Scope of Rapid HIV Testing in Urban U.S. Hospitals

Laura M. Bogart, PhD^a
Devery Howerton, PhD^b
James Lange, PhD^b
Kirsten Becker, MPH^a
Claude Messan Setodji, PhD^a
Steven M. Asch, MD, MPH^{a,c,d}

SYNOPSIS

Objective. The present study examined the scope of rapid human immunode-ficiency virus (HIV) testing in urban U.S. hospitals.

Methods. In a multistage national probability sample, 12 primary metropolitan statistical areas (three per region) were sampled randomly, with weights proportionate to acquired immunodeficiency syndrome (AIDS) populations. All 671 eligible hospitals within areas were selected. Laboratory staff from 584 hospitals (87%) were interviewed by telephone in 2005.

Results. About 52% reported rapid HIV test availability (50% in occupational health, 29% in labor and delivery, and 13% in emergency department/urgent care), and 86% of hospitals offering rapid tests processed them in the laboratory. In multivariate models, rapid test availability was more likely in hospitals serving more patients, and located in high-poverty, high-AIDS prevalence areas, and in the South or Midwest vs. West. It was less likely in hospitals serving areas with large percentages of people who were black/African American or Hispanic/Latino (p<0.05).

Conclusions. Rapid HIV testing is increasing across urban U.S. hospitals, primarily for occupational exposure and in hospitals with greater resources and need. To achieve routine HIV screening, policies should encourage greater breadth of diffusion of rapid testing at the point of care, especially in smaller facilities, the West, and communities with racial/ethnic diversity.

Address correspondence to: Laura M. Bogart, PhD, RAND Corporation, 1776 Main St., PO Box 2138, Santa Monica, CA 90407-2138; tel. 310-393-0411; fax 310-260-8159; e-mail clopart@rand.org.

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^aRAND Corporation, Santa Monica, CA

^bLaboratory Practice Evaluation and Genomics Branch, Centers for Disease Control and Prevention, Atlanta, GA

^cVeterans Affairs Greater Los Angeles Healthcare Network, Los Angeles, CA

^dDavid Geffen School of Medicine at University of California-Los Angeles, Los Angeles, CA

The Centers for Disease Control and Prevention (CDC) 2006 recommendations for human immunodeficiency virus (HIV) testing of adults, adolescents, and pregnant women encourage routine HIV screening in all public and health-care settings. Toward this goal, CDC recommends simplified counseling and testing procedures, including opt-out screening (in which patients can decline testing after notification that it will be performed) and optional prevention counseling; separate written informed consent is not recommended. CDC also recommends repeat screening of pregnant women in the third trimester in jurisdictions with high rates of HIV-infected pregnant women.

The complexity of traditional HIV testing has been a barrier to CDC efforts to expand HIV screening.^{2,3} Traditional testing requires that individuals return one to two weeks post-test for results receipt and prevention counseling, which can reduce risk behavior among those already infected.⁴ However, approximately a third of those tested do not return for results, representing a missed prevention opportunity.⁵

To increase HIV screening, CDC proposes use of same-day rapid HIV testing. ^{1,5} Rapid tests allow HIV-negative individuals to learn their serostatus in less than an hour, eliminating the need to return for results. Six rapid HIV tests with high sensitivity (99.3% to 100%) and specificity (99.1% to 100%) have been approved by the U.S. Food and Drug Administration since 2002. Since November 2007, four have been approved for point-of-care use by trained staff in nonclinical settings under the 1988 Clinical Laboratory Improvement Amendments (CLIA). ⁶⁻¹² All reactive rapid test results require confirmatory testing. ¹³

Rapid HIV testing in hospitals has been shown to be easy to use, to increase rates of results receipt, to be acceptable to patients, and to increase quality of care. 6,14-22 Routine HIV screening can be costeffective. 23,24 Rapid testing may be especially useful to implement in emergency departments, where patients typically do not have continuing relationships with providers and may not return for results, and where substantially greater HIV prevalences have been found than in public health testing sites (2% to 17%). 19,25 Rapid testing of source patients in occupational exposure situations facilitates employee decisions about post-exposure prophylaxis.¹⁷ Rapid testing during labor enables providers to take effective measures to prevent perinatal HIV transmission.²⁶⁻²⁹ Due to the need for expedience during labor, rapid testing may be more useful if test results are processed at the point of care vs. in hospital laboratories. 6,19,27,30

