Patient Risks, Outcomes, and Costs of Voluntary HIV Testing at Five Testing Sites Within a Medical Center

SUPRIYA D. MEHTA, PhD, MHS^a

JONATHAN HALL, MM, LADC-1^b

JEFFREY L. GREENWALD, MD^c

KEVIN CRANSTON, MD^d

PAUL R. SKOLNIK, MD^{b,c}

SYNOPSIS

Objectives. The Centers for Disease Control and Prevention (CDC) recommends offering human immunodeficiency virus (HIV) testing to all patients in all high HIV-prevalence clinical settings. We evaluated programmatic aspects of HIV testing across multiple clinical settings within a single medical center.

Methods. We analyzed programmatic data of HIV testing in the Urgent Care Center (UCC), inpatient floors, outpatient primary care, a non-clinical Drop-In Center, and Emergency Department (ED). HIV testing was by oral mucosal transudate, venous blood samples, or rapid testing fingersticks, with Western blot confirmation. We compared the sociodemographics and behavioral risks of individuals undergoing HIV testing across the five sites and estimated costs per person tested and per HIV-positive test result.

Results. From 2002 to 2004, 16,750 HIV tests were conducted, with 229 (1.4%) previously unreported HIV infections diagnosed among 16,696 valid test results. HIV-positive prevalence was 1.5% for the UCC, 1.5% at the Drop-In Center, 1.4% for primary care, 1.2% for inpatient, and 0.6% in the ED. Behavioral risks were most prevalent in the UCC and the Drop-In Center. The cost per test was lowest in the UCC and highest in the Drop-In Center. The cost per previously unreported HIV infection was lowest in the UCC (\$1,980) and highest in the ED (\$9,724).

Conclusions. Although a significant number of HIV infections were identified, the number of tests performed represents <10% of all clinical visits. Due to personnel and time constraints, offering HIV testing to patients hierarchically in some settings of a high-volume medical center merits evaluation.

^aDepartment of Epidemiology and Biostatistics, University of Illinois Chicago, Chicago, IL

^bDepartment of Medicine, Center for HIV/AIDS Care and Research, Boston Medical Center, Boston, MA

^cHospital Medicine Unit, Department of Medicine, Boston Medical Center and Boston University School of Medicine, Boston, MA

^dHIV/AIDS Bureau, Massachusetts Department of Public Health, Boston, MA

^eDivision of Infectious Diseases, Department of Medicine, Boston University School of Medicine, Boston, MA

Address correspondence to: Supriya D. Mehta, PhD, MHS, Department of Epidemiology and Biostatistics, University of Illinois, 958 SPHPI, M/C 923, 1603 W. Taylor St., Chicago, IL 60612; tel. 312-413-7485; fax 312-996-0064; e-mail <supriyad@uic.edu>.

©2008 Association of Schools of Public Health

Of the estimated 1 million people living with human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS) in the U.S.,¹ approximately 25% are unaware of their status.² In 2003, the Centers for Disease Control and Prevention (CDC) published *Advancing HIV Prevention: New Strategies for a Changing Epidemic*, augmenting previous recommendations “to include offering HIV testing to all patients in all high HIV-prevalence clinical settings and to those with risks for HIV in low HIV-prevalence clinical settings.”³ This strategy also supports simplifying HIV pretest prevention counseling and recommends opt-out HIV screening for all patients in all health-care settings.⁴

Routine screening can be advantageous compared with targeted- or self-referred screening by increasing the number of cases detected.^{3,5-8} With the updated 2006 CDC recommendations advocating the elimination of specific consent for HIV tests, utilizing an opt-out protocol at clinical sites, and routinely testing for HIV for all individuals without a known HIV serostatus,⁴ questions remain about the feasibility of such broad-based recommendations. Implementing such a plan will require a high degree of health-care provider acceptance, improved reimbursement, and recognition of complicated features in the process of HIV testing, most notably counseling for HIV-positive patients and linkage to care.⁹

Studies of HIV testing among Emergency Department (ED), inpatient, and urgent care patients shows the prevalence of previously undiagnosed HIV through routinely offered and targeted testing ranges from 2.0% to 4.0%.^{5,10-15} None of these studies directly compared characteristics of people tested and outcomes of testing across different clinical sites. This information may help develop and refine HIV testing strategies within a hospital system, with the eventual goal of maximizing resource allocation in terms of numbers of HIV cases detected in relation to the availability of personnel time and cost.

The goals of this analysis were to compare across multiple sites within a single hospital system: (1) HIV test results, and patient demographics and behavioral risks and (2) the cost per HIV test conducted and HIV infection diagnosed.

METHODS

Study setting

Boston Medical Center (BMC) is a 547-bed academic affiliate of Boston University (BU). Approximately 50% of BMC patients are uninsured or have Medicaid. In 2004, there were approximately 28,000 hospital admissions, 55,000 outpatient primary care visits, 29,000

urgent care visits, 97,000 adult ED visits, and 28,000 pediatric ED visits.

