A Qualitative Analysis of Emergency Department Nurses' Perceptions of the Effects of an Integrated Clinical Information System

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Abstract

It is essential for emergency department (ED) nurses to efficiently access and record patient information in order to provide treatment to patients, communicate with other health professionals and manage patient flow. Electronic clinical information systems can facilitate improved information access, however few studies have examined whether this potential is being realised, particularly by nurses. This study aimed to explore whether information and communication technology (ICT) improved information access for ED nurses and the impact nurses perceived this had on how they carried out their work. Within a socio-technical framework, a qualitative study design was employed using semi-structured interviews (n=4) and a focus group (n=7) at one Australian metropolitan public hospital ED. The results presented relate to nurses' perceptions of the impact of the technology on one of the themes elicited from the data, namely 'access to information'. Nurses reported that the integrated ED clinical information system made it easier for them to access information, such as test results and previous electronic discharge summaries which had positive effects on patient care and on their roles. This study highlighted the value of technology in facilitating increased volume and improved ease of access to clinical, patient flow-related, knowledge-based and administrative information supporting ED nurses in practicing evidence-based nursing. It reduces the need for unnecessary interruptions of other clinical staff and allows nurses to take on extended roles in patient management.

Keywords: Emergency Nursing; Emergency Service; Hospital Information Systems; Qualitative Research; Interview; Focus Groups

1 Introduction

Emergency departments (EDs) have been shown to be complex communication environments with a fast pa-tient turnaround and team-based care delivery [1]. In this busy environment it is essential for clinicians to efficiently access and record patient information in order to provide treatment to patients and manage patient

flow through the department [2]. Clinicians require information sources that are easily accessible and well organised [3, 4]. A study examining information seeking patterns of a multidisciplinary ED team found that details about individual patients was the most common type of information required [5]. A study in a Canadian ED found that in one third of ED attendances there was an information gap where previously collected information was unavailable to the treating doctor, with the most common gap being in medical history information [6]. Information gaps, such as previously collected information not being available to an ED clinician, have been found to be associated with longer patient stays in the ED [6].

Electronic information systems are being introduced, enhanced and expanded in EDs with the objectives of meeting the needs of ED clinicians in their provision and organisation of patient care. A recent qualitative study exploring attitudes of UK clinical and administrative ED staff towards ED information systems presented a mixed picture with perceptions of both benefits and concerns in the use of these systems [7]. The introduction of ICT in clinical settings has been shown to reduce errors and improve the quality of patient care [8].

The aim of this study was to explore whether ICT improved information access for ED nurses and what impact they perceived this had on how they carried out their work. This study is part of a large, multi-method, multi-site research project examining work practice innovation supported by the use of ICT [9].

2 Methods

2.1 Study design and setting

A qualitative study design was employed using interviews and a focus group to enable an in-depth exploration of nurses' use and perceptions of the ED clinical information system. The use of qualitative methods is recommended to enable in-depth understanding of the use of clinical information systems in complex clinical environments. [10, 11] A socio-technical approach provided a theoretical framework which acknowledges that people, organisations and systems form part of an interrelated network [12, 13]. Nurses are situated within a complex department and organisation attempting to fit information technology into their work routines and communication patterns. The study was conducted in a 280-bed Australian metropolitan public hospital emergency department (ED). The department receives a yearly attendance of 50,000 patients, 74% of whom are discharged. The hospital is part of a large Australian metropolitan Area Health Service which includes ten hospitals and related community health services.

2.2 Participant sample, selection and data collection

Participants were selected purposively with advice from two senior nurses in the ED. Participants were approached face-to-face for participation in the focus group and by email for interviews. Four senior ED nurses were interviewed and one focus group was conducted with seven ED nurses with a range of roles and experience. Data were collected on site between October and December, 2009 by three researchers (NC/JC/JL). The focus group was conducted over one hour and the in-depth semi-structured face-to-face interviews each took approximately 25 minutes. Interview and focus group questions were developed based on a review of the literature regarding the impact of ICT on the work of ED clinicians. The questions centred on how the ED clinical information systems impacted on nurses': work; communication with peers, patients and others; roles; information accessing and recording practices, and patient care. The focus group and interviews were audio-recorded and transcribed.

