Impact of point-of-care testing on patients' length of stay in a large emergency department

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We prospectively investigated whether routine use of a point-of-care testing (POCT) device by nonlaboratory operators in the emergency department (ED) for all patients requiring the available tests could shorten patient length of stay (LOS) in the ED. ED patient LOS, defined as the length of time between triage (initial patient interview) and discharge (released to home or admitted to hospital), was examined during a 5-week experimental period in which ED personnel used a hand-held POCT device to perform Na, K, Cl, glucose (Gluc), and blood urea nitrogen (BUN) testing. Preliminary data demonstrated acceptable accuracy of the hand-held device. Patient LOS distribution during the experimental period was compared with the LOS distribution during a 5-week control period before institution of the POCT device and with a 3-week control period after its use. Among nearly 15 000 ED patient visits during the study period, 4985 patients (2067 during the experimental period and 2918 during the two control periods) had at least one Na, K, Cl, BUN, or Gluc test ordered from the ED. However, no decrease in ED LOS was observed in the tested patients during the experimental period. Median LOS during the experimental period was 209 min vs 201 min for the combined control periods. Stratifying patients by presenting condition (chest pain, trauma, etc.), discharge/admit status, or presence/absence of other central laboratory tests did not reveal a decrease in patient LOS for any patient subgroup during the experimental period. From these observations, we consider it unlikely that routine use of a hand-held POCT device in a large ED such as ours is sufficient by itself to impact ED patient LOS.

INDEXING TERMS: laboratory management • electrolytes • hematocrit

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Near-patient or point-of-care testing (POCT) has generated substantial interest among healthcare providers during the past several years [1]. Devices based on disposable microelectrodes that measure electrolytes, urea, glucose, and hematocrit in small volumes of undiluted whole blood have been reported to provide sufficient reliability, precision, and accuracy for clinical use [2–4]. Similar methods for additional analytes can be expected in the near future [5, 6]. The most obvious advantage of these devices is the ability to rapidly (in <5 min) provide a biochemical test value from a small whole-blood sample.

Despite evidence that these devices clearly work, numerous questions persist regarding POCT [1]. For example, management of patients' data (billing, entry into medical records and medical information systems) is not automatic or always straightforward for these devices, which may lead to problems such as lack of a permanent record and loss of charges. Second, nonlaboratory personnel, whose primary responsibilities may be in a very hectic environment such as the emergency department (ED), are usually the operators of POCT, and may not be familiar with or always comply with preanalytical procedures, quality control (QC), quality assurance, or regulatory policies. Finally, the relation between the increased cost of a POCT device and a beneficial impact on care of patients is unclear. Because these devices generally have costs at least 2–3 times higher per patient than the central laboratory cost [3, 7, 8], it is important to determine whether faster laboratory values will result in a positive clinical or economic outcome.

One area of the healthcare system in which faster laboratory results might result in beneficial patient outcome by allowing faster clinical decisions and decreased length of stay (LOS) is the ED [3, 4, 9–11]. However, the only studies involving the ED to date are based on retrospective surveys of ED clinicians who did not actually use POCT results for clinical decisions [4, 11]. One currently available POCT device is the i-STAT (i-STAT Corp., Princeton, NJ), which can provide values for Na, K, Cl, blood urea nitrogen (BUN), glucose (Gluc), hematocrit (Hct), and

5 Nonstandard abbreviations: POCT, point-of-care testing; LOS, length of stay; ED, emergency department; Gluc, glucose; BUN, blood urea nitrogen; Hct, hematocrit; Hb, hemoglobin; QC, quality control; and PCV, packed cell volume.
hemoglobin (Hb) in ~2 min at the patient’s bedside [2–4]. We wished to determine whether actual clinical use of the i-STAT device in the ED would result in decreased LOS for ED patients as a result of its fast analytical time and the concomitant elimination of sample transport to and processing by the central laboratory.