The current scope of rapid HIV testing in U.S. hospitals is unknown. Research reviews suggest that HIV

tests are not being performed routinely in health-care settings such as hospital emergency departments, ³¹ but no nationally representative peer-reviewed survey has been conducted. Several barriers may inhibit nonrapid and rapid HIV test provision in hospitals, ^{15,32,33} including policy-level barriers (e.g., consent and counseling requirements), logistical barriers (e.g., time pressures, insufficient resources), and educational barriers (e.g., low patient or provider acceptance, lack of provider training or knowledge). ³⁴ Regulatory environments for HIV testing, which vary by state, ³⁵ may impede HIV screening program implementation. Furthermore, general lack of public funds and insurance coverage for HIV screening is thought to be a major impediment to implementing screening programs. ³⁶

We examined the scope of rapid HIV testing in urban U.S. hospitals from 2002 to 2006, prior to release of CDC's 2006 recommendations encouraging routine HIV screening in health care. Diffusion of innovation (DOI) theory was used as a framework to describe rapid test availability over a several-year period.³⁷ According to DOI, an innovation is likely to be adopted if it appears advantageous over existing methods; is compatible with existing infrastructure, resources, and norms; and is relatively easy to use. Institutions with greater resources and larger size are more likely to adopt innovations because they can more easily overcome obstacles.

We hypothesized that larger hospitals have greater resources to implement rapid testing, and would be more likely to offer rapid tests. We also hypothesized that hospitals located in high acquired immunodeficiency syndrome (AIDS) prevalence areas, and areas with high concentrations of subgroups in which HIV is increasing (i.e., black/African American, Hispanic/Latino, and high poverty), would perceive a greater need for rapid testing and would be more likely to offer rapid tests. Further, we predicted that rapid test provision would differ by geographic region, due to state variations in HIV test regulations.

METHODS

Sampling frame and procedures

We modeled our sampling design after the HIV Cost and Services Utilization Study,^{38,39} a national study of patients in care for HIV. We conducted multistage probability sampling by region to arrive at a nationally representative sample of hospitals in major U.S. metropolitan areas. In the first stage, we randomly sampled four geographic locations (primary metropolitan statistical sampling areas [PMSAs]) per census region (Northeast, Midwest, South, and West) from a comprehensive list of 104 PMSAs. We chose the

highest-prevalence PMSA within each region with certainty (Los Angeles; Long Beach, California; New York; Miami; and Chicago) and eight other PMSAs (Atlanta; Boston; Indianapolis; Newark, New Jersey; Oakland, California; Riverside–San Bernardino, California; St. Louis; and Washington, D.C.) with probabilities proportionate to size of the number of AIDS cases reported to CDC as of December 2001.²

Sampling probabilities proportionate to size are widely used in multistage designs with sampling units that are heterogeneous in size, such as AIDS prevalence, to prevent selection of statistically inefficient or problematic samples in which few eligible respondents are present in the sampling unit. 40 Selection of some sampling units with certainty is acceptable when the population distribution is highly skewed among units. Because most data were collected from PMSAs with moderate-to-high AIDS prevalences, precision was reduced for national estimates, but increased for estimates in areas of moderate-to-high AIDS prevalences.

In the second stage, we included all 666 eligible non-rehabilitation hospitals listed in the 2002 American Hospital Association (AHA) database within the selected PMSAs. Hospitals were ineligible if they were receiving CDC funds for rapid HIV test demonstration projects. Rehabilitation hospitals were ineligible because they were unlikely to be using HIV testing for prevention. Seventeen hospitals had closed since the AHA database was compiled. All remaining 649 hospitals were telephoned in random order. An additional 22 subsidiary hospitals were identified during interviews, bringing the total number of hospitals telephoned to 671. The RAND Corporation's institutional review board approved this study.

Hospital survey

The interview protocol and survey items were developed through extensive formative work, including qualitative interviews with laboratory and non-laboratory hospital providers, and consultation with laboratory experts on the study team and advisory board. Interviewers telephoned the hospital and asked to speak with laboratory directors or the person in charge of the laboratory's quality assurance and/or proficiency testing program. We chose to survey laboratory directors because they oversee all tests conducted in the hospital, including all test quality assurance procedures.

Interviewers asked respondents if rapid HIV tests were available in the hospital, with response options yes, no, and not yet, but have concrete plans to start in the near future (defined to respondents as "the next six months"). Respondents in hospitals using rapid tests

were asked which hospital departments provided rapid tests (e.g., labor and delivery, emergency department) and the approximate time period when rapid testing was instituted (i.e., less than six months ago, between one and two years ago, in the past six months to one year, between one and two years ago, and more than two years ago). We calculated the probable year of rapid HIV test program implementation by subtracting the midpoint of the time period chosen (e.g., 1.5 years for the option "between one and two years ago") from the interview date; we added three months to the interview date among respondents who indicated that they had concrete plans to start rapid testing "in the near future." Respondents were also asked if the hospital had subsidiaries.

Hospital and hospital community characteristics

Patient flow. Using AHA identification numbers, hospitals were linked to 2004 AHA data on average daily inpatient census, and number of births and emergency department visits annually.