2.3 Description of ICT at the study site

Electronic clinical information systems in use at the study site were components of the commercially available Cerner Millenium package (software code version 2007.17) developed in the United States. These systems form the basis of the hospital's electronic Medical Record (eMR). Cerner FirstNet (the ED information system) is partially implemented in the ED under study and is used for monitoring patient volumes and tracking patient movement and clinical activities within the ED, with future plans for full nursing and medical clinical documentation. FirstNet acts as the interface through which other Cerner information systems can be accessed, such as Powerchart. Powerchart allows clinicians to place orders for various services such as pathology, medical imaging, diets, and transport requests. Staff can also view diagnostic test results, test order status, images through the picture archiving and communications system (PACS) and discharge summaries from previous ED and inpatient admissions across the Area Health Service. Furthermore, Powerchart facilitates the creation of triage forms and discharge summaries.

FirstNet was first introduced to the ED in 2008. Electronic test ordering and viewing using PowerChart had been in place for all hospital inpatients since 2005. Prior to the implementation of FirstNet, another ED information system was used which was known as the Emer-

gency Department Information System (EDIS). EDIS was an individual database with minimal integration with the hospital eMR. It did not allow clinicians to order and view test results or access other clinical information recorded elsewhere at the hospital or any other facility within the Area Health Service. ED discharge summaries were created in EDIS but these could not be viewed by authorised clinicians outside the hospital's ED.

Since 1997 staff have had access to knowledgebases through the Clinical Information Access Project (CIAP) which they access via the hospital's intranet or since 2008 via hyperlinks from Powerchart and FirstNet. CIAP provides access to resources such as the Monthly Index of Medical Specialties (MIMS). ED staff access the eMR using desktop PCs located throughout the department. Staff use paper-based hospital medical records concurrently with the electronic systems, to record patient observations, medications and progress notes.

2.4 Data analysis

Transcripts of interviews and the focus group were analysed using grounded theory analysis principles [14]. Three researchers (NC/JC/JL) independently coded the transcripts of the focus group and interviews providing triangulation of analysis. The interview questions (the impact of IT on clinicians' work, communication, information access, roles and patient care) were initially used to frame the analysis. The three researchers then discussed their independently derived concepts to agree on a final set which accurately reflected the perceptions of the respondents. Analysis was assisted with the use of QSR NVivo Version 8, 2008. The Nurse Manager of the study Department was sent a summary of the results for member checking in order to validate their content. Ethical approval for the study was granted by the University of Sydney Human Research Ethics Committee (HREC), and by the Area Health Service and site HRECs.

3 Results

3.1 Demographics of participants

Interviews were conducted with four senior nurses (one male and three female) working in the ED: the Nurse Manager of ED; an Acting Clinical Nurse Consultant; a Nurse Practitioner; and a Nurse Educator. The focus group was conducted with seven nurses with experience working in the ED under study ranging from one to 20 years. They held a range of roles including a Clinical
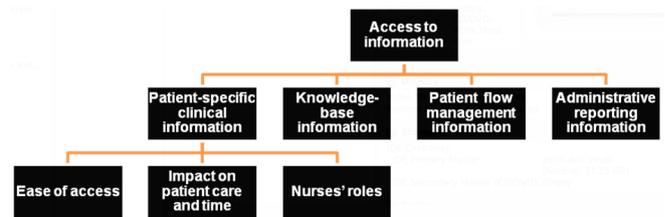

Figure 1: The theme 'access to information' and its sub-themes

Nurse Unit Manager, a Nurse Educator, a Clinical Nurse Specialist and four Registered Nurses. The results presented relate to one of the major themes emerging from the nurses' focus group and interviews, namely *'access to information'*. Information was categorised into: patient specific; knowledge-base; patient flow management, and administrative reporting information (Figure 1). Under patient-specific clinical information we further categorised into three subthemes: ease of access; impact on patient care and time, and nurses' roles (Figure1). The sub-themes within 'access to information' and their definitions and sub-categories are shown in Table 1.

3.2 Access to patient-specific demographic and clinical information

Ease of access Table 2 shows direct quotes by nurses from the focus group and interviews to illustrate their views regarding access to patient-specific information when using the electronic clinical information systems. Most nurses reported that by using the FirstNet system they were able to more easily access patient-specific information including patient demographics, test results and previous medical histories from electronic discharge summaries, compared to their experiences with the previous EDIS system (Table 2). Access to electronic discharge summaries was seen as a key advantage of the system by many nurses. These discharge summaries were available for all patients discharged from any ED or ward area in the Area Health Service. The Area-wide nature of the system allowed the nurses to view patients' presentations at all other EDs in the Area, including accessing their triage category.

