The Role of Rapid vs Conventional Human Immunodeficiency Virus Testing for Inpatients

Effects on Quality of Care

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Background: Rapid testing for human immunodeficiency virus (HIV) has improved HIV screening in the outpatient and perinatal settings, but few data report how it may be used to improve the quality of inpatient care. We compared quality of care for inpatients diagnosed in the emergency department via rapid testing vs patients whose conditions were diagnosed via conventional testing during their hospital admission.

Methods: We reviewed medical records to identify patients with first-time positive HIV tests and concurrent hospital admission who were tested via either rapid testing in the emergency department or conventional testing during their hospital admission. We compared quality-of-care end points for these patients.

Results: We identified 103 HIV-infected inpatients with no previous HIV diagnosis; the conditions of 48 patients (47%) were diagnosed by rapid testing and 55 (53%) by conventional testing. Mean length of stay was 6 days for the rapid test group vs 13 days for the conventional test group (P < .001); multivariate regression analysis showed that testing modality had an independent, statistically significant effect on length of stay. Nine (16%) of the patients in the conventional test group vs none in the rapid test group were discharged without receiving their HIV test results (P = .002). Patients in the rapid test group attended the outpatient HIV clinic in a mean of 22 days vs 50 days for the conventional test group patients (P = .05).

Conclusions: Rapid HIV testing in the emergency department preceding admission may shorten hospital stay, increase the number of newly diagnosed patients with HIV who are discharged from the hospital aware of their HIV status, and improve entry into outpatient care for patients admitted at the time of their initial HIV diagnosis.

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Despite advances in the treatment of human immunodeficiency virus (HIV) infection and AIDS, the annual rate of newly diagnosed HIV infections has not decreased significantly, and an estimated 180 000 to 280 000 people living in the United States with HIV are not aware of their diagnosis. These data have led to increased interest in expanding access to HIV counseling, testing, and referral services. Improvements in HIV diagnostic testing techniques have made rapid, accurate detection of HIV antibodies in whole blood possible and led to the commercial availability of true point-of-care testing. The United Nations Program on HIV/AIDS and the World Health Organization have recommended testing strategies that rely on serial rapid tests rather than conventional enzyme immunoassay (EIA) testing with confirmatory Western blot, and the Public Health Service has advocated that practitioners divulge results of rapid tests before the availability of confirmatory testing in cases where such knowledge would improve patient care. Use of point-of-care HIV testing has allowed improvements in the dismal 40% failure-to-notify rates seen with traditional testing modalities. Additionally, point-of-care testing has streamlined HIV testing in the labor and delivery and occupational exposure settings. Previous Centers for Disease Control and Prevention HIV testing guidelines emphasized how testing in acute care settings may assist in forming differential diagnoses, lead to early initiation of medical management of HIV infection, and inform HIV-infected individuals about behaviors that can prevent HIV transmission. Subsequent reports have documented the viability of using rapid HIV tests for screening patients in emergency departments (EDs). Despite successful implementation of point-of-care HIV testing in...
screening clinics, labor and delivery, and the ED, few published data address the effect that expanded use of rapid HIV testing may have on inpatient care. To assess the value of rapid HIV testing for hospitalized patients, we compared, and report here, quality-of-care measures for inpatients diagnosed as having HIV via point-of-care testing in the ED vs patients whose conditions were diagnosed via conventional testing after admission.

**METHODS**

We conducted a retrospective cohort study comparing quality-of-care and utilization-of-care endpoints for inpatients diagnosed as having HIV in the ED via rapid HIV testing vs inpatients diagnosed during the course of their admission via conventional EIA testing. The institutional review board approved the study. The study was conducted at John H. Stroger, Jr. Hospital of Cook County (Chicago, Ill), Cook County Bureau of Health Service’s 500-bed tertiary care referral center. We used electronic data (Cerner Corp, Kansas City, Mo) to identify patients with first-time positive HIV tests and concurrent hospital admission from January 1, 2003, through May 31, 2004. Patients were excluded from the study if chart review disclosed a previous diagnosis of HIV infection. Additionally, we excluded patients admitted to obstetric and surgical services.

