Clinician Reports of the Impact of Electronic Ordering on an Emergency Department

Andrew GEORGIU ¹, Johanna I. WESTBROOK
Health Informatics Research & Evaluation Unit, Faculty of Health Sciences,
The University of Sydney, Australia

Abstract. The importance of health informatics evaluations adopting a pluralist approach which considers the technical as well as the organizational and social aspects of system implementation has been espoused by many researchers. Kaplan’s 4Cs evaluation framework presents a lens through which evaluations of clinical systems can be assessed, with a focus on communication, care, control and context. Our aim was to investigate the effects of Computerized Provider Order Entry (CPOE) on Emergency Department (ED) work, communication practices and patient care using this framework as a means to orient the study. A qualitative study using interviews and focus groups was undertaken in an Australian 640-bed ED after the introduction of CPOE. Systematic concurrent analysis revealed five themes: i) Expectations; ii) Changes in responsibility; iii) Monitoring of the test order process; iv) System usability; and v) System requirements. CPOE systems in EDs present specific challenges which differ from other hospital departments. Due to the critical nature of clinical work in this setting a poor fit between CPOE and ED work may result in serious incidents.

Keywords. computer order entry, emergency medicine, evaluation studies, hospital information systems, pathology

1. Introduction

Computerized Provider Order Entry (CPOE) incorporates a wide spectrum of systems including laboratory and imaging investigation, procedure and consultation ordering, and medication management. CPOE systems are widely promoted for their potential to improve the quality of care delivery. Their effect on Emergency Departments (EDs) has received little research attention [1]. ED is uniquely positioned at the crossroads of information flow within the hospital providing a portal into health care delivery [2] and thus a valuable setting for evaluating the consequences of CPOE.

A growing number of system evaluations have sought to investigate contextual factors such as the organization of work and culture. But the utilization of existing theoretical frameworks, themselves based on previous evidence, to advance the evaluation process, is not common [3]. Kaplan’s 4Cs [4] framework emphasises the interaction between technology, people, tasks and organizational structure and draws...
attention to: 1) Communication – the way departments linked by computer interact; 2) Care – the effect on care delivery; 3) Control – impact on the management and organization of the department and hospital; and 4) Context – background, setting and culture that impacts on system functioning. Our aim was to investigate the effects of CPOE on ED work, communication practices and patient care using Kaplan’s 4Cs as an orienting framework.

2. Material and Methods

2.1. Design and Setting

The research comprised focus groups and interviews, observation and analysis of documents, to provide rich, in-depth contextual data about clinicians’ experiences of the introduction of the CPOE. The study site was the ED at a 640-bed teaching hospital in Sydney. The ED has a 66-bed capacity and is one of the busiest in Australia averaging around 150 to 180 patients per day. In January 2006, the hospital began implementation of the Cerner Millennium PowerChart (Version 2004.01) system that allows clinicians to electronically place orders including for pathology and radiology tests. This study was carried out during the period May to August 2006, four months after system implementation. The research was approved by the relevant university and Area Health Service ethics committees.

2.2. Data Collection

Seven semi-structured interviews were held with three senior ED doctors along with one focus group of six ED doctors and four separate focus groups involving 16 registered nurses. Chain referral sampling was used to identify and extend the participant base. This involved using individuals as informants to direct the research team to other potential participants. The extension of the participant base was ended after it became clear no new material was emerging. Participants were asked questions about their expectations of the new ordering system; any unexpected consequences or alterations in the way they relate to clinicians and/or patients; the impact on care delivery and what could have been done differently with hindsight.

2.3. Analysis

This study utilised concurrent analysis techniques involving two researchers (AG and JW). This required regular reviews of all interview data, the organization of emerging categories and the identification of possible relationships or patterns. NVivo software was employed for the initial open coding of all data. Grounded theory techniques [5] used incoming data to continuously refine initial categories. This led to the enhancement of analytical themes relevant to the research question at hand. This was followed by the comparison and categorisation of the themes according to Kaplan’s 4Cs framework. In this way the framework was also used as a lens with which to help interpret the results.
3. Results

Analysis of the data revealed five themes presented below along with exemplar verbatim quotes.

3.1. Expectations

The majority of participants (both doctors and nurses) reported that they did not have great expectations of the new CPOE system:

We’ve worked with computer systems here for years now and they’re not foolproof. You’ve got down time, there’s a lot of things, so I didn’t really have the expectations of it, that it would be the solution to our problems. (ED Registered Nurse)

3.2. Changes in Responsibility

Many of the doctors interviewed referred to changes in the way that tests were ordered, noting the shifts in responsibility for some tasks. For example, questions routinely asked of patients by service departments now became the duty of the treating clinician. Nurses reported an increase in their responsibilities as the system provided protocol-driven procedures allowing them to order tests which they had not been permitted to do before. They believed that this had made the patient care process more efficient.