This analysis examines counselor-based, voluntary opt-in HIV testing from January 2002 through December 2004 in five sites: the Urgent Care Center (UCC), the Drop-In Center, inpatient floors, the primary care clinic (PCC), and the ED. Patients in the UCC, inpatient, and PCC were offered confidential testing; patients in the Drop-In Center were offered anonymous or confidential testing; and patients in the ED were offered only anonymous testing. HIV counseling and testing in all sites but the ED was funded under a contract with the Massachusetts Department of Public Health (MDPH). Excluding the ED, testing was conducted Monday through Friday from 8:30 a.m. to 5 p.m. by six full-time counselors. HIV testing was offered in the ED from November 2003 to May 2004, as part of a research study approved by the BU Medical Center Institutional Review Board, evaluating routinely recommended HIV and sexually transmitted disease (STD) testing.¹⁶ Two full-time counselors provided testing Monday through Friday from 10 a.m. to 12 a.m. in the adult ED, and one full-time counselor provided testing from 10 a.m. to 10 p.m. in the pediatric ED. Counselors approached and offered HIV testing to English- and Spanish-speaking ED patients aged 15 to 54 systematically, by going from bed to bed in a consecutive manner. Testing was offered routinely based on age, language, and order of approach; risk was not assessed prior to offering testing. ED patients who reported their HIV status to be positive were not tested.

The Drop-In Center is a non-clinical site where clients are self-referred for HIV testing. There is no pre-screening of risk; all clients are offered testing. Intake ends one hour prior to the center's closing time. Individuals who present after intake hours end are asked to return at another time. In the UCC, a hierarchical screening method was employed due to the high volume of patients. Patients were approached in examination rooms after triage and the counselors monitored the examination room board to first identify patients who presented with (in descending order of priority): infectious diseases, fever, drug or alcohol use, incarceration, STD-related complaint, or homelessness. On the inpatient floors, patients were approached in their rooms and there were also physician referrals. A hierarchical approach was not applied on inpatient floors and testing was offered prior to risk assessment. In the outpatient PCC, patients were tested mostly by physician referral. HIV testing in the UCC, Drop-In Center, inpatient floors, and PCC occurred among patients aged 15 years and older with no upper age limit.

HIV testing

From 2002 to 2003, patients gave a venous blood sample or an oral mucosal transudate (OMT) sample to be tested for HIV by enzyme-linked immunosorbent assay (ELISA), with Western blot confirmation through the MDPH State Laboratory Institute, according to manufacturer's directions (OraSure®, Orasure Technologies Inc., Bethlehem, Pennsylvania). All ED patients were tested for HIV via OMT sample. Beginning in 2004, patients were offered rapid HIV testing in the UCC, Drop-In Center, PCC, and inpatient floors. Blood samples obtained by fingerstick were tested for HIV by OraQuick® Rapid HIV-1 Antibody Test (Orasure Technologies, Inc.). Reactive rapid HIV results were retested for HIV by both ELISA and Western blot confirmation (the latter done irrespective of ELISA results) through the MDPH State Laboratory Institute.

Programmatic costs

The goal of the programmatic cost comparison across sites was to determine the relative rather than the actual costs. To determine the cost of the programs relative to each other, rather than the actual costs, we estimated the personnel costs per specimen tested and per previously unreported HIV infected person detected. This cost comparison provides an understanding of the costs associated with personnel effort and the prevalence of HIV-positive tests. Throughout the medical center, including the ED, HIV counseling and testing supplies and specimen processing were provided by the MDPH at no charge. Therefore, material costs are not included in the programmatic costs estimation.

From 2002 through 2004, there were five full-time equivalent employees (FTEEs) conducting HIV counseling and testing (excluding the ED): 1.5 FTEEs in the UCC, 1.5 FTEEs in the Drop-In Center, 1.5 FTEEs in inpatient, and 0.5 FTEEs in the PCC. From November 2003 through May 2004, there were two FTEEs in the adult ED and one FTEE in the pediatric ED. For personnel costs, each FTEE was assumed: (1) to have an annual salary of \$35,000 (current starting salary for HIV counselors) multiplied by an institutional fringe benefit rate of 27%, and (2) to work five days a week for 47 weeks (holidays plus sick days = five weeks).

Data collection and analysis

Demographic and behavioral data were collected using the MDPH HIV Counseling and Testing Data Collection form at the time of HIV testing. Data were recorded through personal interviews. Demographic and behavioral data were linked to laboratory results by unique identifiers. HIV test results were dichotomized as HIV-negative (non-reactive ELISA) and HIV-positive

(reactive ELISA and Western blot); we used the ELISA and Western blot confirmed results of rapid test results for HIV-negative (non-reactive ELISA, non-reactive Western blot) and HIV-positive (reactive ELISA and reactive Western blot). Data represent the number of tests conducted rather than the number of individuals, and therefore are likely to include some patients who were tested more than once. Identifying information is not recorded in the database, thus it is not possible to identify repeat visits.

Descriptive analyses include frequencies of patient demographics and behavioral risks overall and by site. Pearson's Chi-square test assessed statistical significance of differences in patient characteristics by testing site and in HIV prevalence by patient characteristics. Point prevalence and binomial exact 95% confidence intervals were calculated for HIV-positive test results by site and patient characteristics, to allow observation of within-category differences. Logistic regression was used to calculate univariable odds ratios. Data were analyzed using Stata® software.¹⁷

RESULTS

From January 2002 to December 2004, there were 17,594 pretest counseling sessions and 16,750 HIV tests conducted. Almost 40% of tests took place in the UCC ($n=6,632$), 25% from inpatient floors ($n=4,253$), 17% at the Drop-In Center ($n=2,920$), 9% from the PCC ($n=1,516$), and 9% in the ED ($n=1,427$). Among 16,750 HIV tests, 258 (1.5%) were positive. Of the 258 patients who tested HIV positive, 29 reported a previous HIV-positive test result in their pretest counseling assessment and were excluded from analysis. (Patients who report their HIV status as positive in the UCC, PCC, inpatient floors, or Drop-In Center, but do not have any existing documentation, are tested to provide documentation and facilitate entry into care.) There were 15 indeterminate results and 10 unusable specimens (nine were quantity not sufficient and one was hemolyzed) that were excluded from analysis. Thus, 229 (1.37%; 95% confidence interval [CI] 1.20, 1.56) of 16,696 patients were newly diagnosed with HIV. HIV test results were from 9,404 (56.3%) OMT samples, 1,871 (11.2%) venous blood samples, and 5,421 (32.5%) rapid testing fingersticks (all conducted in 2004).