We prospectively examined the LOS in the ED for 1722 patients during a 5-week period in which the ED clinicians used i-STAT results for the above laboratory tests for clinical decisions. We then compared the LOS for these patients with the LOS for 2918 ED patients from two control periods: one for 5 weeks before institution of the i-STAT device and the other for 3 weeks after the i-STAT was used. To identify patient subgroups that might particularly benefit from use of a POCT device in the ED, we also examined LOS in ED patients subdivided into groups according to presenting symptoms, laboratory tests ordered from the ED, and discharge status. We also used this opportunity to evaluate the analytical performance of the i-STAT in a “real world” setting, where numerous nonlaboratory operators routinely used the device.

Materials and Methods

SETTING OF STUDY

Barnes Hospital is a 1209-bed teaching institution affiliated with the Washington University School of Medicine. The ED at our institution is a level I trauma center connected to the central laboratories via a pneumatic tube system. The current in-laboratory median turnaround time is ~38 min for stat chemistry profiles, 19 min for stat hematology profiles, and 4 min for stat blood gas and (or) whole-blood electrolyte analysis. Completed test results are immediately available in the ED via laboratory information system computer terminals.

POCT DEVICE

Whole-blood values for Na, K, Cl, BUN, Gluc, Hct, and Hb were obtained in the ED by ED personnel using hand-held devices from i-STAT Corp. with the EC6+ cartridge. This cartridge contains ion-specific electrodes for Na, K, and Cl; an amperometric sensor for Gluc that detects H2O2 formation by glucose oxidase; an NH4+ ion-specific electrode containing urease to detect BUN; and a conductance sensor to calculate Hct [2]. Hb values are calculated by the formula: % packed cell volume (PCV) × 340 = Hb (g/L) [12].

Samples for i-STAT analysis were drawn by ED personnel into tubes containing lithium heparin anticoagulant from patients at the time laboratory testing was ordered. A portion of each blood sample was removed from the tube through a syringe, and ~65 μL of whole blood was applied to the EC6+ cartridge. Results are available in ~2 min. About one-third of the patients seen in our ED have one or more laboratory tests performed in the central laboratory that can be measured on the i-STAT device.

POCT quality assurance. Eighty ED personnel (nurses and ED technicians) were initially trained by laboratory personnel to use the i-STAT device. A 1-h didactic session covered the i-STAT system and cartridge components, the theory of operation, QC procedures, proper sample handling, test performance procedures, and instrument care. Each potential operator observed laboratory personnel performing tests and then performed testing under the supervision of a laboratory employee. The i-STAT operators in the ED were provided an i-STAT operating procedure manual, and a checklist covering each step of the training process was completed and reviewed with each operator.

The QC procedure for the i-STAT included ED personnel running the electronic simulator (an instrument electronics and calibration check) twice daily on each of the three i-STAT devices in use in the ED. In addition, aqueous chemistry (i-STAT Corp.) and hematology (Meter Trax Co., Benicia, CA) control materials at two concentrations were assayed on each of the three ED devices once a day. If any QC (simulator or liquid) produced values outside the range of acceptable values, the QC was repeated by the operator; if results were still unacceptable, the device was taken out of service. QC values were entered into the laboratory information system and reviewed daily by laboratory personnel. A repeat limit/panic value policy was established so that samples producing values exceeding these limits were repeated in the ED and the blood sample was also sent to the central laboratory.

LOS STUDY DESIGN

Triage time (time of initial patient interview by a registered nurse) and discharge time (e.g., patient released to home, admitted to hospital) were entered into the hospital information system for every ED patient. LOS, defined as the length of time between triage and discharge, was the end point examined during the study. The study was divided into three periods: control, experimental, control. During the first control period—December 11, 1994, through January 16, 1995—all biochemical testing from the ED was performed in the customary way, through the central laboratory. In the experimental period—February 28 through April 4, 1995—the ED exclusively used the i-STAT for its available tests. The one exception was that patients coming through the ED for prearranged hospital admission did not have i-STAT testing performed (such patients often have laboratory tests ordered by the ED as a courtesy to the admitting floor). In the second control period—April 6–24, 1995—all testing was again performed by the central laboratory. Between January 16 and February 28, 1995, we attempted to begin the experimental period but encountered several problems that necessitated retraining i-STAT operators (see Results).

