the workload. Retrieving information is however one aspect of a two part task: entering and retrieving data. Errors, difficulties or ambiguities in loading information into the system usually manifest themselves as problems at the retrieval end of the process. The directors have observed the following difficulties: missing information, weak screen design causing the wrong patient to be processed, system goes down too frequently, and incomplete testing of the system.

#### **1.4.7. Poor Response Speed**

The response speed of the system effects the staff and their sense of frustration. If the system is too slow they feel they give inadequate service time to the patient so they will find methods to circumvent the system. This leads to the development of workarounds. We have heard of one workaround where a Visiting Medical Officer (VMO) types all his notes into his personal computer before loading them into FirstNet. Other staff have boycotted the system, and others minimise their data entry relying on their conversations to fill in the gaps. When the speed is so slow that staff can't retrieve information for their work tasks, the data entry or retrieval associated with those tasks can be abandoned.

#### **1.4.8. Failure to generate awareness when needed**

This item might well be classed as an unfulfilled requirement but it received special attention from a number of Directors. In a presentation screen which is very busy, staff have a high cognitive load as to their next decision. In this circumstance they want the interface to give them behaviours that enable them to do their work without delay and this requires it behaving so that it generates awareness where it is needed. Two examples are provided where the fair demands of staff needs should be satisfied, namely: lack of row highlighting in the *Tracking List*, and a method for prioritising patients within a triage category. The latter is an example where staff are conscious of the difficulties of attending to patients on lower triage categories in busy times and ensuring that they get progressed up the list.

#### **1.4.9. Poorer system performance compared to prior CIS experience**

*"FirstNet is much slower than EDIS.v6, and it is even slower than doing it on paper."*

The prior experience of staff with other clinical technology colours their view of new technology. In this case staff were promised a technology that would give them a significant improvement over their previous technology. It is evident from these Directors that the previous technology was superior to the new technology, one Director asserted that using the system was slower than doing the records on paper.

#### **1.4.10. Inconsistent**

One director stated that the common method for analysing pathology results was to look for unusual patterns in the data, and any data inconsistencies in patterns would catch the eye. This constituted a skill built up over many years and is an efficient method for review hundreds of results quickly. If a new technology rearranges the format of data from what they are used to, or behaves in a variable manner for seemingly similar situations then staff will require more training, will more often be unsure how to use it, and be slower at performing a given task, and make more errors. Hence, any perceived inconsistencies in the way the system has to be used are going to be identified as problem spots very quickly and irritate and frustrate the staff. Staff found that the system was inconsistent in that different strategies were needed for typing content, e.g. different use of the ENTER key, and inconsistent with the standard practice they had learned using keyboards on personal computers.

#### **1.4.11. Poor data flow/continuity**

Workflow and dataflow and the continuity of these processes are vital to the smooth running of a complex socio-technical process. ED staff have shaped these flows over a period of years and socialised all staff into the streaming. The directors have found that with the workflow of staff needing to use both clinical and nursing notes at the same time, their separation in FirstNet is deleterious. One department considered that the many nursing and medical notes accumulated over a day had to be kept in a single continuous sequence in the clinical record. Their workaround was to keep the one note page open for 24 hours to maintain the needed continuity in the patient record and avoid staff using a significant amount of time at the computer searching for needed information.

#### **1.4.12. Lowers Productivity/efficiency**

The work of the ED is keenly reviewed by external bodies and by self audit. Every Director has a strong sense of commitment to reviewing their working processes and endeavouring to improve them. Hence the introduction of a technology that impacts negatively on their efficiency and productivity is not appreciated. Whilst the directors have only explicitly referred once to the loss of data and the time wasting effect it has along with the increase in waiting time it causes for patients, they also express its impact in requiring repeated entry of data when information is lost or put in the wrong patient's record.

### **1.5. Causality of the Directors' Difficulties**

A recent article in the press has presented evidence that access block times in EDs across the state of NSW are worsening<sup>7</sup>. So we can ask the question: Do the discussions with the ED Directors give any insight into why this might be the case, at least in some hospitals or as one of the contributory factors? It is self-evident from reviewing the discussions with the directors that they are highly critical of the roll out of this technology into their workplaces. They see it as having a detrimental effect on the staff morale, their capacity to do their jobs properly, and the efficient and effective care of their patients. Given that the public desires more than anything else Emergency Departments that meet their acute clinical needs at the time of most distress, a vital question to answer is : what has caused all this trouble and distress amongst the directors. We shall respond to this question by looking from three different perspectives: the technology, the roll out of the technology, and the clinical staff.

#### **1.5.1. The Technology**

The technology is a key element in determining the cause of the contention between the provider of the service, the HSS, and the clinical directors. The software supplied by the Cerner Corporation has a number of modules of which FirstNet is one. The users of most types of software will have had plenty of experiences of it crashing or not behaving as expected. Why should we expect this software to be any different. That is certainly the response that the clinical staff receive from HSS.

However this does not explain the difficulties the HSS have with the software themselves. Patient records have gone missing and IT staff have had to spend lengthy periods of time searching for them and in some cases they never find them. Pathology reports end up in the wrong staff accounts or at the wrong hospitals. These examples strike at the first core function of any information system - it has to store and retrieve information in a highly consistent and repeatable manner without loss or corruption of data.

The second core function of an information system is that it be usable for the task required and to that extent the Directors ask whether the software is fit-for-purpose. It might well be the case that the software was designed for another purpose and therefore is a poor match for the needs of NSW's Emergency Departments. However, we do know that the software was presented as being configurable to any needs, so NSWHealth might genuinely believe it can fit any of the needs of the State's EDs.

The majority of Directors rebuff any assertion that the presentation layer of the system is suitable for their needs. They cite a range of discordancies between their needs and the functions of the software, such as, confusing functions, redundant steps, unused functions, and inappropriate sizing of objects and a lack of compatibility with Australian workflows. Further to that the technology is claimed to be too complex and requiring too much training.

#### **1.5.2. The Roll out of the Technology**

But are all the perceived problems a fault of the software or a problem with collecting requirements and ensuring they are met. In this case some Directors are clear that they were not engaged in defining their

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<sup>7</sup> Sydney Morning Herald, Julie Robotham. 25th Feb 2011, pg. 7. <http://www.smh.com.au/nsw/emergency-waiting-times-fall-further-behind-benchmark-20110223-1b5nt.html>

requirements and that in fact the HSS had a strategy of convening meetings at short notice and then stonewalling requests so as to disenfranchise them. The directors found the choice of clinically relevant content was taken out of their hands such as the design of the SNOMED code sets and the definition of the presenting problem lists.

Given the claim that the configurability of the Cerner suite is substantial enough to satisfy almost any need, it is surprising that the HSS have not been able to solve problems like, redundant screens inappropriate screen sizes and other presentation layer complaints.

On the face of it this would appear to be a decision by the HSS not to put the effort into resolving these issues, so one must ask why. Perhaps the software is not as configurable as oft cited, that such statements are a sales pitch, and that the Directors requests can't actually be met. In fact one director pointed out that configuring the software was far more complex than people realised. However, an alternative pointer to the answer may lie in a presentation by one of the HSS team. In this presentation<sup>8</sup> is a slide (No. 16) that asserts that projects are a balance between Time, Cost and Quality and the HSS must make Time the primary concern in the statement *"As a Program Director my key focus must always be time"*. Further insight into the attitude of the HSS in serving the clinical users can be inferred from another slide (No 15) which asserts some of the "known unknowns" that have to be dealt with such as :

- "Scope will be wrong and/or a key additional license will be needed
- Funding will be inadequate
- Standard reports will not be what the users want/had in the old system
- Network stability issues will occur unexpectedly in a specific site"

This list plus the preference for meeting time deadlines, above all else, has some provocative contents in the light of the ED Directors' complaints. The reference to the need for an additional license unexpectedly has been discussed in pt 1 of this series as the reason for the lack of suitable reporting functions for the directors. However, we see in this list that the "standard reports" are accepted prima facie as not what the users want or had. Without any other information to go on this implies the "system" was provided with standard reports and their level of relevance to the clinical users was irrelevant and didn't require consideration. The most serious consequence of these values are that the directors can no longer research the performance of their own departments, investigate local public health issues or review the case of individual patients, or initiate new research projects. In fact they are hamstrung from performing almost anything for the purpose of researching and building their evidence-based strategies.

The implementation process developed by the NSW HSS received some of the most trenchant criticism, because it failed to meet most of the well defined procedures for successful IT projects. The contraventions included: failure to adequately collect clinical requirements, disenfranchised clinical staff in ownership of the process, failure to deliver what was promised, and the use of mechanisms to deny, dismiss or diminish the importance or validity of complaints.

### 1.5.3. Clinical Recalcitrance?

In a counter case to the HSS's tardiness, one director commented staff need to spend more time and effort learning how to use the system from their own initiative. Also, it has been pointed out that the problems with the logging off required discipline by the staff to remember to do it and was not a fault of the system. In a counter argument, other directors asserted there their staff didn't have enough time to attend more training sessions. So, is this list of laments the act of crying wolf by a group of recalcitrants who don't and won't come in from the non-technological cold.

The Directors assert that such an argument is roundly refuted by the evidence. Each of the Directors but one had been using a clinical information system before they were moved onto the FirstNet system. It is because they have had many years of experience they are able to describe effectively the impact FirstNet has had on their operations and why they know so clearly what needs to be changed about the system.

So is it reasonable to require them to use a technology they consider inferior to their past installation? Clearly the HSS thinks it is fair and reasonable. Our experience with each and every director is that they are very serious about doing the best they can at their jobs and that this is a matter of a strong sense of professional responsibility. The HSS on the other hand appears to have behaved in a manner that decries any respect for these sensibilities and any need for the ongoing development of methods and practice of evidence based medicine in Emergency Departments in NSW.

<sup>8</sup> <http://www.chik.com.au/files/HeN09/HeN09%20Bruce%20Pedersen.pdf>

## 1.6. Conclusions

A number of conclusions can be drawn from the study:

1. Staff are entirely dissatisfied with the SBB and they feel that the deliverables have significantly failed to match the promises.
2. The Directors see that the HSS have failed in their support of the frontline of emergency care across the Sydney basin and their practices are decidedly lacking in proper engagement with the user community which should be their primary concern.
3. Some of the consequences of the HSS decision not to provide the reports needed by the Directors have lead to them being seriously hampered in being able to monitor the quality of their own department's practices and wider changes and trends in community health.
4. The inefficiencies introduced by this technology have lead to a litany of complaints about its behaviour that have gone unheeded over the past three years.
5. It has lead to major strategies to work around the system by staff at all levels, to the point of complete avoidance by some staff.

The major consequences of these failings in the eyes of the ED directors are:

- Lost productivity and inefficiencies,
- Increased risks to patients,
- Disillusionment of staff and loss of morale.

However, the nature of the technology itself and the tension between best-of-breed and enterprise systems leaves some open-ended questions that may be better answered by other sources of information, for example:

- Can the reported faults be identified as bugs that are readily correctable by the HSS or are there weaknesses in the underlying technology that need to be rectified by the vendor itself?
- Can the weaknesses identified by the directors be corrected at all?
- What are the consequences for future work in EDs of not correcting the weaknesses?

## 2. Enterprise System vs Best-of-Breed

### 2.1 Best-of\_breed Systems

Clinical Information Systems (CIS) for particular purposes have typically in the past been developed by clinical experts who have turned their hand to software development. These systems are now known as best-of-breed systems. There have been two major reasons for the popularity of this strategy. Firstly it enabled the interested clinicians to develop a system that was closely tailored to their needs, and secondly they could not get institutional support to pay for commercially designed systems. Some of these home grown systems have proven to be general enough to be adopted by other clinical teams resulting in successful commercial operations that in some cases have grown to be worldwide.

A characteristic of a B-o-B system is its highly tailored user interface which is packed with user functionality, particularly to minimise the number of hierarchical levels a user has to understand and search down through to find desired information (see Figure 19 for an example interface from EDIS). This can have the negative side-effect of creating very busy screens that produce extra cognitive load on a new user, but it is contended that due to the intuitive nature of the interface the user has a high learning curve and overcomes this difficulty rapidly with minimal training effort.

### 2.2 Enterprise Wide Systems

Recently, there has emerged an enterprise wide approach to solving the information systems needs of large institutions like hospitals or whole hospital systems riding on the back of the Enterprise Resource Planning (ERP) systems developed in the manufacturing sector. This approach eschews the best-of-breed movement as being a cottage industry that has resulted in hospitals having many dozens of systems that have limited capacity to cross-communicate with each other. In this day of modern management practices this is seen as an obstacle that requires an enterprise-wide solution that sweeps away the best-of-breed systems by factoring out the common content of all clinical operations needed for the management of the organisation. This seems like a good management idea, but is it a good clinical idea?

The most important aspect of ERP systems is that the processes of the organisation are re-organised to fit the ERP software, thus imposing the vendor imperative. In the clinical case this means sacrificing the clinical processes for the advantage of managerial processes, minimally wherever they are in tension but also for increasing managerial control if desired, and so remodeling of clinical processes is executed with limited reference to the needs of the clinical community.

### 2.3 The Tension between the Two

The ERP model has had mixed success even within the manufacturing industry where it originated with some famous case studies where it has been rejected after many hundreds of millions of dollars expended on installation. So what should we expect *a priori* by using the ERP model to create clinical information systems. The most self-evident and immediate outcome will be the subjugation of clinical practice to managerial priorities. Managers may feel they can achieve such control but for the most part this is not true. Effectively clinical staff will devise methods to circumvent the methods of management that do not allow them to optimise their own objectives which is predominantly to do a quality job at caring for patients.

The ERP technology has most commonly proven to be a disaster for clinicians as it demands a complete re-organisation of their work processes to fit the way the ERP defines the work. The Health Smart project in Victoria is an example of the obstacles to getting a functional ERP system operational. After 5 years effort and \$350 million expenditure there are only 4 hospitals with any level of operational software, and even that service is limited to only parts of the hospitals. This is grossly inefficient by any measure and is the evidence one needs to show that ERP approaches don't work in the clinical domain. At the same time there has been no word of any best-of-breed systems being de-commissioned or failing to serve its community, even though it is well known that the early B-o-B systems now require updating to work in a web-enabled environment. This updating is not necessarily readily available as the original creators have moved on and are not available to do the revisions or the system would be too expensive to upgrade and might better be replaced by a newer technology.

### 2.4. What is the Problem to be Solved?

It is reasonable to address the issues that emerge from the ERP strategy and to try to establish methods for countering it but how do we go about doing that. The first step is to understand the nature of the current situation and the forces that caused it to emerge into the form it currently has.

A starting point is to identify the type of system in terms of Systems Theory that best explains the shape and processes of clinical work. Under a sociological investigation clinical work would be defined as a Complex System. Under a positivist philosophy it would be described in terms of deterministic Structured Analysis and Design. Under the latter form the world to be modeled can be reduced to the generalisations of entities and their relationships along with the movement of the pre-defined and immutable information about the entities to satisfy a set community of people. The Complex System on the other hand models the universe of discourse as weakly unbounded, consisting of entities that vary from time to time in their definitional attributes and used by a fluctuating community of users that are dynamically self-organising as its membership and objectives change. We propose that the latter model better describes the nature of clinical work than the former.

Clinical work, especially in hospitals and clinics, requires the collaboration of a large number of separate professional expertises to care for a complex patient. These staff are themselves only representatives of their expertise and they change from time to time over a single episode of care of a patient. This leads to continuous changes in the language used, the type of care proposed, and the use of available resources in the patient care. A second order dynamic operates on these variables in that professional expertise is continually questioned, experimented with, and changed in the continuing pursuit of process improvement by the individual communities of practice. So there are two orders of change that demand the definition of required information and its reuse be dynamically configurable, as the users of that information have non-predictable usages for it. Hence the optimal behaviour and requirements by clinical users is that information systems behave as they need it to behave, that is they require best-of-breed functionality.

### 2.5. The Failure of Enterprise Systems to Satisfy

Clinical ERP fails to satisfy the clinical requirements of information systems on almost all criteria. Why then are they installed at all? Firstly clinicians who have to use these systems are not responsible for purchasing them for the most part. Secondly the political decision makers are mesmerised by the completely specious aphorism that "ERPs are world's best practice". The inefficiencies in the United Kingdom's NHS roll out contradicts this claim, as does the 5-year \$350 million under-performing HealthSmart project in Victoria, Australia. In addition is the poor service of the FirstNet rollout in NSW as testified by the ED Directors in this study. Thirdly, the decision makers believe the promises of the ERP vendors that they can actually satisfy any requirements. But this claim is also specious, in that it is limited by: a. the complexity of the particular task, b. the funding available and c. the functionality of the ERP software itself. Added to these limitations is the need for a willingness by the clinical staff to completely uproot their current clinical processes to match that of the ERP. In this study we have seen such a course of action taken by only one ED. However this department also managed very closely how much of the ERP

they accepted, cherry picking just the parts that suited them. In effect they kept their own best-of-breed mentality to deal with the ERP gorilla.

## 2.6. Computational Design Limitations

The ERP model is built on the particular foundations of Structured Analysis and Design which takes a highly deterministic view of information systems engineering, plus the assertion that all or nearly all aspects of the organisations functions have already been modeled. In particular they use the entities and relationships from a systems analysis as the shape for the internal data storage models. Hence, there is an inescapable synchronisation between the storage model of the computational process and the model of the thing to be represented in the system, in this case the clinical processes. If the model is not an accurate fit to the real world entity then unfortunately there will be significant reluctance to change the model as it has consequences for a range of dependencies inside the storage structures. Clinical staff have been stuck with this non-revisability of clinical information systems even in their best-of-breed systems if the original designer or engineers have not been available. With ERP systems this is an even greater problem as the ERP vendor is not willing to change something that all their other customers have made do with. Furthermore the deterministic position is staunchly defended by the ERP vendor because they advocate that they have already designed and implemented everything that the purchaser could ever want so they can have whatever they ask for. The unspoken facade to this claim are the limitations cited above plus in a case of reflexive systems theory where the ERP systems are now so complex that they are non-deterministic and the vendor despite all assurances cannot know what they are delivering to their customer. This is an interesting transformation where the ERP vendors have started off with a deterministic methodology and elaborated it so much that now no one person can know how it works and therefore provide a customer with a deterministic and comprehensive solution with any great surety, which is what they assure. In other words they can't deliver what they promise, and in fact the public failures show they fail miserably.