During the study period, point-of-care HIV testing was offered to English- and Spanish-speaking ED patients, not known to be HIV infected, from 18 through 54 years of age, who were able to give informed consent, as part of a Centers for Disease Control and Prevention–funded study.12 Because of the large ED size, routine screening was offered in 2 of the ED’s 3 main treatment areas, or pods. Patients outside the 2 study pods could be referred for rapid HIV testing by ED physicians on the basis of symptoms or risk factors. The rapid HIV-1 test (OraQuick; OraSure Technologies, Bethlehem, Pa) was performed in the ED on whole blood between 9 AM and 8 PM on weekdays. Previous testing has demonstrated that this rapid assay has sensitivity and specificity similar to or better than those of conventional HIV testing.13 Regardless of results, all patients who received the rapid test provided an additional specimen for subsequent conventional EIA testing. All reactive rapid tests were followed by confirmatory Western blot testing performed by a reference laboratory. Only patients confirmed as HIV positive were included for analysis.

We reviewed patients’ medical records, including the electronic record, an HIV inpatient service database, and standard paper charts, to identify demographic, clinical, quality-of-care, and utilization-of-care data, with HIV risk factor information obtained from patient self-report to the HIV ward service physician assistants. We compared rapid and conventional test groups by the following predetermined quality-of-care and utilization-of-care end points: time to primary inpatient care service awareness of HIV diagnosis, time to admission or transfer to the inpatient HIV service, time to empiric treatment or diagnosis of opportunistic infection, length of stay, discharge with appropriate prophylactic medications, discharge with patient knowledge of HIV diagnosis, and initial engagement in outpatient care.

To adjust for severity of illness when assessing the impact of testing modality on length of stay, we performed multivariate regression analysis using SPSS (SPSS Inc, Chicago, Ill). The variables, which were included a priori in the regression model, have been previously documented as predictors of severity of illness in HIV-infected patients.14-16 These variables, which included comorbid diagnoses (congestive heart failure, end-stage renal disease, cirrhosis, chronic obstructive pulmonary disease, and diabetes), opportunistic infection diagnoses (pneumocystis pneumonia, toxoplasmosis, mycobacterium avium complex, disseminated malignancies, and non-AIDS-defining malignancies), and the presence of a human immunodeficiency virus–positive ED presentation were entered into the initial regression model, with testing modality (rapid vs conventional) entered last. The improvement in model fit after the additional testing modality was assessed by comparison of $R^2$ results. We also report $\beta$ coefficients, which represent the change in length of stay for 1 unit of change in predictor variables. The $\chi^2$, Mann-Whitney, and independent samples $t$ tests were used to compare proportions and averages.

**RESULTS**

We identified 158 patients with first-time positive HIV testing at the time of, or during, hospital admission. Fifty-five patients were excluded from further evaluation because of admission to surgical or obstetric services (n=3) or chart review indicating previous HIV diagnosis (n=52). Of the 103 remaining patients, complete chart reviews were done for 86 (83%). Review of electronic records and the HIV inpatient service database was completed for the remaining 17 patients. Except for 1 patient admitted directly from clinic, all patients in this analysis were admitted via the ED. The ED visit times and days determined whether rapid testing was available. Forty-eight patients’ conditions (47%) were diagnosed via rapid HIV testing in the ED and 55 (53%) were diagnosed via conventional EIA testing during their hospital admission (Figure); 28 (58%) of the

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**Figure.** Disposition of study patients. HIV+ indicates human immunodeficiency virus–positive; ED, emergency department; EIA, enzyme immunoassay; and RT, rapid testing.
48 patients in the rapid test group were referred for testing by ED physicians. Results for all 48 patients whose conditions were diagnosed via rapid HIV testing were confirmed by Western blot analysis and HIV viral load testing. Overall, 80 patients (78%) were male, 64 (62%) were African American, and 21 (20%) were Hispanic. The median CD4 cell count was 40/µL. Patients whose conditions were diagnosed by conventional testing required ICU care more often; otherwise, the 2 groups were comparable (Table 1).