AIDS cases. The cumulative number of reported AIDS cases in 2001 for each PMSA was linked to each hospital.²

Hospital service area characteristics. All zip codes in each hospital's service area were extracted from the zip code crosswalk of the Dartmouth Atlas of Healthcare and linked to census data on race/ethnicity and income. The Dartmouth Atlas of Healthcare defines hospital service areas as groupings of zip codes that contain residents who receive most of their hospitalizations from the hospitals in that area (operationalized as the zip codes where the greatest proportion of hospitals' Medicare residents are hospitalized). We calculated the mean percentages of residents who were black/African American, Hispanic/Latino, and living below the poverty level across zip codes in each service area.

Statistical analysis

Multivariate logistic regressions were used to examine the simultaneous contribution of the AHA, census, and AIDS prevalence variables in predicting rapid HIV test availability. To report the model results in terms of rate of HIV test availability, odds ratios were translated into adjusted percentages. Predicted probabilities show the probability of rapid HIV test availability given a particular value of the predictor, adjusting for other variables in the model. For example, the adjusted rate of HIV test usage in the Northeast region represents the mean of the predicted probability of testing in hospitals obtained from the multivariate model, if all hospitals sampled were in the Northeast. For a

continuous predictor such as AIDS prevalence, the adjusted rate of rapid test availability in Chicago, for example, is the mean predicted probability from the multivariate model if all hospitals were in PMSAs with a prevalence of 22,703 (the number of AIDS cases in Chicago). Separate analyses were conducted for any rapid HIV testing in the hospital, in the emergency department/urgent care (of those hospitals with emergency departments/urgent care), in labor and delivery (of those hospitals with labor and delivery units), and in occupational health. Because hospital size and AIDS prevalence data were non-normally distributed, their logs were used.

Sampling weights taking into account the different selection probabilities for each hospital (based on the cumulative number of AIDS cases within each PMSA) were used to adjust the sample data to represent the target population of urban U.S. hospitals. Sampling weights ensure that weighted data from the sample are representative of the entire reference population and allow for calculations of nationally representative estimates. Nonresponse weights were not used because all hospitals listed were contacted, hospitals were called in a random order, and only three staff members refused participation.

RESULTS

Prevalence and diffusion of rapid HIV testing

Laboratory staff at 584 hospitals (87% completion rate) were interviewed by telephone from April to November 2005; 24% were located in the Midwest, 20% in the Northeast, 27% in the South, and 29% in the West;

all hospitals in the West were located in California (Table 1). More than half (52%) of hospitals provided rapid HIV tests. Of hospitals not providing rapid tests, 21% had concrete plans to start offering them. Half of all hospitals provided rapid HIV tests for occupational health. Of hospitals with labor and delivery units, 29% provided rapid HIV tests during labor; of hospitals with emergency departments/urgent care units, 13% provided rapid HIV tests in the emergency department/ urgent care. Smaller percentages were using rapid testing in other hospital inpatient settings, including in surgery (2%), on the ward (2%), in the blood bank (1%), in the HIV/infectious disease department (1%), in primary care (1%), for sexual assault cases (1%), and in admissions (0.3%). Most (86%) of the hospitals providing rapid tests ordered or performed the tests in the hospital laboratory. Overall, 14% of hospitals performed rapid tests at point of care (including 13% in occupational health, 2% in labor and delivery, and 1% in the emergency department/urgent care).

The proportion of the total sample providing rapid HIV tests steadily increased from 2002 to 2005; the projected proportion, based on those who planned to start, is expected to increase steadily (Figure).

Multivariate predictors of rapid HIV testing

Table 2 shows the multivariate models. Hospitals in the South and Midwest vs. the West, in areas with a higher proportion of residents living in poverty, with a higher AIDS prevalence, and with a higher average daily census were more likely to provide rapid tests in any hospital department; hospitals in areas with a higher proportion of black/African American and

Table 1. Characteristics of hospitals surveyed regarding rapid HIV test availability in 2002–2006 (n=584)

	Mean (SD)
Hospital community characteristics	
Mean prevalence of AIDS (i.e., number of AIDS cases) across the 12 selected PMSAs	20,598 (26,142)
Hospital service area	0
Mean proportion of black/African American residents	0.16 (0.15)
Mean proportion of Hispanic/Latino residents	0.19 (0.18)
Mean proportion living in poverty	0.10 (0.07)
Hospital characteristics (patient flow)	
Mean number of patients/day (daily inpatient census)	264 (255)
Mean number of births/year ^a	2,124 (2,228)
Mean number of emergency department visits/year ^b	37,253 (31,319)

^aAmong hospitals with labor and delivery units (unweighted n=360)

