Invited Product Profile: The epoc Blood Analysis System
Enhancing Efficiency and Improving Patient Care Through Implementation of Patient-Side Testing

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Point-of-care testing (POCT) has been possible for over 3 decades. Testing at the patient's side (patient-side test) in order to provide faster results that facilitate more expedient clinical decision making and action was the premise on which POCT was first adopted and implemented. Since then, numerous studies have demonstrated how a patient-side testing approach can reduce turnaround time and lead to operational efficiencies while maintaining the accuracy and quality of a laboratory-based process. In patient populations, where prompt diagnosis, intervention, treatment, and monitoring are essential, clinicians will benefit by obtaining critical test results in a single patient interaction, allowing them to remain at the patient's side during the testing process. Clinical staff, the laboratory, and the health care institution can benefit by streamlining patient testing workflows to enhance patient care and deliver the most cost-effective and efficient use of hospital resources, allowing them to focus on delivering the most value to patients.

The epoc Blood Analysis System (Siemens Healthineers USA, Tarrytown, NY) is a patient-side testing solution that delivers a full menu of laboratory-accurate tests, including blood gases, a basic metabolic panel, hematocrit, and lactate, in less than 1 minute after sample insertion, making it ideal for acute patient populations. The epoc system consists of 3 components: the epoc Reader, the Host2 Mobile Computer, and the epoc blood gas, electrolyte, and metabolite (BGEM) Test Card.

Each epoc BGEM Test Card can analyze blood gases (ie, pH, pCO_2, pO_2), a basic metabolic panel (ie, Na^+, K^+, Ca^{2+}, Cl, glucose, creatinine, blood urea nitrogen, TCO_2), and hematocrit and lactate (Fig. 1). BGEM Test Cards are single-use and stored at room temperature until expiration, which reduces the time, space, and equipment involved in managing inventory that requires refrigeration.[1] With a single Test Card, quality control management and patient testing throughout the hospital are simplified. Only 92 μL of blood is required for the full panel of tests from an arterial, venous, or capillary whole-blood sample. The patient sample is obtained and tested, and immediate results are provided at the patient's side, eliminating the need for transportation or non–value-added steps that may be required when testing is performed in a location away from the patient. Patient-side testing minimizes sample-quality degradation prior to testing, and elimination of sample transport ensures that test results reflect the patient's immediate condition. Because the sample never leaves the patient's side, care providers can use attributes of the epoc system such as electronic patient documentation, critical result management, and positive patient identification to mitigate and/or reduce opportunities for misidentification of patients and/or medical error.

The epoc Reader is a simple-to-use raw-signal acquisition peripheral that includes circuits for amplifying, digitizing, and converting the raw sensor signals to a wireless Bluetooth format that is transmitted to the epoc Host Mobile Computer (Fig. 2). Upon completion of a test, the Host Mobile Computer displays the results to the clinician and wirelessly and securely transmits them to the institution's LIS/HIS/EMR. This allows health care personnel to receive, review, and document results immediately while remaining at the patient's bedside and makes results available in real time to the entire care team via the LIS/HIS/EMR. Health care personnel across the care continuum can be instantly notified when results are critical and require immediate intervention.

ANALYTICAL PERFORMANCE OF THE EPOC SYSTEM

Test results from the epoc Blood Analysis System correlate with those from leading benchtop blood gas and laboratory chemistry analyzers, demonstrating analytical precision, performance, and comparability to traditional laboratory methods. Studies have validated the epoc system's precision and accuracy when compared to traditional laboratory methods, as well as other near-patient and handheld systems on the market.

Agarwal et al[2] at Baylor College of Medicine and Texas Children's Hospital studied the epoc system with regard to precision and accuracy of blood gas and electrolyte analysis compared to the ABBOTT I-STAT method (ABBOTT Point of Care, Princeton, NJ) and the RADIOMETER ABL 835 blood gas analyzer (RADIOMETER America; Radiometer, Brea, CA) used in a pediatric hospital. The method comparisons showed a high level of correlation, leading to the following conclusion from the author: "Thus, in our pediatric hospital setting, the epoc system showed excellent precision and accuracy and compared favorably with the I-STAT and ABL 835 RADIOMETER assay results."

Chen et al[3] chose to evaluate the analytical performance of the epoc system in cardiopulmonary bypass patients. When comparing the precision of the epoc system with a traditional laboratory instrument (the GEM 4000 system; Instrumentation Laboratory, Bedford, MA), the I-STAT System (Abbott Point of Care, Princeton, NJ), the Nova Biomedical Critical Care Xpress (Nova Biomedical, Waltham, MA), and the ROCHE ACCU-CHEK Inform II and Performa glucose meters (Roche Diagnostics, Indianapolis, IN), the epoc system "demonstrated clinically acceptable precision

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The statements by Siemens' Healthineers customers described herein are based on results that were achieved in each customer's unique setting. Because there is no "typical" hospital, and many variables exist (eg, hospital size, case mix, level of Information Technology adoption), there can be no guarantee that other customers will achieve the same results.

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for all analytes" with the appropriate statistical analysis performed. Therefore, the authors concluded that the epoc system was appropriate and applicable to the cardiovascular surgery setting.

Nichols et al[4] evaluated the analytical performance of the epoc system for blood gas and electrolytes. This study included an intensive care unit, cardiac intensive care unit, outpatient hematology/oncology clinic, and the Baystate Health system central laboratory, with the evaluation being conducted by nursing staff, medical laboratory technicians, medical technologists, and pathology residents. The epoc system showed excellent precision and analytical comparability in patient correlations. Additional benefits of the epoc system included room-temperature storage of Test Cards, wireless capabilities, and ease of use. The authors concluded that the epoc system's performance would meet patients' needs.

