

# Monitoring the Impact of CPOE on Healthcare Delivery – A Benefits Realisation Approach

Andrew Georgiou<sup>1</sup>, Mary Lam<sup>2</sup>, Johanna Westbrook<sup>1</sup>

<sup>1</sup>Health Informatics Research and Evaluation Unit, Faculty of Health Sciences, The University of Sydney

<sup>2</sup>Discipline of Health Informatics, Faculty of Health Sciences, The University of Sydney

## Abstract

### Objective:

This paper aims to outline a suite of key indicators of Computerised Pathology Order Entry (CPOE) performance, assess their value as measurements of care delivery and their relevance to health professionals and patients.

### Background:

CPOE systems have the potential to deliver substantial efficiency gains along with improvements in the effectiveness and quality of patient care. However, these potential gains may be offset by poor implementation strategies and inadequate attention to problems. The implementation of CPOE should be associated with careful monitoring of their impact, particularly in areas related to the quality and safety of patient care.

### Methods:

We draw upon results from our own research over five years to focus on four key indicators of CPOE impact: laboratory turnaround times, test volumes, redundant test rate and length of stay. Each indicator is defined and the rationale for its measurement and potential uses identified. Possible confounders to the interpretation of the indicators are assessed and a guide to the quality and reliability of data sources is provided.

### Results:

Turnaround time (TAT) can be used to monitor different parts of the test ordering process eg, total TAT - from the time of specimen collection to test result notification. Test volumes can be measured according to different parameters, eg, the number of tests per patient or per Diagnostic Resource Group to monitor adherence to electronic guidelines and test appropriateness. Redundant tests are those tests that are reordered within an inappropriate time frame and provide no additional clinical information. Length of stay can be used as an indicator of the ability of CPOE to improve efficiency, particularly in acute, time-critical hospital departments.

### Conclusion:

These indicators can provide valuable information by which to monitor the implementation of CPOE and drive benefits realisation.

### Keywords:

Computerised Provider Order Entry, Evaluation, Laboratories, Pathology

## Objective:

This paper aims to outline a suite of key indicators of Computerised Pathology Order Entry (CPOE) performance, assess their value as measurements of care delivery and their relevance to health professionals and patients.

## Background:

Health care systems in Australia and internationally are involved in the complex task of implementing Computerised Pathology Order Entry (CPOE) systems. These systems allow clinicians to directly enter orders into computers (Doolan and Bates 2002) which allow for efficient data management and can contribute to improved effectiveness and efficiency of patient care (Murff and Kannry 2001). The incorporation of decision support using defined order sets and the provision of evidence-based guidelines can also lead to improvements in the quality of care (The Leapfrog Group for Patient Safety 2003). Despite the enormous support for CPOE systems, their diffusion has been beset by implementation problems (Ash et al. 2004; Campbell et al. 2006). It would seem imperative therefore that CPOE implementation is associated with careful monitoring of its impact, particularly in areas related to the efficiency and effectiveness of patient care delivery, through the utilisation of robust performance indicators (quality measures). Evaluation of CPOE has an important role to play in achieving efficiency and effectiveness benefits. Yet there have been few papers documenting specific indicators that could be valuable to this process.

## Methods:

This paper draws upon results from our own research, as well as that of others, to outline four key indicators of CPOE impact on pathology laboratory services: turnaround time, test volume, redundant test rate and length of stay. A performance indicator is defined as a statistic, or other unit of information which reflects, directly or indirectly, the performance of a system (Boyce 2002) and which can help to understand and improve the workings of a system (NHS Institute for Innovation and Improvement 2007). A template is provided for each indicator beginning with a definition and rationale for its measurement, its potential uses and evidence of its utilisation. Possible confounders to interpreting and understanding the indicator are assessed and a guide is provided to the quality and reliability of data sources.

## Results:

Table 1 outlines key features of the four indicators and assesses their potential as measures of CPOE performance.

Table 1. Suite of indicators for the monitoring of CPOE performance

<b>Turnaround time (TAT):</b>	
Definition	The time in which a laboratory can process a specimen and provide a result. TAT can be measured for different aspects of the laboratory process eg time ordered to the time a result is issued, or the time a specimen reaches the laboratory to time a result issued (Georgiou et al. 2007). TAT can also be classified by test (eg, potassium), priority (eg, urgent) or population served (eg, ward setting) (Hawkins 2007).
Aim	To promote timely access to laboratory results.