To ensure full usage of the i-STAT during the experimental period, we removed from the ED computer “quick” ordering system the ability to order a central laboratory “Chem 6” profile (Na, K, Cl, Gluc, CO2, and creatinine). Creatinine and total CO2 are not available on the i-STAT EC6+ cartridge, so ED physicians were allowed to order them from the central laboratory at no additional charge. In analyzing LOS during the experimental period, we both included and excluded patients with either creatinine or total CO2 ordered from the central laboratory or with other chemistry tests performed in the central laboratory.
Printouts of i-STAT results were attached to the patient's ED chart and were available to all physicians who saw the patient and to the admitting floor. Twice a day, i-STAT results were downloaded from the devices to a personal computer and then entered into the laboratory information system for billing purposes as well as to become a part of the patient's permanent record.

ED patient subgroups. Laboratory information system records were searched for all ED patients seen in each study period to determine which patients had one or more of the i-STAT available tests ordered from the ED. These individuals were defined as the study-eligible patients. Additionally, a code designating the discharge destination from the ED for each patient was captured from the information system. Because presenting symptom data are not stored in the information system, we manually assigned the study-eligible ED patients with presenting symptom codes. ED "cover sheets," which include the patient's chief complaint as recorded by the triage nurse, were reviewed by either ED nursing staff or a laboratory medicine fellow to determine the presenting symptom code from a list of 26 common ED presenting symptoms.

Wilcoxon's rank sum was used to test for differences in LOS distributions between subgroups [13]. Nonparametric confidence intervals for differences in LOS distributions were derived by the method of Lehmann [14].

i-STAT method comparison analyses. This study received approval of the Washington University Human Studies Committee. There were three phases of method evaluation of the i-STAT POCT devices. All phases involved paired comparisons by regression analysis of results for patients' samples assayed with the i-STAT device and in the central laboratory. The first phase was a method evaluation of the i-STAT device performed within the laboratory by laboratory personnel. The second phase was a method evaluation of the i-STAT device performed by 10 ED personnel under laboratory supervision before institution of the i-STAT in the ED. The third phase was a method evaluation of the i-STAT device performed by ED personnel during the experimental period. Each day, 10–15 lithium heparin-containing tubes used for routine i-STAT testing in the ED and the corresponding K\(^+\) EDTA tubes used for central laboratory analyses were randomly selected and taken to the central laboratory for analysis within 2 h of i-STAT testing. Tubes were maintained at room temperature while in the ED.

Central laboratory values for Na, K, Cl, Gluc, and BUN were obtained from lithium heparin-anticoagulated plasma by the Ektachem 750 analyzer (Clinical Diagnostics Division of Johnson & Johnson, Rochester, NY). Hct and Hb values were obtained from K\(^+\) EDTA-anticoagulated blood on an STKS analyzer (Coulter, Hialeah, FL). Samples were drawn into tubes containing K\(^+\) EDTA anticoagulant immediately after the lithium heparin-containing tubes had been filled by ED personnel when any component of a complete blood cell profile was ordered.

Results

I-STAT performance in the ED

Before the initial training of ED personnel on use of the i-STAT, laboratory personnel first evaluated its performance. The precision and accuracy were consistent with previously reported studies (data not shown) [2–4, 11]. After the training of ED personnel, but before routine use of the i-STAT device in the ED, a method comparison study with samples from 50 patients performed by ED personnel was also consistent with the previous studies [3, 4, 11] except for three i-STAT Hct values that were falsely high by 8–15% PCV (data not shown). The discrepant Hct values were ascribed to improper sample mixing. Routine ED use of the i-STAT for the 5-week experimental period was approved by the ED and laboratory medical directors.