## 2.7. The Importance of Improvisation and Innovation in the ED

Emergency Departments are places of improvisation and innovation - they are complex systems where work practices are adapted by the staff, and the staff change over time bringing with them new adaptations.

The need for improvisation is caused by a multitude of changing variables, such as, different staff availability at differing times, different hospital situations, different patient case load mixes at different times of the day and the night. Improvisation is also performed in a local environment of trust between members of a team and knowledge of each others competencies and responsibilities and how they are shared in the team. Breaking down this trust is both difficult but also dangerous as its disappearance would certainly make the ED a less productive and efficient workplace, increasing the risks to patient care and outcomes.

Innovation occurs in EDs as senior doctors attempt to improve their services by adjusting protocols for treating a particular patient group, or in conducting research projects or by continuous monitoring of the epidemiological characteristics of the attending patients. Surveillance of the frequency and human demographics of disorders prevalent in the community are the tasks taken on by the senior staff in an endeavour to produce better outcomes for the community at large. The aim is both to be better ready to respond to outbreaks of disease and to provide better service to the general patients by faster processing and more effective care. The innovations rely on the staff collecting data about their patient population and then having tools to analyse that data. The data collection is done by the staff in the normal course of their work and kept in the patient record. However the analysis needs to be done over groups of records on a regular basis by the staff themselves as they understand the nature of the data, its strengths and weaknesses, and the manner in which it can be used within the sphere of their practice.

Enterprise wide systems have historically been produced by following a model for a manufacturing enterprise or retail enterprise and they enforce these models on the users to enable the software to work. There is no room for continual innovation in this model and so the doctors are left without mechanisms to analyse or change their work practices. The only choice is to perform these activities outside the shadow of the enterprise CIS, which leads to innovations of new data collection methods, reduced use of the enterprise system so that it gradually falls into disuse and eventually obsolescence.

The constituency of the clinical community is itself a variable in the use of CISs. In any one year in a teaching hospital many staff trainees are working for a term as short as 10 weeks so they need to have usable technology systems that are intuitive to use. On induction the first task for senior staff is to train the newcomers in the work processes of the specific department and in the clinical treatment of patients. Training in the IT used in the department is at the bottom of the list of priorities vying for the trainees time. This makes the pressure for intuitive technology all the greater.

To introduce an enterprise wide information system for the clinical work of a organisation is to construct generalisations of too broad a scale that doesn't help staff do the work better. For example, all EDs have

patients that require treatment so one can build a CIS to deal with patients and treatments. However, this doesn't allow for the differences in care for say psychiatric patients versus accident victims. It doesn't allow for differences between babies with dehydration and adults with alcohol poisoning. Nor does it provide for the differences in caring for these patients when the staff mix changes either between hospitals or at different times of the year, or different times of the day. Caring for patients effectively in this shifting sea of variables requires technology that is specifically designed and developed for its intended purpose.

Using an enterprise strategy in clinical settings will fail because different clinical groups work in different ways for very good reasons, e.g. cancer clinics have patients attend multiple times over a period of time to get repeated treatment. EDs typically have to treat a patient for a single episode. The shared information between the two is that the ED needs to know that the patient is already under a treatment plan and what it is. But the actions by each are most likely to be entirely different - they both need to record what they do to the patient but more likely than not they do very different things. The commonality is the need to share each others data, not to treat the patient the same. The difference is that they do different things, they record different things and they need their CIS to behave in different ways to optimise their and its contribution to patient care.

In clinical settings a crucial mistake is to assume staff can be coerced to do some particular work process. If it negatively effects their strategies for caring for the patient they will workaround it. So an enterprise system will fail if it doesn't serve the clinical need. As enterprise systems technology is currently defined by relatively fixed ways of work processing they inevitably will be circumvented. An enterprise view can work efficiently in David Jones (Macys or Selfridges) where customers walk in and buy a product, so giving the same technology to every sales staff member no matter whether they are selling furniture or children's clothing is sensible. The transaction in a retail business that relies directly on IT is the customer paying for the purchase - there is nothing else at the point-of-sales. This is quite the opposite in an ED where there are different types of activities to be recorded, and each staff member has to record and retrieve different types of data in a complex, flexible and at times life-threatening situation.

Enterprise systems are the mechanism for enforcing centralised control over the work practices of the staff. They take the decision making of what IT service will be provided away from the users and place it in the hands of the central office. It has to be asked if this is appropriate for the management of the clinical departments.

There is undoubtedly important information to be collected for the management of individual hospitals and the health care services across the state, however does this mean we should be disrupting the well-developed work practices of experienced clinical staff. Clearly a strategy that enables management to extract what they need from clinical practice will be far more effective.

## **2.8. Sharing Information - Serving the Enterprises Needs**

Although the lack of appropriateness of enterprise systems for use in clinical settings has been identified, this is not an argument for denying the usefulness of developed methods for improving intercommunication between existing technologies. Plainly that is a valuable strategy to pursue and will bring many early gains even though it is more piecemeal. Safety gains with the introduction of CPOE are already testimony to the value of introducing improved technology, but that is a technology that has targeted a singular process out of many possible processes. It stands as an exemplar of careful and targeted introduction of technology, not a sweeping away of established methods of health care in specialised and critical care departments.

There is still the need to satisfy the legitimate issues of sharing information across the organisation. This is needed to get a better picture of its operations at an integrated and generalised level, and improve other recognised blockages and limitations of current systems. Computerised Provider Order Entry (CPOE) is generally perceived to require setting up communication between the information systems of the order services and the clinical information system. In the past this has been achieved using a standard interchange format; HL7 v2 is the current de facto standard, which is being continually developed and expanded to meet more and more contexts. The disadvantage of this approach is that an individual messaging system has to be built for sending messages between any two CIS types, that is work for software manufacturers. This is not a difficult problem for the large B-o-B vendors but it does make it difficult for homegrown systems within the one institution. CPOE and CIS built by the one manufacturer as in the case of Millennium should in turn reduce the amount of message passing that uses HL7 by using their own in-built data transfer strategies.

The way forward to delivering much more functionality to the legitimate requirements of both clinical and managerial staff is to look at satisfying both needs in parallel and not subjugating one to the other. A solution that combines best-of-breed systems with effective intercommunication is a much better prospect than a stumbling enterprise system. One insight that appears to be entirely missing from the managerial perspective is that all the information they need about the care of the patient is most readily collected from

the clinical record as recorded at the point of care, so by improving this aspect of the systems they will actually be better provided with data to do their jobs. Any belief that imposing their requirements on the clinicians will give better data and outcomes is entirely self-defeating.

Health reform is pressuring hospitals, health systems, and physician groups to demonstrate value, not just generate volume and that IT improvement has to be seen as part of that drive. To meet this challenge, all members of the care team will need to break down silos and collaborate more closely than ever before. Building trust with IT services is essential, but at the same time this will not occur without IT staff becoming committed to primarily clinical objectives. Success will require the enthusiastic engagement of physicians through the use of sophisticated CIS in quality improvement — and not just on isolated projects. This next level of interdependence and collaboration — known as clinical integration — is vital to any enterprise seeking improved quality, patient safety, and value.

### 3. Defining A New Technology

The question that emerges from the inadequacies and disadvantages of both ERP and B-o-B systems is the quest for a middle ground that solves the problems without creating new disadvantages. The basic case has this formulation:

- ERP Clinical systems, cannot supply fit-for-purpose solutions for the clinical user,
- B-o-B systems cannot provide organisation wide data sharing, exchange and integrated reporting.

One solution that has been designed to assist with this problem is the Health Information Enterprise (HIE) where organisational groups send a minimal data set to a data warehouse where it is collated for reporting purposes and larger scale analytics. HL7 is used as the message structure to ensure a consistent message is transmitted. However this has not proven entirely satisfactory due to delays in data arriving at the HIE, and the lack of fine details required for administration at the level of individual hospitals.

The need is for a technology that satisfies the following as the most general criteria:

- The data fields to be collected can be changed at any time in real-time,
- The clinical users have control over the design of the presentation layer and the workflow,
- Clinical users can perform record retrieval and analytics over all their own data.
- Managerial users can get answers to any questions in real-time across multiple systems,

Technically this means a system has to be designed by generative methods, that is methods that generate a CIS from a design specification, in which:

1. There is complete separation between the three layers of storage, presentation and processing logic.
2. Entities within the system are recognised by a clinically universal coding scheme.
3. A universal clinical data analytics language is required to answer ANY ad hoc query.
4. A design tool is needed to enable staff to design their own system. The systems designed in this tool are used to GENERATE the working Clinical Information System.
5. All CISs designed with this tool should be natively interoperable. That is the design of one system should be able to use the data field in another CIS as the source of that data and it should exchange that data automatically.
6. Communications with outside systems will be done using HL7.

A more detailed description of this technology is provided in Part 9 of this study.

# Appendix 1 - Summary of Issues from Discussions with ED Directors

## 1. Implementation Process of NSWHealth

The process of creating, installing, maintaining and training in the Cerner CIS was managed by the HSS of NSWHealth. Their behaviour in this managerial responsibility was subject to many criticisms which are described below. There appeared to be a strategy by the HSS to dis-enfranchise the clinicians as their approach was supplemented with other negative strategies.

The process of engaging with clinical staff was defective in that:

- the functioning of the system was far less than what had been promised {1, 16},
- an Application Advisory Group (AAG) was created but it didn't have a representative of ED Directors,
- it didn't have stable clinical representation {8, 15},
- the meeting schedule was ad hoc and set at short notice which disadvantaged and ultimately disenfranchised clinical staff {11, 12}
- it added a cumbersome user registration system making it unnecessarily complicated to get new users registered to use the system {3 },
- it discounted the severity or importance of complaints, {4, 9,},
- it constructed an overwhelming delay mechanism to discourage change requests {2, 5, 6,7, 13, 14 },
- the system was not fit for purpose {10, 11}

## 2. Clinical Documentation

Clinical Documentation is of vital importance to clinicians as it has such a dominant importance in their daily workflow. They use it for both recovering current information known about a patient, and for recording their own decisions about the patient. Unfortunately it rarely carries the reasoning of the clinician in arriving at their decisions.

Hence the clinician has two different criteria sets for assessing a CIS, which can be coarsely defined as Input and Output Functions. In the case of Input functions the most important issues are the ease of learning where to insert content and the aids the system will give them while inputting information. In the output or retrieval process the key aspect is the speed at finding the relevant content or answer to a question, and the presentation of standard content for fast pattern recognition strategies.

The problems identified by the clinicians include:

- Content not being discoverable by staff {1, 2, 11, 14, 15, 20, 23, 27}
- Counterintuitive interface operations {2, 3, 13}
- Cross-staff interference in storage processes {4, 21}
- Poor data capture screens and processes {5, 23, 25, 29, 36}
- Over supply of inappropriate information {8, 15}
- Unsatisfactory reuse of data {8, 30, 31}
- Increased time and effort without benefit {12, 22, 26, 33, 35}
- Inadequate identification of the author of documentation {16}
- Staff avoidance of use of the system {17, 19}

## 3. Usability and Staff Behaviour

The usability of the system has been assessed in more details by an Issues List reported in Appendix 3. In this section more general observations are analysed. Directors found that the usability was poor and hindered work practices:

- The system showed a lack of knowledge of ED clinical practice and needed functions {1, 3, 10, 13, 15, 17, 19, 20, 36, 37}
- Sizing of objects on the screen was inappropriate {2}
- Distribution of data across screens is inappropriate {3, 40}
- Loss of functionality available in previous system {5, 6, 7, 9, 11, 18, 38}
- Work around strategies of clinical staff {8, 41}
- Unneeded, undesirable or confusing functions that lower productivity {12, 14, 16, 20, 22, 23, 24, 25, 26, 27, 28, 29, 31, 32, 33, 34, 35, 39, 41, 42, 44, 45, 46, 48, 49, 50, 51, 52, 53, 54, 56}
- Poor quality documentation {30}.
- Sudden loss of screen content {55}

#### 4. Unusable/Useless Functions

The system has a range of functions that are considered by staff to be of no use. The insertion of unneeded functions may seem unproblematic at first glance but in fact it is much more serious. Unusable functions cause two problems, they increase the cognitive load when staff use the user interface and have to determine their next act of manipulation, or it distracts and frustrates staff when they have to do an action that has no clinical relevance.

- Useless documents that clutter the system { 1, 2}
- Ignored input forms created by staff {3}
- Useless content in the reports {3}
- Non-functioning screen functions {4, 10}
- Weird functioning {6, 11}
- Collecting incorrect labels {7}
- Training inadequate {5}
- Too many icons, cluttered user interface {6, 8}
- System too complex {7}
- Unused clinical notes functions {9}

#### 5. Reporting Functionality

The reporting functionality required by Directors to manage their quality controls has been deprecated with the introduction of FirstNet. The common complaint is that functions previously available in EDIS are not available and this has had serious impact on the ability of the directors to review the activities of the ED and plan and test process changes to improve productivity. The lack of reports also increases the time cost of retrieving case materials for dealing with complaints and reviews of cases some time after the patients have left the ED. The list of perspectives presented are:

- Inadequate reporting functions {1, 2, 3, 4,5, 7, 11, 13, 14, 16}
- No motivation to get reports {6, 9}
- Inaccurate reports {8, 17}
- Research projects can't be supported {9}
- Staff not allowed to train to create reports {10}
- Restricted limit on amount of reporting allowed to be generated {12}
- No motivation to enter the data {9, 11}
- Loss of functionality available in previous system {10, 12}
- KPIs invalidated by change in workflow {15}

#### 6. Ordering

##### Pathology Ordering.

The directors were concerned that the process of ordering was much more time consuming than was necessary and compared to their previous system. In particular they were concerned that multiple orders for the one sample could not be directly created and that each order for the one patient needed the same information to be input, that is, there was no model in the software of a collection of orders being made at the one time for the one patient for the one sample. The other concerns related to orders being sent to the wrong hospital and for the wrong patient and any software functionality for filtering results.

- Overly complex - too many unnecessary displays, clicks and inputs {1, 3, 4, 12, 15, 17, 18, 20}
- Doesn't match an appropriate workflow {1, 2, 4, 7, 9, 14, 19, 22}
- Extra work tasks due to faults {5, 11, 13, 21}
- Inappropriate cancellation of orders {6}
- Orders sent to the wrong staff {7, 12}
- Medico-legal requirements unfulfilled {8, 14, 16}
- Patient safety jeopardised {14}
- Unable to get results based filtering {13}
- Too many tests not sufficiently adjudicated by senior clinical staff {10}

##### Radiology Ordering.

Orders for radiology have the same sorts of complaints as for pathology:

- Orders sent to the wrong hospital or go missing {1, 2, 9}
- Extra work tasks due to faults {3, 8, 10}

- Doesn't match an appropriate workflow {4}
- Inappropriate cancellation of orders {5}
- Changes to the report are not available to the ED clinicians {7}

## 7. Patient Record Retrieval

The need to find a patient record is a paramount process in any clinical information system. The directors were especially concerned that patient records could not be found in the system and software functions for searching for patients based on knowledge of the contents of their record were not available:

- Cannot readily retrieve patient records {1, 2, 3, 7, 15}
- Confusion/difficulties as to where the required data is stored {4, 14, 16}
- Extra work tasks due to faults {5}
- Doesn't match an appropriate workflow {6, 9, 10}
- Loss of functionality available in the previous system {8, 9,10, 11, 12}
- Alerts lost vis-a-vis previous system for clinically dangerous patients. {13}

## 8. Tracking List

The tracking list is a key function for managing the workflow of the department and the progress of patients through the system. Deficiencies in its usability impact all aspects of the departments functions:

- Overly complex - too many unnecessary displays, clicks and inputs {1, 2, 5, 8, 11, 14, 16, 19}
- Unwillingness by NSWHealth to change the system {3}
- Cannot retrieve patient records {4, 10, 12}
- Doesn't match an appropriate workflow {6, 7, 9, 11, 13, 17, 18}

## 9. Data Management

Data management consists of general topics related to overall functioning of the system and the issues of standards for data:

- Doesn't match an appropriate workflow {1,3}
- Does not provide appropriate information {2}
- Loss of functionality available in previous system {4}
- Fails to separate doctor and other users access to records {5}
- Fails to ensure a secure EMR {6, 7}

## 10. Print Functions

Many departments have found that the process of printing from the FirstNet suite is problematic. In some cases it might appear that the problem is not a property of FirstNet but of the way the local environment has been set up. Nevertheless it is important to understand that for the user the difference between intrinsic problems and extrinsic problems has no separation whilst it is still necessary to identify who should be responsible for rectifying the situation.

- Inadequate reporting functions {1}
- Inadequate functionality {2, 3}
- Risk of inadvertent mistake {4}
- Overly complex - too many unnecessary displays, clicks and inputs {5, 6}

## 11. Work Arounds

In the course of using a clinical information system staff develop strategies to overcome the difficulties the system puts in their way. These can be by abandoning the system entirely and reverting to the use of paper, or more subtly by keeping the one electronic note open for 24 hours for everyone to write their notes in. The key aspect of work arounds is that they constitute subversion of the policy processes created by the software that the staff are not prepared to collaborate with.

- Not signing documents {5, 1}
- Unrecorded alterations to documents {2}
- Unattached test results {3}
- Create a single note for the one 24 hour period {4}
- Negotiate with others to complete process {6}
- Diagnosis manually entered into tracking list {7}

## 12. SNOMED CT Coding

SNOMED CT has been introduced into the Australia medical scene by the Commonwealth government. There is little use of it throughout the country, so clinical staff are familiarising themselves with it. It appears that the introduction into FirstNet of SCT has not been well planned and many confusions exist in the minds of the implementers resulting in user interface problems in the EDs.

- Inappropriate information together in the one place {1, 4, 8}
- Nonsensical information {2}
- Missing content {3}
- Inadequate functionality {5, 6, 7}

### 13. Training

The need for training with any CIS is known to be of paramount importance in the success of any implementation. However what is less often described in the literature is the extent of training and impediments to training especially due to the complexity of the system. The notion that a system can be too complex for successful training is reviewed in a later part of this series of essays: The directors were very concerned with the system not being of sufficient simplicity in design for training to be efficient and reliable as the trainers could not teach a consistent approach to using the system.

- Continual re-training needed {1}
- Training needs are too great as system is too complex {2, 4, 5, 6, 7, 10, 11}
- Different instructions from different trainers {3}
- Training needs take too much time away from clinical work {5, 8, 11, 12}
- Loss of functionality available compared to the previous system {9}

### 14. Clinical Policies/Protocols

Clinical Policies or Protocols are important in defining the procedures to be followed for different clinical cases. Whilst experienced staff would use them infrequently they are most important for the training of inexperienced staff as they define what they have to learn to care for patients. In fact they are crucial for on-going patient safety and safety for the clinical staff for that matter.

