

# Electronic Test Management Systems and Hospital Pathology Laboratory Services

**Andrew Georgiou**

*The University of Sydney, Australia*

**Johanna Westbrook**

*The University of Sydney, Australia*

**Joanne Callen**

*The University of Sydney, Australia*

**Jeffrey Braithwaite**

*University of New South Wales, Australia*

## INTRODUCTION

Pathology can be described as the branch of medicine that deals with the nature, causes, and process of disease (McGrath, 2003). Pathology laboratories consider clinical and pathologic data and integrate them within an ever-changing context and then transmit a meaningful answer back to doctors and patients. In doing so, pathology laboratories play a key role in translating data into meaningful information (Hardwick, 1998). Pathology services are information intense organisational bodies that rely heavily on the proficient administration of information for patient care purposes (Travers, 1997). It is estimated that 70% of all important decisions affecting a patient's life involve a laboratory or pathology test, and pathology data represent an average of 70% of documents residing in electronic repositories (Becich, 2000).

Yet, pathology services are still widely seen as a backroom function with many people unaware of their importance. Pathology has been dubbed the "hidden science that saves lives" by the Royal College of Pathologists in England (The Royal College of Pathologists, 2000). Pathology departments are facing challenges from new information and communication technology (ICT) advances and the advent of managed care approaches to health care planning and delivery. The Review of NHS Pathology Services in England in 2006 emphasised the key role of pathology services in patient pathways that begins with the choice of the most suitable test or investigation, and proceeds to the interpretation and supply of clinical advice across clinical

specialties (Review of NHS Pathology Services in England, 2006). ICT developments are behind many of the moves aimed at extending the role of pathology services beyond the basic request and reporting cycle (Friedman, 1996).

## BACKGROUND

In the last 10 years, there has been much emphasis on the potential for computerised provider order entry (CPOE) systems to improve the provision and quality of health care (Doolan & Bates, 2002; Sittig & Stead, 1994). CPOE systems provide clinicians with the ability to place orders directly into computers linked to databases containing specific clinical information and decision-support software (Birkmeyer, Lee, Bates, & Birkmeyer, 2002). Many health care systems internationally are involved in the implementation of CPOE systems (Humber, 2004; NSW Government Action Plan for Health, 2002; The Leapfrog Group for Patient Safety, 2003). These systems are cornerstones for the establishment of electronic medical records (Hwang, Park, & Bakken, 2002).

Even though there has been substantial support for the implementation of CPOE systems (The Leapfrog Group for Patient Safety, 2003) along with a growing evidence base of their impact on the delivery of health care (Birkmeyer et al., 2002; Doolan & Bates, 2002) and its efficiency (Mekhjian et al., 2002), uptake has been neither rapid nor even (Ash, Gorman, Seshaddri, & Hersh, 2004). Some of the initial enthusiasm for

CPOE systems has been tempered by high profile cases of physician resistance (Berger, 2004), and implementation difficulties (Dykstra, 2002) along with concern about the huge investment and costs involved (Ash & Bates, 2005). Moreover, evidence about the unintended consequences of CPOE systems (Ash, Berg, & Coiera, 2004; Campbell, Sittig, Ash, Guappone, & Dykstra, 2006) and their potential to facilitate new types of errors (Koppel et al., 2005) have led to a renewed focus on the importance of evaluation (Ammenwerth & de Keizer, 2005; Friedman & Wyatt, 1997; Gell, 2001) as a means to improve their design and implementation.

So far the attention of the research and evaluation literature has tended to focus on high profile issues like medication errors, with less attention to areas like pathology laboratories and medical imaging, which together make up a major proportion of hospital orders (Abelson, Connelly, Klee, Maag, & Smith, 2001; Georgiou, Williamson, Westbrook, & Ray, 2007). CPOE is by definition a system-wide phenomenon with implications for the way the whole hospital and related entities work and function. These issues and challenges cannot be addressed by silo-based approaches where departments are considered independently of each other (Georgiou & Westbrook, 2006; Stablein et al., 2003). Pathology services are themselves made up of a number of organisational subparts each with their own ways of operating and functioning (Davidson & Chismar, 1999b), that will be affected by (and in turn affect) CPOE implementation (Wears & Berg, 2005). In the following sections, we draw on existing research evidence and literature reviews (Georgiou & Westbrook, 2006; Georgiou et al., 2007) alongside our own research experience to formalise an evaluation framework that can be used to assess the impact of CPOE on pathology services.

## **EVALUATING THE IMPACT OF CPOE ON PATHOLOGY PROCESSES**

A systematic review by Georgiou et al. (2007) conceptualised three stages in the pathology test management process beginning with: (a) the decision of the doctor or responsible clinician (doctor or other delegated health professional) to order a pathology test; followed by (b) the processing of the test order in the pathology laboratory and ending with (c) a result that is communicated to the clinician and health care team responsible for

the care of the patient, which will then be used as part of the clinical decision-making process (Georgiou et al., 2007). Each of these stages involves a dimension of time (Howanitz & Howanitz, 2001) which can be measured by turnaround time (TAT) indicators involving a number of measures including: (1) Laboratory TAT - the time taken for the test order to be processed in the laboratory before a result is issued, and (2) Total TAT—the total time it takes for an order to be placed, processed and a result issued (Georgiou et al., 2007).

### **Test Order Stage**

Each of the stages in the pathology test order process can be assessed with a range of indicators that have been used to monitor the impact of CPOE systems on pathology services and patient care (Georgiou et al., 2007). The ability of CPOE systems to provide decision support will most likely have an effect on the first stage of the pathology test order process involving the clinician's decision about which test to order. Some researchers have paid particular attention to the ability of decision support systems to affect clinical compliance with practice guidelines (Overhage, Tierney, Zhou, & McDonald, 1997; Solomon et al., 1999). Decision support may also affect the appropriateness and volume of tests ordered. This is particularly the case for “redundant” tests, that is, tests that are repeated within an inappropriate time frame and provide no additional information (Bates et al., 1998; van Walraven & Naylor, 1998). The volume of tests can in turn be measured in different ways, for example, the number of tests per day (Hwang et al., 2002), or for a specified period, or per patient/admission (Tierney, Miller, & McDonald, 1990; Westbrook, Georgiou, Dimos, & Germanos, 2006). The volume of tests is likely to have a significant effect on test costs which can also be measured in various ways such as: total laboratory costs (Nightingale, Peters, Mutimer, & Neuberger, 1994) or per admission (Tierney et al., 1990). Some research has concentrated on the effect that CPOE systems have on work practices of clinicians and pathology services staff. One of the most important issues in this area involves quantifying the time spent ordering tests and its impact on other tasks (Shu et al., 2001). Another key concern in the area of work practices is ensuring that the new technology does not foster practices which affect the quality and safety of the ordering process (Koppel et al., 2005).

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