Systematic Review Of Point Of Care Testing In Emergency Care

Nurjannah

Abstract. The study aims to review systematically the evidence of using Point of Care Testing (POCT) in Emergency Departments (EDs). It will identify and qualitatively synthesise whether POCT in emergency care is safe, effective and has effective outcomes for patients. The systematic review was based on principles and guidelines produced in the report by the National Institute for Health Research (NIHR) Centre for Reviews and Dissemination (CRD), the University of York (2001) and the Critical Review Advisory Group (CRAG), by the School of Health and Related Research (ScHARR), the University of Sheffield (1996). A thorough and systematic search strategy was adapted to identify, collate and summarize all relevant studies the published research 1951 - 2008. There were 33 studies that met the inclusion criteria of the systematic review which consisted of 3 studies of Randomized Controlled Trial (RCT) design, 15 studies of diagnostic test design, 3 studies of before-and-after design and 12 articles of cohort design. There was clinical and methodological heterogeneity from all included studies. Thus, non-quantitative synthesis was performed. There is evidence that POCT in emergency care is safe, effective and has effective outcomes for patients. In clinical outcomes, POCT may provide an independent and significant predictor for serious adverse events and death. However, POCT seems to be unlikely to reduce the mortality rate. In economical outcomes, POCT in EDs may decrease turnaround time and reduce unnecessary admission to hospital, in particular to Intensive Care Unit (ICU) and Coronary Care Unit (CCU), but there are inconsistencies in the results over reducing ED and hospital length of stay. (JKS 2010;2:63-70)

Key words: Point of Care Testing, Emergency Care, Emergency Department.

Introduction

The quality of care of critically ill and surgical patients not only depends on medical, surgical or nursing skills, but also on the rapid contribution provided by the diagnostic support services such as pathology services.¹ For many years, all or the majority of pathology services were performed in a central laboratory. It was necessary to centralize the laboratory testing due to the complexity of the tests.² With the evolution of the technology nowadays, testing can be performed outside the central laboratory, thus POCT has emerged.³⁴ POCT is performed outside the central laboratory but inside the hospital, by clinical staff. It has various applications and is particularly used in settings that need rapid response of diagnosis and therapy.⁵ These settings include emergency care,⁶ operating rooms,⁵ critical care⁷ and primary care settings.⁸ In the United States, POCT comprised of 20% of all testing in the 1990s. It has been developed since then and in the past decades has seen increasing attention in the use of simple single test devices or desk top chemistry analyzers among doctors in Europe, particularly in Britain.⁹ People who attend to the EDs have a wide range of complaints from acute illnesses, injuries, serious and non serious illnesses. All of these conditions require competent and prompt assessments.¹⁰ The hospital should set a plan that patients in ED should be removed as soon as possible and admitted to appropriate facilities.¹¹ One of the principal reasons for waiting in emergency care is waiting for diagnostic tests.¹² To support this target, POCT is considered as a device that can assist quicker medical decision making so that the triage process will be more effective in the EDs and suitable treatment can be started earlier for patients.¹³

POCT is a new, important and interesting health technology but there have been no systematic reviews of them in relation to emergency care. The aim of this review is

Nurjannah adalah dosen pada Bagian Ilmu Kesehatan Masyarakat Fakultas Kedokteran Universitas Syiah Kuala
to identify whether POCT in emergency care are safe, effective and have effective outcomes for patients.

Methods

We search for evaluations of the outcomes of POCT in emergency care using computerised searches of electronic databases of Medline (1950 to April Week 1 2008), CINAHL (1982 to April Week 1 2008), Embase (1980 to April week 1 2008), IBBS (1951 to April Week 1 2008) and Cochrane Database of Systematic Reviews (1991 to April week 1 2008) using the keywords point of care testing, near patient test, bedside test, extra laboratory testing, rapid test, set testing, office laboratory and emergency care, Accident & Emergency (A&E) Department, Emergency Department and emergency services. All experimental and observational studies focusing on POCT and emergency care for adult patients and published in English language were included. Because of many different types of point of care testing, this review will only focus on clinician-directed POCT which can be only performed by qualified staff in emergency settings regardless of source of specimen and modalities.

Being an important part of the review, quality assessment of studies was conducted by using the guidelines from the CRD Report\(^\text{14}\) and the Critical Appraisal Skill Programme (CASP)\(^\text{15}\). For RCTs, the studies were considered high quality if the total of the quality assessment was 80% of the total score which consists of 12 questions. Cohort and before-and-after study design checklists consist of 10 questions and diagnostic tests checklist consists of 8 questions. The scoring system of these design are similar to RCT.