Among all patients tested, 59% of patients were male, the median age was 36 years, 39% were black, 23% were white, 19% were Hispanic, and 8% were Haitian (Table 1). HIV prevalence was similar in the UCC (1.5%), Drop-In Center (1.5%), inpatient floors (1.4%), and PCC (1.2%), and lower in the ED (0.6%).

Table 1. Overall patient demographics and HIV results by site of HIV test, 2002–2004

	Total N (percent)	UCC N (percent)	Drop-In Center N (percent)	Inpatient N (percent)	PCC N (percent)	ED N (percent)	P-value
Age (in years) ^a							
15–24	2,930 (18.0)	1,085 (16.6)	512 (19.0)	495 (11.8)	248 (16.7)	590 (42.4)	
25–39	6,953 (42.6)	3,316 (50.6)	1,333 (49.5)	1,227 (29.3)	635 (42.3)	442 (31.8)	
40–54	5,202 (30.8)	1,775 (27.1)	740 (27.5)	1,688 (40.3)	457 (30.8)	359 (25.8)	
≥55	1,403 (8.6)	375 (5.7)	107 (4.0)	775 (18.5)	146 (9.8)	0 (0.0)	<0.001
Gender							
Female	6,776 (41.0)	2,371 (36.1)	1,092 (38.4)	1,834 (43.6)	711 (47.5)	768 (55.0)	
Male	9,734 (59.0)	4,191 (63.9)	1,753 (61.6)	2,374 (56.4)	787 (52.5)	629 (45.0)	<0.001
Race							
White	3,838 (23.0)	1,024 (15.5)	1,141 (39.2)	1,228 (29.0)	197 (13.0)	248 (17.4)	
Black	6,420 (38.5)	2,961 (44.8)	788 (27.1)	1,599 (37.7)	419 (27.6)	653 (45.8)	
Hispanic	3,184 (19.1)	1,281 (19.5)	507 (17.4)	809 (19.1)	298 (19.7)	283 (19.8)	
Haitian	1,271 (7.6)	640 (9.7)	69 (2.4)	209 (4.9)	279 (18.4)	74 (5.2)	
Cape Verdean	478 (2.9)	238 (3.6)	41 (1.4)	97 (2.3)	54 (3.6)	48 (3.4)	
Asian	321 (1.9)	112 (1.7)	87 (3.0)	51 (1.2)	62 (4.1)	9 (0.6)	
Other, unknown	1,184 (7.1)	341 (5.2)	277 (9.5)	247 (5.8)	207 (13.7)	112 (7.9)	<0.001
Education							
<High school	3,442 (20.6)	1,536 (23.3)	339 (11.7)	929 (21.9)	281 (18.5)	357 (25.0)	
≥High school/GED	11,116 (66.6)	4,776 (72.3)	2,139 (73.5)	2,170 (51.2)	1,024 (67.6)	1,007 (70.6)	
Declined, missing	2,138 (12.8)	291 (4.4)	432 (14.9)	1,141 (26.9)	211 (13.9)	63 (4.4)	<0.001
Homeless							
No	14,826 (94.6)	6,010 (93.2)	2,268 (94.8)	3,852 (94.8)	1,468 (98.5)	1,228 (96.3)	
Yes	842 (5.4)	436 (6.8)	124 (5.2)	212 (5.2)	23 (1.5)	47 (3.7)	<0.001
Referral source							
Self	11,061 (66.3)	6,315 (95.6)	1,774 (61.0)	1,815 (42.8)	213 (14.1)	944 (66.2)	
Physician	3,924 (23.5)	215 (3.3)	192 (6.6)	2,266 (53.4)	1,251 (82.5)	0 (0.0)	
Other	1,711 (10.3)	73 (1.1)	994 (32.4)	159 (3.8)	52 (3.4)	483 (33.9)	<0.001
HIV specimen source							
OMT	9,404 (56.3)	4,203 (63.4)	1,174 (40.2)	2,512 (59.1)	110 (7.3)	1,427 (100)	
Venous blood sample	1,871 (11.2)	61 (0.9)	1,183 (40.5)	32 (0.8)	625 (41.2)	0 (0.0)	
Fingerstick for rapid test	5,421 (32.5)	2,368 (35.7)	563 (19.3)	1,709 (40.2)	781 (51.5)	0 (0.0)	<0.001
HIV results							
Negative	16,467 (98.6)	6,502 (98.5)	2,867 (98.5)	4,181 (98.6)	1,498 (98.8)	1,419 (99.4)	
Positive	229 (1.4)	101 (1.5)	43 (1.5)	59 (1.4)	18 (1.2)	8 (0.6)	0.067

^aTesting was not conducted among patients <16 years of age in the UCC, Drop-In Center, or outpatient PCC, or among patients <15 years of age in inpatient floors and the ED. Programmatically, HIV testing was not offered to ED patients >54 years of age. Statistical comparison excludes the ED.

