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Evaluation of an HIV Nucleic Acid Testing Program With Automated Internet and Voicemail Systems to Deliver Results

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Abstract

Background—Nucleic acid testing (NAT) in routine HIV testing programs can increase the detection of infected individuals, but the most effective implementation of NAT remains unclear.

Objective—To determine how many HIV cases can be identified with NAT and how many persons can be contacted, to identify predictors of acute and early HIV infection cases, and to test reporting of negative results by automated Internet and voicemail systems.

Design—Prospective study.

Setting—San Diego County, California.

Participants—Persons seeking HIV testing.

Measurements—Rates and predictors of HIV infection by stage, notification of positive NAT results, use of automated Internet or voicemail systems to access negative NAT results, and estimated HIV infections prevented.

Results—Of 3151 persons tested, 79 had newly diagnosed cases of HIV: 64 had positive results from rapid HIV test, and 15 had positive results only by NAT (that is, NAT increased the HIV detection yield by 23%). Of all HIV infections, 44% (in 35 persons) were in the acute and early stages. Most participants (56%) and persons with HIV (91%) were men who have sex with men (MSM). All persons with NAT-positive results were notified within 1 week. Of all 3070

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uninfected patients, 2105 (69%) retrieved their negative NAT results, with 1358 using the Internet system. After adjustment for covariates, persons reporting MSM behavior, higher incomes, younger ages, no testing at substance abuse rehabilitation centers, no recent syphilis, and no methamphetamine use were more likely to access negative NAT results by either Internet or voicemail systems.

Limitation—Findings may not be generalizable to other populations and testing programs.

Conclusion—Nucleic acid testing programs that include automated systems for result reporting can increase case yield, especially in settings that cater to MSM.

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Despite decades of prevention efforts in the United States, the incidence rate of HIV has remained stable (1). Because the earliest stages of HIV infection represent a period of maximum infectiousness related to high HIV load, accurate detection of HIV infection during acute and early stages may be critical to control the HIV epidemic (2–4). To protect the U.S. blood supply, blood donors are screened for acute HIV infection by nucleic acid testing (NAT) (5), which can detect infection approximately 12 days before antibody positivity (2). Extending the use of NAT to routine HIV testing programs might help decrease the HIV incidence rate by identifying persons with acute infection that would otherwise be missed by antibody screening. Although this concept was effective in pilot studies in the United States and Africa, it needs to be broadly implemented in routine HIV testing programs (6–9). We evaluated an HIV testing program that incorporated NAT, automated reporting of negative results, and direct contact tracing for positive results. Specific outcomes measured included additional yield of HIV cases, characteristics of persons with acute and early HIV infection, and uptake of automated reporting of negative HIV results.

Methods

Study Design, Setting, and Participants

This was a prospective study of an HIV testing program (the Early Test; www.theearlytest.ucsd.edu) that was designed to identify and stage HIV infection. Starting in February 2007, the Early Test program operated at HIV testing sites in San Diego County, including HIV testing sites for men who have sex with men (MSM) at the Lesbian, Gay, Bisexual, Transgender Center and the Gay Men's Health Clinic; the San Diego County Health Department; the University of California, San Diego (UCSD), Antiviral Research Center; and substance abuse treatment centers. During the study, the only social marketing was distribution of flyers at gay-oriented venues and printing advertisements in gay-oriented publications. Sites were instructed to offer study enrollment to anyone who presented for HIV testing. The staff at each site, after protocol training by UCSD Early Test personnel, obtained consent and performed procedures. Persons 18 years or older who presented for routine HIV testing and were able to give informed consent were offered enrollment in the Early Test program. From April 2008, participants were also offered an Internet-based survey after online retrieval of negative NAT results. Analyses represent testing until 1 January 2009. The study was approved by a local program for the protection of human research subjects.

