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Editorial

Computerized provider order entry systems – Research imperatives and organizational challenges facing pathology services

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Abstract

Information and communication technologies (ICT) are contributing to major changes taking place in pathology and within health services more generally. In this article, we draw on our research experience for over 7 years investigating the implementation and diffusion of computerized provider order entry (CPOE) systems to articulate some of the key informatics challenges confronting pathology laboratories. The implementation of these systems, with their improved information management and decision support structures, provides the potential for enhancing the role that pathology services play in patient care pathways. Beyond eliminating legibility problems, CPOE systems can also contribute to the efficiency and safety of healthcare, reducing the duplication of test orders and diminishing the risk of misidentification of patient samples and orders. However, despite the enthusiasm for CPOE systems, their diffusion across healthcare settings remains variable and is often beset by implementation problems. Information systems like CPOE may have the ability to integrate work, departments and organizations, but unfortunately, health professionals, departments and organizations do not always want to be integrated in ways that information systems allow. A persistent theme that emerges from the research evidence is that one size does not fit all, and system success or otherwise is reliant on the conditions and circumstances in which they are located. These conditions and circumstances are part of what is negotiated in the complex, messy and challenging area of ICT implementation. The solution is not likely to be simple and easy, but current evidence suggests that a combination of concerted efforts, better research designs, more sophisticated theories and hypotheses as well as more skilled, multidisciplinary research teams, tackling this area of study will bring substantial benefits, improving the effectiveness of pathology services, and, as a direct corollary, the quality of patient care.

Key words: Computerized provider order entry, evaluation studies, hospital information systems, laboratories, pathology

INTRODUCTION

Pathology laboratories have traditionally been considered to be on the leading edge of development in information and communication technologies (ICT). The information-intense nature of pathology has made ICT an indispensable part of the way the pathology laboratories function.[1] In the past, computers and computerized

information tended to be narrowly construed within the clinical setting or department in which they resided. This was probably a reflection of the functionally limited (by today's standards) and specialized nature of past generations of computer systems.[2] In today's environment, the capacity of ICT systems has increased markedly and there is an emphasis on networked clinical information systems. Healthcare services have become more specialized and hence fragmented, but the quality and safety literature continues to remind us of the importance of coordinated team-based care. Inter-connected information systems which provide greater access to a wide range of information to a broad number of healthcare providers are thus imperative. Computerized provider order entry (CPOE) systems are a good example of these types of systems. CPOE systems allow clinicians to place orders directly using computers and are associated with immediate improvements in the legibility and completeness of clinical orders.[3] They can also incorporate other systems including laboratory and imaging investigation, medication management and clinical documentation systems, which means that they are able to link departments across the hospital and beyond, allowing greater information access and enhanced levels of communication.[4]

Pathology is aphoristically described as the "hidden science that saves lives," dutifully working behind the scenes to make its critical but often overlooked contribution to the provision of patient care.[5] But in the last decade or so, the emphasis of many leading pathology commentators has been to stress the opportunity that ICT offers to move away from an ancillary role toward a more pro-active role in the improvement of patient care and outcomes.[6,7] This is a point strongly emphasized by the Carter Review of the NHS Pathology Services in England in 2008, which noted that given the significant role pathology plays in the diagnosis, choice of treatment and efficacy of treatment, we should start to evaluate pathology for its contribution as part of a multidisciplinary undertaking, providing complex inter-related care to patients.[8]

ICT is a contributing factor to a number of major changes taking place in pathology and within health services more generally. In this article, we draw on our research experience over 7 years investigating the implementation and diffusion of CPOE systems to articulate some of the key informatics challenges confronting pathology laboratories.