Significant quality-of-care and utilization-of-care differences existed between patients whose conditions were diagnosed via rapid testing and conventional testing. Patients in the rapid test group had less time between admission and transfer to the inpatient service, shorter length of stay, and less time between hospital discharge and initial outpatient HIV clinic follow-up. Rapid test group patients referred by ED providers did not have significantly longer stays than rapid test group patients routinely screened by study staff (7.1 days vs 5.5 days; \(P = .19\)). Additionally, 16% (9) of the conventional test group, but none of the rapid test group, were discharged without receiving their HIV diagnosis (Table 2).

In evaluating the influence of predictor variables on length of stay, stepwise, multivariate regression showed that ICU stay, opportunistic infection diagnosis, and rapid vs conventional testing each independently influenced length of stay. While the presence of the predictor variable, ICU stay, added most to length of hospital admission, diagnosis of a serious opportunistic infection and conventional testing contributed almost equally to increasing length of stay. A model combining the predictor variables of ICU admission and opportunistic infection diagnosis accounted for 63% of the variability in length of stay, with the addition of testing modality (rapid vs conventional) accounting for an additional 6% of that variability (Table 3). The potential predictors of comorbid illness, CD4 count less than 50/µL and respiratory failure requiring intubation, were excluded from the model because of lack of independent effect on length of stay.

Our findings show that patients tested via the rapid HIV test in the ED had a shorter time to being recognized as HIV infected, shorter delays before being placed on an inpatient HIV service, and less time between discharge and initial outpatient HIV clinic follow-up. Rapid testing resulted in shorter stays compared with conventional testing by 5.4 days (95% confidence interval, 2.5-8.3 days) after adjustment for ICU stay and diagnosis of serious opportunistic infections.

The prompt availability of results afforded by the rapid test may have contributed to more efficient inpatient care, which in turn may account for shorter stays for these patients. This greater efficiency is also suggested by the shorter time to medical staff knowledge of HIV status and transfer to HIV inpatient ward. The shorter times to initial outpatient care for rapid test recipients may be related to their more prompt admission to the inpatient HIV service, which is staffed by a team experienced in coordinating care for patients with HIV. Because our clinic has no wait times for new outpatient appointments after inpatient admission, other logistic explanations for time to outpatient care seem unlikely.

Among the most important outcomes of rapid HIV testing in the inpatient setting, all rapid test recipients were notified of their HIV-infected status before discharge. Nine (16%) of the conventionally tested patients were not notified and may have been at greater risk of subsequently engaging in behaviors that put others at risk of acquiring HIV. Although inefficiencies in our institution's system for HIV testing inpatients and notifying providers of results...
might have contributed to this high rate of failure to notify, the point-of-care nature of rapid HIV assays simplifies the result notification process, thereby ensuring that patients and providers receive these vital test results.

Our study should be interpreted in light of its limitations. The conventionally tested patients were more likely to have had ICU stays during their admission. Although lack of randomization may have resulted in selection bias (eg, sicker patients may have been excluded from rapid HIV testing in the ED), no conventionally tested patients were screened for inclusion in the rapid testing study and excluded because of critical illness. Nevertheless, physician referrals for patients outside the study pods may have been limited to patients well enough to give consent. Also, since critically ill patients generally have longer hospital stays, sicker patients not screened via the rapid test in the ED theoretically may have been more available for conventional testing on the wards, simply because of their longer hospital stays. However, on average, conventionally tested patients had orders for HIV testing placed soon after admission, making this source of bias less likely.

While the multivariate regression attempted to control for severity of illness, the retrospective nature of the study may have limited our ability to assess level of acuity completely. Our regression model used generally accepted contributors to degree of illness in patients with HIV, such as comorbid conditions, CD4 count, opportunistic infections, ICU stay, and need for mechanical ventilation.12,13 Despite this, unrecognized confounding factors, which can affect nonrandomized studies, may have influenced length of stay more than did testing modality and could have disparately affected patients in the rapid vs conventional test groups. However, stratification of patients in the rapid test group according to whether they were referred for testing by ED providers because of symptomatic disease vs routinely screened by study staff did not show a statistically significant difference in length of stay. This suggests that shorter stays for rapid vs conventional test groups extend to these more symptomatic, potentially sicker, patients who received the rapid test and supports the results of our multivariate analysis, ie, rapid testing per se led to shorter stays.

