Point-of-care testing in critical care medicine: improving outcomes, cost effectiveness, and turnaround time

Point-of-care testing (POCT) is testing carried out at or near the patient’s bedside. POCT devices have provided rapid and reliable testing performed both in healthcare settings and at home. These devices serve to augment or supplement the function of existing laboratory-based devices. As advances in technology are implemented, newer point-of-care testing devices are applied in different medical fields. The use of POCT devices may provide a cost-effective approach to diagnostic medicine, as studies have shown that performance measurements such as length-of-stay (LOS), therapeutic turnaround time (TTAT) and mortality can be improved.1 For critical care medicine, these measurements play a very important role, since not only do they determine the monetary costs, but they also determine the cost in lives.

GROWING POPULATIONS

In the 21st century, the world’s population will continue to grow, and in particular the population densities of major metropolitan areas are likely to increase. In 2000, the world population growth rate was 1.4%, yielding an annual increase of about 85 million people.4 In more developed countries, this distributed annual growth is not a major problem, but in developing regions it will put further pressure on already stretched resources. In 2000, 60.8% and 12.9% of the world’s 6.1 million people were located in Asia and Africa respectively.2

One of the many outcomes will be an increase in demand for hospital laboratory services. Considering laboratory results take several hours – in some cases days – to become available, patients are consequently forced to stay in hospitals for longer periods than is necessary. This time of ‘unproductivity’ uses up hospital resources. POCT devices with their relatively fast turnaround time have the capacity to increase productivity and thus improve the patient ‘turnover’ rate, whereby a patient goes into hospital, is diagnosed, treated and eventually discharged – making the same resources available for the next patient. The future ability to treat more patients over the same time interval is, in this author’s opinion, a necessity, based on current trends in healthcare.

ECONOMIC BENEFITS OF POCT DEVICES

Point-of-care testing can provide timely diagnostic capabilities for physicians at many levels of healthcare, in both outpatient and inpatient settings. In addition to the clinical benefits from greater promptness of results, the overall costs for using integrated point-of-care testing tend to be reduced compared with the cost of laboratory-based systems.5 Examples of common POCT devices in use today are glucose meters, blood gas measuring devices, and rapid immunoassays for infectious diseases. Many of these devices can be usefully applied in the realm of critical care, since constant patient monitoring is a necessity in the intensive care unit (ICU).

Cost of point-of-care testing

In a study carried out in 2001, the results from two POC lactate measuring devices were compared to laboratory-based lactate measurements. The findings showed that the costs for operating the handheld POCT device ($248) were relatively lower when compared to bench-top ($536) and central laboratory ($493) lactate test.6 Additionally, the study showed a transportation cost ($3.61/specimen) was applied to non-POCT samples. Additional studies are listed in Table
Rapid TTAT is likely to contribute to a reduction in length-of-stay (LOS), complications and mortality. These measurements in any combination can ultimately be linked to hospital costs. A longer length of stay may lead to complications, thereby increasing costs, and possibly higher mortality too. Hospital LOS alone, if shortened, can provide substantial savings.

In critical care medicine, early detection of potential co-morbidities such as organ dysfunction and infections is a necessity in order to provide adequate patient care. Rapid results are required, since any delay may cost a patient’s life. In the emergency department, quick and qualitatively accurate diagnostic methods are needed in order to ‘rule in’ or ‘rule out’ a particular disease. Since the emergency department is usually the first place a patient enters before heading to the ICU, adequate assessment of the patient’s needs must be made here in order to maximise the resources of the hospital. Cardiac injury markers, lactate, or specific antigens from infectious organisms are just a few examples of the analytes that POCT can be used on.

In the case of cardiac injury markers, Ng et al.’s study analysed the use of POCT cardiac marker testing in patients with suspected coronary ischaemia in the emergency department. The study showed that the outcomes justified the higher costs when compared to conventional methods. Test results were provided earlier than conventional methods, allowing physicians quickly to ‘rule in’ or ‘rule out’ coronary ischaemia in suspected patients, thereby shortening length of stay in the emergency department and reducing coronary care unit admissions by 40%. Ultimately, the greatest savings for critical care patients can be found in the reduction of length of stay and the cost of pharmaceutical treatment, since a day saved is also a day’s worth of hospital medication saved.