THE CHALLENGE TO PROVIDE GENERALIZABLE AND TRANSFERABLE EVIDENCE

The implementation of CPOE systems, with their improved information management and decision support structures, provides the potential for enhancing the role that pathology services play in the patient care pathway.[9] Beyond eliminating legibility problems, CPOE systems can contribute to the efficiency and safety of healthcare by reducing the duplication of test orders and diminishing the possibility of misidentification of patient samples and orders.[10] The incorporation of sophisticated decision support features means that CPOE can also help clinicians make evidence-based decisions, thus enhancing the "end-to-end connectivity" which links the pathology laboratory's provision of test results with clinical decision making and their contribution to improved patient care.

For all the enthusiasm and planning that has gone into the introduction of ICT systems like CPOE and the optimism about the contribution they could add to making healthcare safer, cheaper and better,[11] their diffusion across healthcare settings remains variable and is often beset by implementation problems.[12] There has been a lack of generalizable evidence needed to help healthcare organizations decide on what type of systems and implementation methods will work, where and in what circumstances.[13]

When we first began investigating the impact that the CPOE systems have on pathology services, we found that research involving pathology services was uncommon.[10] There was a normative and relatively unchallenged idea that CPOE systems had the capacity to improve the management of medication and significantly decrease the number of adverse medication events. Some of the key research in the area often involved studies from the 1980s and early 1990s, usually involving "home-grown" systems developed by clinical and management ICT champions and pioneers of the time.[10] By the early 2000s, the situation had changed dramatically and commercially developed "off the shelf" systems were fast becoming the norm.

Pathology services need evidence that can help them to enhance the implementation and sustainability of CPOE systems while maximizing their benefits and contribution to safe and quality patient care.[14] Questions requiring answers include whether or not and the extent to which CPOE systems decrease the time taken to order, collect and process tests (i.e. turnaround times);[3] reduce the volumes of tests deemed to be redundant or inappropriate;[15,16] and improve the quality of pathology services used to ensure that the right processes are being carried out and are meeting the relevant standards.[17] This is particularly relevant for monitoring the effect of electronic decision support and its potential to promote the practice of evidence-based care.[18]

Research in this field is now active, and has provided evidence of the impact of CPOE on decreasing pathology turnaround times and improving the quality of information exchange between the laboratory and the ward.[19-21] For instance, a 2009 study that examined

the effect of CPOE on turnaround times across four Australian hospitals showed that median times decreased significantly across all hospitals by percentages ranging from 9% in the smaller of the hospitals, to 23% in the larger hospitals.[22] Other studies have taken these findings further to demonstrate the positive contribution that shorter turnaround times can have on the length of stay of the patient in emergency care settings.[22-24]

Evidence for the ability of decision support systems to improve clinical performance and patient outcomes is limited.[25] There are many reasons for this. Decision support systems can be difficult to implement and sustain. Gaining agreement about standards (e.g. commonly agreed laboratory order sets or diagnostic algorithms relevant for specified patient conditions) [26] to incorporate into decision support rules is difficult and processes to achieve this efficiently and safely are underdeveloped. Clinical resistance to electronic ordering systems and decision support prompts and alerts[27] may be related to problems with usability, incompatibility with existing systems and ways of performing clinical and laboratory work.[28]

It may well be that the enormous enthusiasm for decision support systems has given rise to some distorted, and perhaps overly optimistic, expectations. A report by the US Agency for Healthcare Research and Quality in 2009 suggested that progress is more likely to occur when we stop viewing decision support as a substitute for the clinician and start to understand it more as a complex intervention requiring attention of its benefits, challenges and limitations.[29] This is reminiscent of a message that featured in the report for the UK's NHS Connecting for Health Evaluation Programme in 2008 which concluded that instead of a definitive answer about whether decision support works or not, the focus should be on obtaining a better appreciation of the situations and contexts where it may prove effective.[25] Both the UK and the US reports highlight what we consider to be a key imperative of pathology informatics researchers – the need to develop, constantly refine and use robust evidence-based performance measures as a means of encouraging explicitness and clarity about what is being achieved and the desired outcome.[30] Scientific research designs, performance indicators, rigorous definitions and data validity and reliability are important not only in clinical research, but also in informatics and health services research.