Luukkonen et al[5] analyzed the accuracy of the epoc system with regard to performance and interchangeability of a handheld blood gas device. The results from the epoc system were compared to those from the Siemens Healthineers RAPIDLab 1265 and RAPIDPoint 500 Blood Gas Systems. More specifically, parameters such as pH, pCO_2, pO_2, Hb (calc), Na^+, K^+, iCa^{2+}, glucose, and lactate levels were measured. The study concluded that the epoc system correlated well with the reference devices and is suitable for rapid measurement of blood gases, electrolytes, and metabolites in the intensive care unit.

CLINICAL, OPERATIONAL, AND ECONOMIC OUTCOMES

Studies have also shown improved time to treatment because of the timeliness of patient test results being made available to clinicians, leading to the implementation of treatment more quickly and decreased operational costs and time.[2–10]

Han et al[6] studied the implementation of the Severe Sepsis and Septic Shock Early Management Bundle (SEP-1) on patient care and outcomes. Time to lactate draw and antibiotic administration was calculated, and mortality rate investigated. Patients with delayed lactate measurements had the highest in-hospital mortality rate. This study showed that delayed lactate measurements and therefore delayed medication management increase mortality in patients with initial elevated lactate levels. The epoc system enables a patient-side result in less than 1 minute after sample insertion. This allows for faster diagnosis and treatment. For example, at Huntsville Hospital in Alabama, the epoc system has become crucial for quickly moving patients from hospital entry to treatment room and in monitoring patients' status during and after procedures.[7] More specifically, integrating the epoc system into the entire patient care continuum has allowed the Huntsville staff to

FIGURE 1. The epoc Test Card and Reader.

FIGURE 2. The epoc Reader and wireless capability. This figure can be viewed online in color at www.poctjournal.com.

screen patients for sepsis within the care units at the patient side—a lactate level is measured as soon as the signs and symptoms begin, and treatment can commence once a diagnosis is confirmed. The test requires a small amount of blood and 3 minutes to complete, which is much preferable to tubes of blood and a 30-minute wait on STAT orders from the laboratory. In sepsis, mortality increases by 8% for every hour that passes prior to starting treatment. Huntsville Hospital's sepsis mortality rate decreased by approximately 50% in the first 3 to 6 months of use, and staff expects even better results once the epoc system is implemented at the patient side throughout the entire hospital. "Without epoc, we cannot get everything done in a timely manner. With epoc, we can. This really makes a difference in patient outcomes," said Carrie Hicks, RN, sepsis coordinator at Huntsville.

By moving patient testing to the bedside with the epoc system, patients, caregivers, the laboratory, and hospital administration may all benefit from a simpler, more efficient process. With the elimination of process complexities, not only can turnaround time improve, but also clinical staff can realize operational efficiencies that may reduce costs compared to the current process.

Results from Agarwal et al[2] indicated that the epoc system had many advantages over the I-STAT method. For example, the epoc system uses a single Test Card for all analytes versus the I-STAT System, which uses multiple test cartridges and greater sample volume to obtain an equivalent menu of test results. Additionally, the epoc system provided results in a quarter of the time it took for results to be obtained from the I-STAT System. The authors went on to say, "And lastly, the smart card technology of epoc reduces costs and maximizes efficiency in the hospital setting." The authors stated in their conclusion that with the "need for immediate laboratory results in the critical care setting, [they] conclude that the operational advantages, interface capabilities, and cost-benefit ratio of the [epoc system] will propel it as a favorable [patient-side test] instrument, particularly in the intensive care setting of both adult and pediatric hospitals."

Blount Memorial Hospital (BMH) in Maryville, Tennessee, was influenced to purchase the epoc system because the Test Cards did not need to be refrigerated, and the operational costs were reasonable.[8] The epoc system enables BMH to have multiple analyzers at a cost lower than traditional instrumentation. In addition, the epoc system allows them to provide more cost-effective patient testing while meeting Joint Commission–related guidelines and patient safety goals (e.g., patient identification, critical value handling, and data management). Overall, BMH has improved clinical and patient satisfaction, increased staff efficiency, and decreased the cost and time associated with an enhanced patient care process.

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Children's Hospital & Research Center Oakland in Oakland, Calif, chose the epoc system because it was efficient and cost-effective.[9] The "expendables" cost half of what Children's Hospital & Research Center Oakland previously spent. In addition, the Test Cards use less storage space and require no refrigeration, which is useful in emergency situations. "We can pick up and go quickly to a med STAT or Code Blue without running to a refrigerator for a cartridge," said Dr Vivienne Newman, clinical director of Children's Pediatric Intensive Care Unit.

Pinnacle Health System implemented the epoc system in October 2009, with a 5-year projected cost reduction of $195,000.[10] They achieved a 48% reduction in operating expenses by the end of June 2010, an 8-month break-even return on investment. More impressive to note is that the same utilization and sample volume were compared from 2009 and 2010 in order to calculate this economic benefit.

CONCLUSIONS

The epoc system is efficient, easy to use, and cost-effective when compared with laboratory standard methods. Preanalysis sample degradation is minimized; data entry and transcription errors are reduced; misidentifications are fewer, and operating costs have decreased. Patient-side testing with the epoc system lets clinicians and laboratories stay focused on activities through which they can bring the most value to patient care. Empowered by actionable patient test results in less than 1 minute, the epoc system enables clinicians to stay at the patient's side, reducing time to diagnosis and treatment. The streamlined process further enables the laboratory to achieve its goals in order to satisfy the needs of patients and clinicians.

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