- Policies are not available on-line {1, 2, 3}

### 15. Downtime and Backups

The installation of any information technology requires proper planning for alternative processing methods when the system fails or needs to be taken out of service for maintenance and repair. This is a well understood process in the IT industry. Hence efficient methods should be in place to cater for downtime and to ensure no data is lost should any part of the technology fail. The directors are concerned that unscheduled downtime is too frequent, the alternative methods for data recording during downtime do not match the promised process and the current process is inadequate and then there is no efficient method of uploading the data collected during the downtime.

- Poor hardware support {1}
- No Backup technology - revert to paper/board {2, 3, 5, 6, 7, 8, 11, 13, 14}
- Daily random freezes {4}
- Loss of functionality available in previous system {5, 9}
- Inappropriate scheduled downtime {10}
- Other users effected by downtime {12}

### 16. Positives

There are some positive features of the system particularly the availability of test results within the patient record negating the need to move to another system to see the results.

- Test results available in the same system {1}
- Department processes transparent {2, 4, 5, 6}
- Creates an identity for a patient across the hospital {3}

### 17. General Observations

The theme of general observations captures more holistic expressions of concern and the consequences of poor design on the work in the departments. Some one-off aspects of the introduction of FirstNet are also described.

- The problems are extensive and have been documented before {1}
- It requires more time with the computer, less time with the patient {2, 5}
- System is too complex and not flexible {3, 8, 13, 32}

- System has poor usability, too many clicks {4, 5, 30}
- Majority of doctors would not want to go back to paper {9}
- Slow time to resolve issues {10, 29}
- Inconsistencies between different parts of the system {11}
- Clinicians need to be more engaged in the process {12}
- System lacks Australian workflows {14, 25}
- System has focus on management of billing and not the ED processes {15, 16, 19}
- System encourages the development of workarounds {17}
- System emphasises enterprise data needs over ED workflows {19, 20, 21}
- System lacks synchronisation with other pertinent systems {23, 24}
- Report statistics optimised to make NSWHealth look good but are not truthful {13}
- Australian appropriate Pathway created but not used {26}
- Poor response time {28}
- Lacks flexible governance {31}
- Insufficient security {33}

## Appendix 2

# Compilation of ED Director's Views about the FirstNet Clinical Information System

### Introduction

This document is a compilation of the statements of 7 ED Directors about their experience in the introduction of the Cerner FirstNet Clinical Information System into their Departments from 2007-2010. Points highlighted in purple are thought to be potentially useful in a study of the software architecture and development. Points highlighted in yellow are assessed as being particularly informative. Items highlighted in brown are about Workarounds, and items in green are about the interface functions.

### 1. Implementation Process of NSWHealth's Health Support Services

1	H8: Initial Promises. Initially they were told about a lot of the features that would be delivered and people looked forward to those advantages but NSWHealth hasn't delivered what was promised.
2	H8: Ignoring Complaints. Then team prepared a list of 400 problems with the use of FirstNet on its first release. More recently because there have not been any more complaints NSWHealth has told them that the list is considered to be closed.
3	H8: Delays in User Registration. Other systems allow the Emergency Department Nursing Unit Manager or the Emergency Department Director to issue log-in authority to staff. This is quick and easy. With FirstNet, the log-in is issued by a central unit. This requires a written request form and can take days to achieve.
4	H7: NSWHealth have made sure that it serves their needs and they operate on a mental heuristic that the system couldn't be as bad as the clinicians report or they make counter claims.
5	H7: The process to get anything changed or initiated is so difficult that clinical staff have no capacity to influence what is given to them.
6	H7: Clinical staff have now accepted that they can't change the system.
7	H7: Change requests are generally not supported due to insufficient resources allocated to making the change.
8	H7: NSWHealth doesn't consult the clinicians.
9	H7: The system causes constant frustration and contempt which cannot die down or escape. You can't escape and can't accept it as it is so constant a reminder of its inefficiencies.
10	H7: EDIS is administratively oriented, while FirstNet is patient oriented. There is a lack of functions for managing the department.
11	H6: Issues in the management of the implementation process. Deciding who should attend the meeting as the representative of the end-user community is important. It is impossible for ED staff to attend such a half-day or day-long meeting, especially at short notice, hence their attendance was irregular at best.

12	H6: There was no representative of ED Directors and it should have been a requirement.
13	H6: Cerner did not have the capacity to improve the system readily or easily.
14	H6: There is too greater backlog of tasks in the FirstNet program. Setting priorities is controlled by NSWHealth who have their own preferences.
15	H6: Application Advisory Group - the AAG was composed of a random collection of staff without considered representation of medical staff. The meetings were run on an ad hoc schedule with short warning times that made it doubly difficult for medical staff to attend. At meetings staff were constantly advised that problems could not be solved for at least two years so further discouraging staff participation. Their staff no longer attempt to participate in the AAG.
16	H6: Roll out of FirstNet didn't match the promises.

## 2. Clinical Documentation

1	H8: Signing of Notes. Unsigned medical notes were a serious problem when FirstNet was introduced. The notes did not appear on the Flow Chart and were therefore not available to treating teams. Hundred of notes became accessible only to the author. This was corrected so that now the unsigned notes do appear on the flow chart.
2	H8: However, problems still arise when the documents are saved but not signed. Documents may become difficult to find even for the experts. The First Net trainers state "Never use the save button". Cerner was asked to remove the save button. However, the answer was that it could not be done.
3	H8: The doctors should sign the records. However the system should not offer the "save" modality. It causes such problems.
4	H8: Another problem occurs if the record is unsigned and the doctor walks away to an emergency leaving the data on the screen. The unsigned data can be cancelled by the next person who wants to use the computer.
5	H8: Poor Template Design. A number of electronic charting systems using templates exist for emergency physicians. The doctors enter data by circling positive findings, backslash-ing negative findings and writing text directly on to electronic templates that are selected according to the patient's presenting symptom. Most templates have dropdown boxes to expand the information collection if desired. Diagrams for recording finding are provided.
6	H8: Other template software provides a thorough, comprehensive record of each patient encounter. They provide an aid to memory for more junior staff so that the history and examination is appropriate to the patients presenting problem. They are valuable from the medico-legal point of view as well as promoting optimal patient care. They are very user friendly and doctors require minimal training in their use.
7	H8: When completed, the templates are electronically converted to a prose document that is suitable for a discharge letter. It can also provide discharge instructions to the patient and "patient information" regarding their diagnosed problem. Some of these template systems also generate prescriptions.

8	H8: Cerner FistNet tries to match these template systems. The templates for medical documentation in the FirstNet system are basically “ Adult General Examination” and “Paediatric General Examination”
9	H8: The templates are not symptom generated and try to cover every topic and every specialty. Each template is like an index to a comprehensive textbook on socio-economics combined with medicine. You scroll through a list of demographic information, social information, signs and symptoms. As with other templates, you circle or backslash to confirm or deny. However, when this information is converted to prose, it is a series of disconnected phrases that do not provide a grammatically correct easy to read document.
10	H8: The FirstNet templates are a list of words. There are no diagrams although it is possible to find diagrams in another part of FirstNet. The templates do not flow according to usual work practice. They do not act as an aid to memory. They are not user friendly. If a junior doctor tries to use the template, it can take hours to document the record of a single patient.
11	H8: Writing documentation is problematic. There are three choices to use: PowerNotes, Clinical Documentation and Clinical Notes. Each has a number of choices if you use them so that any one note may be placed somewhere where no-one else can find it.
12	H7: Clinical documentation is done through the system. Everyone has made the sacrifice of greater time than paper to enter data into the system but little benefit re accessing aggregated data has been shown to accrue from the effort.
13	H7: Case Study: Documentation Screen. To add a note click on the note icon and a window opens into which the note can be written. The note is then shown on the screen. Subsequently if you click on the text of the note it then disappears entirely. To add to the note you have to do a right click on the notes icon and then select Open to open the note. The delete process can only be reversed by moving to the top menu bar and selecting Edit and then Undo and without this knowledge new users are lead to the belief that their work has just disappeared and is irrecoverable.
14	H7: Triage box allows about 2.5 lines of text or ~50 words. Choosing from the triage problem list of 51 items is not compulsory nor even close to being comprehensive so staff workaround by writing their own entries. The entries are free text and thus not part of a searchable “reason for presentation” database field.
15	H7: Most staff write in a text description of the problem as the problem list is defective with poor wording, "bleed haematuria" or unfamiliar descriptions "orbital disorder" and lacks common usage of terminology. The database search for diagnosis or problem requires an exact match and does not assist with finding synonyms or approximate matches not found because of spelling mistakes.
16	H7: CASE Study: A referral letter needed to be re-sent to a different provider after the weekend. Staff went to the Discharge letter, ticked the box "Correct", and it was then noted that they could make changes to the original letter and save them to the system without needing to make any identification of self as editing the letter. The letter was saved under the name of the original authoring doctor and no record is made that it was the work of a different author or the extent to which it was changed. This means that the EMR does not constitute a valid legal record.

17	H7: Some medical registrars avoid the system by writing their material on paper and put it in the medical record which leads to all the problems of a dual system.
18	H5: Because of the time sensitivity, the attitude to the documentation depends on the role of the person in the system. It will be all right to take a little longer to prepare information for someone else, if you are in a certain role. If it is important and it has to be accurate and available to others who are tracking the same patient so that it takes longer, then it will often get delegated to a more junior member of the team, despite the fact that 'quality' documentation (almost by its nature) takes longer than low quality documentation.
19	H2: In 'clinical documentation', only the 'discharge summary' is used. All other documentation is done on paper. We use the triage form but it is not in 'clinical documentation' though we would class it as clinical documentation. We E-order to PowerChart for pathology/radiology.
20	H2: All notes on a patient cannot be seen in one page. In 'Clinical notes', when nurses fill out 'continuation notes', they should read old notes from 'clinical notes' and then see 'pathway' but they have to move to other pages to find this material so it is inefficient.
21	H2: Clinical staff have to sign in to confirm arranging a test for patients, at which time the user name cannot be changed. If one doctor signed on to one workstation and then went away to take care of patient, and during that time, another doctor has come to the workstation and signed the previous doctor off all his work will be lost.
22	H2: There is no button to add new clinical notes. When reviewing 'continuation notes', there is no button to add a new one. It needs to be done in another place, so it is inefficient.
23	<p>H2: <b>Limited Use of Functionality - Access to Information is too Complicated.</b> It Appears that only the functionalities for patient management are used. "Functionalities for clinical staff are of limited use. For example: From the list of medical pre-designed documents generated for the patient's electronic record, the index is not clear. Staff have to scroll through an index which has every document in the AHS from across many disciplines. For example, ED staff can choose Botox clinic documents. Staff are required to scroll through hundreds of documents one by one to identify what document they want to use. Once they have identified the document they want to use such as 'ED discharge summary', there are too many clicks to complete the form, and the process is unnecessarily complicated". Subsequently staff compliance drops, then a mixed paper and electronic record is generated. Clinical staff only use FirstNet to input comments, generate a discharge summary report, order tests, view results and find patients and they ignore other functionalities. (See screenshots Figures 16, 17)</p> <p>We have since found out that you can streamline/group selected documents however this is cumbersome and not well known, We can never repeat the process.</p>
<b>Medical Process for assessing a patient</b>	
24	H2: Before seeing a patient, a staff member goes to the 'To be seen' tab, allocates themselves to the patient. The KPI package pops up and staff insert the 'seen by time'. Ideally it would be good if there was an arrival time default inserted into this time as a prompt for staff.
25	H2: The Dr sees the patient and then returns to the computer and documents the interview. If they document in FirstNet when they record the patient's chart they have multiple clicks to open the chart before they can start documenting.

26	H2: The Dr can enter a diagnosis via the documentation / diagnosis (chart) or depart process. A diagnosis is nine clicks to enter.
27	H2: A diagnosis is not flagged or seen on the tracking list so other staff need to search through the entire documentation to find it. This is time consuming as it is not possible to identify externally which note from a set of documents contains the diagnosis.
28	H2: Dr "seen-time" needs to be on the tracking list (or LOS) since Dr "seen-time" is used to manage dept case load, and ensure triage categories get a balanced throughput.
29	H2: FirstNet does not work well on differentiating practitioners and MOs, because both of them are assigned patients in the same place.
	<b>Observations</b>
30	H2: Unable to see previous observations - Lose 'feel' for patient as everything in silos.
31	H2: Poor graphical representation - graphing not finite enough to be of use.
32	H2: FirstNet has 'vital signs' functionality but the trends are not finite enough here the important thing for staff in ED is to see the trend. Successive results cannot be displayed together making it far more difficult to get a trend or sequence of processes.
33	H2: Staff will not search for trends because the system is too slow, making staff reluctant to open charts.
34	H2: No prompts for unusual observations, e.g. diabetic BSL or any form of useful alerts.
35	H2: <b>Unnecessarily Difficult to add allergies:</b> Staff think there are too many steps to record allergies and a complex and non-intuitive process. Adding an allergy is a 7 step process. Once the screen is opened it is difficult to work out 'how' to add the allergy. There is no rational flow to the data entry, nor are there prompts to guide the user. Staff are required to be trained or they would take a long time to work out the process. <b>On the other hand, compliance becomes a problem because it is just too difficult especially as staff turn over every 3 months. The data source becomes unreliable, and clinicians would not now rely on this record for this information. This functionality will be an issue when Cerner medications/ prescriptions on line goes live. (See screenshot 18)</b>
36	H2: Not all allergies are in the list, such as 'elastoplast', therefore the allergy cannot be recorded.

### 3. Usability – Staff Attitudes and Behaviour

1	H7: The usability of the system is not good enough, because the designers are not experienced in the medical practice.
2	H7: The Presentation record is shown in a tiny box with horizontal and vertical scroll bars so reading each record requires continual manipulation of the scroll bars. It should open as a large window that can be readily read without requiring other manipulations. The box to type in the record opens to a size that always needs to be enlarged to avoid the need to use scroll bars. If it opened just 20% bigger it would be OK!
3	H7: Certain basic information is needed in the top of the screen: MRN, DOB, Address, without needing to move to a separate screen to find the details.

4	H7: Triage can't prioritise patients. The Triage scoring system is not sufficient to prioritise patients and in the past nurses have set priorities so that lower triage patients get some throughput in busy times. NSWHealth introduced a priority column in the Tracking list, but it didn't automatically alter the priorities when a new patient was inserted in the list, that is if a new patient was given priority 1 then all other patients in the list needed to have their priorities manually changed. Even if this is done the patients order on the tracking screen does not change. EDIS allowed for priorities with automatic adjustment of number and position on the tracking screen with doctors habit being to choose the top of the list.
5	H7: Loss of graphing of Vital Signs (compared to EDIS). This is a loss of a fast recognition process. There is complex but rudimentary graphing available but the axes have dynamic scaling so the pattern recognition advantage is lost - you have to check the scales to understand the graph instead of instinctive recognition.
6	H6: The daily patient list used to find a patient which included using key words search for diagnosis (from a vague description) could be generated easily in EDIS. Cerner's FirstNet does not provide this function.
7	H6: You cannot use any normal function or short-cut as learnt in the Windows operating system.
8	H6: Staff try to enter the minimum amount of data and keep away from the irrelevant content.
9	H6: The MRN can't be loaded from the IPM (PAS system) but has to be manually entered. This leads to keystroking errors and loss of time.
10	H5: Significant workflow issues exist in FirstNet.
11	H5: Many types of screens are built in FirstNet. Each type is built for a specific purpose. However, EDIS has a limited number of screens. Doctors and nurses can access the same screens, therefore, FirstNet provides the users the opportunity to choose the screen they want to use.
12	H5: There are some strange print buttons in Cerner's products. They use a print server. Clinicians could enter the number of copies of the medical record into the print server.
13	H5: Does not allow triage nurse to flag patients for research activities.
14	H4: There are a great number of non-relevant content screens, that have to be clicked through to progress the work.
15	H4: Co-ordination within the system isn't apparent. For example, a person is discharged and he may have to be re-triaged. But the staff cannot identify that the person has come previously during the same day.
16	H4: When a doctor is preparing a note and something requires their attention elsewhere. The doctor leaves the device for a while. When he comes back, someone else takes over the computer, the previous note will not be saved as a draft.
17	H4: The interface of the FirstNet is not friendly, though the clients always request for a more friendly interface for the system.
18	H4: The user cannot use control + c and control + v functions with FirstNet.

