individual. The application of VAP-II may be useful not only in elucidating the roles played by specific lipoprotein abnormalities in contributing to CHD, but also in yielding valuable insight into the specific benefits of therapeutic regimens to decrease CHD risk.

This work was supported by National Institutes of Health Grants HL07708 (to J.W.C.) and M01-RR070.

References


Utilization, Reliability, and Clinical Impact of Point-of-Care Testing during Critical Care Transport: Six Years of Experience. Amy C. Gruszeczki,1 Glen Horton,2 John Lam,3 Diane Kahler,4 Debbie Smith,4 Julie Vines,4 Lee Lancaster,4 Thomas M. Daly,1 C. Andrew Robinson,1 and Robert W. Hardy* (1 Department of Pathology, 3 Departments of Medicine, Pathology, and Surgery and the Gene Therapy Center, and 4 Department of Critical Care Transport, University of Alabama at Birmingham, Birmingham, AL 35233; 2 Department of Laboratory Medicine, National Institutes of Health, Bethesda, MD 20892; * address correspondence to this author at: Department of Pathology and Laboratory Medicine, University of Alabama at Birmingham, WP230, 619 South 19th St., Birmingham, AL 35233: fax 205-975-4468, e-mail rhardy@path.uab.edu)

The use of point-of-care testing (POCT) has been reported in the setting of critical care transport (1–6), although the overall benefits have not been evaluated in depth. In addition, problems with testing reliability may be uncovered only after an extended period of field use. This report describes the use of POCT by our critical care transport program over 6 years.

All critical care transports made from January 1996 to December 2001 were reviewed. Transport vehicles were ambulances or twin-engine jets. The transport teams consisted of a physician on transport or with radio contact, a respiratory therapist, and a registered nurse. All transports were equipped with i-STAT® portable analyzers (i-STAT Corporation) and disposable cartridges for testing. The analyzer and cartridges were stored in an insulated bag for temperature control during the trip. The analytical performance verification protocol (electronic controls) recommended in the i-STAT System Manual was followed before each patient test. Liquid controls were run monthly. Proficiency testing was completed in accordance with the requirements of the College of American Pathologists.

The manufacturer’s test cartridges were the G3, 6+, EG7+, and glucose. Tests included pH, Pco2, Po2, calculated bicarbonate, total CO2 base excess, oxygen saturation, sodium, potassium, chloride, urea, glucose, hematocrit, and calculated hemoglobin and glucose. Each cartridge requires 65 µL of whole blood for testing. The blood was drawn and analyzed by physician order. From 1997 through 2001, the team filled out an evaluation form in accordance with the requirements of the College of American Pathologists.

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were in cardio-respiratory arrest at initial evaluation. Hospital. Six patients were not transported because they were in cardio-respiratory arrest at initial evaluation. Patients’ ages ranged from neonatal to 92 years. The patient care time (time from initial evaluation of the patient to the release from care at the destination) ranged from 20 min to 20 h, with a mean time of 2 h and 58 min (SD, 2 h and 5 min). The trips consisted of local, intrastate, interstate, and international locations. POCT was performed during the transport of 706 (17%) patients. Over the 6 years of testing, the rate of use per case ranged from 18% to 11% per year. Most testing, 77% (n = 505), was performed at the hospital before transport, with some testing done in the ambulance (14%; n = 92) or in the jet (7%; n = 47). Eight percent (n = 50) of testing was done at multiple sites, i.e., hospital and ambulance, hospital and jet, ambulance and jet.

The patients transported had a wide variety of diagnoses, including trauma, cardiac, pulmonary, and transplant conditions and premature birth. The transport team assigned an acuity rating of critical, serious, or fair reflecting the patient’s condition. Critical acuity patients, 39% of our overall population, had unstable conditions, were on ventilators or intra-aortic balloon pumps, required continuous monitoring, and were at high risk for complications. Patients with serious acuity (40%) had partially stable conditions, required frequent monitoring, were at moderate risk for complications, and were usually admitted to the intensive care unit. Patients considered to be in fair condition (21%) were stable, required minimal monitoring, were at low risk for complications, and were admitted to the hospital floor. Approximately 66% of POCT was performed on patients graded critical, with less frequent use on patients graded serious (30%) or graded fair (4%).

Nonanalytical test failures were reported in 76 i-STAT uses during 1146 patient tests over 6 years, or ~7%. Reasons for these failures were cartridge failure (55%), operator error (42%), or analyzer failure requiring repair by manufacturer (3%). Importantly, in all cases of these failures, results were not reported because the i-STAT suppressed displaying results. Repeat testing was done in all cases except the two analyzer failures requiring repair by the manufacturer. The operator errors can partially be attributed to the moving environment in which testing occurs. Regular maintenance and quality-control and -assurance programs likely contributed to dependable operation.

Of a total of 3500 cartridges purchased over 6 years, 1146 were used for patient testing, an average of 1.6 cartridges per case. The supply cost for a cartridge averaged approximately $5.00. For this low-volume testing environment, more than one-half of all cartridges were used for quality-assurance testing or personnel training, or expired before use. Total capital costs were approximately $15 000, and no additional staff time was required. Costs averaged approximately $50 per case where POCT was used or approximately $8 per case if divided among all transports. Costs were allocated over all transports because the technology was available on all trips.