The data extraction form produced by the CRD\(^\text{16}\) was adapted and modified to suit different study designs. All basic information such as date of extraction, detailed bibliography of study and more specific data relating to study design, inclusion and exclusion criteria, analysis and results were applied into the data extraction sheet.

In this review, both types of experimental and observational study design were included. As a result, it was not possible to use a statistical approach to generate the results. Non-quantitative synthesis is considered as the feasible choice when synthesising the results from different study designs.\(^\text{10}\)

Results

During the search process, a total of 1361 studies were identified from electronic sources and reference lists from relevant papers. The flow chart describing the process of studies inclusion and exclusion can be found in Chart 1 below. The 33 articles that satisfied the inclusion criteria consist of 3 studies of RCT design, 15 articles of diagnostic test design, 3 studies of before-and-after design and 12 articles of cohort design. There was no case control studies, case series or cross-sectional studies included as they failed to meet the inclusion criteria. All of the studies included have good quality as no study scored less than 10% of the total score using quality assessment form adapted from CRD and CASP.
In terms of clinical outcome, data from RCTs and non RCTs showed a non significant reduction in 30-day mortality rate from using POCT compared to central laboratory test.16-18 Eighteen studies for diagnostic accuracy showed that POCT appears to have relatively high sensitivity and specificity.19-36 However, point of care tests in two studies were considered to have relatively low accuracy in detecting AMI using POC h-FABP (sensitivity 69% and specificity 74%)30, and detecting ACS using sF (sensitivity 35% and specificity 92%).33

The prognostic value of POCT describes the relationship between the results measured by POCT with the increase in serious adverse events and mortality. It seems that the results from five studies included indicated that POCT with optimum cut-offs may provide better risk stratification.37-41 In other words, the POCT is more likely to be an independent and significant predictor for serious adverse events and mortality. For example, the study37 examined the predictors of
cardiac events using CK-MB at 1 year (OR: 4.9) and another\textsuperscript{38} studied the predictors of cardiac events at 30 days using CK-MB (OR: 3.5).

In terms of ED length of stay (LOS), there were five studies that had documented the length of stay in the EDs.\textsuperscript{16,36,42-44} It appears that the results from these five studies are not concordant. Two studies reported that the use of point of care did not significantly reduce the time spent in the ED.\textsuperscript{16,44} whereas the remaining three studies show the length of stay in the EDs is significantly reduced after using the POCT.\textsuperscript{35,42,43}

For hospital LOS, data from RCTs and non RCTs showed that the results from four studies which had documented this outcome are also not concordant.\textsuperscript{16,17,23,45} Three studies\textsuperscript{16,17,45} showed that the use of POCT significantly reduced the hospital length of stay whereas another study\textsuperscript{23} showed the use of POCT is unlikely to reduce significantly the time of hospitalization.

There were seven studies\textsuperscript{16,23,28,29,34,38,46} which reported the turnaround time outcome. The results from both RCTs and non RCTs are concordant. All of the studies concluded that turnaround time is significantly shorter by using point of care testing in emergency care.

Only one study\textsuperscript{17} observed the outcome of hospital admission. This study showed that the use of POCT significantly decreased the number of patients admitted to the hospital.

There were two included studies\textsuperscript{17,21} that observed the outcome of admission to ICU or CCU. Both studies are in the agreement that the need for admission into ICU and CCU was significantly decreased after the use of POCT.

Discussion

Most of the studies included in the review point out a positive association between POCT and effective outcomes. However, a few studies do not show significant effective outcomes.

In terms of mortality rate, three studies\textsuperscript{16-18} showed that there is a non-significant decrease of mortality rate between those patients whose samples were tested at the point of care and those whose samples were tested by the central laboratory. It may refer to the fact that mortality rates not only depend upon the diagnostic stage which involves pathology services such as POCT but also on many other factors for instances treatment choices, patients conditions (age, severity of diseases, mental status and nutrition) and quality of health care. Although there was no difference in mortality rates between the two groups, this does not exclude the possibility that point of care testing may influence the treatment choice. The study\textsuperscript{16} pointed out that POCT may influence treatment decision making (14%) and prevent unnecessary treatment (3.6%).