 $^{^{}b}$ Among hospitals with emergency departments/urgent care units (unweighted n=498)

HIV = human immunodeficiency virus

SD = standard deviation

AIDS = acquired immunodeficiency syndrome

PMSA = primary metropolitan statistical sampling area

70 60 50 Percent 40 30 20 10 0 Late 2002 2003 2004 2005 Early 2006 (projected) Year of rapid HIV test adoption

Figure. Cumulative percentage of U.S. hospitals offering rapid HIV tests from 2002 to 2006 (n=584)

Note: Data points are: 13.7% (late 2002), 35.8% (2003), 44.3% (2004), 59.9% (2005), and 62.2% (early 2006). HIV = human immunodeficiency virus

Hispanic/Latino residents were less likely to provide rapid tests (Table 2, Model I). In occupational health, hospital location in the Northeast, South, or Midwest (vs. West) and a higher average daily census were related to a higher probability of rapid testing; location in areas with a higher proportion of Hispanic/Latino residents was associated with a lower probability of rapid testing (Table 2, Model II). In the emergency department/urgent care, the probability of rapid testing was higher in hospitals located in the Midwest vs. the West, in areas with a greater AIDS prevalence, and in areas with a higher number of emergency department visits per year (Table 2, Model III). In labor and delivery units, rapid testing was more likely in hospitals located in the Northeast or Midwest vs. the West, and in hospitals in areas with a greater AIDS prevalence and with a higher number of births annually (Table 2, Model IV).

DISCUSSION

Rapid HIV tests are increasingly available in urban U.S. hospitals. However, hospitals primarily provide the test for index patients in occupational health situations, to allow employees to make informed decisions about post-exposure prophylaxis. The numbers of patients screened for this purpose cannot have the larger public health impact of routine screening efforts recommended by CDC.

Rapid HIV testing availability was substantially lower in hospital venues other than occupational health. Less than 30% of hospitals offered rapid tests in labor and delivery. However, CDC recommends rapid HIV testing of all women in labor of undocumented HIV status, due to the relatively small window of time to administer antiretroviral therapy to prevent mother-child transmission. The CDC's Mother-Infant Rapid Intervention at Delivery (MIRIAD) study demonstrated that rapid HIV testing during labor is feasible, accurate, and acceptable to women with undocumented HIV status. ^{6,42} Future research is critical for understanding the types of barriers, such as test cost and concerns about quality assurance procedures and staff training that may impede rapid testing in this setting.

Only 13% of hospitals provided rapid HIV tests in the emergency department/urgent care. Emergency departments routinely care for a large number of people across the socioeconomic spectrum, many of whom have limited contact with health care. Lack of rapid testing in the emergency department is said to be a missed opportunity to detect a high number of infections among individuals otherwise not intending to test. 19,43-45 To overcome barriers to rapid testing, such as providers' time constraints, hospital emergency departments may need to employ dedicated staff for rapid HIV testing that are available to test patients and process test results. 46 Streamlined, adjusted testing procedures, such as videotaped pre- and post-test