HIV = human immunodeficiency virus

UCC = Urgent Care Center

PCC = primary care clinic

ED = Emergency Department

GED = graduated equivalent degree

OMT = oral mucosal transudate

The proportion of male clients HIV tested was lowest in the ED (45%), while men comprised more than 60% of clients tested in the UCC and Drop-In Center. A greater proportion of ED and UCC patients were black, and a greater proportion of Drop-In Center and inpatient floor clients were white. Almost 60% of clients undergoing HIV testing on the inpatient floors were aged ≥40 years, compared with 32.8% in the UCC, 31.5% in the Drop-In Center, and 40.6% in

the PCC. Behavioral risks were more prevalent among UCC and Drop-In Center patients (Table 2). Patients tested at the Drop-In Center were more likely to report same-sex intercourse, injection drug use, or sex with an HIV-positive person than patients at any other testing venue. Patients tested in the UCC were more likely to report sex under the influence of drugs or alcohol, or a history of STD in the past three years.

HIV-positive test results by patient characteristics

Among demographic factors, patients who were male, aged 25 to 54, of non-white race other than Asian, uninsured, with less than a high school education, or referred for HIV testing by a physician were more likely to test HIV positive (Table 3). The prevalence of infection was greater than 2% among patients who were Haitian, Cape Verdean, uninsured, or had less than a high school education. HIV-positive results were

more prevalent among patients who reported same-sex intercourse, history of STD, sex with an HIV-positive person, inconsistent condom use, or anal-receptive and anal-insertive intercourse. Other factors by which HIV test results did not differ (results not shown) were: sex under the influence of drugs or alcohol, sex with a commercial sex partner, sex in exchange for drugs or money, homelessness, and having a casual sex partner.

Table 2. Patient risks by site of HIV test, 2002–2004^a

	Total N (percent)	UCC N (percent)	Drop-In Center N (percent)	Inpatient N (percent)	PCC N (percent)	ED N (percent)	P-value
Sex partner gender							
Opposite gender only	14,308 (91.8)	5,979 (94.1)	2,168 (79.3)	3,628 (95.8)	1,320 (94.0)	1,213 (93.0)	<0.001
Same or both genders	1,278 (8.2)	377 (5.9)	567 (20.7)	159 (4.2)	85 (6.0)	91 (7.0)	
IDU							
No	15,372 (92.1)	6,044 (91.5)	2,474 (85.0)	4,007 (94.5)	1,481 (97.7)	1,366 (95.7)	<0.001
Yes	1,324 (7.9)	559 (8.5)	436 (15.0)	233 (5.5)	35 (2.3)	61 (4.3)	
Use of needle exchange program among IDUs							
No	795 (63.2)	359 (65.5)	262 (61.9)	116 (58.9)	25 (80.6)	33 (55.9)	0.074
Yes	463 (36.8)	189 (35.5)	161 (38.1)	81 (41.1)	6 (19.4)	26 (44.1)	
Sex under the influence of drugs or alcohol							
No	12,061 (72.2)	3,920 (59.4)	2,328 (80.0)	3,577 (84.4)	1,233 (81.3)	1,003 (70.3)	<0.001
Yes	4,635 (27.8)	2,683 (40.6)	582 (20.0)	663 (15.6)	283 (18.7)	424 (29.7)	
STD diagnosis							
No	13,696 (82.0)	4,322 (65.5)	2,592 (89.1)	4,064 (95.9)	1,436 (94.7)	1,282 (89.8)	<0.001
Yes	3,000 (18.0)	2,281 (34.5)	318 (10.9)	176 (4.1)	80 (5.3)	145 (10.2)	
Sex with an HIV-positive person							
No	16,100 (96.4)	6,327 (95.8)	2,677 (92.0)	4,205 (99.2)	1,492 (98.4)	1,399 (98.0)	<0.001
Yes	596 (3.6)	276 (4.2)	233 (8.0)	35 (0.8)	24 (1.6)	28 (2.0)	
Sex with a CSW							
No	15,464 (92.6)	5,768 (87.4)	2,686 (92.3)	4,131 (97.4)	1,480 (97.6)	1,399 (98.0)	<0.001
Yes	1,232 (7.4)	835 (12.6)	224 (7.7)	109 (2.6)	36 (2.4)	28 (2.0)	
Exchanged sex for money or drugs							
No	16,319 (97.7)	6,425 (97.3)	2,791 (95.9)	4,201 (99.1)	1,503 (99.1)	1,399 (98.0)	<0.001
Yes	377 (2.3)	178 (2.7)	119 (4.1)	39 (0.9)	13 (0.9)	28 (2.0)	
Number of sex partners							
0	773 (4.6)	150 (2.3)	53 (1.8)	390 (9.2)	115 (7.6)	65 (4.5)	<0.001
1	4,409 (26.4)	1,527 (23.3)	535 (18.4)	1,372 (32.4)	454 (30.0)	521 (36.5)	
2–4	5,234 (31.4)	2,640 (40.0)	1,008 (34.6)	756 (17.8)	311 (20.5)	519 (36.4)	
5–9	1,810 (10.8)	1,039 (15.8)	359 (12.3)	205 (4.8)	74 (4.9)	133 (9.3)	
≥10	1,418 (8.5)	659 (10.0)	443 (15.2)	165 (3.9)	50 (3.3)	101 (7.1)	
Missing	3,052 (18.3)	588 (8.9)	512 (17.6)	1,352 (31.9)	512 (33.8)	88 (6.2)	
Condom use with current sex partner							
Always	2,293 (13.7)	588 (8.9)	719 (24.7)	496 (11.7)	179 (11.8)	311 (21.8)	<0.001
Sometimes	8,062 (48.3)	4,609 (69.8)	1,268 (43.6)	1,255 (29.6)	450 (29.7)	480 (33.6)	
Never	4,693 (28.1)	1,170 (17.7)	711 (24.4)	1,859 (43.9)	482 (31.8)	471 (33.0)	
Missing	1,648 (9.9)	236 (3.6)	212 (7.3)	630 (14.9)	405 (26.7)	165 (11.6)	