3.3. Monitoring the Test Order Process

Doctors expressed concern that the integration of CPOE with the results reporting system hindered their monitoring of test orders. In their old results reporting system the status of each test was immediately flagged as “to follow” the moment it was logged. The new system configuration only provided information about the test after a result was ready. As test results can often determine the immediate course of action in ED, sometimes between whether a patient should be admitted or discharged, this system design feature had potentially serious safety consequences.

The situation that I was involved in was with somebody who was vomiting blood. He admitted to drinking a little bit, and his bloods came back and had everything there except the two AST [Aspartate aminotransferase] and ALT [Alanine aminotransferase] part of the liver function test, but they had everything else, and it looked on a casual glance like a full set of liver function tests. Three hours later, the AST and ALT come back on the computer and they’re 10,000! By this stage, I’m on the phone, but there’s been nothing on the computer screen to say we’re doing these tests, they’re to follow. They just don’t show up. (ED Registrar)

3.4. System Usability

Clinicians drew attention to the “cumbersomeness” and “inefficiency” of the new system. Numerous screens and tick boxes prompted clinicians for “unnecessary” information. Figure 1 provides an example of a screen which asks the ordering clinician for information about pregnancy regardless of the sex or age of the patient.
3.5. System Requirements

A common theme among participants was the importance of designing systems that adequately address the specific context and needs of each setting.

What people didn’t realise was that different environments require different programs, and different tweaks to different programs, and they have different needs and necessities. (ED Staff Specialist)

![Figure 1. Screenshot of information required about pregnancy which appears regardless of patient age or sex](image)

There was a strong desire for greater consultation about the design of the system. The commonly held perception was that a lot of mandatory fields had been introduced without appropriate consultation with clinicians about their value or effectiveness.

3.6. Kaplan’s 4Cs Framework

Each of the five themes were conceptualised in terms of Kaplan’s 4Cs framework – the impact of the CPOE system on communication within the ED and other hospital departments; its relationship to care delivery; its effect on control within the hospital; and areas where the impact is reliant on the practice setting or context (Table 1).

<table>
<thead>
<tr>
<th>Theme</th>
<th>Communication</th>
<th>Care</th>
<th>Control</th>
<th>Context</th>
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<td>Expectations</td>
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<td>Changes in responsibility</td>
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<td>Monitoring the test order process</td>
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Two of the five themes were related to both a) communication and b) delivery of care. In both cases the communication issues (e.g., repetitive screens, monitoring of the test order process and efficiency) were also associated with the provision of care. Control within the hospital was affected by responsibility shifts (e.g., doctors being allocated new tasks) or work process changes (e.g., nurses ordering). Similarly, the “System requirements” theme addressed issues of control, and responsibility for decision-making. In many cases this was shown by concerns that the system had been set up on the basis of system provider expectations rather than user needs. The contextual themes include those that may impact on the utilisation of the new system (e.g., prior expectations and busy schedules), highlighting the complexity of ED work practices.
4. Discussion

This study is among the first to report experiences of CPOE in an ED setting. Our use of an existing framework enabled us to collect and analyse rich qualitative data that provided insights into the unique situation of study participants and the ED setting. The advantages of CPOE can be dependent on a range of context-specific factors [6]. What may appear as useful for one department may not be for another. The introduction of electronic decision-support in EDs can be challenging, particularly if the support is not seen to be achieving intended goals and causing frustration and slowing down work [1]. These concerns have prompted the call for the selective and gradual deployment of patient- and context-specific decision support carried out in consultation with clinical users with careful attention to their possible effect on workflow and the ED culture [7]. The inability to know instantly what tests have been ordered and at what stage in the laboratory process they are at can lead to confusion and have major consequences for patient care [8]. Badly designed interfaces (e.g., fragmented displays that prevent a coherent overview) can lead to cognitive errors [9] such as the misinterpretation of information, resulting in substandard care.

5. Conclusion

CPOE presents challenges for the ED setting different from other hospital departments. It is imperative that system planners give due consideration to the potential for CPOE to affect (possibly adversely) the delivery of patient care; and carefully consider the likelihood of dysfunctional shifts in work responsibilities and clinical practice.

Acknowledgements. The authors thank ED staff. The research was supported by an Australian Research Council Grant LP 0989144 and a Commonwealth Department of Health and Ageing Quality Use of Pathology Program (QUUP) grant.

References