19	H3: The system allows any user to assign a patient to any other user, accidentally or deliberately, without their knowledge. As a result unseen patients can be taken off the waiting list and not be seen by a doctor until the error has been discovered.
	Staff Login-Logout Processes
20	H8: Log-in Issues. The FirstNet system allows anyone with access to view the patient record. However, when you enter data, you have to use your own log-in. However, if you have the screen open under your log-in, anyone can enter data under your name. It is also possible to log into multiple terminals and to have them all open under your log-in at the same time. This makes it easier to have someone else enter data under your log-in.
21	H7: It should recognize the roles of staff and serve them information and forms according to their roles. It has no intelligence to know about staff roles and personal customisation.
22	H7: Using the system causes daily grief where it logs out users too quickly. It should have a biometric login. If the system logs out automatically, the documents will not be saved, therefore, some important information is lost and has to be re-entered.
23	H7: The interviewee has estimated that from the extra number of logins caused by automatic logouts and lost effort the cost is \$120M per annum in NSW.
24	H7: Case Study: Spent 15-20 minutes to enter a detailed case history of a patient - turned to answer a question from a nurse and when returned the system had discarded the document and logged out the user - happens frequently. This especially happens frequently to nursing staff who are interrupted more often.
25	H6: Continual automatic log-outs with subsequent login requirements drives everyone mad.
26	H4: Not all the clinical staff remember to log off the system before they leave the terminal. There is a function on the top of the screen to change users, however, sometimes the clinical staff are be too busy to log in with their own identification. Therefore, all the patient information is identified with the previous person logged in.
27	H3: Senior Staff access the computer at least 50-60 times per shift. Due to time constraints it is impractical to log on and off each time. As a result logged in PCs are often left unattended, compromising security and creating a range of problems when users inadvertently access another's PC .
28	H3: Staff may accidentally place a long list of orders on a PC logged in to another user. The system does not allow such orders to be signed off, and orders must be cancelled and reentered under the correct log in. This process can waste a great deal of time
29	H3: The system allows any user to assign a patient to any other user, accidentally or deliberately, without their knowledge. As a result unseen patients can be taken off the waiting list and not be seen by a doctor until the error has been discovered.
	Usability - Text Processing functionality

30	H7: The documentation process is terrible, not consistent with other standard text processing software, too quirky.
31	H7: It doesn't format text as expected, and it does not match what they are used to.
32	H7: Use of keyboard short cuts and mouse buttons is not consistent, that is, they can be used in some places and not in others. Haven't been able to sort out a systematic pattern to allowable and non-allowable locations for usage.
33	H7: When filling out the Discharge Summary pressing ENTER to move to a newline quits the form altogether. To add a newline you must press CTRL ENTER.
34	H7: Spell checking doesn't allow for own words to be added. Spellchecking does not include a medical vocabulary!
35	H2: Handover - handover button is not clear, i.e. it is not easy/intuitive to find. The description of interface is not clear and accurate such as assigned patients, reassign to provider, etc.- (see First Net manual)
	Nurse Tasks
36	H2: Nursing staff go to the un-triaged tab, locate a patient and click on the nurse protocol icon, on the form there is no mandatory arrival time for staff to calculate triage benchmarks, so it is too hard to calculate and adjust treatment times. This effects the quality and triage KPIs.
37	H2: Nursing task alerts do not work because there is: 1. no flashing, 2. no alerts, 3. when there is a change of status it has to be done manually, 4. Nurses do not want to use it because there is only one alert type and you can't determine where the 'alert' is and what it means.
	<b>Triage</b>
38	H2: In FirstNet, there are ~250 categorized presenting problems in the clinical screen. Staff need to match these to one of the 51 Manchester scores, which determines the triage category. The Manchester forms are not built into the system therefore, the triage nurse has to select the presenting problem, then manually search the paper copy of the Manchester forms to identify the discriminators (symptoms) and then assign the matching category. Concomitantly, Clinicians are not allowed to add more presenting problems that would help cover this absence, so this leads to triage typing the presenting problem and associated manchester discriminators into the comments, which reduces work efficiency and distorts the reporting of presenting problems. (See screenshot 7)
39	H2: In FirstNet, triage staff have to manually identify the triage category by using a Manchester code which in turn is used to manually select a guideline/policy to follow. This costs time and reduces the working efficiency when it could be done computationally, by installing the Manchester codes and linking them to the guidelines.
40	H2: Triage display is too complicated to read and too hard to find basic information on the display. Triage process is too long.

41	H2: Triage staff need to wait for the patient to be clerked. Clerking is a longer task than triaging so as patients bank up they are not receiving prompt triage and therefore increasing their risk of an adverse event. To do this takes a good 1-2minutes minimum, at which point nursing staff and often ambulance staff get frustrated as the triage process is delayed while clerical staff add patients onto the system. The patient cannot be triaged until they are on the system. In an emergency, the patient is treated regardless, we don't wait for the computer, clerical staff follow the patient into resus to obtain details.
42	H2: Triaging a patient by a staff member - Staff pick a patient off the un-triaged list – this is an issue if two different staff pick the same patient. Staff need to be able to delete or send an 'in error' message to the 'in error' triage form that another staff member has completed.
	<b>Clerking</b>
43	H2: Changes to come from PAS to FirstNet
44	H2: Creating Patient is Time Consuming - There is no way for a patient to be triaged on the system before being clerked first, which is inconvenient as it is time consuming and patients in life-threatening conditions need to be triaged initially. The clerk has to go through 4 screens (an extensive process) to register a patient. The first screen is a patient search, the second is full registration, the third is return to the tracking screen, and the fourth move is to the triage screen. (See screenshot - figures 4, 5, 6 & 7)
45	H2: Change NOK details-only choice is yes if click yes details disappear.
46	H2: Pre-registration has a 'no tracking' form so information cannot be collected with identification of the needs the need to be dealt with, so this delays the clerking procedure.
	<b>Admission process</b>
47	H2: Drs flag admission on tracking, then NUMs order. We have changed this work practice to the use of admission events to streamline the admission process.
	<b>Depart process</b>
48	H2: 16 steps for Drs to fast track discharge patients from the system.
49	H2: ED to Ward transfer forms are incomplete. 3 MET calls.
50	H2: Lengthy process for Generating Discharge Referral Form. More than 21 clicks for generating 'Discharge Referral Form' because there are hundreds of choices from PowerForms mandatory field 'doc type'.
51	H2: Ambiguous Use of Symbols in the Tracking List: Icons are used to represent specific tasks but are not removed/overwritten/transformed when their status changes so clinical staff have to look at all the symbols to get an idea of the current status of the patient and to interpret if a task is finished or not, or what state it might be in. e.g. in the case of the two actions which have one icon 'ask for bed'  'bed arranged', the first event symbol should be overridden/eliminated for efficiency and also to save screen 'real estate' as the screen is taken up by symbols that constitute superseded knowledge. (See screenshot 1)
	<b>Staff Login Processes</b>
52	H2: Inflexible Signature Process. Clinical staff will log in on one workstation and won't log out. During their shift, they will come and go, others may sit at their workstation but forget to log them out until they order a test, at which point, individual log ons become an issue. Clinical staff are required to sign to confirm orders for patients. If the order form has been filled out, the user name cannot be changed. If one doctor signed on to one workstation and then goes away to take care of a patient, and during that time another doctor comes to the workstation and signs off the previous doctor to log in himself, then the previous doctor when he returns will have to complete the form entirely again.
53	H2: Login duration is too long with an average of 10.3s for login.
	<b>Useability - Text Processing functionality</b>

54	H2: Lack of efficient List Sequencing. The choices are ordered by alphabetic order only by the first character, however, there are lots of forms starting with the same letter such as ECG and ED, the second letter of the word is not used in the sequencing. This wastes time for staff. (See screenshot Fig 15)
55	H2: As mentioned one of the most frustrating aspects is the deleting of text if you hit the wrong button - this seems to affect the comments section on the tracking screen and free text boxes with documentation e.g. the discharge summary.
56	H2: The many clicks is a major source of frustration with what appears to the end user as redundant functionality. E.g. having to specify twice in different drop down menus that you are doing a discharge summary.

#### 4. Unusable/Useless Functions

1	H7: Useless empty documents automatically created and stored in the EMR with no information in them. They clutter the catalogue of documents making navigation more difficult.
2	H7: System is cluttered with unusable templates. A group of clinicians wrote a template for clinical notes but it was not quite finished. It has been implemented but its uptake is variable because of the remaining bugs that frustrate use.
3	H6: Useless information is listed in the report, along with irrelevant content. They have lost the capacity to print the contents based on their needs, such as contact number.
4	H4: Some functions in the FirstNet do not work. Print function is a good example. Following the advised procedure completing a sequence of screen requests for printing documents sometimes leads to uncompleted print jobs and the staff are at a loss as to resolving the problem. There is a hot button on the screen that is known to be reliable for completing the print function, BUT it does NOT print any identifying information of the patient. Hence the staff use the button as a work around to a failed print request and may remember or not to write the patients details on the top of the printed paper.
5	H3: Clinical staff are exposed to a broad range of functions during training, many of which will not be used, or will be used too infrequently to be used confidently and efficiently.
6	H3: There are too many icons on the tracking list for users to realistically remember the functions behind them.
7	H3: A printed list of explanations for all the icons was put in everyone's pigeon hole but they all ended up in the rubbish bin as the list was regarded as too extensive to commit to memory.
8	H3: Icons are gradually being increased as more hospitals come on line and request icons for their own particular functions, and it has made the icon set unusable for many staff.
9	H3: The clinical staff currently do not use the clinical notes functions in the system as it is considered cumbersome and would need to be part of a hospital wide initiative. Some staff have their own templates or prefer to prepare a word document.
10	H2: No access to Help manual. Help manual won't load. (See screenshot 12)
11	H2: Delay reason alerts do not work - no flashing, no alerts, staff have to change the status manually.

## 5. Reporting Functionality

1	H8: Inadequate Reporting Functions. The reports related to KPIs are generated.
2	H8: However, it is not possible to generate ad hoc reports such as a list of the top ten diagnoses for a particular period.
3	H8: Reports cannot be generated regarding such things as disease incidence.
4	H8: It is also difficult to gain information regarding the caseload of individual staff members.
5	H8: It is not possible to obtain a report based on diagnosis.
6	H7: ED Director doesn't know how to get reports out of the system and hasn't tried. Have heard from other's that they are not useful.
7	H6: Can't review Pre-arrivals (aka Expects).
8	H6: No reports were initially available with FirstNet and NSWHealth expressed the view "You don't need them!". Nine reports are now available none of which support ED operations. Some reports do not accurately reflect the real data to the extent that some are algorithmically incorrect. Reports are not accurate, that means the reporting mechanism is not accurate. Even if physicians enter correct data into every field, they could not obtain a correct report.
9	H6: If you only care for what you use then there is no encouragement for staff to care about the data they enter into the system. There is no incentive to comply to data entry if the ability to generate ad hoc reports for managerial, research and project purposes is not easily available.
10	H6: The IT Manager who has extensive experience in generating the ED reports was not allowed access to the tables to extract their own reports. He were not allowed to go for training in the Cerner Command Language (CCL) to learn the necessary skills. This point needs to be viewed in juxtaposition to another Director's statement that there only two places where programming can be done: a particular AHS and Cerner. With EDIS, they could extract reports on every field. While with FirstNet, they have no permission to access any data fields but only to rely on embedded standard reports. With EDIS the report could be formed rapidly and easily, and matched to the clinical process.
11	H6: Previously, before the introduction of FirstNet, the ED used centralized report writing software for providing documents and reports to other clinical units. To facilitate this process they would email other clinical units to gain his/her agreement on the report which was to be prepared. With the FirstNet, there is no such function which could be easily used. Furthermore, they cannot identify the patient about whom the report was requested as easily as in EDIS with FirstNet.

12	H6: More fields can be tracked in FirstNet than EDIS, however, that would only mean committing to recording more but getting less. Instructions/recommendations were given that when running FirstNet reports, a maximum period of one month per report per run is allowed as anything more than a month will slow the entire system down. Extracting a month's worth of data via FirstNet's Discern Explorer took as long as 40 minutes. In EDIS data was copied across from the main server to a repository database where data was extracted using Crystal v10. The time taken to extract a year's worth of data was only 5 minutes.
13	H6: Decision support tool should be placed in the system. KPIs relevant to running the ED should be present. Certain clinical pathways are necessary to do the job easier and train staff. After all, this is the purpose of using an information system.
14	H6: There is no daily issues list.
15	H6: KPIs. The introduction of FirstNet destroyed the departments KPIs. The times for "Dr Seen" were blown out because it took so much more time to do all the documentation, including the time to get to the right place in FirstNet to enter the data – then the system defaulted to time of data entry time not the time the staff actually took with the patient. Trainee staff on an 8-10 week rotation would leave the automatically entered time and not change it to the actual time. Furthermore there various screen fields where if the time is set back it doesn't stay on the corrected time but changes back to default time. In one place it can be changed and it will stick but in other places it won't. The training was not training people on the correct screen for setting the time. Trainers didn't know that the changes had to be done in a certain place and so were incorrectly training staff.
16	H2: Presenting problems that are not available in the supplied list are sometimes written into the notes and so distort the reporting.
17	H2: Finally the reporting functionality is poor from an ED managers point of view. The SNOMED diagnoses does not help as there is no simplified classification of common problems that gives an overview of our workload and changes in time.

## 6. Ordering

	Pathology Ordering.
1	H8: Electronic ordering requires many steps, multiple clicks. If you order a number of pathology tests, each order is timed for the moment you complete the order. ( e.g. There may be a minute or two between each entry.)
2	H8: The electronic order generates a label for each test. If all the tests are not entered at exactly the same time, each test will require a separate specimen tube with it's own label. This is despite the fact that it is usual for groups of tests to be done on the same specimen. (There is a work around to correct this fault. You have to change the collection times so that all collections occur at the same time. This is confusing and not intuitive.).
3	H8: Each part of a pathology order has to be ordered individually and this requires repeat typing of all the patient information into each part.
4	H8: Doctors are asked to sign and date specimen tubes. If the time written does not agree exactly with the time on the electronic order, the test is not done.

5	H8: These problems occur frequently. However, usually we can sort things out with Pathology by talking with them. The main consequences are delays in patient treatment.
6	H8: Another serious problem is related to FirstNet being an Emergency Department system only. If a patient is admitted to the ward or discharged from the Emergency Department, Pathology orders recorded in FirstNet are no longer actioned and are cancelled.
7	H7: CASE STUDY: Message Centre - Reporting Results: All tests are the responsibility of the orderer. Nurses can order some tests in advance of a doctor seeing a patient but cannot delegate the order to the doctor who subsequently takes the case. The responsibility of following up the test is transferred by the system to a generic doctor, the name of whom the system insists the nurse must enter at the time the test is ordered. It does this by sending that result to the generic doctors inbox ( and not the treating doctors) for follow-up. A staff member had been away for a week and had 500+ reports in their inbox. Some reports came from another hospital and so were not the patients of this staff member.
8	H7: Tests should be reviewed but: It is accepted by ED supervisors that the vast number of basic pathology tests eg FBCs that are available for review before the patient is discharged from ED do not need to be followed up at a later date as it is assumed they are viewed and acted upon by the treating doctor during the patients stay in ED. It is not possible to clear these results from the message centre in bulk. They can only be removed by clicking on each in turn. As the supervision doctors do not have time to follow up all these results they remove them from the system one at a time but without analyzing them by clicking an "OK" button that implies the result has been followed up. The system records that the doctor has followed up the result (by the mere fact they have clicked a check box for each one) and thus it implies they have followed up the result when they have not. This medico legal issue is not recognized or acknowledged.
9	H7: CSF Testing - has 3 categories of tests: Microscopy and Biochemistry with results that come back during the patient visit. A third test is Cultures that are returned after a later period of time. This requires three separate orders in the current system but should be fixed to be one order, which they traditionally are. The results are reported separately which inhibits the efficiency at which staff can recognise their association and the importance for diagnosing cerebral diseases.
10	H6: The order sets match the culture of US being larger and more oriented to blanket testing. In Australia the recommendation and policy is only order necessary tests. Order sets could be different for different hospitals but all are shown in the same screens making it more time consuming to use. Local development was invited but you can't block anyone else's order sets so you see the everyone else's, which clutters your work. You can't even have your own order sets as a default hence you have to hunt thru everyone else's order sets to find your own. Less experienced centre's are given the same positioning of the experienced centres, who will have done a lot of work researching and developing an optimum order set. The Department of Health insists that everyone must agree to make a change in the system, but this doesn't won't give credence to professional rank of the much more experienced centres.

11	H6: For checking of test results they are sent to a personal inbox of the orderer. This is not satisfactory, as often someone else has to check the results. There is no mechanism to screen/filter the results making it necessary for each result to be individually read. This has lead to the workaround strategy of not checking results. While with EDIS they could filter the results, so that they could view the results more easily. Too many results are shown in FirstNet.
12	H6: Sometimes, the results have been sent to the wrong inbox or get lost. A pt had a test, the director checked for it to come. The Lab could see their result but the director couldn't see it in the FirstNet To the observer the result never appeared in the record. This problem wastes time at both ends of the communications. The icons on the Tracking List are supposed to change to tell you the result is available but this effect is lost in all the clutter on the screen
13	H6: Incorrect ordering in FirstNet produces disconnected reports for related purposes. This is because of poor design. Ordering of CSF fluid which gives a specimen you want the set of tests to come back as a unified report – if the grouping is not done in the ordering system, e.g. an inexperienced user, the results won't come back together. For example with head injury, the system needs to group all the tests looking for hemorrhage together and all the tests for meningitis together irregardless of them being input as different items, E.g. it should prompt: are you looking for meningitis. At the moment you have to scroll down deeply to find the related results. Inappropriate over-testing that looks much like the USA practices –which are set up with underlying philosophy that lots of tests will improve the efficiency of treating the patient. They have to do a particular common test even if the pt didn't need it, because of the risk of litigation. Ordering radiology tests there is no priority or urgency given to them so the Dr has to phone the dept to say that it is urgent.
14	H6: Cerebral Spine Fluid Test - CSF test. This test consists of a set of tests which need to be interpreted collectively to determine if the patient is at risk of a sub-arachnoid haemorrhage. In the EDIS system the set of tests were reported together and staff could see all the necessary content to make an appropriate interpretation. In FirstNet the set of results are spilt into 3 separate subsets of Microscopy, Blood Chemistry, and Cultures that are reported in different parts of the system. Inexperienced doctors will not be aware of the importance of seeing all subsets together and will interpret any one set as indicating the patient is not at risk. There are at least two known cases of patients suffering secondary haemorrhages resulting in severe permanent disability when the results were not interpreted correctly due to this change in information presentation, resulting in preventative measures not being made as soon as would have been possible.
15	H6: Every time for a test, they must re-enter the patient identifying data for each test even for orders for the same patient ordered at the same time.
16	H6: Problem with Blood cross match samples. If the service provider changes the report, the report will change in the system.
17	H3: It takes the clinical staff a long time to make orders, because they have to fill in the same information for different orders for the same patient. For radiology orders there are three mandatory fields for essentially the same information. Staff generally copy and paste the information or make a token keystroke in the mandatory field.