continued on p. 613

Table 2 (continued). Patient risks by site of HIV test, 2002–2004^a

	Total N (percent)	UCC N (percent)	Drop-In Center N (percent)	Inpatient N (percent)	PCC N (percent)	ED N (percent)	P-value
Anal-insertive sex (men only)							
Did not have	6,359 (65.3)	3,401 (81.2)	585 (33.4)	1,375 (57.9)	631 (80.2)	367 (58.4)	
<6 weeks ago	467 (4.8)	173 (4.1)	186 (10.6)	56 (2.4)	38 (4.8)	14 (2.2)	
≥6 weeks ago	525 (5.4)	295 (7.0)	97 (5.5)	67 (2.8)	42 (5.3)	24 (3.8)	
Missing	2,383 (24.5)	322 (7.7)	885 (50.5)	876 (36.9)	76 (9.7)	224 (35.6)	<0.001
Anal-receptive sex							
Did not have	13,813 (82.7)	6,099 (92.4)	1,746 (60.0)	3,315 (78.2)	1,405 (92.7)	1,248 (87.5)	
<6 weeks ago	190 (1.1)	62 (0.9)	85 (2.9)	11 (0.3)	15 (1.0)	17 (1.2)	
≥6 weeks ago	195 (1.2)	86 (1.3)	57 (2.0)	17 (0.4)	9 (0.6)	26 (1.8)	
Missing	2,498 (15.0)	356 (5.4)	1,022 (35.1)	897 (21.2)	87 (5.7)	136 (9.5)	<0.001
Vaginal sex							
Did not have	999 (6.0)	267 (4.0)	244 (8.4)	348 (8.2)	83 (5.5)	57 (4.0)	
<6 weeks ago	9,437 (56.5)	4,328 (65.6)	1,563 (53.7)	1,984 (46.8)	879 (58.0)	683 (47.9)	
≥6 weeks ago	4,829 (28.9)	1,617 (24.5)	766 (26.3)	1,511 (35.6)	418 (27.6)	517 (36.2)	
Missing	1,431 (8.6)	391 (5.9)	337 (11.6)	397 (9.4)	136 (9.0)	170 (11.9)	<0.001

^aAll risks refer to past three years except where noted: receptive and insertive anal sex, vaginal sex, and condom use (no reference period specified). Analysis limited to patients with valid HIV test results available, and those who did not test HIV-positive subsequent to a previous HIV-positive test result.

HIV = human immunodeficiency virus

UCC = Urgent Care Center

PCC = primary care clinic

ED = Emergency Department

IDU = injection drug user

STD = sexually transmitted disease

CSW = commercial sex worker

Programmatic costs

The programmatic cost per HIV test and per previously unreported HIV infection was lowest in the UCC (\$30.29 per HIV test and \$1,980.00 per HIV-positive test result). The UCC had the highest HIV prevalence detected (1.5%), and also the greatest number of patients tested per eight-hour shift (6.3). While the Drop-In Center had the same HIV prevalence as the UCC, it had the lowest number of patients tested per eight-hour shift (2.8), contributing to its higher cost per HIV test (\$68.74) and cost per HIV-positive test result (\$4,652.00). Although the ED had a higher number of HIV tests per eight-hour shift (5.5) than inpatient (4.0), PCC (2.8), and the Drop-In Center (4.3), it had the lowest prevalence (0.6%) and highest cost per HIV-positive test result (\$9,724) (Table 4).

DISCUSSION

We found a high prevalence (>1%) of HIV among patients accepting voluntary testing in four out of five sites within our medical center. Self-reported risk varied considerably by site. The costs per HIV test conducted

and HIV-positive test result were lowest in the UCC. The cost per HIV test was highest at the Drop-In Center, which had the lowest number of tests per eight-hour shift. The cost per HIV-positive test result was highest in the ED, which had the lowest HIV prevalence. These results are supported by a recent analysis comparing the cost-effectiveness of targeted testing to CDC's recommendations for mass testing.¹⁸ Targeted testing was more cost-effective through greater number of infections detected and more transmissions prevented.¹⁸ This analysis also took into account the trade-off in saved time and resources for opt-out testing compared with the potential reductions in transmissions through targeted risk assessment and counseling, and found that targeted counseling and testing were more cost-effective, even when the HIV prevalence was as low as 0.3%.¹⁸

Our comparison of HIV testing in multiple sites within a single medical center allows for a discussion of certain advantages and disadvantages of targeted and universal HIV testing. The detection of all cases of HIV infection would require routine HIV testing of all patients, as CDC recommends. To facilitate this,

Table 3. Number and percent HIV-positive test results by site and patient characteristics