During the experimental phase, 10–15 samples from the ED were delivered each day to the central laboratory for method comparison studies to determine the accuracy of the i-STAT in routine use by multiple, nonlaboratory operators. In the first several days of the initial experimental phase that began on January 16, 1995, six i-STAT Hct values were 10–20% PCV higher than the Coulter value. To address this problem, we aborted this experimental period. We retrained and decreased the number of ED operators to ~30 registered nurses, who again performed 50 i-STAT analyses under laboratory personnel supervision with acceptable i-STAT Hct values. However, upon resuming the experimental period on February 28, 1995, we observed four more markedly increased i-STAT Hct values within the first 4 days. At this point, we ceased reporting i-STAT Hct values into the laboratory information system, informed ED clinicians to ignore i-STAT Hct values, and proceeded with the experimental phase, using only chemistry values from the i-STAT for clinical decisions. When the i-STAT printouts were attached to the ED chart, Hct values were marked through by ED personnel.

The method comparison results obtained during the 5-week experimental period are shown in Table 1. Na and K compared extremely well with results by the Ektachem analyzer, with only two and three samples producing outliers of as much as 7 and 0.5 mmol/L, respectively. Cl showed somewhat less correlation ($r^2 = 0.82$). However, except for one i-STAT value of 83 mmol/L (vs 103 mmol/L in the central laboratory), no values differed by $>9$ mmol/L. Comparison studies for BUN demonstrated that the i-STAT produced values 8–9% higher than the Ektachem, but results by both methods correlated well. Values for Gluc were difficult to compare directly because the samples taken to the main laboratory had been at room temperature for as long as 2 h in the ED after i-STAT analysis. Therefore, glycolysis is a likely reason why the central laboratory values averaged 255 mg/L lower than the i-STAT values. Although i-STAT Hct values were not used clinically during the experimental period, we nevertheless continued to compare i-STAT Hct values with Coulter STKS Hct values and found that the i-STAT generally produced values 3–4% PCV higher, as previously observed [4]. However, 21 samples gave i-STAT values that differed from Coulter results by $>8$% PCV (19 being falsely higher) and 8 differing by $>10$% PCV (Table 1). This was consistent with the
Table 1. Comparison of i-STAT and central laboratory values.

<table>
<thead>
<tr>
<th>Analyte</th>
<th>n</th>
<th>Lab.</th>
<th>i-STAT</th>
<th>Slope</th>
<th>Intercept</th>
<th>r²</th>
<th>Outliers*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na, mmol/L</td>
<td>380</td>
<td>138.5</td>
<td>138.5</td>
<td>1.04</td>
<td>−4</td>
<td>0.86</td>
<td>2</td>
</tr>
<tr>
<td>Cl, mmol/L</td>
<td>379</td>
<td>102.2</td>
<td>100.3</td>
<td>0.91</td>
<td>6.9</td>
<td>0.82</td>
<td>11</td>
</tr>
<tr>
<td>K, mmol/L</td>
<td>379</td>
<td>3.9</td>
<td>4.0</td>
<td>1.0</td>
<td>0.1</td>
<td>0.98</td>
<td>3</td>
</tr>
<tr>
<td>Gluc, mg/L</td>
<td>360</td>
<td>1204</td>
<td>1459</td>
<td>0.97</td>
<td>286</td>
<td>0.92</td>
<td>ND</td>
</tr>
<tr>
<td>BUN, mg/L</td>
<td>369</td>
<td>191</td>
<td>205</td>
<td>1.09</td>
<td>−5.0</td>
<td>0.98</td>
<td>12</td>
</tr>
<tr>
<td>Hct, % PCV</td>
<td>312</td>
<td>36.8</td>
<td>40.0</td>
<td>0.97</td>
<td>4.2</td>
<td>0.84</td>
<td>21</td>
</tr>
</tbody>
</table>

* Defined as an absolute difference between i-STAT value and ED or central laboratory value for the same sample of ≥7 mmol/L for Na⁺, 6 mmol/L for Cl⁻, 0.5 mmol/L for K⁺, 80 mg/L for BUN, and 8% PCV for Hct. Because of time delays as long as 2 h between i-STAT and central laboratory analysis, outliers were not determined (ND) for Gluc.