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	Model I: hospital (n=584)		Model II: occupational health (n=584)		Model III: emergency department/ urgent care (n=498)		Model IV: labor and delivery (n=360)	
	Adjusted percentage (95% CI)³	P-value	Adjusted percentage (95% CI)	P-value	Adjusted percentage (95% CI)	P-value	Adjusted percentage (95% CI)	P-value
Region	170 97 70 60/ 96 76		VV CV 00 10/ 70 00		7007 4 7 7 000		(60 70 10 0) 01 01	
west Northeast	34.23 (23.24, 43.26) 41.58 (32.09, 51.07)	0.084	32.30 (21.26, 43.44) 40.92 (31.29, 50.55)	0.046	11.03 (4.48, 17.58)	0.29	13.12 (0.21, 26.02) 27.22 (16.03, 38.41)	0.0018
South	69.08 (59.29, 78.87)	<0.0001	69.60 (59.87, 79.33)	<0.0001	13.35 (6.06, 20.63)	0.089	19.62 (11.07, 28.16)	0.10
Midwest	61.46 (53.27, 69.65)	<0.0001	52.72 (44.26, 61.18)	<0.0001	21.91 (14.04, 29.79)	<0.0001	65.51 (54.35, 76.67)	<0.0001
Community characteristics		0.00		000		6600		/
AIDS prevalence		0.003		0.73		0.023		\0.000\
Low (Indianapolis)	44.94 (34.12, 55.76) 54 68 (50 66 58 70)		49.23 (38.61, 59.85)		9.29 (3.11, 15.47)		10.66 (5.06, 16.27)	
High (New York)	62 72 (52 65 72 80)		49.80 (38.92, 60.68)		22 00 (8.76.35.24)		70 16 (56 93 83 39)	
Percent African	(0)	0.020	(0)	0.14		0.14		0.13
American/black								
Low	54.54 (48.81, 60.27)		51.05 (45.01, 57.09)		11.90 (6.89, 16.90)		26.67 (18.96, 34.38)	
Medium	52.93 (48.45, 57.40)		49.99 (45.39, 54.60)		12.72 (8.87, 16.56)		27.97 (22.52, 33.42)	
High	50.63 (45.68, 55.57)		48.49 (43.49, 53.50)		13.97 (9.99, 17.94)		29.88 (23.88, 35.89)	
Percent Hispanic/Latino		<0.0001		<0.0001		0.38		0.75
Low	57.12 (51.03, 63.21)		53.59 (47.36, 59.81)		14.05 (9.00, 19.10)		29.01 (2.00, 36.02)	
Medium	52.33 (47.57, 57.09)		49.56 (44.84, 54.28)		13.18 (9.77, 16.59)		28.60 (23.88, 33.32)	
High	45.13 (38.21, 52.04)		48.49 (43.49, 53.50)		12.02 (5.89, 18.14)		28.02 (19.25, 36.79)	
Percent poverty		0.0055		090.0		69.0		0.90
Low	48.94 (42.89, 54.99)		47.27 (41.19, 53.34)		13.81 (8.43, 19.19)		28.55 (21.87, 35.24)	
Medium	52.22 (47.91, 56.52)		49.55 (45.16, 53.93)		13.39 (9.92, 16.87)		28.74 (23.70, 33.78)	
High	56.45 (49.20, 63.70)		52.52 (44.80, 60.24)		12.83 (6.24, 19.43)		29.00 (18.14, 39.85)	
Hospital characteristics								
Inpatients/day		< 0.0001		<0.0001		0.38		0.27
Low	43.64 (37.66, 49.62)		40.74 (34.72, 46.76)		12.46 (7.64, 17.28)		26.68 (19.13, 34.22)	
Medium	56.83 (51.81, 61.86)		53.76 (48.69, 58.82)		13.34 (9.83, 16.85)		28.44 (23.43, 33.45)	
High	65.76 (59.35, 72.18)		62.86 (56.36, 69.35)		13.99 (9.52, 18.47)		29.74 (23.90, 35.58)	

Table 2 (continued). Multivariate predictors of rapid HIV test availability in 584 U.S. hospitals

	P-value	0.035
Model IV: labor and delivery (n=360)	Adjusted percentage (95% CI)	26.40 (20.92, 31.87) 29.51 (23.99, 35.03) 31.86 (23.39, 40.32)
	P-value	0.0013
Model III: emergency department/ urgent care (n=498)	Adjusted percentage (95% CI)	9.86 (5.91, 13.80) 13.56 (9.88, 17.25) 16.41 (10.68, 22.14)
	P-value	1 1
Model II: occupational health (n=584)	Adjusted percentage (95% CI)	
	P-value	1 1
Model 1: hospital (n=584)	Adjusted percentage (95% CI)₃	
		Emergency visits/year Low Medium High Births/year Low Medium High

The percentages have been adjusted for all variables listed in the table. P-values were calculated from the multivariate model after sampling weights were applied. For illustrative purposes, adjusted percentages are presented at meaningful cut-points for continuous census variables (low = 25th percentile, medium = median, high = 75th percentile) and for AIDS prevalence PMSAs, of the 12 selected PMSAs). However, these variables were included in the multivariate models as continuous. Adjusted percentages for all PMSAs are available by request to the first author.

 $^{\mathrm{b}}$ This group was used as the comparison group in the multivariate analyses and the reference category for all calculated p-values.

CI = confidence interval

HIV = human immunodeficiency virus

AIDS = acquired immunodeficiency syndrome

PMSA = primary metropolitan statistical sampling area

counseling, have helped to decrease the burden of HIV testing in the emergency department.⁴⁷

The finding that most rapid HIV testing (among those using the test) occurred in the hospital laboratory shows a possible inefficiency in testing protocols. Even with rapid testing, provision of results must be expedient enough to be of benefit. Although rapid test results may be available in less than an hour, test processing in the laboratory vs. at point of care may lead to results reporting delays. 19,30,42 Of hospitals conducting rapid testing, only 1% conducted pointof-care tests in labor and delivery; however, research shows that point-of-care testing in labor and delivery can lead to faster provision of results.^{6,19} In addition, laboratory-based testing protocols that prioritize rapid HIV testing for labor and delivery ahead of other laboratory tests may help to shorten the length of time to receipt of results.