	HIV-positive N	Percent HIV-positive (95% CI) ^a	Unadjusted odds ratio (95% CI)
Site			
Emergency Department	8	0.56 (0.24, 1.10)	Ref.
Primary care clinic	18	1.19 (0.71, 1.87)	2.13 (0.93, 4.92)
Inpatient floor	59	1.39 (1.06, 1.79)	2.50 (1.19, 5.15)
Drop-In Center	43	1.48 (1.07, 1.99)	2.66 (1.55, 5.67)
Urgent Care Center	101	1.53 (1.25, 1.86)	2.76 (1.34, 5.67)
Gender			
Female	78	1.15 (0.91, 1.43)	Ref.
Male	145	1.49 (1.26, 1.75)	1.30 (0.98, 1.71)
Age (in years)			
15–24	14	0.48 (0.26, 0.80)	Ref.
25–39	106	1.52 (1.25, 1.84)	3.22 (1.84, 5.64)
40–54	93	1.85 (1.50, 2.26)	3.39 (2.24, 6.91)
≥55	8	0.57 (0.25, 1.12)	1.19 (0.50, 2.85)
Race			
White	24	0.63 (0.40, 0.93)	Ref.
Black	100	1.56 (1.27, 1.89)	2.51 (1.61, 3.93)
Hispanic	39	1.22 (0.87, 1.67)	1.97 (1.18, 3.28)
Haitian	30	2.36 (1.60, 3.35)	3.84 (2.24, 6.60)
Cape Verdean	10	2.09 (1.01, 3.81)	3.40 (1.16, 7.15)
Asian	1	0.31 (0.00, 1.72)	0.50 (0.07, 3.68)
Other, unknown	25	2.11 (1.37, 3.10)	3.43 (1.96, 6.02)
Health insurance status			
Insured	167	1.24 (1.06, 1.44)	Ref.
Not insured	45	2.05 (1.50, 2.73)	1.66 (1.19, 2.32)
Education			
≥High school/GED	126	1.13 (0.95, 1.35)	Ref.
<High school	69	2.00 (1.56, 2.53)	1.78 (1.33, 2.02)
Declined, missing	34	1.59 (1.10, 2.21)	1.41 (0.96, 2.07)
Referral			
Self	135	1.22 (1.02, 1.44)	Ref.
Physician	72	1.83 (1.44, 2.31)	1.51 (1.13, 2.02)
Other	22	1.29 (0.81, 1.94)	1.05 (0.67, 1.66)
Sex partner gender			
Opposite gender only	178	1.24 (1.07, 1.44)	Ref.
Same gender or both	34	2.66 (1.85, 3.69)	2.17 (1.49, 3.15)
Injection drug use			
No	208	1.35 (1.18, 1.55)	Ref.
Yes	21	1.59 (0.98, 2.41)	1.17 (0.75, 1.85)
History of STD diagnosis			
No	171	1.25 (1.07, 1.45)	Ref.
Yes	58	1.93 (1.47, 2.49)	1.56 (1.15, 2.11)
Sex with an HIV-positive person			
No	205	1.27 (1.11, 1.46)	Ref.
Yes	24	4.03 (2.60, 5.93)	3.25 (2.11, 5.01)
Number of sex partners			
0	11	1.42 (0.71, 2.53)	Ref.
1	50	1.13 (0.83, 1.49)	0.79 (0.41, 1.53)
2–4	77	1.47 (1.16, 1.83)	1.03 (0.55, 1.95)
5–9	28	1.55 (1.03, 2.23)	1.09 (0.54, 2.20)
≥10	23	1.62 (1.03, 2.42)	1.14 (0.55, 2.36)
Missing	40	1.31 (0.94, 1.78)	0.92 (0.47, 1.80)
Condom use with current sex partner			
Always	30	1.31 (0.88, 1.86)	Ref.
Sometimes	120	1.49 (1.24, 1.78)	1.14 (0.76, 1.70)
Never	46	0.98 (0.72, 1.31)	0.75 (0.47, 1.19)
Missing	33	2.00 (1.38, 2.80)	1.54 (0.94, 2.54)

continued on p. 615

Table 3 (continued). Number and percent HIV-positive test results by site and patient characteristics

	HIV-positive N	Percent HIV-positive (95% CI) ^a	Unadjusted odds ratio (95% CI)
Number of sex partners			
0	11	1.42 (0.71, 2.53)	Ref.
1	50	1.13 (0.83, 1.49)	0.79 (0.41, 1.53)
2–4	77	1.47 (1.16, 1.83)	1.03 (0.55, 1.95)
5–9	28	1.55 (1.03, 2.23)	1.09 (0.54, 2.20)
≥10	23	1.62 (1.03, 2.42)	1.14 (0.55, 2.36)
Missing	40	1.31 (0.94, 1.78)	0.92 (0.47, 1.80)
Condom use with current sex partner			
Always	30	1.31 (0.88, 1.86)	Ref.
Sometimes	120	1.49 (1.24, 1.78)	1.14 (0.76, 1.70)
Never	46	0.98 (0.72, 1.31)	0.75 (0.47, 1.19)
Missing	33	2.00 (1.38, 2.80)	1.54 (0.94, 2.54)
Anal-insertive sex (men only)			
Did not have	75	1.18 (0.93, 1.48)	Ref.
<6 weeks ago	10	2.14 (1.03, 3.90)	1.83 (0.94, 3.57)
≥6 weeks ago	20	3.81 (2.34, 5.82)	3.32 (2.01, 5.48)
Missing	40	1.68 (1.20, 2.28)	1.43 (0.97, 2.11)
Anal-receptive sex			
Did not have	161	1.17 (0.99, 1.36)	Ref.
<6 weeks ago	5	2.63 (0.86, 6.03)	2.29 (0.93, 5.65)
≥6 weeks ago	14	7.18 (3.98, 11.8)	6.56 (3.73, 11.5)
Missing	49	1.96 (1.45, 2.59)	1.70 (1.23, 2.34)
Vaginal sex			
Did not have	31	3.10 (2.12, 4.38)	Ref.
<6 weeks ago	99	1.05 (0.85, 1.28)	0.33 (0.22, 0.50)
≥6 weeks ago	74	1.53 (1.21, 1.92)	0.49 (0.32, 0.74)
Missing	25	1.75 (1.13, 2.57)	0.56 (0.33, 0.95)
Year of HIV test			
2002	98	2.27 (1.84, 2.76)	Ref.
2003	61	1.27 (0.97, 1.62)	0.55 (0.40, 0.76)
2004	70	0.93 (0.72, 1.17)	0.40 (0.30, 0.55)

^a95% CIs for HIV prevalence are binomial exact CIs.