Impact on patient care and time Nurses perceived that the ease of access to clinical information had improved patient care (Table 2). Some nurses commented that the electronic discharge summary meant that clinical staff (mainly doctors) spent increased time entering data, but they acknowledged that the time spent resulted in more complete and clear information for themselves and their colleagues to access. Nurses were able to access trends across time as opposed to viewing individ-

Information types	Definition		Definition
Patient-specific clinical information	How access to patient-specific information through the ICT impacts on ED nurses' work practices.	Ease of access	How the ease with which patient-specific information can be accessed through ICT changes work practices.
		Impact on patient care and time	Changes in patient care delivery and nurses' time related to accessing patient-specific clinical information using ICT.
		Nurses' roles	Changes in nurses' work roles and responsibilities due to their use of ICT.
Knowledge-base information	How access to information through ICT as textbooks, journal articles and guidelines impacts on ED nurses' work practices.		
Patient flow management information	How access through ICT to information that assists with managing patient flow through the ED (eg. bed allocation, returned test result alerts) impacts on ED nurses' work practices.		
Administrative reporting information	How access through ICT to administrative information (patient throughput, key performance indicators) impacts on ED nurses' work practices.		

Table 1: Access to information, its subthemes and their definitions

ual patient presentations in isolation. Nurses reported that this and the access to patient encounters from other hospitals in the Area Health Service allowed them to provide more holistic care through consideration of a more comprehensive patient history. The nurse practitioner in the ED (Nurse C) reported that her faster access to information allowed her to see patients sooner, thus saving time and potentially improving the timeliness of care delivery. However, it was reported by some that nurses had to go through more steps to locate forms in the system compared to paper.

Nurses' roles Nurses commented on their changing roles in the ED which were supported by the clinical information systems. They reported that they could refer to the clinical information system when questioning a doctor about the care of a patient. They felt that having access to the same information as the doctors enabled them to challenge a doctor if they felt this was required. Nurses did not report any problems with the concurrent use of paper-based and electronic records when accessing information, however one nurse did comment that documenting in both the paper-based record and electronic record increased workload.

3.3   Access to patient flow management information

The clinical information system allowed nurses to have an overview of patient care and their path through the ED (Table 3). One particular feature of FirstNet that nurses reported assisted them in this was that they could easily see which doctor was looking after which patient. Some doctors used a patient plan function in the system which allowed nurses to be aware of the care intended for a patient, enabling them to access the information they required, preventing interruptions to the doctor. Nurses also reported that there were system functions which allowed them to keep track of laboratory and imaging investigations ordered and the stage the orders were at, whether requested, in progress or completed with results available.

3.4   Access to knowledge-base information

Nurses reported that they used the Clinical Information Access Project (CIAP) system for knowledge-based information retrieval (Table 3). CIAP is a New South Wales Department of Health initiative which provides online access to clinical resources for all clinical staff to enable access to knowledge databases for information regarding diseases, treatment guidelines and medication information from resources such as MIMS. Nurses in the focus group also reported that they accessed policies from the Area-based intranet. Participants felt that clinical knowledge was now easily available to nurses when they needed it.