18	H3: There are two mandatory fields in the pathology form, so they must fill in the same information again.
19	H3: The key clinical information in the first mandatory field of the pathology and radiology forms is not automatically populated through to subsequent requests.
20	H2: Pathology orders require too many clicks.
21	H2: After Blood tests are ordered, any add ons is a problem as they cannot be sent electronically.
22	H2: Change to work practice to flag urgent bloods done at a local level.
	<a href="#">Radiology Ordering.</a>
1	H8: Electronic ordering of imaging is also a problem. When we first began to use FirstNet, x-ray orders were being generated for patients who were at another hospital in the area health service. (e.g. A patient in another hospital had an x-ray ordered electronically but the order was received at the x-ray department at our hospital.)
2	H8: Staff have been receiving the wrong X-rays. Orders from this hospital are known to have been sent to another hospital.
3	H8: Completing the electronic ordering for x-rays is a problem. There are many steps that seem ridiculous. Doctors are asked to confirm that male patients are not pregnant.
4	H8: Each area x-rayed requires a separate electronic entry. Like Pathology orders for each entry requires duplicate typing of information.
5	H8: As with Pathology, x-ray orders cannot be actioned if the patient is discharged or admitted to the ward.
6	H8: Misdirected Results. Orders from this hospital are known to have been sent to another hospital. This problem has not occurred lately.
7	H6: Problem with Radiology reporting. The fact that a report is changed from its initial form is not identified and the original is lost entirely. So, if an abnormal report is missed the pt gets the wrong treatment. The resulting behaviour is that radiology reports are printed out when they are generated. This leaves the problem of mixed paper and electronic record. If the service provider changes the report, the report will change in the system. Therefore, you can only get the updated report, meanwhile losing the original one entirely. Amendments and additions to the orders report were not preserved in the system. Hence staff were in dispute with other departments about the contents of their reports which would change. Now, staff print the reports so that they have the original record for settling disputes. NSWHealth has been requested to provide a log of changes to the report so the staff know what has been done to it.
8	H2: In radiology orders, the system should identify if the questions are suitable for this patient. If suitable, system also can answer some of these questions. e.g. if male, the question 'are you pregnant' should not be asked.
9	H2: Order an x-ray and they go missing.
10	H2: Form must be printed as patients missing on RISPACS. This practice has stopped but the odd patient still goes missing, it has something to do with the AUID and has slowly been resolved, as a workaround radiology have 2 screens up to monitor orders in FirstNet matches orders coming across Rispacks.Update?

### 7. Patient Record Retrieval

1	H8: Retrieving Patient records. The Flow Chart retains data from 1000 events. If information is required on a patient prior to this, retrieval of data is difficult.
2	H8: CASE STUDY: Recently, data was requested regarding a patient who was thought to have suffered an adverse event at another hospital after transfer from my hospital. It took all day to retrieve the data using four staff members. Two of these staff members were experts in FirstNet seconded from Information Technology Services branch of NSWHealth.
3	H8: There have been a number of medico-legal cases where efforts to find the patient record have failed.
4	H8: Difficult Data Retrieval. The multiple screens are a problem because they offer multiple places and ways to record data. This makes data retrieval difficult. This causes problems with ongoing patient management.
5	H7: When you click on a patient note from the patients document list to open it for viewing the system frequently and inexplicably opens another document in the patients list of documents.
6	H7: Lab Results are sequenced in the reverse vertical sequence to customary reporting by world conventions. This results in not being able to look for patterns that have been learnt over a long time and so has serious efficiency issue. Now staff have to read the list of results starting at the bottom and moving up the list. NSWHealth have refused/ignored the request to change the ordering sequence.
7	H7: Can't get reports of patients who have left the ED more than 72 hours ago. Reviewing cases is an important part of learning and training of staff.
8	H6: With EDIS, physicians could find a patient by searching the free text information, while FirstNet does not provide this function.
9	H6: In EDIS, they could access a patient record by viewing the date of their episode and the final diagnosis of the patient, but it is not easy with FirstNet and instead of the final diagnosis, the presenting problem is posted against the patient's summary report.
10	H6: There are many unsafe patients in ED, both by social and medical criteria. Therefore, certain patients when presenting should have alerts in their record flashed up to the staff.
11	H6: Searching free-text has been lost.
12	H6: With EDIS they can search back years for patient records, while with FirstNet they cannot.
13	H6: Alerts in the system are not relevant to ED. Lost the alerts functions for behavioural risky patients (violent, mental). Lost the alerts for clinical risky patient (e.g. rare diseases, frequent visitors, known treatment requirements, etc)
14	H3: Accessing very basic information can be complex and non-intuitive. For example locating the GPs phone number requires opening the patient folder, clicking on "patient information", clicking on "PPR summary", left clicking to highlight the GPs name, right clicking to display "more info", then left clicking on "more info" to get the number.

15	H2: No easy access to information re: the patients triage on the tracking screen. The the triage form is hard to find - yet this is our core business. We have a workaround that I think is unique to us- we have triage hover, if you hover over a column in tracking it displays the triage information to the user
16	H2: Inefficient Access to Progress Notes. FirstNet can only show the clinical notes of the latest episode. Staff have to change search criteria to find other episodes or past history. A lot of staff don't know how to change the search criteria because it is unintuitive. This can put patients at risk as clinicians have inadequate past history. (right click on blue bar) (See screenshot 8, 9, 10)

### 8. Tracking List

1	H8: 1. Confusing Icons. The multiple icons can be confusing because of the numbers involved and the similarity between the icons. It is not possible to identify the function of all icons simply by hovering over them. They may not cause people to make mistakes, however, they cause confusion and delays in documentation.
2	H8: . Some icons are not specific enough to be useful. For example, the consult icon does not specify from whom the consult is being requested.
3	H7: Tracking List: the mechanisms for changing it are available but not accessible due to the change process.
4	H7: To Be Seen Tracking List: On selecting a patient record it is instantly removed from the screen so you can't get to their record without going to another screen. It should not move the entry until some action is taken on the clinical record.
5	H6: There are too many columns shown in the tracking screen.
6	H6: After sorting on a column in the Tracking list this can't be switched to another sort.
7	H4: The tracking list has limited value, because screen icons only show a task has been initiated and does not register that a task is completed.
8	H4: It is very easy to choose a wrong patient when the clinical staff is tracking a lot of patients. So that, sometimes the system shows the wrong patient information.
<b>Clerking/Registration</b>	
9	H2: Patients must see clerk first rather than triage, contrary to recommended guidelines, because of FirstNet's logical limitation. Staff are dissatisfied because this process may put patients in danger if care is needed urgently or are waiting to be triaged as we do not know 'what' is wrong with the patient.
10	H2: If the patient has no MRN in the PAS or the patient does not register in the PAS, it will prompt an error message when operating 'add encounter', and then the clerk has to deal with this issue by going to IPM.
11	H2: Currently, users do not use alert functionality in FirstNet because it does not work very well. More specifically, there is one icon that encompasses two different alerts so it is difficult for users to see at a glance what the patient has an alert for, especially when there are 80 patients in the ED and 20 have alerts. In FirstNet, users have to open each patient's chart and then remember or transcribe the alert onto the tracking screen (current practice), which makes it inefficient.
12	H2: Pre arrivals do not have necessary information filled out in the Tracking List so key information is missing for triage and clerking. Pre arrivals need to be tagged by clerical staff on arrival. This is a manual process and relies on staff. If this does not happen then the 'pre hospital information' is lost.

13	H2: In pre-registration, the clerk needs to modify some patients' information such as 'mode of arrival'. In contrast, in full-registration, the clerk also needs to change some information of patients.
14	H2: Errors are made in documentation of the wrong patient because patient's are not highlighted in the tracking list. Staff can click the indicator arrow in the first column, but the row is not highlighted. If a patient is removed or added to the Tracking List e.g. discharged or triaged then the list is added to (on a triage) or shortened (on a discharge). However the "select" arrow stays in the same physical position on the screen hence the patient it was pointing to will have changed, as the order of patients in the list will have changed. So if a doctor selects a patient, then pauses or leaves the screen for a short time the pt the pointer is indicating may change. If they are not aware that the system can change the pt it is pointing at without their intervention then they will not check the record and so subsequently open a different pt record to the one they intended. So commonly notes go into the wrong patients record. However those wrong notes may in turn trigger serious adverse interventions for that patient. There is at least one known occurrence of this happening.
15	H2: Need comments columns to be bigger.
16	H2: Each tab needs refashioning within its purpose.
17	H2: <b>Lack of Aids and Explanations:</b> There are a lot of symbols in FirstNet but there are no tips on the meaning of the symbols shown in the system making learning more difficult for the new staff member. There are lots of icons (bed: Needs a bed. Key: needs full clerical registration . 'Patient Care', 'Disposition'), but no descriptions of the icons shown in the system, and they are not self explanatory. Staff have to keep at their side a paper describing the symbols. For example: there are three indicators to represent different allergies and sometimes the functionality will be displayed when users right-click but there is no indicator showing that function exists. Hence staff at times fail to input appropriate data. (See screenshot Figure 2)
18	H2: <b>Category System Unfit for Purpose:</b> There are 250 presenting problems in the FirstNet list, but this hospital limits the use to 51 in line with our Manchester triage for reporting and quality purposes. Staff have to search the full list when it would be more efficient to have only a list of 51. In the interface the Diagnosis entry is supposed to replace the Presenting Problem entry if there is one, but this does not work in the system. Presenting problem is only relevant until the patient has seen a doctor then we require the diagnosis to be displayed on the tracking page. EDIS did this well. The presenting problem was displayed until a diagnosis overrode the entry and was displayed in place of the presenting problem. (See Screenshot Figure 11)
19	H2: <b>Duplicate Menu Headings.</b> Two menus have the same name 'Patient' but different content. (See screenshots Figures 13 & 14)

**9. Data Management**

1	H6: FirstNet can show the ED is "full" whereas the staff understand the transient characteristic of "being full" but can't see any real figures as there is no: 1) formal reporting, 2) nor predicted modelling.
2	H6: The EMR consists of FirstNet, SurgiNet, PowerChart, Enterprise Scheduling, and Discharge Referrals. The rich source of information that the eMR collects is not used to feedback to the managers neither the real-time capability nor the capacity of this department in relation to another. For example, a high load of geriatric patient presentations in ED during winter season will become a 'push' factor from ED to an inpatient ward when it should be a 'pull' factor from the inpatient ward to ED. If EMR is able to provide information that gives the current capacity/ capability of the ward, the ward in turn is able to predict when patients will be discharged, how many beds will be available and thus streamline the admission process.

3	H6: Triage with FirstNet should follow The Australian Council on Healthcare Standards (ACHS) guideline, The Australasian Triage Scale (ATS). The ATS has been referenced by the Australasian College of Emergency Medicine document which states that "Triage is the first point of public contact with the Emergency Department" and Waiting Time is "the time difference between the time of arrival and the time of initial medical assessment and treatment." While FirstNet requires the clerk process to be completed before triage which is a US workflow.
4	H6: A department map, which highlights the availability of the beds and the patient in it, allows for a quick visual assessment of the capacity of the department. The bed map was available in EDIS, while it is not available in FirstNet.
5	H4: The log of the system does not separate the writer of a document for a patient case from someone who views a record in the system. So it is difficult to identify who actually saw the patient.
6	H2: FirstNet has an event management mechanism which enables users to add requests, confirm, and even delete events, so the veracity of the EMR cannot be secured.
7	H2: Currently, the blue form placed in the patient's paper record is a declaration to staff that our patients have a mixed electronic and paper record and it facilitates patient safety as their information is in different areas, some electronic, some in the paper notes.

## 10. Print Functions

1	H8: Printing notes produces a hodge-podge order to the notes. There is no sequencing of the notes when they are printed. They need to be in chronological order.
2	H3: There are about 8 computers sharing only one printer. If the printer goes down, all these computers are not able to print the pathology report. It is not possible to make a "hot swap" replacement of the computer, so staff need to redirect printing to other sites in the ED. Many staff will need to consult senior medical or clerical staff for instructions regarding redirecting printing.
3	H3: Pathology requires both an electronic order and a paper order to accompany the sample and so if a printer is down the paper order has to be done by hand, or go to other terminals. For example, on a busy holiday weekend the printer was down from Friday evening until Tuesday morning causing significant time costs.
4	H3: The clinical staff are not guaranteed to collect the correct output, because 8 computers use only one printer, hence at busy times there is a serious likelihood that the wrong printout is collected by a staff member.
5	H3: Printing certain fields can take a large number of mouse clicks which may be beyond the scope of the average user to remember. Many staff rely on cutting and pasting into a word document
6	H3: An interesting situation is that a "purportedly paper-less system actually uses more paper."

7	H4: Sometimes when staff print a label, maybe 5 staff make orders simultaneously. When the labels are printed out, it is hard to match the label with the patient. Moreover, they are in a busy environment therefore, they just pick up a label and attach it to the sample. The system is designed firstly, and then the training focuses on how to make a barcode work properly.
8	H4: Likewise, when the clinical staff finish writing a document in the system, only one copy of the document is printed. If they want another copy of the document, they click the print button on the screen, so only the content in the document is printed out without the patient identification and other information.

**11. Work Arounds**

1	H3: Under the proposed system for faxing discharge summaries, once the clinical staff prepare and sign a summary they cannot change the destination within the system in order to divert the fax to another provider who is not the patient's GP or elect not to send the fax for confidentiality reasons. The planned workaround is to not sign the referral in the event that a decision is made not to fax.
2	H3: Without signing, the documents will not be stored, and it is necessary to print a hard copy for inclusion in the patient's paper medical record.
3	H7: CASE STUDY: A referral letter needed to be re-sent to a different provider after the weekend. Staff went to the Discharge letter, ticked the box "Correct", and it was then noted that they could make changes to the original letter and save them to the system without needing to make any identification of self as editing the letter. The letter was saved under the name of the original authoring doctor and no record is made that it was the work of a different author or the extent to which it was changed. This means that the EMR does not constitute a valid legal record.
4	H6: The e-gate to the IPM is not fast enough so the clerk issues a new MRN for the patient. This causes down stream delays when the old MRN eventually arrives, and goes onto the tracking list. This creates situations where the blood results for a patient are not connected to the on-line record in FirstNet because they have been ordered using the new MRN.
5	H5: Establishing different notes between sites. The same note is kept for the current 24 hours rather than writing a new note for each activity so that, all the previous information is in the one place. Therefore, only one note per day and that note is clear enough.
6	H2: After Blood tests are ordered, any add ons is a problem as they cannot be sent electronically. The workaround is achieved by filling in a paper request and phoning pathology to add the tests. However sometimes the patient needs another blood test done.
7	H2: FirstNet only displays the Presenting Problem on the Tracking list when it should insert the diagnosis when it becomes available. Staff are required to work around the system and type the diagnosis onto the tracking page for later ease of reference. This means staff need to transcribe the diagnosis from a mandatory field in the system onto the tracking page. This costs time and potentially introduces errors, especially given that selecting the correct pt record from the tracking list is so problematic. (See screenshot Figure 11)

### 12. SNOMED CT Coding

1	H7: Lists have many categories of information loaded together, diagnosis, signs, symptoms.
2	H7: There are many nonsensical categories, e.g. "vomiting and wasting disease of piglets".
3	H7: No reliable way of dealing with <diagnosis uncertain> or <diagnosis unknown>.
4	H7: Symptoms should be put in a separate list to diagnosis.
5	H7: The search function is not intelligent enough, clinicians need to enter a similar word and see a list of alternatives, because sometimes they do not know the exact diagnosis name as stored in the system.
6	H2: <b>Terminology Differences:</b> The search engine does not work well. For example, CTPA is named with a different name in FirstNet called CT chest PE studies, this is hard for clinical staff to work with as CTPA is the terminology that staff would be used to. Try to search it on Google and you get a better response than FirstNet. (See screenshot 15)
7	H2: Finally the reporting functionality is poor from an ED managers point of view. The SNOMED diagnoses does not help as there is no simplified classification of common problems that gives an overview of our workload and changes in time.
8	H2: To add to the SNOMED comments - it is not only hard to find things, frequently there are diagnoses not present, so you have to chose an alternative that is a best fit.

### 13. Training

1	H8: Training is a problem of two parts. The system is constantly changing (e.g. the icons on the screen are moved about) and so all staff need to be continually re-training.
2	H8: the training volume is too great due to the complexity of the system so the absolute demand is too large especially when trainee staff rotate every 12 weeks.
3	H6: Different trainers tell the staff different ways to use the system, which leads to inconsistent practice across the ED. This in turn increases the difficulty of using the system as different staff have stored information in different ways.
4	H4: It takes the users a long time to learn how to use it, especially the new doctors who have no experience with the system. Because of the busy work, they can only spend 2 hours on learning how to use the system instead of the 2 days required time. As a result, they cannot get the time to learn the system as it is too complicated and so they call on the trainers made available by the Hospital.
5	H3: The FirstNet system is overly complex and many functions are counterintuitive. As a result, junior doctors and registrars who are generally very adept at navigating around unfamiliar IT systems struggle to effectively utilize the system despite 3 hours of formal training and on the run assistance from Senior Staff. The ED staff spend a lot of time on informal training.
6	H3: FirstNet training is unfunded, and takes place at the expense of clinical coverage.

7	H3: Informal training from experienced staff is often fragmented, may not always impart the best approach to using the system, and is inevitably a distraction from essential clinical duties of trainers.
8	H3: There is total 7 hours orientation for JMOs who are new to the ED. 4 hours are allocated to clinical orientation, 3 hours on FirstNet. Despite this disproportionate allocation of time to IT, it is still inadequate for learning how to effectively use the system. Orientation to the former EDIS system was provided in house, and took no more than 15-20 minutes
9	H3: Staff who have completed FirstNet training are generally only able to make use of a small number of the functions in the CIS, and many functions will never be used.
10	H3: Junior staff usually attempt to restrict their learning to the functions in the system directly concerned with their jobs. At times junior staff are distracted by, or waste considerable time attempting to familiarize themselves with functions that are only of relevance to senior staff or unhelpful in the ED setting.
11	H3: Due to the complexity of the system adequate competence can only be achieved after staff have had significant opportunity to improve their skills through practice with using the system during clinical shifts. This inevitably results in loss of efficiency in patient processing.

#### 14. Clinical Policies/Protocols

1	H6: Previously one could develop policies based on his/her working practices. FirstNet inhibits access to the existing policies and the capacity to create new policies. The workaround has been to place the policies on an off-site disk drive.
2	H6: The ED needs clinical a decision support tool which gives real-time response. The AHS controls clinical policies and as there is no support tool for editing policies the ED is limited in its ability to keep its policies up-to-date. This comes about by a requirement that all policies be defined by a State Board.
3	H2: There are no Manchester codes in the system and the concomitant guidelines that go with them.

#### 15. Downtime and Backups

1	H7: The hardware backup is poor as staff from the central service won't come to the site until a hospital car becomes available for their transport.
2	H7: System uptime is ok, they also use a paper-based backup system during downtime.
3	H7: Downtime causes a switch to paper for recording which is then entered into the computer at a later time.
4	H7: System subject to daily random freezes requiring it to be rebooted.
5	H6: Unplanned downtime is about 3 per month. Planned downtime is greater than with EDIS. Longest downtime was 18 hours. No backup system for downtime so the ED reverts to paper.
6	H6: Paper-based documents are for backup. FirstNet can be down for a very long time. During the last two months a downtime has happened 3 times.