HIV = human immunodeficiency virus

CI = confidence interval

Ref. = reference group

GED = graduated equivalent degree

STD = sexually transmitted disease

CDC has suggested eliminating pretest counseling and separate written consent.³ While these process modifications should mitigate several logistical barriers, it remains to be seen whether they will be sufficient to permit routine HIV testing in high-volume settings.

In our medical center, inpatient and outpatient volume far exceed counselor resources (e.g., UCC volume is approximately 80 patients daily, with one to two counselors offering testing in this area). We propose that in an opt-out approach with no risk assessment or pretest counseling, person-time would still be required, at minimum (1) to inform patients they will be tested for HIV, (2) for specimen collection and processing, (3) for delivering test results, (4) for documentation, and (5) for linkage to care. Even

if this process took only a few minutes per person, a clinician-delivered program (i.e., nurses or physicians) is likely to be time- and cost-prohibitive. Thus, in our medical center, while we detected an HIV prevalence higher than 1% in all the testing sites except for the ED, it is not possible to offer testing to all patients due to the large volume of patients cared for and limited current resources.

Opt-out HIV screening for all patients in all clinical sites has not been conducted or evaluated in many clinical sites, including our own. A comprehensive programmatic evaluation would need to measure at each clinical site: numbers of patients declining opt-out testing, reasons for refusing, patient preferences for pretest counseling, counselor time involved in

specimen collection and processing, documentation, delivering results, and patient outcomes (follow-up with linkage to care). This information would quantify, and give descriptive value to, the effectiveness of CDC recommendations for HIV testing in medical settings. Additionally, as Girardi et al. report, while opt-out pretest counseling increased HIV testing volume in their medical center, the number of new infections detected remained constant compared with the period of targeted testing before, thus suggesting that opt-out testing may facilitate HIV testing among low-risk patients.¹⁹

Limitations

Results of the analysis were limited by data collected through the MDPH HIV Counseling and Testing Data Collection form. This analysis does not produce a true measure of HIV prevalence, because data represent the number of tests conducted rather than the number of individuals, and therefore are likely to include some patients who were tested more than once. There is evidence to suggest that patients who undergo repeat HIV testing are at higher risk for HIV infection.^{20,21} In this case, our data would overestimate the prevalence of high-risk behaviors. We excluded from analysis individuals who reported their previous HIV test results as positive, but there may have been patients with previous HIV-positive test results who did not report it. Use of various HIV diagnostic tests may have introduced bias into the HIV prevalence detected. Demographic

and behavioral risk information of people who were not offered testing (selection bias) or who declined testing (volunteer bias) may have differed from those who accepted HIV testing, which would affect our observed prevalence and associations. Given the mixture of confidential and anonymous testing, we cannot calculate the proportion of patients who entered into HIV primary care, an important aspect in evaluating program success.

Our cost analysis is limited because these data were collected for programmatic purposes. As such, we did not have data points that would have allowed a more detailed cost analysis. We estimated programmatic costs using a standardized FTEE salary for HIV counselors and did not account for material costs. Also, HIV testing for patients aged 15 to 54 in the ED was coupled with STD testing for patients aged 15 to 29. Seven hundred fifty-four (53%) ED patients were offered STD testing, and 546 (38%) were tested. Our simplified cost analysis does not take into account the extra time spent offering and testing for STDs. The person-time this took away from conducting additional HIV tests led to an overestimation of the cost per HIV test. However, even if twice as many HIV-positive test results had been detected, HIV testing in the ED would still have the greatest cost per HIV-positive test result (\$4,862). We do not have measures of the personnel time spent in follow-up activities for HIV-positive people, nor were we able to calculate the cost per HIV-positive person entered into care. The current analysis highlights the

Table 4. Personnel costs and cost per HIV test and HIV-positive test result by site^a

	<i>Urgent Care Center</i>	<i>Drop-In Center</i>	<i>Inpatient</i>	<i>Primary care clinic</i>	<i>Emergency Department</i>
Dates of observation	January 2002 to December 2004	January 2002 to December 2004	January 2002 to December 2004	January 2002 to December 2004	November 2003 to May 2004
Total number of patients tested for HIV	6,603	2,910	4,240	1,516	1,427
Total number of patients with HIV-positive results	101	43	59	18	8
Number of full-time employees	1.5	1.5	1.5	0.5	3.0
Total number of eight-hour shifts	1,057	1,057	1,057	352	259
Number of tests per eight-hour shift	6.2	2.8	4.0	4.3	5.5
Personnel costs	\$200,025	\$200,025	\$200,025	\$66,675	\$77,788
Personnel costs per HIV test	\$30.29	\$68.74	\$47.18	\$43.98	\$54.51
Personnel costs per HIV-positive test result	\$1,980	\$4,652	\$3,390	\$3,704	\$9,724

^aThe number of eight-hour shifts was estimated for all sites except the Emergency Department, where they were documented.

HIV = human immunodeficiency virus

need for more detailed cost analysis, such as that conducted by Holtgrave et al.¹⁸

Our analysis found that the yield and cost of HIV testing and patient risk varied by clinical site. These results suggest that testing procedures and results from one clinical site might not necessarily be extrapolated to other clinical sites, even within a single medical center. Findings from our site also might not necessarily be extrapolated to other medical centers and geographic locales. Implementing CDC recommendations for routine HIV testing in clinical sites should take into consideration local procedures and resources.