Sub-themes	Quotes
Ease of access	"I am more likely to look up blood results and stuff like that because they're right at a click of a button basically" (Focus group nurse)
	"...if we get representations you quickly have a flick through it so you can tell whether they're telling the right story or not and see what happened last time" (Focus group nurse)
	"Just the fact that you can actually just log in, pull up a patient now and get a basic idea of why they presented and what the plans were. . . without having to go to the effort of getting CID [Clinical Information Department] and pulling patient's notes and reviewing files and stuff. You get a lot of information from the system." (Nurse A)
	"...in EDIS really all you could get was a triage sheet, a discharge summary for the patient, for that presentation whereas FirstNet if you go into the patient you've got all their discharge summaries. If they're an obstetric patient you've got their antenatal booking stuff, you've got their deliveries, like their postpartum stuff, their discharge summaries for all that sort of stuff." (Nurse A)
	"We can check why this person presented at [another hospital in the Area Health Service] two days ago. We can check what their triage was, we can check what their discharge summary was I mean so that in itself, that's good." (Focus group nurse)
Impact on patient care and time	". . . ease of access to things like you can't say that it hasn't helped patient care because like we can get to bloods whenever we want . . . " (Focus group nurse)
	"...with discharge summaries they're spending more time in front of the computer. But the benefits are you're getting a more comprehensive discharge summary. You're getting something that you can actually read. It hasn't got doctors' handwriting over it and so from that point of view it's much better" (Nurse A)
	"I think it impacts on patient care positively because basically things are done more quickly. . . in my role I can find out information more easily. . . you can look up previous discharge summaries. . . so you know what's going on with the patients more thoroughly so yes, we're spending more time in front of the computers but I think it's showing a more well rounded picture because you can read those things. You know, I think it's better." (Nurse B)
	"I can see on the screen, who's waiting and what their problem is, and I can flag them up, see them as soon as they get here or triage can come and get me and I can go out and instigate their stuff a lot quicker. So their access to care is quicker" (Nurse C)
	"...accessing the clinical forms in the FirstNet is not as easy as it used to be, yeah so there's actually a 4 or 5 step process to actually get into see the chart. So if we went fully electronic medical records you'd have the patient's name and their triage category. If the doctor wanted to actually read the triage to see what was wrong with the person it would take them, I don't know, 30 seconds say to actually get into it with a few clicks and stuff to actually find the triage and actually be able to read it before they went to see the patient." (Nurse A)
Nurses' roles	"...technology does back you up. . . " (Focus group nurse)
	"You're not afraid to challenge [the doctors] if you look at something and go this isn't right. You can go well I know this isn't right because of A, B, C and D and you go to them and say well I don't agree with that and this is my reasoning why and just being able to challenge their thinking" (Focus group nurse)

Table 2: Quotes from ED nurses regarding access to patient-specific information when using ED electronic clinical information systems

Sub-themes	Quotes
Access to patient flow management information	"I think the benefit with it though over EDIS is rather than walking around and asking seven doctors 'are you seeing this patient?' you look on the screen oh you own that, you go and see that doctor directly" (Focus group nurse)
	"Some of [the doctors] will put a plan like what we're waiting on down the list of the patients... so you don't have to specifically go and find them and interrupt them from what they're doing... you've got a bit of an idea what's going on" (Focus group nurse)
	"We've also set up a system here that the other hospitals haven't got with radiology which we use a coloured dot system to whether they've got the request, whether they've performed the request and whether results are available. So yeah, from that point of view it's quite good." (Nurse A)
	"When we put a request on the system it comes up with the little nuclear sign. When [the] radiology clerk gets the request...and process[es] it, it turns green. They change it to green which means they've got it and it's been processed then once the person's actually had the exam the radiographers change it to a black dot. So if there's a black dot next to the patients it means that their radiology things are complete. So it's similar to the pathology one which keeps count of where we're up to." (Nurse A)
	"...it comes up on the system that it's been ordered and then it's not a double order of tests so you know what people have done and you can check what people have done, which I think that's a good thing, you know." (Nurse B)
Access to knowledge-base information	"...a lot of people use the MIMS on it a lot." (Focus group nurse)
	"[CIAP is used by] a lot of people that are doing any sort of research." (Focus group nurse)
	"...before I used to go to books... for looking up diseases and processes and care of things... now you just look it up on the internet..." (Nurse B)
Access to administrative information	"...a lot of it's instantaneous and a lot of it you can actually do while sitting in the office..." (Nurse A)
	"from a management point of view and managing [Key Performance Indicators], the timing and stuff that the system's allowing makes it a lot easier so... you know... exactly how long your patients have been here down to the minute, where they're up to in the process, what they're waiting for." (Nurse A)
	"Everything has to go through Area and it's taking a long time to actually get reports that actually function and a lot of issues with the reports in FirstNet at the moment" (Nurse A)
	"If the reports were built and functioning it would be [easier], but EDIS was easier that we could develop our own reports and put in our processes and pull our own information depending on what we needed and it was very easy to create reports and run them whereas FirstNet it's not so easy... Well it's impossible at the moment." (Nurse A)
	"...a computer system that we can't get any reports out of? That's not telling us what we really want to know..." (Focus group nurse)

Table 3: Quotes from ED nurses regarding access to patient flow management, knowledge-base and administrative reporting information when using ED electronic clinical information systems

3.5 Access to administrative reporting information

The senior nurses, in particular, presented their perspectives on how ease of access to administrative information assisted them in their management of the ED (Table 3). The Nursing Unit Manager was able to access relevant information whilst in his office in relation to the number of ED patients waiting to be seen and their triage categories, which was invaluable in the managment of the department. It was commented however, that the current reporting functions in FirstNet required further development.