7	H6: The backup processes have been lost.
8	H5: The system going down is not a regular issue. Cerner does have back-up system; however, its back-up system is not effective. Any key information has to be manually re-entered into the system.
9	H4: An important issue is downtime. With FirstNet it happens 4 to 6 hours a month, while with other systems it is only about 15 minutes and 2 to 3 times in 2 years.
10	H4: Scheduled downtime occurs on the weekend, and though a weekend is a good time as a downtime for other departments in the hospital, for ED it is possibly the worst time due to the high patient load.
11	H4: There is no paper record now, so when downtime comes, there is supposed to be a downtime application running in at least one location. They try to record all the information locally during the downtime. However, FirstNet does not provide a means for uploading this information to the main system after the downtime.
12	H4: Others parties use the tracking list instances, for instance, the ambulance service. When the system is not available, it effects many services.
13	H3: If the system goes down there is a detailed downtime procedure. The first step is to account for all patients that have been triaged. A list of patients is maintained on certain PCs, but there is then reliance on a paper notes system.
14	H3: The back-up system is to keep the patients' main information on a physical board. The ED maintains a physical board as it has found it essential to ensure a up to date patient tracking

## 16. Positives

1	H6: The only benefit obtained from using FirstNet is that the test results are in the system, rather than logging into to another system, as they had to do with EDIS. However if there is uncertainty about the results then they login to the pathology system.
2	H5: FirstNet makes the whole department more transparent in the way EDIS never did.
3	H5: Creates the identity for a patient across the hospital.
4	H4: It is easy to track the patient information.
5	H4: The clinical staff could quickly gain a clear picture between the system and the results.
6	H4: Access to historical patient ED information is convenient.

## 17. General Observations

1	H3: The general issues regarding the system design, implementation, training, change process, and the willingness/ability of Cerner to make modifications are very extensive and have been well documented in a number of forums over several years. It is beyond the scope of this document to detail these issues
2	H4: At times clinical staff spend much more time on the computer instead of with the patient.
3	H4: The system itself is too complicated. The clinical staff are not familiar with the whole system, and they never use some functions in the system.
4	H4: The usability is a big issue, for instance, the number of clicks for each operation, that are not necessary due to screens that have no content and function.
5	H4: All too frequently the extent of information required to be input into the system is substantial so it will take the clinical staff a long time to complete the data entry. During this time they cannot see another patient, hence lowering the productivity of the staff. The duration is lengthy due to both the volume of data requested and the poorly designed interface for progressing through the data fields.
6	H5: FirstNet is only "a tracking system" from the Director's point of view, and in their hospital they use other systems to achieve other work, such as orders, discharge summary and clinical documentation. However, these four functions have been released in other hospitals under the label FirstNet.
7	H5: Implementation of tracking and EMR. 90% of information can be documented by PowerNotes. Now, they need to have admission summaries, which is not the full EMR, just some elements in the EMR.
8	H5: Health care is a complicated system, therefore, there is not a simple system that could meet all the requirements of the health care. The best way is not to introduce complexity. Only use a complex system to meet a complicated need (health care).
9	H5: By now, the majority of doctors would not like to go back to EDIS. 75% of the issues will be addressed, and Cerner is pretty flexible.
10	H5: Issues can easily be raised in FirstNet. However, the time line to solve these issues is slow if it has to be referred to Cerner.
11	H5: Different sub-systems have been designed by different teams in Cerner leading to inconsistencies between different parts of the system. Consistency of the system is important.
12	H5: There needs to be improvement in the interaction of IT and clinician. Clinicians lack engagement in the continuous process of introducing new technology. They do not use half of the functions which should be used.
13	H5: The system is cumbersome in some ways and it is not as flexible as people think.
14	H6: The behaviour of EDs in Australia is quite different from US. Therefore, using a US system like FirstNet creates some unfilled functions or operates against the current workflow in Australia.
15	H6: In EDIS the focus was on management of the Department. FirstNet is entirely oriented on recording patient details related to billing, so with FirstNet, it is difficult to get a department view for a manager.

16	H6: The developers in Cerner/NSWHealth know nothing about the ED and have made no effort to find out, while the developers of EDIS were relatively better.
17	H6: EDs in US, states cannot share data easily to say what is happening.
18	H6: When clinicians work with the system for a while, they will find their own way to work with and around the system. Different clinicians will have different ways.
19	H6: People in the enterprise do not know ED, but they told the clinicians what data they needed to collect.
20	H6: The enterprise system takes ownership of the ED's data, local people loose access to their own data.
21	H6: FirstNet does not match the work process. It lacks an alert function and patient plan (a brief patient summary).
22	H6: KPIs are not set according to the standards of the College of Emergency Medicine or conventions in the field. NSWHealth opted for KPIs that would make their figures look the best, e.g. they identify time in ED from time of triage not time of arrival. Hence it is not possible to assess the amount of time a patient has been waiting. A patient's arrival time cannot be determined.
23	H7: The system doesn't have the Medications management system.
24	H7: Ideally the system should synchronise with the GP record for medications and complaints.
25	H7: It doesn't appear to be written by a doctor as it does things in ways that a doctor wouldn't do: things that frustrate normal workflow.
26	H7: A major effort was made to design a cardiac pathway but it hasn't been introduced as a form/template into the EMR.
27	H8: Unreliable Movable Computers. COWS are too heavy to move about and too unreliable. In some double bed rooms they cannot be moved past the first bed to get to the second bed.
<b>System Processes</b>	
28	H2: The system is slow and takes many seconds to refresh. Over a shift this is time consuming and frustrating
29	H2: The Depart process is slow and is best avoided. However we cannot avoid it but we have allocated staff different roles so we do not double on data entry for each ED role
30	H2: The description of the interfaces is not clear and accurate. ( assigned patients, reassign to provider, etc. see FirstNet manual).
31	H2: Flexible governance - not all sites have the same resources and issues and the computer system needs the flexibility to adapt to any environment.
32	H2: The Rule of Thumb expressed by the staff is that "Only 10% functionality is used".
33	H2: It is not role specific for staff, thus allowing people to do tasks they should not be allowed to do.

## Screenshots from FirstNet illustrating issues for ED Directors

The screenshot shows the 'Tracking List' interface in FirstNet. The table contains columns for Bed, Name, T, R, Age, A, Alert, Presenting Problem, Triage, Arrival, LOS, FT, DS, Dx, Events, Patient Care, MO, and NR. The 'Events' column is filled with numerous small, colorful icons representing different patient events, such as vital signs, lab results, and care actions. The icons are not clearly labeled, making them difficult to interpret.

Figure 1. FirstNet Screen: Ambiguous Use of symbols in Tracking List.

This screenshot shows a different view of the 'Tracking List' in FirstNet. The table includes columns for Bed, Name, T, R, Age, A, Alert, Presenting Problem, LOS, FT, DS, Event, Patient Care, MO, NR, IP, Notes, Lab, Rad, and Comment. The 'Notes' column contains text entries like '50', '1.0', and '1.0'. The 'Event' column contains icons similar to those in Figure 1. The 'Lab' and 'Rad' columns show numerical values and patient identifiers (e.g., BR1624, BR1838, BR1720).

Figure 2. FirstNet Screen: Tracking List Icons. Lack of Explanations.

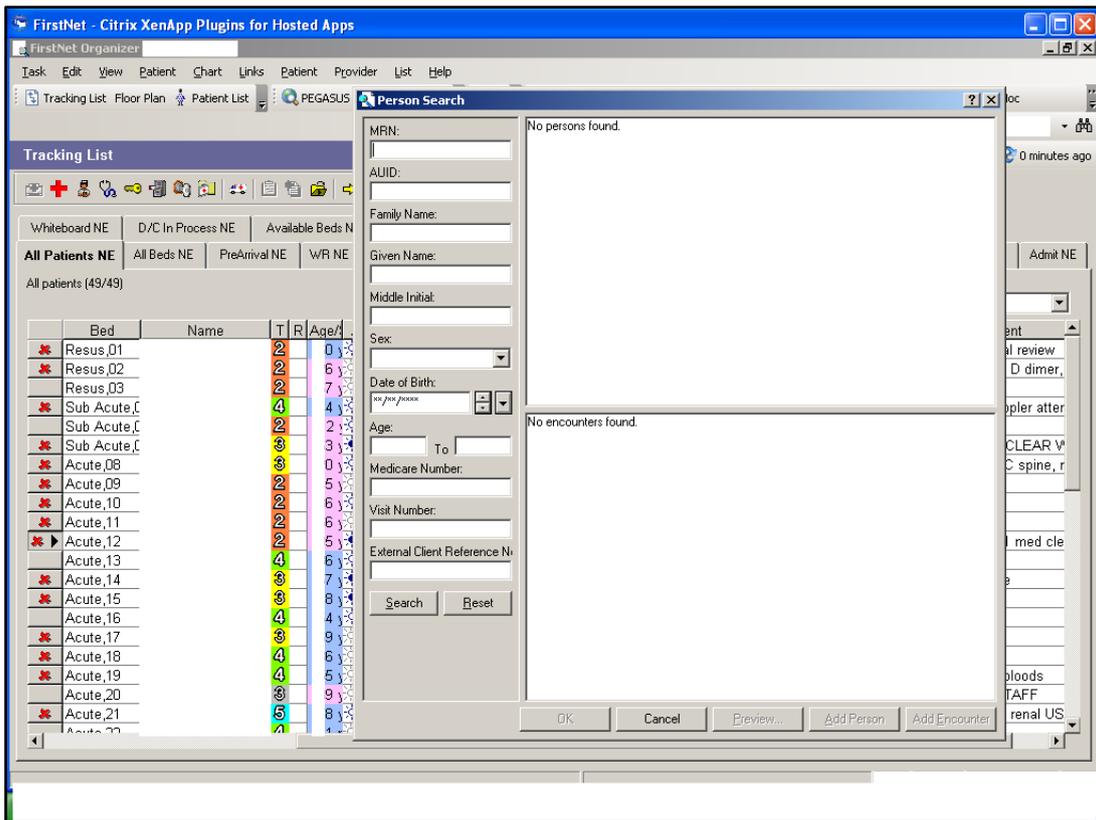


Figure 3. FirstNet Screen: Previous Document Search

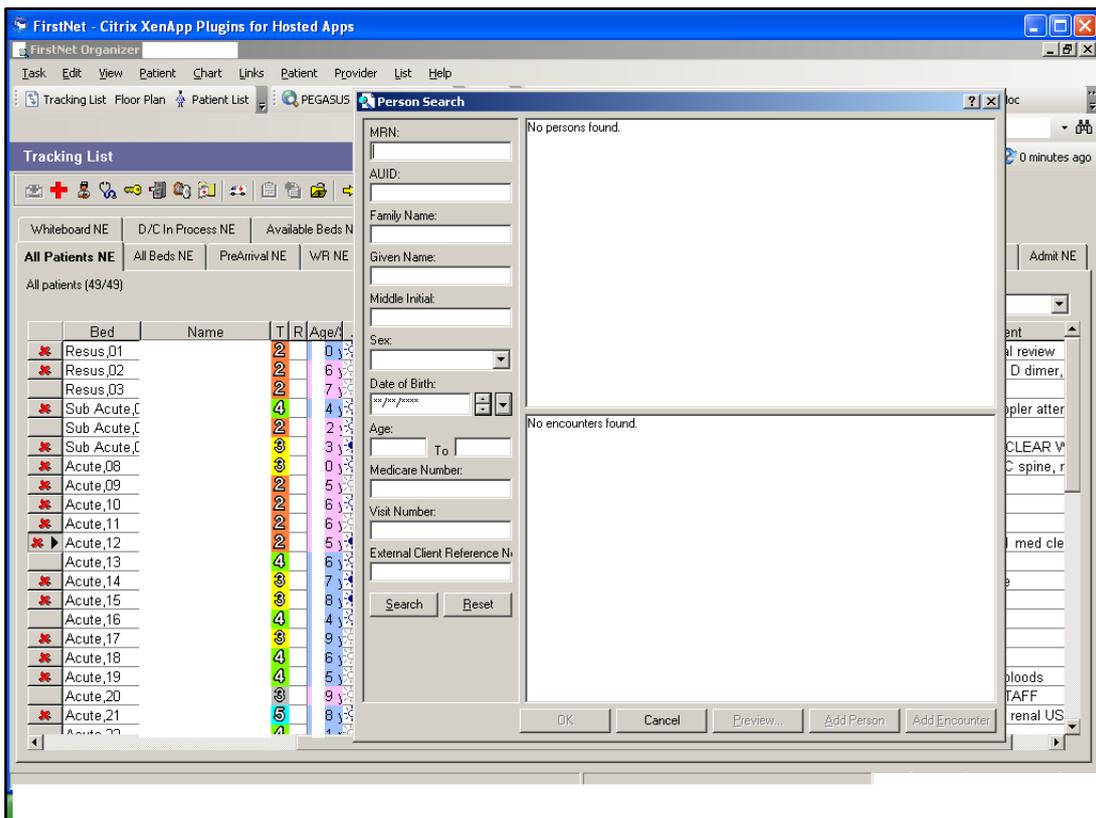


Figure 4. FirstNet Screen: Creating a Patient is Time Consuming - Step 1 - Patient Search

**Figure 5.** FirstNet Screen: Creating a Patient is Time Consuming - Step 2 - Complete Full RegistrationForm.

Bed	Name	T	Age	A	Alert	Presenting Problem	LOS	FT	DS	Events	Patient Care
Wait Rm			4				0:18				
Wait Rm			0				0:07				

**Figure 6.** FirstNet Screen: Creating a Patient is Time Consuming - Step 3 - Return to Tracking Screen

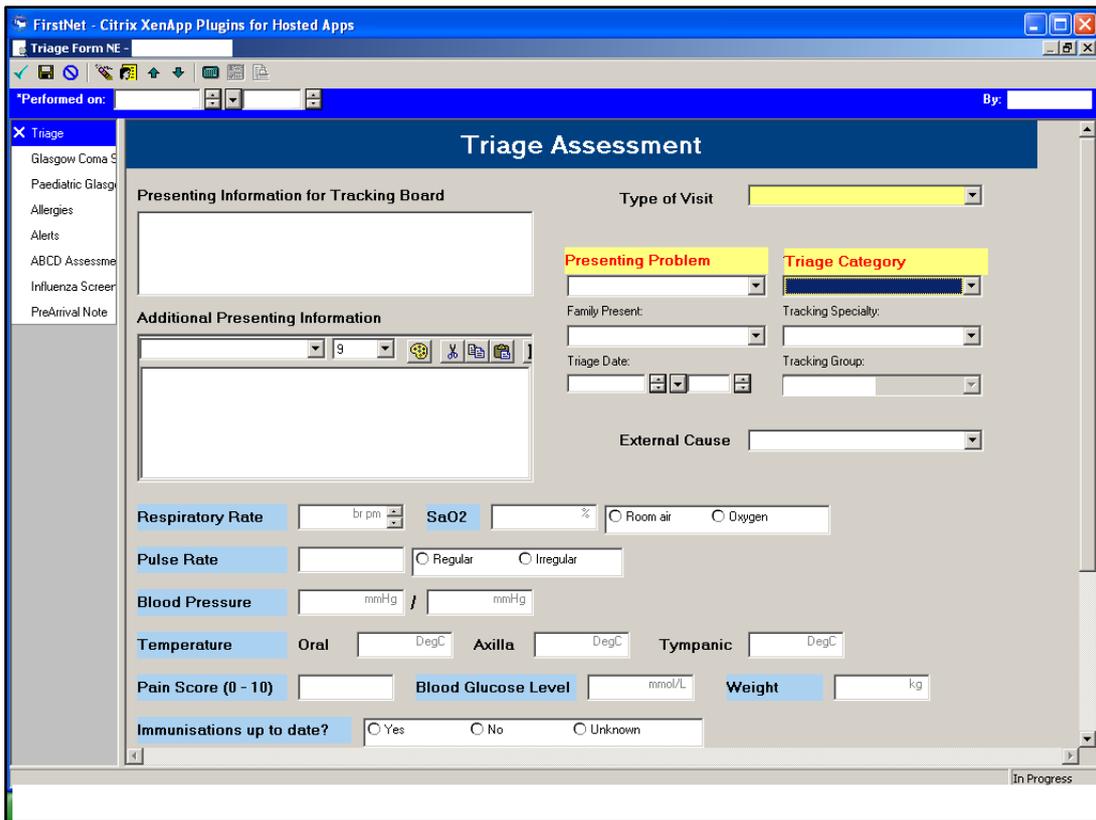


Figure 7. FirstNet Screen: Creating a Patient is Time Consuming - Step 4 - Complete Triage Assessment. Triage category assigned manually.