Early problems of reliability we experienced with i-STAT Hct values.

**ED Population Characteristics and LOS**

Because of the problems with i-STAT Hct values, only ED patients with one or more of Na, K, Cl, BUN, or Gluc tests ordered were included in the study-eligible patient population. During the two control periods, a total of 8941 patients were seen in the ED, of whom 2918 (33%) had at least one of the above tests ordered from the central laboratory (Table 2). The median LOS for the 5923 ED patients without these laboratory tests ordered was 105 min, whereas the median LOS was 201 min for the study-eligible ED patients who had these biochemical tests ordered (Table 2). LOS for the two control periods were not significantly different (P = 0.4) and thus are combined for all comparisons with the experimental period. During the 5-week experimental period, 2067 (34%) ED patients were study-eligible; their median LOS was 209 min, whereas that for the 3963 study-ineligible ED patients was 109 min (Table 2).

Figure 1 depicts the categorization of the 2067 ED patients eligible for i-STAT testing during the experimental period, based on their laboratory testing pattern. Of these, 345 patients had the i-STAT available tests performed in the central laboratory, and their median LOS was 206 min. (These patients consisted of those "preadmitted" and those who "slipped through" the study design, and their results are not included in subsequent LOS analyses.) Of the 1722 patients who had i-STAT testing performed in the ED, 1631 also had other central laboratory testing performed in addition and a median LOS of 212 min; 938 of these patients had complete blood count and (or) a Chem 12 series of biochemical tests (aspartate aminotransferase, calcium, cholesterol, creatine kinase, total bilirubin, BUN, uric acid, lactate dehydrogenase, alkaline phosphatase, phosphorus, total protein, and albumin) performed in the central laboratory in addition to i-STAT testing (median LOS = 205 min). Thus, despite the large discrepancy in LOS between ED patients who had laboratory testing and those who did not (Table 2), routine use of the i-STAT device clearly did not decrease the overall LOS, or its distribution (Fig. 2), when other central laboratory testing was performed.

During the experimental period, only 91 of the 1722 patients...
(5.3%) with i-STAT testing had no other central laboratory tests performed; for these patients, the median LOS was 164 min (Fig. 1). Interestingly, only 35 of the 2918 study-eligible patients (1.2%) during the combined control periods had no other central laboratory testing besides a Chem 6 or 7 (Chem 7 = Chem 6 plus BUN); their median LOS was 159 min. Because of the small number of patients with no other central laboratory tests, the 95% confidence interval for the difference between experimental and control periods is −28 min to 24 min.

Given that the LOS of ED patients admitted to the hospital may be affected by factors beyond the control of the ED and because these patients do not have to wait for results of all central laboratory tests before discharge to the floor, we examined how use of the i-STAT might impact the LOS for patients discharged home vs those admitted to the hospital. During both the control and experimental periods, 55–56% of ED study-eligible patients were admitted to the hospital and 37–38% of these patients were discharged home (Table 3). The LOS did not differ significantly between the experimental and control periods for those patients admitted or for those sent home (Table 3).

**EFFECTS OF VARIOUS PRESENTING CONDITIONS**

The acuity, number, and type of diagnostic procedures, as well as the number of physician consultations, will vary considerably according to the presenting symptoms of an ED patient. Therefore, we examined the impact of the i-STAT device on the LOS for groups of ED patients with different presenting symptoms (Table 3). The LOS for these categories of patients varies considerably (e.g., chest pain vs abdominal pain). However, of the presenting symptoms categories with at least 30 patients in both the control and experimental periods, in none did the use of the i-STAT significantly improve the median LOS (Table 3).