In accordance with DOI, hospital resources and need for testing predicted rapid HIV testing availability. Larger hospitals (with a higher inpatient caseload) were more likely to provide rapid HIV tests within and across departments. Larger hospitals tend to have greater resources, in terms of budgetary funds and staff members, with which to initiate and sustain testing programs. Further, hospitals, labor and delivery units, and emergency departments/urgent care centers in areas of higher AIDS prevalence were more likely to offer rapid HIV tests. As HIV testing becomes routine, one would expect observed differences in rapid testing across hospitals in different types of communities to decrease, and that hospitals will begin to offer rapid tests, regardless of community factors.

Geographic region was a robust predictor of rapid testing. Hospitals in the Western region (three PMSAs sampled in California) were less likely to be providing rapid HIV tests. The relatively strict regulatory environment of California for rapid HIV tests likely contributed to lower levels of availability in this region. In California, laboratories must apply in writing to the California Department of Health Services for permission to offer rapid HIV tests as waived tests; the backlog of applications in 2005 (the time of the present study) was high. Removing some of the bureaucratic barriers to testing may increase rapid testing rates.⁴⁸

Hospital service area characteristics, including those associated with need for HIV screening (i.e., poverty and race/ethnicity), were significantly related to rapid HIV testing in the hospital as a whole. Hospitals in areas of higher poverty, representing those in greatest need, were more likely to be providing rapid tests. However, hospitals with higher percentages of African American and Latinos residents—those racial/ethnic groups

most affected by HIV—were less likely to be providing rapid tests. This disparity is inconsistent with our findings for poverty. Hospitals with higher proportions of racial/ethnic minorities may have fewer resources with which to institute rapid testing programs, or they may prioritize resources for other health problems instead; institutional discrimination may also play a role. These inconsistent findings merit further investigation prior to making conclusions.

Limitations

Several limitations exist in our analysis. Rural hospitals and hospitals currently receiving funds from CDC for rapid HIV test demonstration projects (including MIRIAD) were not represented in our sampling frame. Geographic variation in testing could have been directly influenced by hospitals that participated in the MIRIAD study. However, analysis of the present study data with and without MIRIAD hospitals yielded similar results for region (data not shown), suggesting that geographic differences are due to another unmeasured variable.

We obtained census information for each hospital's service area as a proxy for the likely sociodemographic characteristics of patients; we therefore did not capture information about patients residing outside of the hospital service area. In addition, although we randomly selected PMSAs within region, all of the Western PMSAs were in California. Further, our results characterize the state of rapid testing relatively soon after approval; additional studies are needed to follow the scope of rapid testing over time, after more widespread dissemination of CDC's 2006 recommendations for HIV screening.

CONCLUSION

Our nationally representative survey found low rates of rapid HIV test provision in hospitals, even in clinical settings such as emergency departments and labor and delivery, where the test's short turnaround time would be most useful. Although rates of rapid testing in hospitals have been increasing, they remain lower than ideal to achieve CDC's recommendations, especially with respect to point-of-care use. Further research is needed to examine barriers to HIV testing in hospitals, including those related to cost, feasibility, training, staffing, regulatory environment, and hospital resources. Policies should be developed to encourage greater breadth of diffusion of rapid testing of patients within hospital settings, especially in smaller hospitals and at the point of care.

Adoption of streamlined counseling processes,

instituting universal testing regardless of risk, and use of dedicated staff for HIV testing may further aid the acceptability of HIV testing to providers and patients. 46,47,49-51 Revised counseling and testing procedures may be promising avenues for increasing HIV screening within hospitals. In the meantime, hospitalbased rapid HIV testing is falling short of its potential to help identify the estimated one-in-four HIV-infected Americans unaware of their HIV status.52