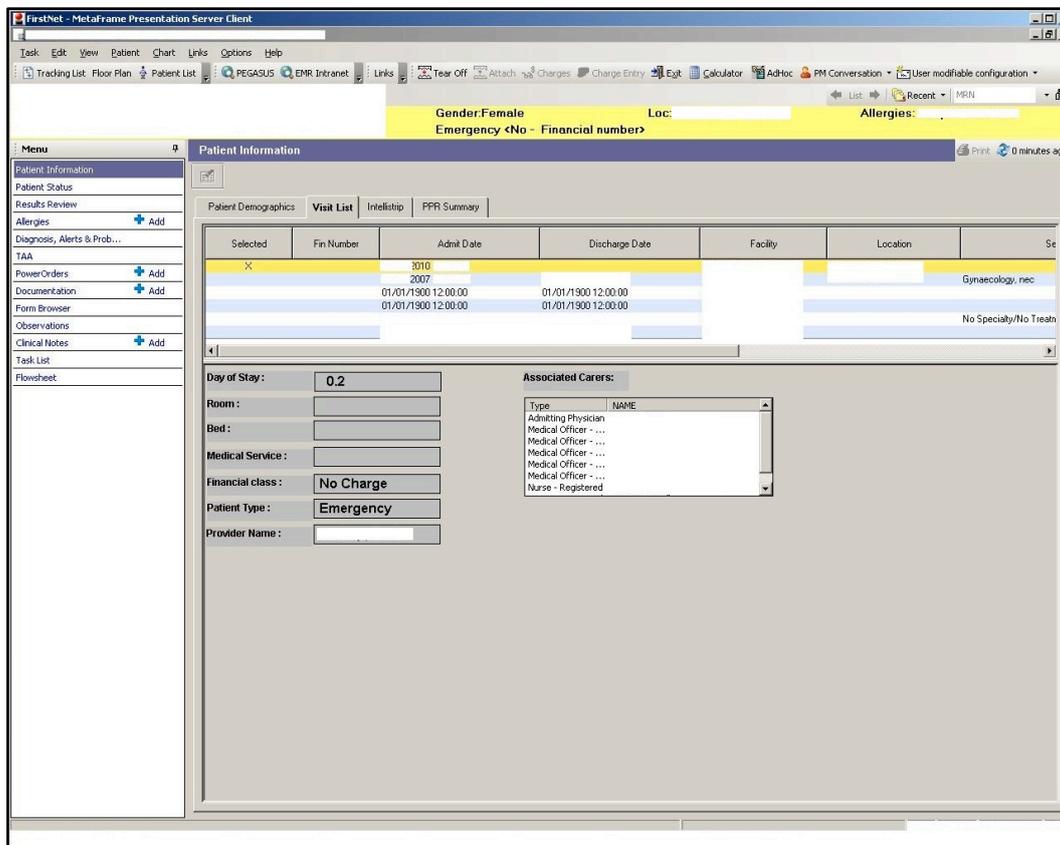


Figure 8. FirstNet Screen: Inefficient Access to Progress Notes -1

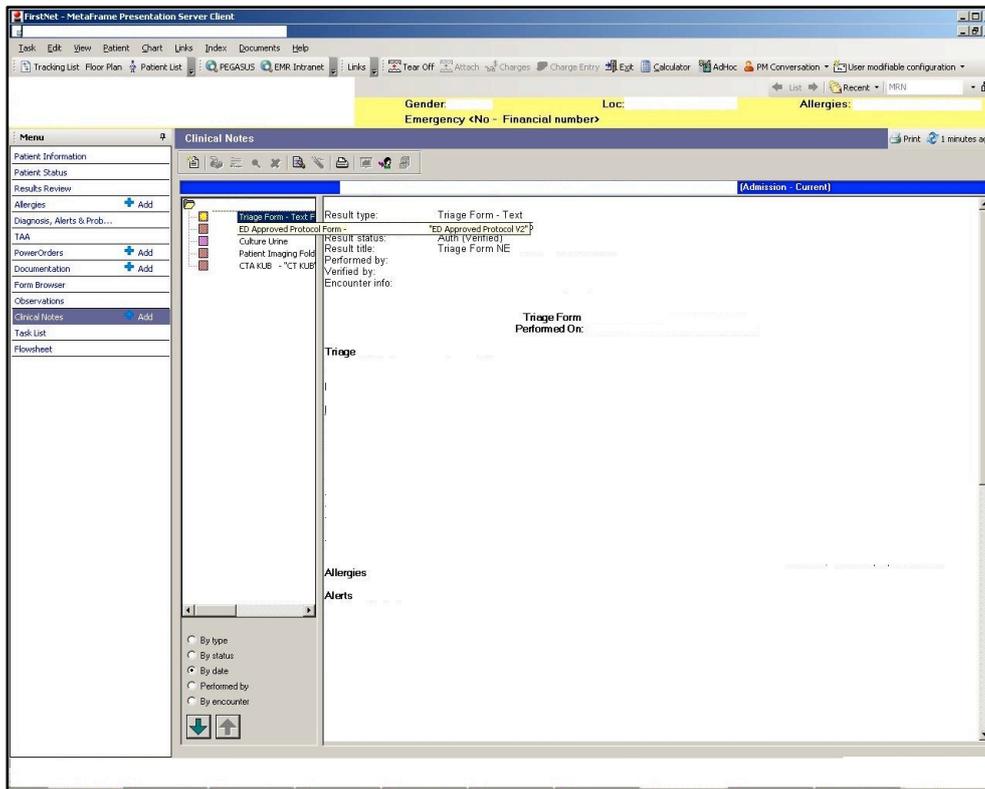


Figure 9. FirstNet Screen: Inefficient Access to Progress Notes -2

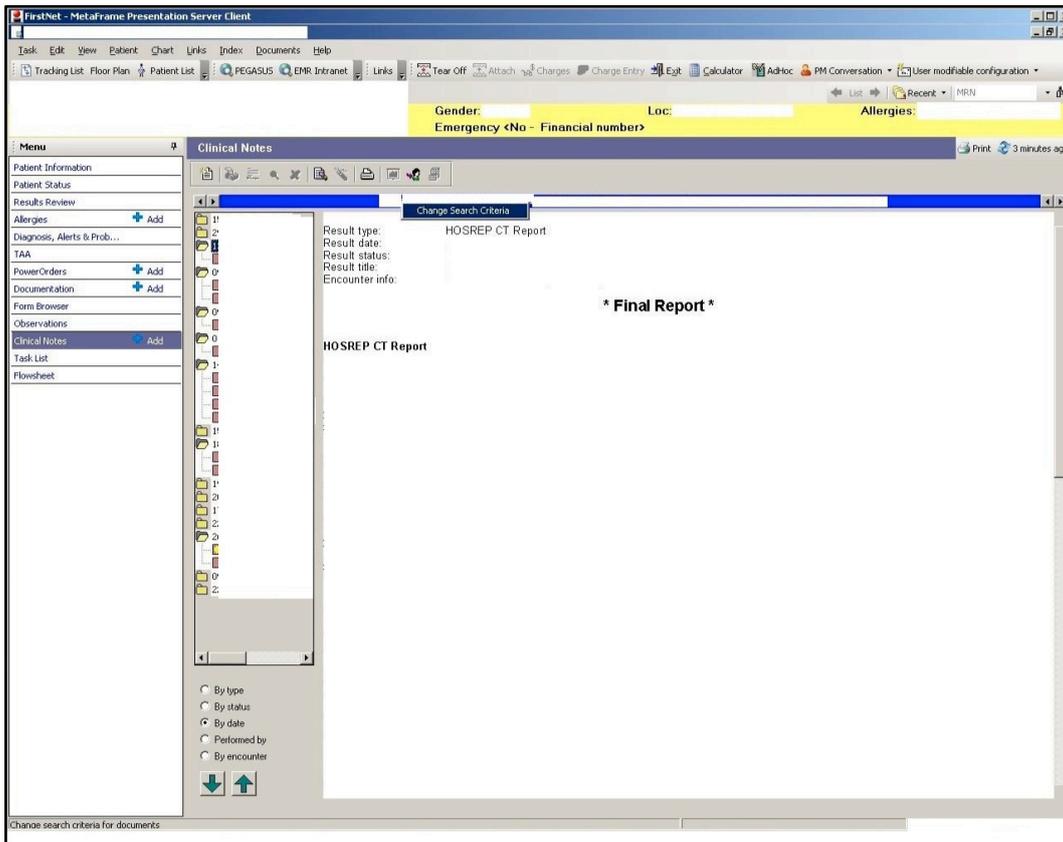


Figure 10. FirstNet Screen: Inefficient Access to Progress Notes - 3.

The screenshot shows the 'FirstNet - MetaFrame Presentation Server Client' interface. The main window displays a 'Tracking List' with columns for MRN, Bed, Name, T, R, Age/S, Alert, Presenting Problem, Dx, Patient Care, MO, Comment, Bed Mgt, and I/C Comment. The table lists numerous patients with their respective details. A 'Quick Filter' bar is visible above the table, and a 'Patient Name' search field is on the right. The interface includes a menu bar at the top and a toolbar with various icons.

Figure 11. FirstNet Screen: In Charge Comments. Category system unfit for purpose.

The screenshot shows the 'FirstNet - MetaFrame Presentation Server Client' interface with the 'Allergies' section selected. The patient information at the top indicates 'Gender: Female' and 'Allergies: Allergies Not Recorded'. The 'Allergies' table is empty, and there are buttons for 'Add', 'Modify', and 'No Known Allergies'. A 'Windows Help' error dialog box is overlaid on the screen, displaying the message: 'Cannot find the O:\Program Files\CERNER\FirstNet\_ev.HLP file. Do you want to try to find this file yourself?'. The dialog box has 'Yes' and 'No' buttons.

Figure 12. FirstNet Screen: No Access to Help Manual - Error Message.

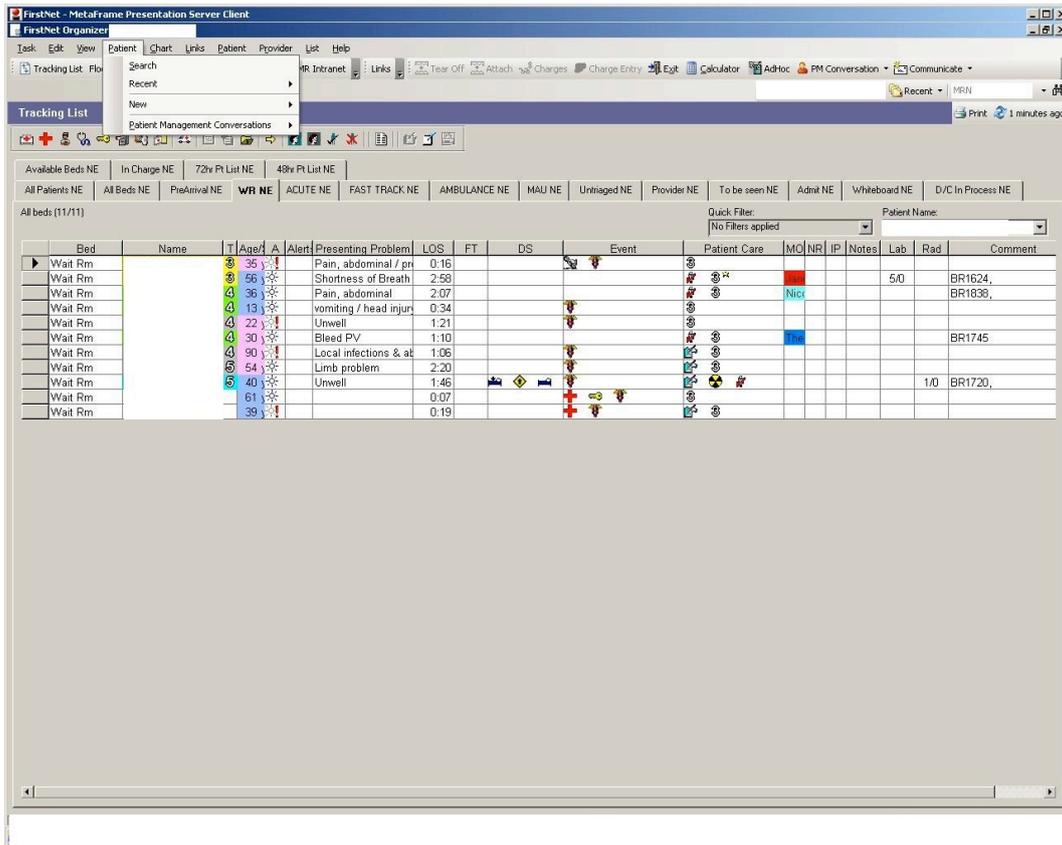


Figure 13. FirstNet Screen: Duplicate Menu Names-Contents in Menu 1

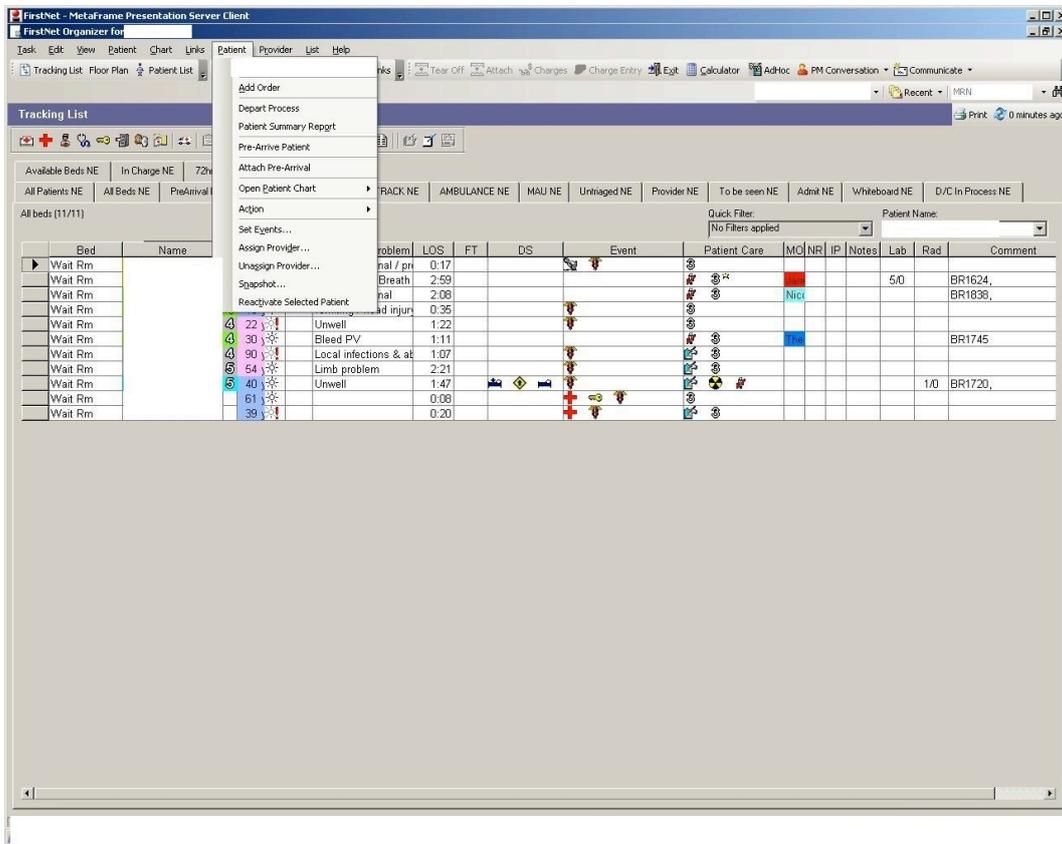


Figure 14. FirstNet Screen: Duplicate Menu Names-Contents in Menu 2.

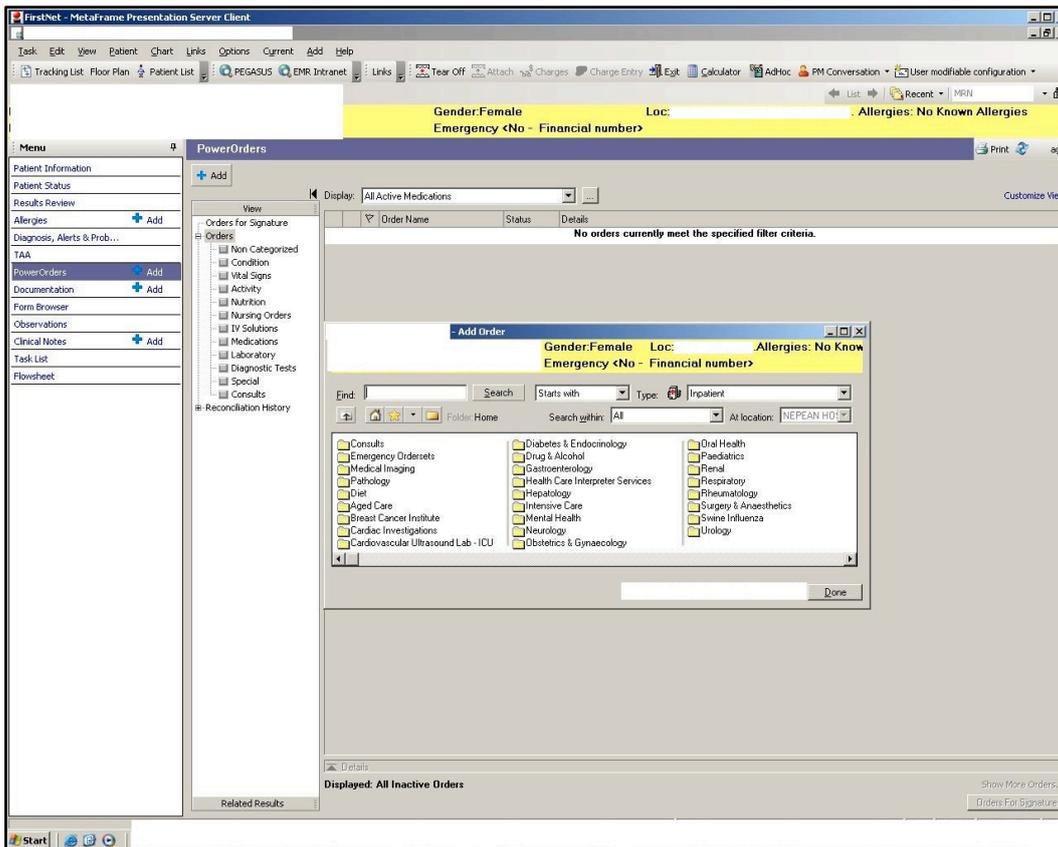


Figure 15. FirstNet Screen: Add Order shows terminology differences.

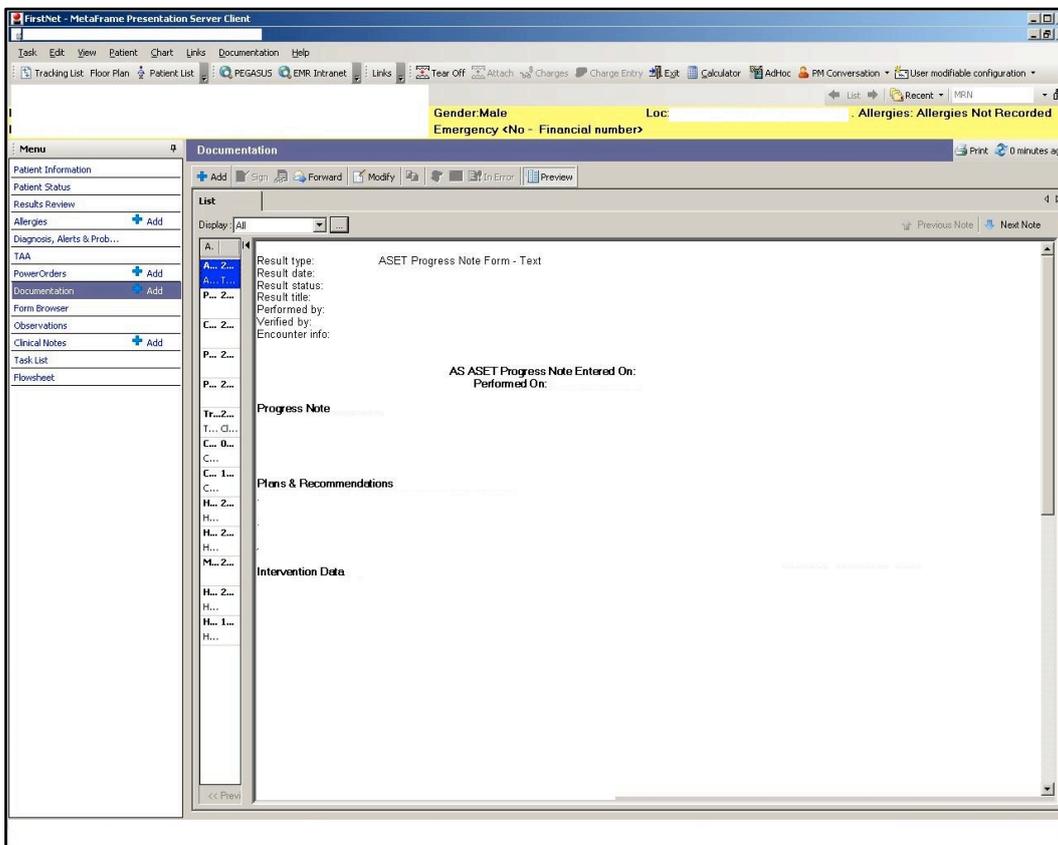


Figure 16. FirstNet Screen: Add Document. Access to forms is too complicated.