Additionally, care must be taken in generalizing from our results. The higher rates of HIV prevalence found in urban settings, such as inner-city Chicago, where this study was conducted, may affect the applicability of our results to settings that have lower rates of HIV seropositivity. Also, HIV testing services are guided by state-specific regulations and hospital-specific practices. By state law, our institution requires written consent before all HIV testing and does not release reactive EIA results unless confirmed by Western blot testing, which was performed for all conventionally tested patients. Our results therefore may not be directly generalizable to settings that do not require confirmatory Western blot testing.

Table 2. End Points for Quality and Utilization of Care

| Outcome                                                                 | Rapid Test | Conventional Test | P Value *
|------------------------------------------------------------------------|------------|-------------------|-----------
| Interval, mean (95% CI), d                                              | NA         | 3.4 (2.4-4.4)     | NA        |
| Between admission and conventional EIA ordered                         | NA         | 8.0 (7.0-9.0)     | NA        |
| Between admission and presumptive HIV diagnosis documented in chart    | 0.8 (-0.5 to 2.0) | 6.4 (4.7-8.0) | <.001     |
| Between conventional EIA ordered and result posted in electronic record | 1.4 (0.0 to 2.9) | 6.9 (4.1-9.6) | <.001     |
| Between admission and placement on HIV inpatient ward service          | 1.4 (0.3 to 2.6) | 2.5 (0.8-4.3) | .31       |
| Discharged with PCP prophylaxis, No. (%)                               | 20/23 (87) | 34/38 (89)        | .77       |
| Length of stay, mean (95% CI), d                                       | 6.4 (5.2 to 7.7) | 13.2 (10.1-16.4) | <.001     |
| Initial outpatient follow-up within 30 d of discharge, No. (%)         | 34/48 (71) | 31/55 (56)        | .13       |
| Interval between discharge and initial outpatient follow-up, mean (95% CI), d | 21.5 (11.4 to 31.5) | 49.5 (22.6-76.3) | .05       |
| No. (%) of patients discharged without knowledge of their HIV diagnosis | 0/48       | 9/55 (16)         | .002      |

Abbreviations: CI, confidence interval; EIA, enzyme immunoassay; HIV, human immunodeficiency virus; NA, not applicable; PCP, Pneumocystis carinii pneumonia.

*Based on independent samples t tests, Fisher exact test, and χ² values.
†Based on patients with CD4 cell counts less than 200/µL determined before discharge.

Table 3. Multivariate Regression With Length of Stay as Dependent Variable

<table>
<thead>
<tr>
<th>Predictor Variables</th>
<th>R²</th>
<th>Impact on Length of Stay (95% CI), d†</th>
<th>P Value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU stay</td>
<td>0.57</td>
<td>10.9 (7.4-14.4)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Serious OI diagnosis</td>
<td>0.63</td>
<td>6.2 (3.4-9.0)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Conventional testing</td>
<td>0.69</td>
<td>5.4 (2.5-8.3)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; ICU, intensive care unit; OI, opportunistic infection.
†β Coefficients represent the change in length of stay according to the presence of the predictor variable.
†P values refer to both R² values and β coefficients.

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patients, this approach may not be adequate for inexperienced providers or overworked house staff. Existence of the testing inefficiencies noted above that may have resulted in discharging patients without disclosure of their HIV diagnosis has prompted reevaluation of HIV result reporting practices at our institution.

In spite of these limitations, our results suggest that there may be an important role for rapid, point-of-care HIV testing in the inpatient setting. For the newly identified HIV-infected patient, inpatient rapid HIV testing may contribute to better care and decrease chances of being discharged without knowledge of infection status. Although not the focus of this study, more rapid determination of HIV status for hospitalized patients may also add to health care worker safety and facilitate decisions regarding the need for, and choice of, postexposure prophylaxis in cases of blood or body-fluid exposure. Additionally, the potential increased cost of rapid HIV testing may be offset by savings from shortened stay and improved access to outpatient resources. Recent findings suggesting that the cost-effectiveness of screening the general population for HIV may compel health policymakers to delineate the most efficient HIV testing strategies.18-20 The role of point-of-care, rapid HIV testing in the inpatient setting, and how this modality may fit into screening the general population for HIV, should be elucidated further by randomized, controlled trials.

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REFERENCES