The Diagnostic Accuracy

Currently, patients with chest pain are usually diagnosed and risk stratified by using cardiac markers including myoglobin, CK-MB and cTnT and cTnI. However, other new markers of necrosis and ischemia such as h-FABP, BNP and sP are also used to identify patients who present to the ED with chest pain.\textsuperscript{22,25,26,30,33} POCT for cardiac markers is increasingly used in EDs. The use of individual markers may under diagnose the cardiac disease due to variations in sensitivity and specificity and may be inadequate for triaging patients with chest pain in EDs.\textsuperscript{48} This is concordant to what this review found from the included studies, which suggest that using multi markers is more likely to improve sensitivity for cardiac conditions such as AMI or ACS. Several of the included studies have also shown that the use of other new markers of BNP, h-FABP and
sF has also resulted in increasing of sensitivity to diagnose AMI, heart failure or even to distinguish chest pain from cardiac or pulmonary aetiologies. This is consistent with the results of the study by Wang et al.\textsuperscript{49} which observed the use of ten multiple markers in detecting cardiac conditions.

The ED is rapidly growing as the triage site for Post Exposure Prophylaxis (PEP). EDs play an important role in providing the care of HIV patients for out-of-hours service.\textsuperscript{48} Reliable and rapid HIV testing may help implement PEP properly in the ED.\textsuperscript{5} The study\textsuperscript{45} discovered that the rapid HIV test in the ED may have an important role in the inpatient setting by increasing the number of newly diagnosed patients.

Qualitative D-dimer test is widely used in the ED to rule out the diagnosis of Pulmonary Embolism (PE).\textsuperscript{20} The two included studies show that the qualitative D-dimer test has the same accuracy as the quantitative D-dimer test. Besides being used to exclude PE, D-dimer testing is also used to detect bacteraemia using the device of SimpleRed\textsuperscript{®} D-dimer. Even though the result showed moderate sensitivity and specificity, it suggests that the D-dimer assay is useful in the rapid screening of patients with bacteraemia from those who have no bacteraemia.\textsuperscript{35}

Blood ketone POCT is used to distinguish Diabetic Ketosis (DK) and Diabetic Ketoacidosis (DKA) for patients with simple hyperglycaemia in the EDs. Even though urine ketone dipstick testing has been found to be a sensitive test to detect patients with DKA, to apply it as a screening test is still questioned.\textsuperscript{50} However, the study\textsuperscript{24} discovered that blood β-OHB at the point of care may allow clinicians to determine DK or DKA from patients with simple hyperglycaemia owing to excellent sensitivity and specificity.

Paracetamol and salicylate are commonly found as causes of drug overdose and self-poisoning.\textsuperscript{51} Having a rapid, accurate and reliable test in the ED may be needed to speed up treatment. The study\textsuperscript{34} showed that POCT to detect paracetamol and salicylate has a relatively high sensitivity and specificity.

POCT could be a solution for length of stay problems in EDs. Positively, POCT has a potential outcome to shorten length of stay (LOS) in the ED, but other sources of delay that have an impact on ED LOS also need to be considered. In addition, POCT also has a shorter turnaround time compared with central laboratory testing.\textsuperscript{5} This is consistent with results from the review that show all included studies have a shorter turnaround time in POCT compared to central laboratory. However, the decrease in turnaround time does not mean a decrease of LOS in ED. This is proved by the findings in included studies which show inconsistencies in reducing the ED length of stay. Two studies support the view that the use of POCT may reduce the time spent in the ED, while three studies disagree with that. This suggests that LOS in the ED not only depends on the rapid result of pathology tests but also on other factors. Again, it is important to find out the delay from other sources that support the ED services. Furthermore, the faster test results available from POCT do not necessarily indicate an improvement in medical outcomes. This may be reflected by length of stay in hospital. All included studies are consistent in the view that the use of POCT is unlikely to reduce hospital LOS. With each ED and hospital having a unique process and system, it is difficult to generalize about LOS. POCT is not the only effective resource to shorten LOS, but it is found that POCT reduces the time to make medical decisions that are dependent on the POCT results.\textsuperscript{52} This may indicate that triaging in EDs by using POCT can differentiate whether patients should receive immediate treatments or not.
Conclusion

To conclude, there is evidence that POCT in emergency care is safe, effective and has effective outcomes for patients. In terms of clinical outcomes POCT may be unlikely to reduce the mortality rate, but the use of the POCT may provide an independent and significant predictor for serious adverse events and death. Overall, POCT has relatively high sensitivity and specificity to detect a certain condition. For economical outcomes, POCT appears to have inconsistencies within the results over reducing ED and hospital length of stay. However, the study concluded that there was consistency in the outcome of decreased turnaround time and reduction in unnecessary admissions to hospital, in particular, to CCU and ICU.

Reference list

19. Runyon M.S et.al. Comparison of the Simplify D-dimer assay performed at the


43. Pierhopes W et al. Point of care pregnancy testing provides staff satisfaction but does not