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What effect does electronic ordering have on the organisational dynamics of a hospital pathology service?

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Abstract

The aim of this triangulated (multi-method, multi-setting, multi-staged) study was to identify the consequences of an electronic ordering system on the functioning and organisational dynamics of a hospital pathology service. The study was carried out in five pathology departments during the period August 2005 to April 2006. It included five focus groups involving 21 participants and 67 interviews with 38 participants, along with a total of 21 hours of observation. The findings revealed three key themes with implications for the functioning and organisational dynamics of the pathology service. These included: a) work process changes that affect the output of the pathology laboratories; b) temporal considerations, particularly as they related to efficiency of laboratory processes; and c) communication channels and the resulting changes in the mode of information exchange and communication. These themes emerged from a close analysis of the contextual setting of each department. Successful CPOE implementation should be premised on a solid understanding of the organisational, communication, information and temporal circumstances in which the system will operate.

Keywords:

Computer order entry, Evaluation studies, Hospital information systems, Pathology, Qualitative research

Introduction

Pathology services are made up of a complex array of organisational structures and laboratories, each with idiosyncratic work practices and specialised test procedures contributing to the prevention, detection and management of disease [1, 2]. Historically, pathology has been at the forefront of health information and communication technologies (ICT) innovation [3, 4]. This is because of the significant contribution that ICT makes to the management of the service's information-intensive work processes.

In the past, the impact of new pathology systems (eg, the introduction of a new laboratory information system) has generally been confined within the boundaries of the department, helping it to improve efficiency and effectiveness. The difference with Computerised Provider Order Entry (CPOE) is that it is not laboratory centric, but incorporates a wide spectrum of systems including imaging, clinical procedures, consultations and medications along with clinical documentation systems, which by definition increases interaction and integration across hospital departments by facilitating greater access to shared information and expanded communication channels [5]. New ICT systems such as CPOE have the potential to act as catalysts for changing interactions within the hospital, affecting the nature and definition of jobs and work processes [6]. To date these areas of impact have received limited research attention [7]. The aim of this qualitative study was to identify the key consequences of CPOE on the functioning and organisational dynamics of different departments of the pathology service through a comparison of work processes before and after implementation of the system.

Material and Methods

Research setting

This research was carried out in a pathology service employing over 300 staff located at a major metropolitan tertiary referral hospital in Sydney, Australia. The service covers a broad suburban network comprising seven major hospitals. In November 2005 the pathology service's laboratory information system was replaced by the Cerner Corporation's (Kansas City, USA) Pathnet system which automates clinical and managerial pathology data processes. This was integrated into a hospital-wide PowerChart (version 2004.01) in January 2006. Ethics approval for the study was provided by the relevant Area Health Service ethics committee.

Research design

The study was carried out across five pathology departments (Clinical Chemistry, Haematology, Central Specimen Reception, Microbiology and the Blood Bank) during the period August 2005 to April 2006. It included five focus groups involving 21 participants and 67 interviews with 38 participants. Four focus groups and 10 interview sessions were transcribed resulting in 232 A4 pages (94,198 words). All initial focus group and interview sessions were semi-structured and used a set of questions which explored participants' understanding and expectations of the new system, along with the impact they expected the system to have on their work and

relationships with professionals across the hospital. These initial expectations were then followed up as a means of exploring what happened, how it happened and why it happened following system implementation. The interviews and focus group discussions were supplemented by 22 observation sessions amounting to 21 hours.

Participants in the study were chosen on the basis of their experience and knowledge of the topic under investigation and their potential to help in the testing and scrutiny of emerging hypotheses [8]. This included 24 laboratory scientists, 18 technicians and 11 other pathology and management staff.

Analysis

Data collection and analysis were carried out concurrently and used NVivo 2.0 software to initially code transcriptions and then refine them into analytical levels related to the research aim. All quotes presented in this paper are provided verbatim as a means of conveying the contextual richness of the findings. A research log containing observation and interview recordings along with reflections on the investigation process was maintained throughout the course of the study. Closure was achieved when it became clear that sufficient data had been gathered to render the study phenomenon coherent and explicable [9]. Further data collection would have realised redundancy.

Results

Contextual make up of pathology settings

The Central Specimen Reception (CSR) can be described as the receiving dock for pathology laboratory specimens. It is also responsible for organising the collection of specimens from patients across the hospital by a team of blood collectors. Specimens are passed on to departments such as Clinical Chemistry and Haematology. Clinical Chemistry undertakes the analysis of blood and other body fluids from chemical components, while Haematology is the study of blood and its cellular elements. Both departments deal with a large proportion of urgent and life threatening tests, the bulk of which emanate from critical care units and the Emergency Department where patient treatment is often reliant on laboratory results. This means that issues like turnaround time (the time taken for a request to be processed and a result issued) are an organisational priority.