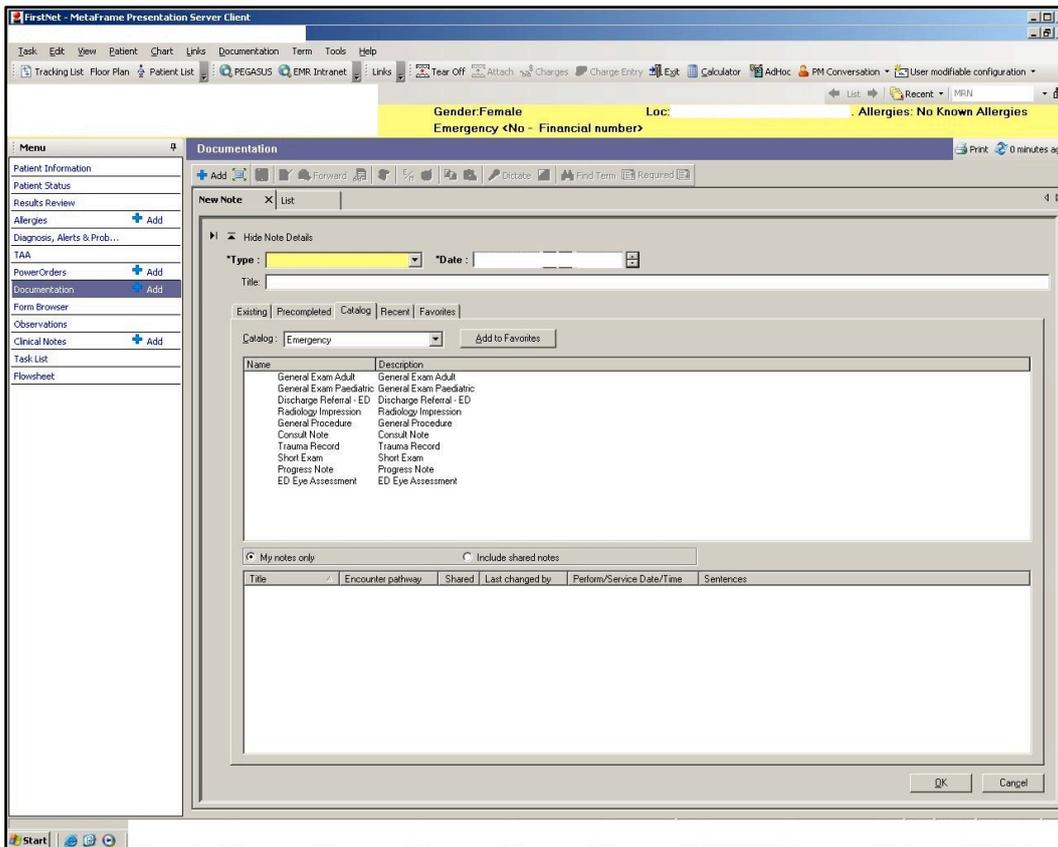


Figure 17. FirstNet screen. Index of Documents. Access to forms is too complicated.

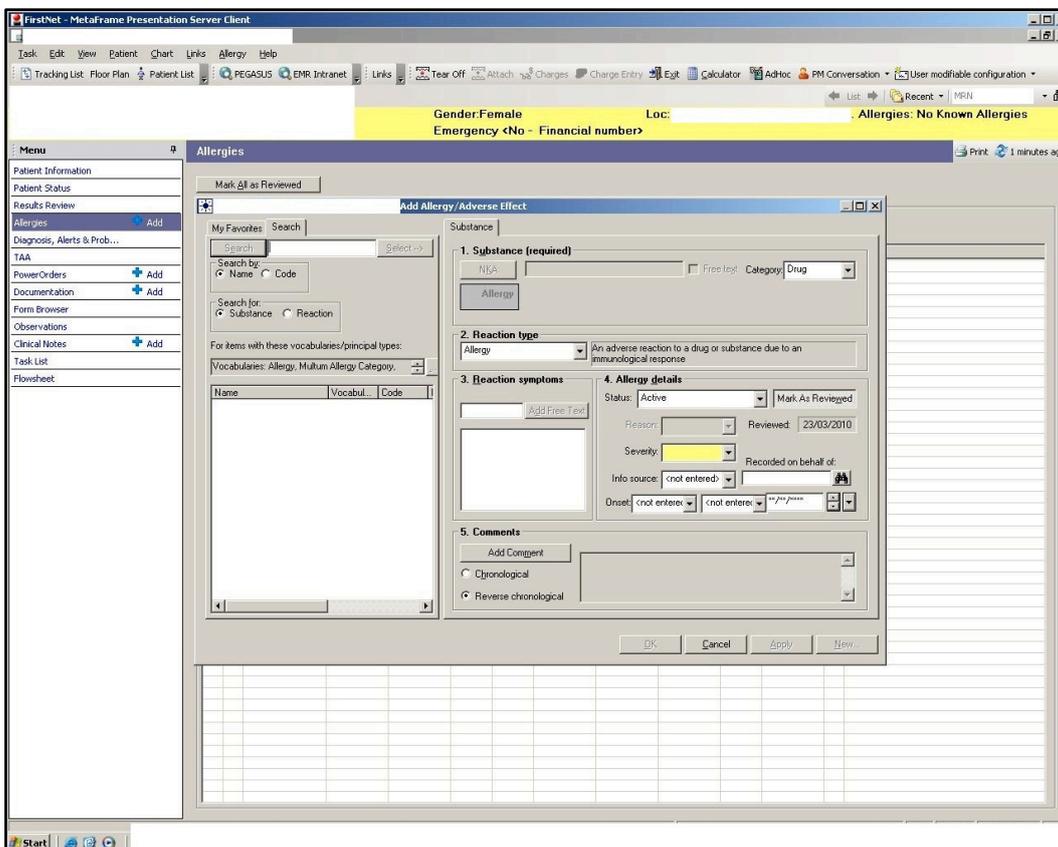
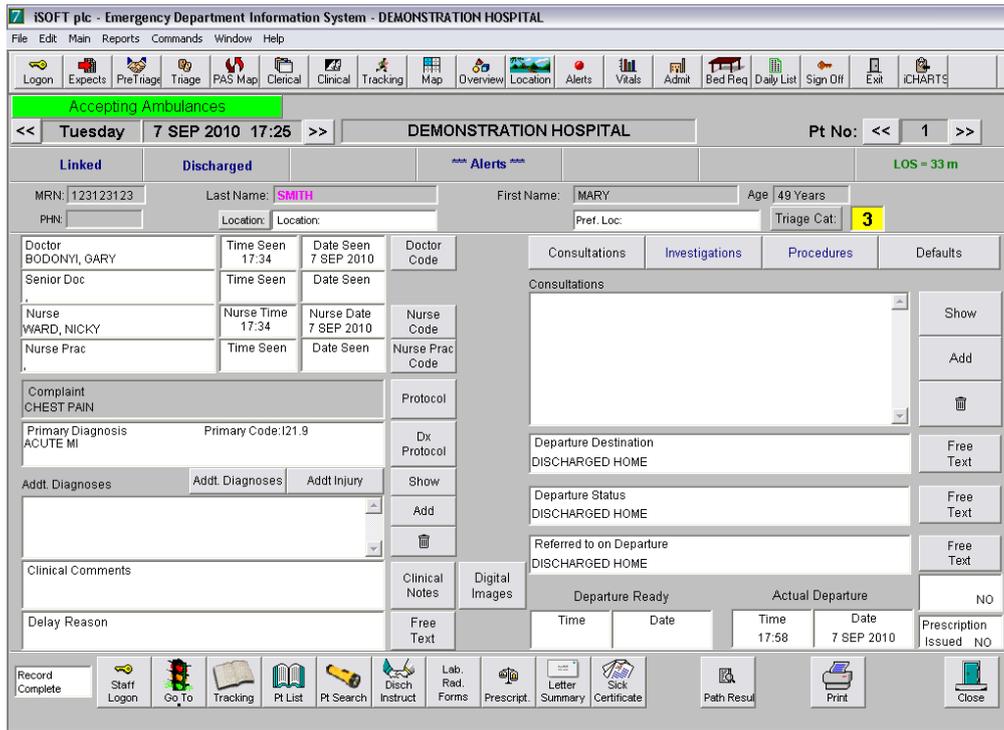


Figure 18. FirstNet Screen: Unnecessarily difficult to Add Allergies window.



**Figure 19.** Clinical interface for touch screen showing a high density of available activities.

### Appendix 3 - Classification of the Issues List with the Directors' Comments

Unfulfilled requirements	H5: System back-up procedure is not very effective. H8: it is time consuming so record is left on paper.
	H2: There are only 51 categorized presenting problems in the clinical screen. Clinicians are not allowed to add more presenting problems. H6: It is a problem, it needs free text. In order to use free-text, physicians always choose 'other'.
	H2: The system is cumbersome and inflexible. H5:The system has some cumbersome aspects. It is not as flexible as people think. H8: On a case where a patient attended the hospital on two consecutive days they could not find the pervious days notes and it took an IT staff member all day to find the patient record.
	H2: The triage categories are not clear enough on the tracking screen
	H2: Comments section: Diagnosis, VMO and ward does not appear on tracking. H8: You cannot find the GP.
	H2: Only the content in the document is printed out without the patient identification and other information. H5: There are some strange print buttons in Cerner's products.
	H6: Useless information listed in the report, irrelevant content.
	H6: They lost the capacity to print the content based on their needs, such as contact number. H8: Does not know. They do not print with FirstNet.
	H8: If you forget a test for a sample, you are not able to add it. You must get another sample from the patient or go to physically go to other pathology department and beg them to add the order.
	H2: Once the clinical staff prepare a fax, they cannot change the destination within the system. H6: True. You cannot identify which GP it goes to.
	H2: The documents are sent automatically after signing. Without signing, the documents will not be stored electronically in an identifiable location. H8: True. They did improve it, but it is still difficult to find the documentation, if it is not on the flowchart. They used to get an unsigned record report and have to chase up doctors, but that is now abandoned. Hundreds of records lost in the first year using of FirstNet.
	H2: System does not ensure that staff enter mandatory patient information.
	H2: The ED had to match their 50 Presenting Problems (Manchester codes) to that of FirstNet which had 250. H8: True. You do not have descriptions of simple diagnoses. When they search for the diagnosis, they may not get the result just because they use different language usage.
	H8: SNOMED descriptions are ridiculous and bizarre with many uncommon items.
H2: The builds of the system are restrictive. H8: True. Impossible to get them change the already built functions.	

	<p>H2: The user cannot use control + c and control + v functions with FirstNet. H8: True. The use of the keyboard short cuts it not consistent from screen to screen.</p>
	<p>H2: The system does not have loaded the paper based clinical documents of patients from its introduction so notes are not entered now.</p>
	<p>H2: The system is costly to support and lacks technical documentation. H5: It is really costly. The system is quite massive. A lot of data is stored in the system, and the data transfer in the system is vast.</p>
Not Parsimonious	<p>H2: Only a small amount of the functions in the CIS are used, some functions will never be used.</p>
	<p>H2: All too frequently the extent of information required to be input into the system is substantial. H8: Now as they have gotten used to the system, the have gotten faster, however they would be much faster if they didn't have it all.</p>
	<p>H8: There are so many different screens, it is difficult to know what to do.</p>
	<p>H2: The tracking list has limited value. Screen icons only show a task has been initiated and does not register that a task is completed.</p>
	<p>H2: Too many screens for patient care. (No. of clicks)</p>
	<p>H2: Too complex to record for a patients day to day information. H8: Nurses should enter all the data into the system, but now they just keep it as brief a possible so they are worthless.</p>
	<p>H2: Too many layers on screens, lots of things buried under other things.</p>
	<p>H2: Need to scroll through 'too much information' to get to the one thing wanted. H8: Agree, its hopeless.</p>
	<p>H2: There are a great number of non-relevant content screens, that have to be clicked through to progress the work. H6: People get through as quickly as possible, e.g. Dr Seen time is not reliable.</p>
	<p>H2: Too many icons: cannot remember all the function of the icons. H6: True, they are complete rubbish.</p>
	<p>H2: Delays in getting things done because of the increased number of steps required to complete tasks. H7 True. H8: Absolutely agree.</p>
	<p>H2: Useless function button in the note screen.</p>
	<p>H2: System is user-unfriendly and un-intuitive. H5: The sub-systems have been designed by different teams in Cerner.</p>
	<p>H2: Triage has to identify the category number by the manual lookup of Manchester codes.</p>
	<p>H2: Multiple admissions on the one day are not separated into DIFFERENT episodes so staff do treat them as differently and don't use the earlier record to be representative of the most recent record.</p>
	<p>H2: Non intuitive and takes time to fill in data.</p>

Lacks Intuitiveness	H2: Triage benchmarks cannot be easily modified. H8: True, hard to get anything changed.
	H2: No correlation between an icon and its purpose. H8: Agree. I don't use them and don't know what they mean.
	H2: Problem with misleading results and incomplete presentation of results. H5: It is a design issue, and you can choose. H6: you can only get the update report, meanwhile losing the original one entirely.
	H2: Tracking patients after discharge has proven difficult and time consuming. Some clerk processing has to be carried out after the discharge has been completed and the flow needed to fulfill this work is too complicated.
	H2: All post discharge results from tests generated from the ED are sent to the ED Director, which is a large number. There is no facility to separate the results into different classes, such as Admitted, Classes of Discharge, Not created in ED, so as to make it faster for the Director to process. H5: They have a five day list. The patient records within 5 days are on the list, and there are usually 400-500 patients. H8: True. Sometimes I used to spend a whole day on the pathology tests.
Limitations to training	H2: Only a small amount of the functions in the CIS are used, some functions will never be used.
	H2: It is far too complicated so it is hard to get ED staff to do anything with it.
	H2: Staff cannot use many of the functions when needed. H6: True. For some functions they do not care.
	H2: System requires a long time for training.
	H2: Staff were told different things by different trainers during training. H6: True. Did not train based on best policies used in practice.
	H2: The system itself is too complicated. H5: Health care is complicated system, therefore, there is not a simple system that could meet all the requirements of the health care. The best way is not to introduce complexity. Only use complex system to meet a complicated system (health care). H8: True. The average needs to Identify, track, order, record clinical data, view results, record diagnosis. Anything else are distractions.
	H2: New staff always forget to log off. H5: It is useless to train the clinicians to remember to log off.
	H2: The HSS try to train the staff to remember to log off before they go to another place during the training sessions. The HSS claim for "The force of the system" to solve this issue. H6: Rubbish. H8: No it won't. In ED, there are so many demands that attending to patients is more important than data entry. Something may happen suddenly, therefore, the clinicians have no time to logoff even if they know they need to.
	H2: Hard to sustain engagement in training and usage with the clinical staff who are accustomed to the windows-based interface. H5: Unusable if you just pick up a clinical system.
Poor Reliability	H2: Missing Information (Note) . H8: Yes, if it hasn't been signed, it will get lost. It frequently happens when you are in the middle of doing something.

	<p>H2: System goes down at any time.</p> <p>H2: Ambulance uses the system to see loads and use it to route to other hospitals.</p> <p>H2: The HIE feed does not work. H8: The data is totally flawed.</p> <p>H2: When the clinical staff are tracking a lot of patients it is very easy to choose the incorrect patient from the list. H8: The screen is fiddly and it is easy to write in the wrong patient note.</p> <p>H2: The completed version has not been tested after modifications from the first UAG testing. H6: Probably.</p> <p>H2: PowerForms (documentation) have issues and have not been tested adequately. H8: True, they cannot use it (No staff use it). In the past they have used the T-System software, which is excellent.</p>
Poor Response Speed	<p>H2: Long systems response time when searching for patients at triage. H5: Does not allow triage nurse to research patients.</p>
Failure to generate awareness when needed	<p>H5: There is no row select.</p> <p>H6: Can't unsort on any column. Shows LOS but not arrival time.</p> <p>H8: When a patient goes to different sections, clinicians need to change screens between different areas to track the patient.</p> <p>H8: For lower triage categories staff need to prioritise the patient who is next to be seen, previously many of the nuances that come from conversations for making a decision were very useful and are now lost.</p>
Poorer system performance from prior CIS experience	<p>H2: EDISV9 broke down only a couple of times over many years</p> <p>H2: Slower than previous system for all functions (i.e. ordering bloods, ordering x-rays, entering diagnosis) H8: FirstNet is much slower than EDIS.v6, and it is even slower than doing it on paper.</p>
Inconsistent	<p>H2: The system has different programming techniques when entering patient information. H8: True. It's a weird setup</p>
Poor data flow/continuity	<p>H2: The clinical notes of the same patient are not saved together thus when a nurse attends a patient who was previously attended by a doctor she has to search for the doctors comments separately.</p> <p>H3: Workaround - Establishing different notes between sites. The same note for 24 hours, all the previous information there are instead of creating a new note. Therefore, only one note per day and the note is clear enough.</p> <p>H8: True, apart from the last 1000 data entries screen which is time sequenced, you must search throughout the notes.</p> <p>H2: Only clerks could start the patient flow, contrary to NSW Health instructions, The normal work flow at the ED starts with the nurse.</p>
Lowers Productivity/efficiency	<p>H2: Already recorded information of waiting patients is lost inexplicably.</p>