### Table 3. LOS of ED patients categorized by discharge destination or presenting symptoms.

<table>
<thead>
<tr>
<th></th>
<th>Combined control period</th>
<th>Experimental period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of patients</td>
<td>Median LOS, min</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2918</td>
<td>201</td>
</tr>
<tr>
<td><strong>Destination</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Admitted</td>
<td>1650</td>
<td>196</td>
</tr>
<tr>
<td>Home</td>
<td>1060</td>
<td>210.5</td>
</tr>
<tr>
<td>Other a</td>
<td>208</td>
<td>183.5</td>
</tr>
<tr>
<td><strong>Presenting symptom group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chest pain</td>
<td>318</td>
<td>152.5</td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>257</td>
<td>225</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td>235</td>
<td>172</td>
</tr>
<tr>
<td>Nausea/vomiting</td>
<td>185</td>
<td>206</td>
</tr>
<tr>
<td>Trauma</td>
<td>195</td>
<td>219</td>
</tr>
<tr>
<td>Weakness</td>
<td>74</td>
<td>220</td>
</tr>
<tr>
<td>Cough/URI</td>
<td>60</td>
<td>184</td>
</tr>
<tr>
<td>Seizure</td>
<td>72</td>
<td>215</td>
</tr>
<tr>
<td>Dizziness</td>
<td>60</td>
<td>215.5</td>
</tr>
<tr>
<td>Syncope</td>
<td>41</td>
<td>198</td>
</tr>
<tr>
<td>UTI symptoms</td>
<td>38</td>
<td>245.5</td>
</tr>
<tr>
<td>Other b</td>
<td>1109</td>
<td>208</td>
</tr>
<tr>
<td>Unknown</td>
<td>274</td>
<td>200</td>
</tr>
</tbody>
</table>

a Patients who died, transferred to another facility, or left against medical advice.

b Presenting symptom groups with <30 patients in one or more of the study periods; these symptoms include altered level of consciousness, sickle cell crises, arrhythmias, renal failure, hypertension, osmolality/electrolyte abnormality, vaginal bleeding, back pain, psychiatric, rule-out anemia, and hypotension. URI, upper respiratory infection; UTI, urinary tract infection.
Discussion
We prospectively examined the impact of POCT for Na, K, Cl, Gluc, and BUN on patient LOS in the ED by instituting a 5-week experimental period during which i-STAT values were used for clinical decision making. Because it produces technically valid results (2–4) and is easy to operate, the i-STAT is an ideal device for prospectively determining whether rapid bedside results would decrease LOS in the ED. LOS in the ED for 1722 patients during this experimental period was compared with the LOS for 2918 patients during two control periods, one preceding and one following the experimental period. We found that use of i-STAT results in the ED for clinical decisions failed to shorten ED patient LOS, regardless of final disposition, presenting symptoms, or the presence or absence of other central laboratory testing.

The impact of laboratory value turnaround time on total ED LOS is uncertain, but the general perception is that “faster is better.” Two recent studies (4, 11) suggest that POCT could improve ED LOS in 17–19% of ED patients, based on results of retrospective ED physician interviews. Our finding that 2918 ED patients with biochemical testing performed in the central laboratory had a median LOS that was 96 min longer than 5923 ED patients who had no biochemical testing suggests that laboratory turnaround time may indeed affect ED LOS. Furthermore, Saxena and Wong have suggested that delays in obtaining laboratory test results amplify the multiple demands on ED physicians by leading them away from one patient to another, thus extending the actual time for physicians to act on laboratory results (10). However, some portion of the longer LOS when biochemical tests are ordered is undoubtedly due to the patients being “sicker,” requiring other nonlaboratory procedures and additional physician consultations.