In contrast the Microbiology department deals predominantly with diseases caused by infectious agents (eg, bacteria, viruses, fungi and parasites). These agents require time to grow before an appropriate test result is available. Consequently, for Microbiology the concept of timeliness has a different contextual meaning from that of the Clinical Chemistry or Haematology department. The role of the Blood Bank is to provide compatible blood components for patients. This involves blood grouping, antibody screening and identification and pre-transfusion testing. For both departments the existence of robust communication channels with clinicians is an important aspect of their work. In the Blood Bank this meant a high reliance on the telephone and fax machine to order, confirm and send blood products. For Microbiology, their communication channels include the provision of reliable patient-centred information which can make a vital contribution to the department's test analysis, interpretation and reporting.

Changes in work practices

For CSR, the new system had minimised their previously cumbersome data entry tasks and enhanced the efficiency of work processes leading to improved levels of data accuracy and fewer incidents of test request duplication. These work process improvements were particularly evident in the changes that occurred in the department's blood collection procedures (see Table 1). In the past the collectors headed straight off to the wards where they were required to sort and verify the handwritten requests, identify any duplicates and then take blood specimens from patients which entailed a number of handwritten tasks. The new system provided a printout to the laboratory eliminating the need to sort out any duplicates. While this new procedure slightly increased the amount of time collectors spent in the laboratory to identify and organise their print outs, it resulted in the removal of a number of handwritten procedures leading to a significant decrease in the time spent on the wards. Blood collectors also reported that the new system eliminated the need to handwrite patient information and identification details through the provision of printed labels which they felt significantly reduced the possibility of making a mistake.

Table 1- Representative selection of verbatim quotes from participants

Work practices	"So even though it seems more time consuming, when they get to the ward it's a quicker process." (CSR participant)
Temporal considerations	"A lot of our work is STAT [urgent and life threatening] work, so the turnaround time is expected to be within the hour for the majority of the work. Biochemistry [Clinical Chemistry] have that issue as well". (Haematology participant) "We did try to flowchart all the processes in the lab. It was a horrendous exercise… We had to do it to try and build a new system" (Clinical Chemistry participant)
Communication channels	If it is ordered by phone or fax you know straight away, but if it is ordered electronically it will just sit in the 'end list'… (Blood Bank participant) "Do you see us … sitting reading plates and looking up the whole of the patients' clinical notes? (laughter)" (Microbiology participant)

Temporal considerations

The elimination of previous data entry requirements for the laboratories was also associated with a major decrease in the time it took the laboratory to produce a result that was available to clinicians. For the Haematology and Clinical

Chemistry departments timeliness is an essential component of their work and was one of the indicators which they identified as key to judging the impact of the new system (see Table 1).

Both departments are also subject to a complex array of organisational factors and procedures that affect the temporal flow of the laboratory process. For instance, Haematology and Clinical Chemistry are required to service several hospitals across a large metropolitan area. These hospitals have different levels of laboratory capacity. Some periphery hospital laboratories do not carry out coagulant testing while others do so only in urgent cases. The task of ensuring the temporal coordination and efficiency of laboratory work is a major task which involves a processing cycle designed to ensure that specimens are delivered to the appropriate laboratory within the correct timeframe. Failure to do so means that a courier run may be missed and the laboratory is forced to either perform extra work on site or else arrange for special (usually expensive) transportation to ensure delivery of a specimen. Participants reported that it required a major effort to identify and detail these procedures in a flowchart in order to ensure the smooth transfer, to the new electronic ordering system (see Table 1).

Communication channels

In some cases the new system involved a shift from previous synchronous communication channels (eg, telephone calls) to asynchronous channels involving standardised orders and electronic messages, which can represent major challenges for previously existing pathology processes. For the Blood Bank, the asynchronous character of electronic ordering of life-critical blood products was delayed because of department concerns that an asynchronous order may go unnoticed (see Table 1). The Blood Bank concern about asynchronous communication channels contrasted with that of the Microbiology department who were concerned that the new system's ability to improve communication across the laboratory – ward interface should not lead to the transmission of enormous volumes of irrelevant information where a lot of data is transmitted irrespective of its context or value (see Table 1).

Discussion

An organisational and communication perspective

The findings from this study reveal three key themes which have implications for the functioning and organisational dynamics of the pathology service. These include a) work process changes that affect the output of the pathology laboratories; b) temporal considerations, particularly as they related to efficiency of laboratory processes; and c) communication channels and the resulting changes in the mode of information exchange and communication. These categories emerged from a close analysis of the contextual setting of each department, their contrasting and interconnected scientific and organisational tasks and the role they play in the pathology test order process [7]. This process begins with a clinician's decision to issue an order, its collection and passage through the laboratory process and subsequent test result application as depicted in Figure 1.