Rationale	Clinical satisfaction with pathology services is related to the timeliness of test results because of its effect on time to patient diagnosis and/or treatment (Howanitz and Howanitz 2001).
Potential uses	Measure the impact of CPOE on laboratory performance and hospital efficiency.
Confounders	TAT can be affected by a number of institutional factors such as bed size, staffing levels, location and case mix; and by process factors like method of specimen transport (Hawkins 2007).
Data sources	Most laboratory services are required to collect and report TAT figures. The completeness and robustness of these data sources may be variable and depend on the data definitions employed (Australian Council on Healthcare Standards 2007).
Evidence	Several studies of CPOE performance using TAT report significant decreases (Mekhjian et al. 2002; Thompson et al. 2004) including a broad ranging Australian study with control which reported a significant average decrease in TAT of 15.5 minutes/test assay following CPOE implementation (Westbrook et al. 2006).
Comments	TAT measures are comprised of multiple sequential steps which each have their own minimum or fastest time (eg, centrifuge spinning time) which means that normal distributions are not expected (Hawkins et al. 1999). The Australian Council on Healthcare Standards monitors TAT using a numerator of total number of test results within a specified time period (eg, less than 60 minutes) and a denominator of the total number of requests for the relevant test received by the laboratory (Australian Council on Healthcare Standards 2007)
<b>Test volumes:</b>	
Definition	The total number of test assays requested or blood specimens taken for a given period measured through a variety of methods eg, per patient per day, per patient per Diagnostic Related Group (DRG). Test volumes can also be measured by specific test assay eg, Troponin T.
Aim	To optimise efficient and effective test ordering.
Rationale	Test ordering volumes for pathology services continue to rise and account for a large proportion of health spending (Conyers 1999). The impact of excessive ordering is not just financial; it may lead to an increase in false positives resulting in unnecessary, expensive diagnostic examinations (Axt-Adam et al. 1993).
Potential uses	Measure test ordering efficiency.
Confounders	Research in this field shows that the volume of test ordering may be affected by the type of hospital (ie, teaching or non-teaching), seniority and position of clinical staff and even by the number of doctors who see a patient (Valenstein 1996).
Data sources	Laboratory information systems provide the raw data for monitoring test volumes. However, for comparing test volumes by DRG, patient or by doctor, data linkage to hospital or specific department information sources may be required.
Evidence	Many studies of the impact of CPOE on test volumes have either reported significant decreases (Hwang et al. 2002; Wang et al. 2002) or no significant change (Ostbye et al. 1997; Westbrook et al. 2006).
Comments	A major weakness of past studies has been the absence of explicit criteria to identify what is meant by inappropriate test ordering (van Walraven and Naylor 1998). Statistical Process Control methods can be a valuable means of monitoring variation in ordering patterns (Thor et al. 2007).
<b>Redundant tests:</b>	
Definition	A redundant test occurs when a test is reordered within an inappropriate time frame and provides no additional information (Bates et al. 1999; van Walraven and Raymond 2003). The measurement of redundant test rates requires the specification of tests and a time frame based on published literature or service guidelines. The redundant test rate can be calculated using the number of redundant tests for a specific test as the numerator and the total number of that test as the denominator.
Aim	To improve the appropriateness of test request selection.

Rationale	Redundant test rates are a modifiable component of laboratory utilisation and an area where CPOE decision support prompts and alerts can be effective (Bates et al. 1999; Georgiou and Westbrook 2006).
Potential uses	Measure the effectiveness of test ordering.
Confounders	Measures of redundant test rates need to carefully consider the clinical circumstances in which a repeat test may or may not be undertaken (van Walraven and Naylor 1998).
Data sources	Laboratory information systems provide the raw data for monitoring test volumes. However, they may not provide the desired flexibility with which to monitor chosen criteria for redundant tests. Audits may need to be undertaken independently.
Evidence	There is evidence that CPOE reminders can lead to a reduction in the redundant test rate (Bates et al. 1999).
Comments	There is considerable evidence that redundant test ordering is both common and costly. Monitoring the impact of CPOE on redundant test rates can make a significant contribution to reducing costs and improving laboratory utilisation.
<b>Length of stay:</b>	
Definition	Length of stay (LOS) represents the number of days a patient remains in hospital from admission to discharge. Average LOS is calculated by dividing the number of days stayed by the number of discharges (including deaths). LOS can also be monitored using case mix groupings or by specific hospital settings, eg, emergency department.
Aim	To contribute to the efficiency and effectiveness of patient care delivery.
Rationale	LOS is a frequently reported indicator of hospital efficiency used to monitor the impact of organisational changes and the effect of new technology.
Potential uses	To monitor the impact of CPOE on the efficiency of patient care processes.
Confounders	There is little evidence that improvement in laboratory efficiency (eg shorter TATs) leads to decreased hospital LOS. This is because TAT and LOS can be affected by institutional factors such as bed size, staffing levels, location and case mix; and by process factors eg, method of specimen transport (Hawkins 2007).
Data sources	Hospital Patient Administration Systems can provide LOS data as can Emergency Department Information Systems (EDIS) for emergency department LOS. Linking deidentified PAS or EDIS data with Laboratory Information Systems may allow simultaneous analysis of TAT and its effect on LOS.
Evidence	Most CPOE studies show no significant change in LOS when CPOE is introduced (Overhage et al. 1997; Hwang et al. 2002).
Comments	Critical care and emergency care settings may be valuable domains to monitor CPOE and LOS. ED LOS is one of the major factors contributing to hospital overcrowding (Sinnott 2004) and laboratory TAT is one of the many factors which can effect ED LOS (Chan et al. 1997).

## Conclusion:

The utilisation of performance indicators is crucial for monitoring the impact of CPOE systems and for ensuring the realisation of benefits from their implementation in complex hospital settings. But as the above template reveals, an indicator can never capture all the complexity of the system it purports to measure. In some cases indicators may provide succinct answers to questions. In most cases however, the best they may achieve is a picture of the variation in the system for which statistical process control methods (assessing common and special causes) can be of value (Thor et al. 2007).

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## Contact details:

a.georgiou@usyd.edu.au Tel: + 61 2 9036 7331