THE ROLE OF COMPUTERIZED PROVIDER ORDER ENTRY IN WORK PRACTICE INNOVATION

The other noticeable feature about research in this area is the lack of attention paid to the effect that CPOE has had and is predicted to have on the organization and work functions of pathology laboratories.[10] All too often there is a failure to appreciate that pathology services consist of multifaceted organizational structures with their own formalized rules, conventions and cultural ways of working that have developed and evolved over time.[31] Existing research has not sufficiently distinguished between the various departments that make up pathology services and the effect of CPOE on them.

When CPOE systems are introduced, they often come with a corresponding set of complex, wicked problems and challenges.[32] One of the underlying problems identified with CPOE systems is that the order process is conceived in a linear way. Clinicians initiate orders which are then processed by nurses, pharmacists, pathology departments, etc.[33] In reality, the ordering process involves an array of collaborative interactions across many professions; it is a complex adaptive system. The source of clinical decisions may come from diverse influences and sources.[34] This collaborative effort is in turn reliant on the numerous processes which underpin communication and information exchange.[35] The potential discrepancy therefore between the way CPOE conceptualizes the ordering process and the way it is carried out within hospitals has prompted some prominent informatics researchers to warn that hospitals need to be prepared to expect the unexpected.[36,37] The task is to find new research models, including attending to sociological and psychological theories to account for the systems dynamics, and conducting, for example, multi-method, triangulated research, and simulation modeling. The goal should be to provide fresh perspectives in understanding CPOE and its effects.

Our own research findings have often noted the potential for dramatic shifts in responsibilities, procedures and even work practices after CPOE systems are introduced. In some cases, these have led to "workarounds" which occur when the system does not allow you to do what was previously done in the same way.[28] This was also highlighted by a 2007 study of an emerging electronic laboratory order system in Holland which identified a number of usability problems leading to inefficient order behavior, omissions and order errors.[38]

Processes of planning and implementation of CPOE systems need to take into account how the technology will both affect and be affected by the organization in which it is being installed.[39] The formalization of data in ICT systems like CPOE may also create ambiguity and uncertainty[40] because it can dramatically change the information environment in which people work.[41] Data are always produced with a particular purpose, and their specificity and flexibility is likewise customized to suit that purpose.[42] For pathology services, the transfer of timely, complete and reliable information across the

interface that connects the inpatient setting and the laboratory is a critical component of the pathology test process. This is because a clinical note supplied by a physician to the laboratory can trigger different courses of action ranging from the way a test is processed through to the way it is interpreted. The design of CPOE systems and the way they solicit and exchange data are critical considerations that require collaborative input from both sides of the inpatient setting and laboratory interface.[43]

What remains is a final and recurring research theme which aptly sums up the key message of this article. One of the substantial benefits of information systems is their ability to integrate work, departments and organizations. But unfortunately, health professionals, departments and organizations do not always want to be integrated in the way that information systems allow. It may seem a truism, but a persistent theme that emerges from our research is that *one size does not fit all*. This finding applies not only to the areas of research where we have utilized key performance indicators to systematically quantify the effect these systems have on efficiency, effectiveness and quality of healthcare,[19,20,22] but also to the qualitative studies investigating the usability of these systems and their impact on work processes.[28,44,45] CPOE systems are constructed with the purpose of giving people the means to make them work. It may well be that people decide not to make them work. Their usefulness is therefore reliant on the conditions and circumstances in which they are placed. It is these conditions and circumstances that are part of what gets negotiated in the complex, messy and very challenging area of ICT implementation. The solution to this challenge is not likely to be simple and easy, but current evidence suggests that the combination of concerted efforts, better research designs, more sophisticated theories and hypotheses as well as more skilled, multidisciplinary research teams tackling this vital area of study will lead to enormous and beneficial contributions to the quality of pathology services, and, as a direct corollary, the quality of patient care.

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