Pathology services, like those in other parts of organisations, can be defined as vehicles for converting inputs into outputs. What this study shows is that the production of outputs, in this case laboratory test results, involve aspects of information processing, communication and organisation all carried out within a unique temporal framework [10].

Planning, organising and controlling the pathology work environment

The introduction of electronic ordering has important consequences for the work of pathology services and their role in the delivery of healthcare. New technologies like electronic ordering greatly enhance the speed of communication, provide the potential for higher volumes of data to be transferred, and allow the linkage and storage of information across multiple sources [11]. Prior research has shown that whilst this opens up the possibility of significant benefits including efficiency gains, [12] work innovation [13] and greater effectiveness [7], there is also the risk of the unintended consequences leading to the introduction of potentially dysfunctional work practices [6, 14].

Our results showed significant advantages of electronic

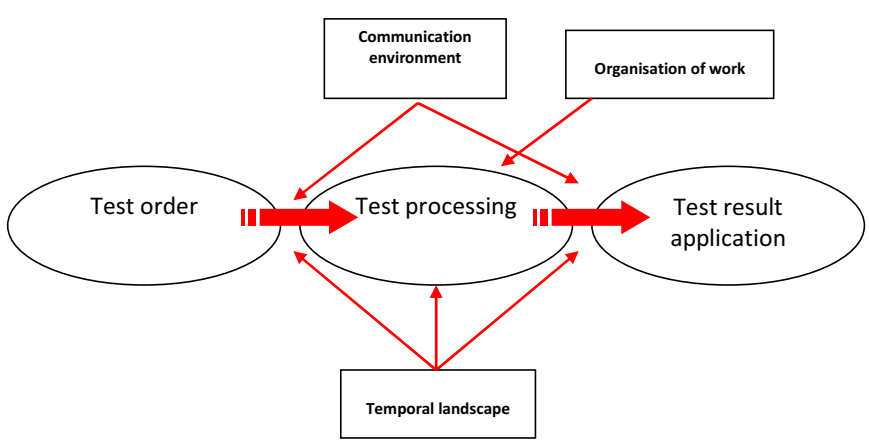

Figure 1 - The organisational, communication and temporal implications of CPOE

ordering leading to improved efficiency (elimination of data entry tasks) and safety (less handwritten errors). However, they also revealed that some features of the new system may lead to unexpected features as in the case of the Blood Bank's concern about a potential failure to be notified of an urgent blood product.

Communication environment

The idea of providing data and information to the right people at the right time and place is a key feature of most new information and communication technologies. However, a case study by Davidson and Chismar of a private, urban, acute care unit using in-depth interviews, showed that the structuring and formalisation of data in electronic ordering systems has the potential to create ambiguity and uncertainty about orders [15]. As the findings of this study highlight, the availability of masses of information to the Microbiology laboratory was not a guarantee of its appropriateness and usability. Information exchange should not neglect the social context which provides information with its meaning and importance [16]. Berg and Goorman assert that data are always produced with a particular purpose, hence their specificity and flexibility should be customised to suit that purpose [17].

The temporal landscape

Organisations are constantly searching for ways to improve their use of time. This is because of the implications that time has for how work is prioritised, allocated and coordinated [18]. Work is organised to suit timeframes that may contain different assumptions and meanings. In this study we witnessed both the concern for ensuring the efficient production of laboratory test results as measured by turnaround times, and the need to fit work into a series of time cycles that impacted on the coordination and synchronisation of work, eg, tests from remote laboratories. Time in the laboratory process can be considered either as a dependent variable (eg, turnaround time) that has been affected by data entry efficiencies introduced by electronic ordering, or alternatively as an independent variable (eg, fitting into existing laboratory procedures) whereby the electronic ordering system is modified to fit the temporal exigencies of the pathology service [19].

Limitations

This study used rich contextual data to examine key features of pathology services and the impact of electronic ordering. Even though the findings are presented in a conceptualised framework their generalisability are likely to be affected by the particular circumstances of other settings.

Conclusion

This study has shown that CPOE can impact upon many features of the pathology service. CPOE implementation should be premised on a solid understanding of the organisational, communication, information and temporal circumstances in which the system is meant to operate [17]. As this study has shown, new technology will affect the organisation of the healthcare facility, but the new technology's fit and usability will also be shaped by how users manage, plan and negotiate its uptake.

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