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REFERENCES

- 1. Branson BM, Handsfield HH, Lampe MA, Janssen RS, Taylor AW, Lyss SB, et al. Revised recommendations for HIV testing of adults, adolescents, and pregnant women in health-care settings. MMWR Recomm Rep 2006(RR-14);55:1-17
- HIV and AIDS-United States, 1981-2001. MMWR Morb Mortal Wkly Rep 2001;50(21):430-4.
- Centers for Disease Control and Prevention (US). Advancing HIV prevention: interim technical guidance for selected interventions. 2003.
- Weinhardt LS, Carey MP, Johnson BT, Bickham NL, Effects of HIV counseling and testing on sexual risk behavior: a meta-analytic review of published research, 1985–1997. Am J Public Health 1999; 89:1397-405.
- Revised guidelines for HIV counseling, testing, and referral. MMWR Recomm Rep 2001;50(RR-19):1-58.
- Bulterys M, Jamieson DJ, O'Sullivan MJ, Cohen MH, Maupin R, Nesheim S, et al. Rapid HIV-1 testing during labor: a multicenter study. JAMA 2004;292:219-23.
- Delaney KP, Branson BM, Uniyal A, Kerndt PR, Keenan PA, Jafa K, et al. Performance of an oral fluid rapid HIV-1/2 test: experience from four CDC studies. AIDS 2006;20:1655-60.
- Wesolowski LG, MacKellar DA, Facente SN, Dowling T, Ethridge SF, Zhu JH, et al. Post-marketing surveillance of OraQuick whole blood and oral fluid rapid HIV testing. AIDS 2006;20:1661-6.
- Greenwald JL, Burstein GR, Pincus J, Branson B. A rapid review of
- rapid HIV antibody tests. Curr Infect Dis Rep 2006;8:125-31. Chembio Diagnostic Systems Inc. HIV 1/2 STAT-PAK $^{\text{TM}}$ Assay. Package Insert. Medford (NY): Chembio Diagnostic Systems Inc.;
- OraSure Technologies, Inc. OraQuick advance rapid HIV-1/2 antibody test. Package Insert. Bethlehem (PA): OraSure Technologies,
- Trinity Biotech PLC. Uni-GoldTM Recombigen® HIV. Package Insert. Wicklow (Ireland): Trinity Biotech PLC; 2004.
- Notice to readers: protocols for confirmation of reactive rapid HIV tests. MMWR Morb Mortal Wkly Rep 2004;53(10):221-2.

- Kassler WJ, Dillon BA, Haley C, Jones WK, Goldman A. On-site, rapid HIV testing with same-day results and counseling. AIDS 1997;11:1045-51.
- Hutchinson AB, Corbie-Smith G, Thomas SB, Mohanan S, Del Rio C. Understanding the patient's perspective on rapid and routine HIV testing in an inner-city urgent care center. AIDS Educ Prev 2004:16:101-14
- Hutchinson AB, Branson BM, Kim A, Farnham PG. A meta-analysis of the effectiveness of alternative HIV counseling and testing methods to increase knowledge of HIV status. AIDS 2006;20:1597-604.
- Landrum ML, Wilson CH, Perri LP, Hannibal SL, O'Connell RJ. Usefulness of a rapid human immunodeficiency virus-1 antibody test for the management of occupational exposure to blood and body fluid. Infect Control Hosp Epidemiol 2005;26:768-74.
- Lubelchek R, Kroc K, Hota B, Sharief R, Muppudi U, Pulvirenti J, et al. The role of rapid vs. conventional human immunodeficiency virus testing for inpatients: effects on quality of care. Arch Intern Med 2005;165:1956-60.
- Kelen GD, Shahan JB, Quinn TC. Emergency department-based HIV screening and counseling: experience with rapid and standard serologic testing. Ann Emerg Med 1999;33:147-55.
- Doyle NM, Levison JE, Gardner MO. Rapid HIV versus enzymelinked immunosorbent assay screening in a low-risk Mexican American population presenting in labor: a cost-effectiveness analysis. Am Obstet Gynecol 2005;193(3 Pt2):1280-5.
- Wurcel A, Zaman T, Shen S, Stone D. Acceptance of HIV antibody testing among inpatients and outpatients at a public health hospital: a study of rapid versus standard testing. AIDS Patient Care STDS 2005;19:499-505.
- Roberts KJ, Grusky O, Swanson AN. Outcomes of blood and oral fluid rapid HIV testing: a literature review, 2000-2006. AIDS Patient Care STDS 2007;21:621-37.
- Ekwueme DU, Pinkerton SD, Holtgrave DR, Branson BM. Cost comparison of three HIV counseling and testing technologies. Am I Prev Med 2003:25:112-121.
- Paltiel AD, Walensky RP, Schackman BR, Seage GR 3rd, Mercincavage LM, Weinstein MC, et al. Expanded HIV screening in the United States: effect on clinical outcomes, HIV transmission, and costs. Ann Intern Med 2006;145:797-806.
- Rothman RE, Ketlogetswe KS, Dolan T, Wyer PC, Kelen GD. Preventive care in the emergency department: should emergency departments conduct routine HIV screening? A systematic review. Acad Emerg Med 2003;10:278-85.
- ACOG Committee on Obstetric Practice. Prenatal and perinatal human immunodeficiency virus testing: expanded recommendations. Obstet Gynecol 2004;104:1119-24.
- Forsyth BW, Barringer SR, Walls TA, Landry ML, Ferguson D, Tinghitella TJ, et al. Rapid HIV testing of women in labor: too long a delay. J Acquir Immune Defic Syndr 2004;35:151-4.
- Centers for Disease Control and Prevention (US). HIV counseling, testing and referral: standards and guidelines. 1994.
- Guay LA, Musoke P, Fleming T, Bagenda D, Allen M, Nakabiito C, et al. Intrapartum and neonatal single-dose nevirapine compared with zidovudine for prevention of mother-to-child transmission of HIV-1 in Kampala, Uganda: HIVNET 012 randomised trial. Lancet 1999;354:795-802.
- Rapid point-of-care testing for HIV-1 during labor and delivery—Chicago, Illinois, 2002. MMWR Morb Mortal Wkly Rep 2003;
- Branson B. Current HIV epidemiology and revised recommendations for HIV testing in health-care settings. J Med Virol 2007;79 Suppl 1:S6-10.
- Sibbald B. New rapid HIV test opens Pandora's box of ethical concerns. CMAJ 2000;162:1600.
- Galvan FH, Brooks RA, Leibowitz AA. Rapid HIV testing: issues in implementation. AIDS Patient Care STDS 2004;18:15-8.
- Burke RC, Sepkowitz KA, Bernstein KT, Karpati AM, Myers JE, Tsoi BW, et al. Why don't physicians test for HIV? A review of the U.S. literature. AIDS 2007;21:1617-24.
- Health Research and Educational Trust. State HIV testing laws-2007 [cited 2008 Feb 4]. Available from: URL: http://www.ucsf .edu/hivcntr/StateLaws/Index.html
- Levenson D. The challenges of universal HIV screening: why cost, logistics, and some state laws present hurdles to CDC recommendations. Clinical Laboratory News 2007 [cited 2007 Nov 1]. Available