4 Discussion

This study showed that an Area-wide integrated ED clinical information system, provided nurses with improved access to information. The increased volume of information and the ease of access to patient-specific clinical information, knowledge-bases and administrative information supported them in evidence-based nursing practice. Access to patient information from multiple sites and across time, particularly from online electronic discharge summaries allowed nurses to build a more complete picture of the patient, filling gaps in information which have been shown to contribute to shorter stays in an ED for non-admitted patients [6].

Using a socio-technical approach [12, 13] allowed us to examine nurses' perceptions of how accessing information using the electronic clinical information systems impacted on work practices within the social and organisational context of a fast-paced ED environment, involving communication with other clinicians in order to provide and organise patient care. In addition to the benefits of ease of access to patient-specific information, many nurses commented on how their needs for patient management and administrative information were supported by the clinical information systems, thus meeting the needs of nurses as identified in other studies for both patient-specific and organisational information [5] to support them in their work providing and organising patient care [2]. Nurses reported that access to knowledge-bases supported the nurses in practicing evidence-based nursing. Improved access and use of CIAP has been shown to improve the accuracy of nurses' answers to clinical questions [15, 16], and our study shows that nurses access and use CIAP.

Improved access to information through the systems may also prevent unnecessary interruptions to colleagues in the ED. Hospital nurses have previously reported the importance of being able to easily identify which doctor is looking after which patient [3]. In our study nurses reported being able to easily access this information, as well as sometimes more detailed patient care plan information entered by the doctors, using the information system as an asynchronous communication tool [1], reducing the need to interrupt the doctor. Interruptions to ED doctors have been found to occur several times an hour [17], and reducing them may reduce errors [18].

With information to back them up, nurses reported that they were able to take on different roles in patient management. With access to the same information as doctors the nurses perceived that they had increased autonomy. In a previous study nurses reported that better access to organised information through an ED information system enabled them to use their expertise and provided them with increased work satisfaction [4]. It has been claimed that one of the unexpected consequences of ICT implementations has been shifts in the autonomy of clinicians [19], and our study highlights nurses' expanding roles occurring with increased access to information in clinical information systems.

Nurses' improved ability to easily access diagnostic test results is important given that due in part to high patient turnover and team-based care, EDs have been identified as environments where there is an increased risk of failure to followup test results potentially leading to delayed or missed diagnoses occuring [20, 21]. A systematic review recently reported that lack of follow-up for patients treated in the emegency department ranged from 1.0% to 75% of tests with impacts on patients ranging from inappropriate antibiotics prescribed to missed cancer diagnoses [20]. Studies have shown that nurses can play an integral role in test-result follow-up [22, 23] and our results indicate that an integrated ED clinical information system could facilitate this process.

This study builds upon previous work undertaken during earlier stages of system implementation [24, 25], making valuable contributions to the evaluation of ED information systems across time. This work presents useful and new insights into nurses' views on how improved information access through an integrated Area-wide clinical information system changes their work, roles in the ED, communication with colleagues, and improves their organisation and provision of patient care.

4.1 Limitations

This study was qualitative and undertaken in one ED so results may not be generalisable to other settings. We have presented one theme which arose from the analysis. Other themes arose and will be presented in further publications. This study was conducted at one point in

time during the implementation, and it will be important to examine the use of clinical information systems over time. This study is being performed in conjunction with modelling of longitudinal quantitative ED data which will allow measurement of the impact of the systems over time and across ED settings. This quantitative data will include diagnostic test turnaround times, as well as patient throughput indicators over time and at multiple sites. In combination, these approaches will allow measurement of key performance indicators alongside a broader understanding of their impact elicited from interviews.

5   Conclusion

An Area-wide integrated ED clinical information system provided nurses with increased access to clinical information, patient management information, knowledge-base information and administrative information, supporting them to provide evidence-based care of patients. The increased information access also allowed nurses to play larger roles in patient management and reduced the need to interrupt doctors.

Acknowledgements

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