### Table 1. Economics of point-of-care testing in the ICU

<table>
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<th>Reference</th>
<th>Study objectives</th>
<th>Economic outcomes</th>
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<td>5.</td>
<td>Comparison of two POC lactate devices vs. central laboratory</td>
<td>The costs for measuring lactate were lower for handheld POCT ($248) vs. benchtop ($536) vs. central lab ($493), &amp; transportation cost ($3.61/specimen) for non-POCT.</td>
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<td>6.</td>
<td>Adoption of whole-blood analyser in ICU.</td>
<td>The whole-blood analyser reduced labour costs to $36,000 from $132,000 prior to POCT.</td>
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<td>7.</td>
<td>Multisite RALS testing in ICU.</td>
<td>POCT for the ICU improved TTAT, and generated 75% in savings compared with laboratory testing.</td>
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<td>8.</td>
<td>Evaluate bedside coagulation testing</td>
<td>Costs for two aPPT &amp; PT devices were higher ($4.84 vs $4.84) than laboratory testing ($3.77 including transportation costs).</td>
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<td>9.</td>
<td>POCT vs. laboratory-based testing in ICU</td>
<td>Fully loaded ICU costs are high, but patients with MI or suspected MI need first priority and POCT is well suited for this purpose.</td>
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<td>11.</td>
<td>Integrate POCT in critical care</td>
<td>NPT decreases process steps &amp; response times by up to 80%, permitting reductions in personnel costs exceeding $400,000/yr.</td>
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<tr>
<td>12.</td>
<td>Analyse bedside reagent testing of blood</td>
<td>Total cost/patient for hospitalisation was $2,380 in the ICU for bedside testing vs. $3,925 for laboratory testing.</td>
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Abbreviations: aPPT = activated partial prothrombin time; MI = myocardial infarction; NPT = near-patient testing; PT = prothrombin time; RALS = remote automated laboratory system.

1,4,5,7–13 which identify savings from the use of POCT vs. conventional methods, with the emphasis on critical care.

Some studies have shown that testing methods, whether conventional or POCT, incur costs that are trivial compared to the costs for medication. A study from Germany showed that medication charges are one of the major cost components in sepsis management. Sepsis is a serious blood infection, which incurs a mortality rate of 28 to 50% in its most severe form where multiple organ dysfunction occurs. The medication costs were 9,304 euros ($9,434.28 US) per patient and contributed up to 46% of the total cost for severe sepsis in Germany.

Based on the studies shown in Table 1, we can see that, in most cases, POCT can provide more cost-effective testing based on the savings garnered from the reduction in personnel and supplies. Occasionally using POCT devices may cost more than conventional methods, but taking into account savings gained from improved patient outcomes may still offset the higher costs.

### Patient outcomes

Favorable outcomes may offset any high costs resulting from POCT. One of POCT’s prime benefits is its ability to give physicians the results needed fast and early, allowing them to provide timely treatment. This time to treatment is called the therapeutic turnaround time (TTAT).

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### RAPID TURNOVER RATE

Today, staff in hospitals are required to deal with more patients, with the same amount of space and resources. There are two possible choices, to cope with what they have, or to enlarge their facility to accommodate the greater influx of patients. The latter would increase hospital costs, as the study at the University of Southern California showed, while the form can risk a decline in the quality of care for patients. A possible solution would be to diagnose and treat patients more rapidly to maximise the time and resources available to a hospital without building more beds or hiring new personnel. Point-of-care testing can provide such rapid diagnosis since, at the very least, specimen transportation time is nullified, since testing is done at the bedside. The next question is, where most effectively to use POCT.

There are two time periods when point-of-care testing plays a particularly significant role: at
the time of admission, and during inpatient monitoring. In the case of critical care medicine, admission is usually in the emergency department, while the inpatient monitoring takes place in the ICU. Admission time roughly spans a 24-hour time frame, when a patient is triaged and subsequently referred to the appropriate site for treatment, e.g. home, outpatient care or inpatient ward. Clearly patients who have presented with conditions that can be treated at home should be treated there. The quick identification of these patients, as well as the critically ill patients, is vital in rapidly ‘turning over’ the patients in the emergency department.

In the ICU, patient monitoring must be accurate and provide the best possible picture for the critical care physician, who needs to observe the increase or decrease in a patient’s health status in order to implement the appropriate treatment. Additionally, the physician must be wary of new complications, such as nosocomial infections or organ dysfunction. Here, rapid immunoassay-based tests for infectious diseases or POC lactate testing devices, among many others available, can play a role. Early detection can provide enough time for a physician to implement preventative measures or adequate treatment.

CONCLUSION

The cost in lives must never be reckoned in the same terms as monetary costs, especially in critical care medicine. But in a time of economic troubles, it is hard to separate the two. Measures must be implemented to reduce costs, but at the same time to provide patients with the necessary treatment they need. The introduction of point-of-care testing may provide just such a capacity in healthcare systems today. Rapid, near-patient or bedside testing is what defines point-of-care procedures. Their availability, being ready in the hands of the critical care staff, can save precious time for patients in the ICU or emergency room. Prevention or early treatment of illnesses and/or complications will ultimately shorten a patient’s stay in the hospital, provide better outcomes, and bring cost savings to both hospital and patient. The potential rewards for using POCT in intensive medicine merit further research into the use of additional POCT devices in the ICU and emergency department, since these two areas of medicine are the most costly. Improving the quality and speed of diagnosis may turn out to be the key to both good patient outcomes, and cost-effective healthcare in intensive care medicine.

REFERENCES


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