The clinical impact of POCT during critical care transport was evaluated through subjective questionnaires completed by transport teams. No biases or trends were evident in the completion of the forms. The questionnaires provided information on a subset of patients undergoing POCT, representing many diseases. The teams, under the direction of the physician, filled out evaluation forms for 182 (30%) trips where the i-STAT portable analyzer was used. Although not all 182 evaluation forms were fully completed, 153 teams responded positively to the question of necessity of POCT. On the basis of the teams’ subjective opinion from 151 transports (i.e., all that responded to this question), POCT provided a moderate or substantial improvement in the condition of 14% of patients (21 of 151), and an uncertain or no improvement in 86% (130 of 151).

Measurement of the impact of laboratory testing on the traditional clinical outcomes of mortality or specific medical complications is complex. In the critical care transport setting, episodes of care are brief and there are few deaths or clinical complications. We assessed clinical impact by examining how often POCT produced identifiable changes in patient treatment by a retrospective evaluation of each patient chart. These were quantifiable examples where treatment decisions were directly linked to test results. Therapeutic yield is defined here as the number of testing episodes that led to a change in treatment divided by the total number of testing episodes. With 1146 cartridges, our overall therapeutic yield was 50%. The most frequent categories of testing and the associated treatments are listed in Table 1. Blood gas analysis had the highest therapeutic yield for any individual category of testing. POCT after emergent intubation occurred 22 times with no change in ventilator settings. POCT was used nine times during cardiopulmonary resuscitation. Admittedly, in our evaluation, the possibility exists that some clinical decisions, such as ventilator adjustments, could have been made based on clinical evaluation or pulse oximetry results. Most other treatment decisions, such as transfusions and the adjustment of electrolyte concentrations, would less likely have been made based on clinical evaluation.

POCT results were also valuable when no abnormal results or therapeutic interventions occurred and may lead to an underaccounting for therapeutic yield in that laboratory results would rule out a change in status, e.g., blood gases after emergent intubation to check ventilator settings then found to be adequate. In accordance with 77% of testing performed at the hospital before transport, 208 interventions were performed there as well. Notably, only one-fourth of all
POCT was performed in the ambulance or jet during actual transport. Although this “before transport” portion of testing may impact overall transport costs by altering transport time, it remains a topic for future utilization review.

One concern with POCT in critical care transport is the potential for excessive utilization because of the availability and ease of testing. A primary finding of this study was the low rate of utilization. Although POCT equipment was available for all transports over the 6 years, testing was performed in only 17% of cases. Rates were higher in patients with high acuity than for patients with more stable conditions. The annual rate of use was relatively constant, and rampant overuse of laboratory testing in this environment clearly did not occur for this testing program.

In many clinical settings, POCT has been reported to improve patient care (7–12). One of the most controversial aspects of POCT is the cost (7, 8, 10, 11). In the intensive care unit, it may not be cost-effective to use POCT when a substantially less expensive central laboratory test is available. In the transport setting, the issue is the cost of POCT vs no testing at all. We found that POCT represents a very small fraction of overall transport costs and a relatively small cost per case considering the potential for significant clinical benefit.

POCT has a unique niche in critical care transport, and our experience shows that testing can be performed with high reliability. POCT provides the benefit of rapid analysis of critical analytes and blood gases in a setting where no other laboratory analysis is available. POCT in the transport setting is infrequent and is relatively inexpensive. This study demonstrated that the use of POCT led to changes in patient treatment 30% of the times when testing was performed.

We would like to thank Carol Howard for sharing her insight and experience with POCT in preparation of this manuscript.

References

Use of Inductively Coupled Plasma Mass Spectrometry to Measure Urinary Iodine in NHANES 2000: Comparison with Previous Method, Kathleen L. Caldwell,2 C. Brook Maxwell,1 Amir Mukhmudov,1 Sam Pino,2 Lewis E. Bruwerman,2 Robert L. Jones,1 and Joseph G. Hollowell1 (1 Inorganic Toxicology and Nutrition Branch, Division of Laboratory Sciences, National Center for Environmental Health, CDC, 4770 Buford Hwy., NE, Mail Stop F18, Atlanta, GA 30341; 2 Section of Endocrinology, Diabetes, and Nutrition, Department of Medicine, Boston Medical Center, Evans Bldg., Room 201, 88 Newton St., Boston, MA 02118-2393; 3 Department of Pediatrics, University of Kansas Medical Center, 435 N. 1500 Road, Lawrence, KS 66049; * author for correspondence: fax 770-488-4609, e-mail KlC7@cdc.gov)

Urinary iodine (UI) concentrations directly reflect dietary iodine intake and consequently test biochemical assessment of the iodine status worldwide (1).

The Iodine Laboratory of the Division of Laboratory Sciences at the National Center for Environmental Health, CDC, measured the UI content of specimens as part of the National Health and Nutrition Examination Survey (NHANES) 2000 and will measure UI in the US population through future NHANES analyses, using inductively coupled plasma mass spectrometry (ICP-MS). In this report, we describe the ICP-MS laboratory method and compare that method with the established Sandell–Kolthoff (S-K) spectrophotometric method used in NHANES III.

The ICP-MS method described previously (2) was