- from: URL: http://www.aacc.org/AACC/publications/cln/2007/oct/coverl_1007.htm
- Rogers EM. Diffusion of innovations. 5th ed. New York: Free Press; 2003.
- Frankel MR, Shapiro MF, Duan N, Morton SC, Berry SH, Brown JA, et al. National probability samples in studies of low-prevalence diseases. Part II: designing and implementing the HIV cost and services utilization study sample. Health Serv Res 1999;34(5 Pt 1):969-92.
- Shapiro MF, Berk ML, Berry SH, Emmons CA, Athey LA, Hsia DC, et al. National probability samples in studies of low-prevalence diseases. Part I: perspectives and lessons from the HIV cost and services utilization study. Health Serv Res 1999;34(5 Pt 1):951-68.
- 40. Kish L. Survey sampling. New York: John Wiley and Sons; 1965.
- Graubard BI, Korn EL. Predictive margins with survey data. Biometrics 1999;55:652-9.
- 42. Jamieson DJ, Cohen MH, Maupin R, Nesheim S, Danner SP, Lampe MA, et al. Rapid human immunodeficiency virus-1 testing on labor and delivery in 17 U.S. hospitals: the MIRIAD experience. Am J Obstet Gynecol 2007;197(3 Suppl 1):S72-82.
- 43. Lyons MS, Lindsell CJ, Ledyard HK, Frame PT, Trott AT. Emergency department HIV testing and counseling: an ongoing experience in a low-prevalence area. Ann Emerg Med 2005;46:22-8.
- Lyons MS, Lindsell CJ, Ledyard HK, Frame PT, Trott AT. Health department collaboration with emergency departments as a model for public health programs among at-risk populations. Public Health Rep 2005;120:259-65.

- Rothman RE. Current Centers for Disease Control and Prevention guidelines for HIV counseling, testing, and referral: critical role of and a call to action for emergency physicians. Ann Emerg Med 2004;44:31-42.
- Anderson J, Smith MJ, Kostman J. Implementation of a rapid HIV testing program in an inner city hospital emergency department. Paper presented at the XVIth International AIDS Conference; 2006 Oct 13–18: Toronto.
- 47. Calderon Y, Leider J, Hailpern S, Haughey M, Chin R, Lombardi P, et al. Program B.R.I.E.F.: video assisted rapid HIV testing in an urban ED. Paper presented at the XVIth International AIDS Conference; 2006 Oct 13–18; Toronto.
- 48. Rotheram-Borus MJ, Leibowitz AA, Etzel MA. Routine, rapid HIV testing. AIDS Educ Prev 2006;18:273-80.
- Koo DJ, Begier EM, Henn MH, Sepkowitz KA, Kellerman SE. HIV counseling and testing: less targeting, more testing. Am J Public Health 2006;96:962-4.
- Spielberg F, Branson BM, Goldbaum GM, Lockhart D, Kurth A, Rossini A, et al. Choosing HIV counseling and testing strategies for outreach settings: a randomized trial. J Acquir Immune Defic Syndr 2005;38:348-55.
- Walensky RP, Losina E, Steger-Craven KA, Freedberg KA. Identifying undiagnosed human immunodeficiency virus: the yield of routine, voluntary inpatient testing. Arch Intern Med 2002;162:887-92.
- Glynn M, Rhodes P. Estimated HIV prevalence in the United States at the end of 2003. Paper presented at: National HIV Prevention Conference; 2005 Jun 12–15; Atlanta.