Our results are in agreement with a study that prospectively examined the impact of a dedicated ED stat laboratory (10) but differ from two recent studies that addressed the potential impact of the i-STAT by asking ED physicians whether i-STAT results would have expedited clinical decisions for patients they had previously treated without knowledge of the i-STAT results (4, 11). Despite the different conclusions and approaches used, there are remarkable similarities in the ED populations of these earlier studies (4, 11) and ours. Like our population, 55% of the Stanford University ED population was admitted (4). Furthermore, ED patients released home in the Stanford study had a median LOS of 215 min, almost the same as the median LOS of 215 min for our patients discharged home. In both of the retrospective studies (4, 11), the distribution of patients by presenting symptom is remarkably similar to our findings in much larger populations. For instance, much like our findings (Table 3), chest pain was the presenting symptom in 13%, abdominal pain in 7–10%, shortness of breath in 11–12%, and nausea/vomiting in 5–7% of all patients in these two studies (4, 11). In the study by Tsai et al. (11), 10 of 210 patients (4.8%) studied had only i-STAT-available tests performed in the central laboratory. This is comparable with the 5.3% of our patients who had only i-STAT testing during the experimental period, but more than the 1.2% of patients who only had a central laboratory Chem 6 or Chem 7 panel during the control periods. Taken together, it is unlikely that the different conclusions from our study and those of Sands et al. (4) and Tsai et al. (11) are due to major differences in ED patient populations.

Several differences in study design and ED settings may account for the different conclusions. First, our study was prospective, i.e., only i-STAT results were available to ED physicians, and actual patient LOS was tracked; in contrast, the conclusions of the earlier studies (4, 11) were based on surveys of ED physicians asking “what if” these results had been available in 2 min. The response to such a “what if” question for a new, “faster is better” tool might be biased toward the affirmative. Second, our study examined nearly 5000 ED patients and was carried out 24 h/day, not just “when the research assistant was available” (11). Third, neither of the EDs in the earlier studies (4, 11) is stated to be connected to the central laboratory by a pneumatic tube or other “rapid-transit” system. Perhaps our results would have been different if our ED was located far from the central laboratories and not connected by pneumatic tube. The different conclusions of these studies emphasize the importance of investigating any new technology in the actual setting in which it may be used.

An interesting observation from this study is the increase in the number of patients who received i-STAT tests and no other central laboratory tests during the experimental period (5.3%) vs those having only a Chem 6 or 7 panel ordered during the control period (1.2%). Although the LOS for these small groups did not differ during the experimental and control periods, it is interesting to speculate whether the availability of rapid electrolyte testing led to more rapid discharge and less additional testing for some patients during the experimental period. Do ED physicians preventively order more tests, knowing they must wait anyway for results of the tests they initially require? If so, use of the i-STAT might decrease unnecessary central laboratory testing. An alternative hypothesis would be that, when results are immediately available, the tests would be ordered more frequently simply because there will be no time delay. Our study cannot address these possibilities; however, as POCT test menus expand, the number of ED patients whose laboratory testing can be done immediately will increase.

An unexpected observation from this study was the poor reliability of i-STAT Hct values despite intense efforts at retraining i-STAT operators. Conductance methods produce slightly higher values than particle counting methods (11) and can be markedly affected by large alterations in electrolyte and protein concentrations (15). In some clinical settings, e.g., pediatric perfusion procedures, these interferences can be clinically very significant (15). However, none of the cases of discrepant i-STAT Hct values we saw reflected marked hypo- or hyperproteinemia, and we can only ascribe these discrepant values to improper sample mixing. i-STAT samples were obtained from tubes by use of a syringe, as in previously published evaluations of the i-STAT (3, 4, 11). For Hct discrepancies as large as 19% PCV, it is likely that ED personnel failed to mix the contents of either the tubes or the syringes when there were...
time delays between drawing the blood and performing the
i-STAT analysis. This raises the question of whether numerous
nonlaboratory operators in a busy environment such as the ED
will always maintain awareness of preanalytical factors such as
proper sample mixing, regardless of how simple the device is to
operate. One approach to overcoming this potential problem is
to have one or two dedicated operators at a central location in
the ED [3]. However, this could substantially add to the cost and
might itself introduce transport and analysis time delays.

We did not perform a cost analysis in this study, preferring
first to determine whether POCT would have a beneficial
impact on patient care. Our results emphasize the importance of
examining the impact of POCT in a particular setting before its
institution and also raise the question as to whether some tests
on the i-STAT can really be made “operator-proof” in a
nonlaboratory setting.

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script.

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