CONCLUSIONS

Despite thousands of HIV tests having been conducted at this urban medical center over the past few years, and a significant number of HIV-positive individuals having been identified, the numbers of patients tested represent a minority (<10%) of patients evaluated clinically in these sites. Thus, it is likely that there were patients at risk for HIV who were not offered testing due to personnel constraints. Our results indicate HIV testing should be focused on patients who are uninsured, are younger than age 55, are males who report same-sex intercourse, and patients who report a history of STD or sex with an HIV-positive person. Clinicians play a significant role in identifying people at risk for HIV, as demonstrated by the approximately one-third of all HIV-positive people who were identified by physician referral.

While it is important to offer HIV information and testing to all patients, if the main goal is to identify HIV-infected individuals, our results indicate that pragmatically, HIV testing should remain targeted until a feasible and resource-efficient system that preserves linkage to care is in place for testing all patients for HIV infection.

Human immunodeficiency virus (HIV) counseling and testing in the primary care clinic, Urgent Care Center, Drop-In Center, and the inpatient medical service was funded through a contract with the Massachusetts Department of Public Health, HIV/AIDS Bureau (49304350099, PI Skolnik). Data collection in the Emergency Department was funded by a cooperative agreement from the Centers for Disease Control and Prevention (CDC), Division of HIV/AIDS Prevention (RR18/CCR120999, PI Mehta).

The findings and conclusions in this report are those of the authors and do not necessarily represent the views of CDC. The funding sources had no role in the analysis and interpretation of these data or the preparation, review, or approval of this article.

For Emergency Department data collection, CDC project officers were involved in the design and conduct of the study. Data were collected and analyzed while Dr. Mehta was affiliated with the Department of Emergency Medicine at Boston University School of Medicine.

REFERENCES

1. Glynn M, Rhodes P. Estimated HIV prevalence in the United States at the end of 2003. National HIV Prevention Conference; 2005 Jun 12–15; Atlanta. Abstract 595.
2. Centers for Disease Control and Prevention (US). HIV/AIDS surveillance report, 2003 (Vol. 15). Atlanta: Department of Health and Human Services, CDC (US); 2004.
3. Advancing HIV prevention: new strategies for a changing epidemic—United States, 2003. *MMWR Morb Mortal Wkly Rep* 2003; 52(15):329-32.
4. Revised recommendations for HIV testing of adults, adolescents, and pregnant women in health-care settings. *MMWR Recomm Rep* 2006;55(RR-14):1-17.
5. Walensky RP, Losina E, Malatesta L, Barton GE, O'Connor CA, Skolnik PR, et al. Effective HIV case identification through routine HIV screening at urgent care centers in Massachusetts. *Am J Public Health* 2005;95:71-3.
6. 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.
7. Paltiel AD, Weinstein MC, Kimmel AD, Seage GR 3rd, Losina E, Zhang H, et al. Expanded screening for HIV in the United States—an analysis of cost-effectiveness. *N Engl J Med* 2005;352:586-95.
8. Greenwald JL, Rich CA, Bessega S, Posner MA, Maeda JL, Skolnik PR. Evaluation of the Centers for Disease Control and Prevention's recommendations regarding routine testing for human immunodeficiency virus by an inpatient service: who are we missing? *Mayo Clin Proc* 2006;81:452-8.
9. Greenwald JL. Routine rapid HIV testing in hospitals: another opportunity for hospitalists to improve care. *J Hosp Med* 2006;1: 106-12.
10. Routinely recommended HIV testing at an urban urgent care clinic—Atlanta, Georgia, 2000. *MMWR Morb Mortal Wkly Rep* 2001;50(25):538-41.
11. Voluntary HIV testing as part of routine medical care—Massachusetts, 2002. *MMWR Morb Mortal Wkly Rep* 2004;53(24):523-6.
12. 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.
13. Alpert PL, Shuter J, DeShaw MG, Webber MP, Klein RS. Factors associated with unrecognized HIV-1 infection in an inner-city emergency department. *Ann Emerg Med* 1996;28:159-64.
14. Glick NR, Silva A, Zun L, Whitman S. HIV testing in a resource-poor urban emergency department. *AIDS Educ Prev* 2004;16:126-36.
15. Pincus JM, Crosby SS, Losina E, King ER, LaBelle C, Freedberg KA. Acute human immunodeficiency virus infection in patients presenting to an urban urgent care center. *Clin Infect Dis* 2003; 37:1699-704.
16. Mehta SD, Hall J, Lyss SB, Skolnik PR, Pealer LN, Kharasch S. Adult and pediatric emergency department STD and HIV screening: programmatic overview and outcomes. *Acad Emerg Med* 2007; 14:250-8.
17. StataCorp. Stata statistical software: Release 9.2. College Station (TX): StataCorp.; 2005.
18. Holtgrave DR. Costs and consequences of the US Centers for Disease Control and Prevention's recommendations for opt-out HIV testing. *PLoS Med* 2007;4:e194.
19. Girardi E, Puro V, De Carli G, Orchi N, Ippolito G. Consent policies and rates of HIV testing. *JAMA* 2007;297:2478-9.
20. Fernyak SE, Page-Shafer K, Kellogg TA, McFarland W, Katz MH. Risk behaviors and HIV incidence among repeat testers at publicly funded HIV testing sites in San Francisco. *J Acquir Immune Defic Syndr* 2002;31:63-70.
21. MacKellar DA, Valleroy LA, Secura GM, Bartholow BN, McFarland W, Shehan D, et al. Repeat HIV testing, risk behaviors, and HIV seroconversion among young men who have sex with men: a call to monitor and improve the practice of prevention. *J Acquir Immune Defic Syndr* 2002;29:76-85.