Study Procedures

The Figure summarizes enrollment procedures. At enrollment, participants were provided standard HIV risk-reduction counseling, data were collected on reported HIV risk behaviors, point-of-care rapid HIV antibody testing (RT) was performed (Oraquick Advance rapid

HIV, Ora-Sure Technologies, Bethlehem, Pennsylvania), and RT results and posttest counseling were given by trained personnel. If the RT result was positive, a blood sample was collected and sent for confirmation by immunofluorescent assay (Fluorognost, Sanochemia, Stamford, Connecticut), viral load testing (Cobas Amplicor HIV-1 test, Roche Molecular Systems, Pleasanton, California), and a detuned HIV enzyme-linked immunoassay (EIA) (Vironostika LS EIA, bioMerieux, Durham, North Carolina) from February 2007 to August 2008 and Vitros LS EIA (Ortho-Clinical Diagnostics, High Wycombe, United Kingdom) from August 2008 to January 2009. If the RT result was negative, blood plasma was collected and sent to the American Red Cross for NAT by Procleix HIV-1/HCV Assay (Chiron, Emeryville, California, and Genprobe, San Diego, California) without pooling. We encoded NAT results by a unique identification number and sent them to Early Test staff by secure electronic data transfer. Patients with a negative RT result were told that if they were not contacted by Early Test staff within 2 weeks, they could call the Early Test voicemail number or log in to the Early Test Web site to retrieve their NAT results (only negative test results were posted to these systems). Patients were guided to enter a personal identification number twice to access an anonymous report of negative NAT status. We never communicated HIV antibody or positive NAT results over the Internet or through a voicemail system. If the NAT result was positive for HIV, then confirmatory testing was initiated with HIV viral load (Cobas Amplicor HIV-1 test). The patient was contacted by using information provided at the time of initial testing.

Data Collection and Analysis

Patients who were not offered the Early Test or who declined participation were not available for data analysis. During the pretest assessment, collected data included contact information, demographic characteristics, income, exposure risk categories, sexual behavior, recent diagnosis of sexually transmitted infections, and drug use. Risk behavior measures changed during the study because of changes in state reporting requirements. From February to October 2007, clients reported risk over the previous 3 months. From November to December 2007, clients reported risk since their last HIV test. From January 2008 to January 2009, clients reported risk over the past year. Risk factors for sexually transmitted infections and drug use were defined as being reported “any time” versus “none” or “not reported.” Number of sexual partners and condom use with anal sex were defined only for those who reported behavior in the past year. The Internet-based survey was available starting in April 2008 for clients retrieving their negative NAT results. Main questions about the Internet results system asked about the importance of the Early Test for the community (rated “not very important” to “very important”), personal Internet use (less than once a month to daily), and whether participants would refer someone to the Early Test program.

We analyzed HIV case finding by reported HIV risk, sex, ethnicity, and estimated duration of infection. Stage of HIV infection at diagnosis was defined as acute HIV infection when NAT results were positive and RT results were negative, consistent with an infection within 10 days (95% CI, 7 to 14 days) of testing (2); as early HIV infection when the RT results were positive with detuned EIA results, consistent with infection of less than 133 days (CI, 113 to 160 days) (10); and as chronic HIV infection when the RT results were positive with detuned EIA results, consistent with infection of greater than 133 days (10).

We analyzed persons who reported their sex and sexual orientation. Univariate analyses used the chi-square test for tables and dichotomous variables and univariate logistic regression for ordinal variables. The Fisher exact test was used for analyses with fewer than 5 observations in any 1 cell. For risk factors associated with acute and early HIV infection in MSM, variables known to be possible risk factors for HIV acquisition were analyzed in SAS, version 9 (SAS Institute, Cary, North Carolina), with exact multivariate logistic regression without selection methods by using LogXact procs (Cytel Software, Cambridge,

Massachusetts) for SAS to accommodate the smaller number of outcomes. This methodology restricts use of continuous covariates with many response levels. To minimize the number of covariates for the exact methods, we condensed some risk factors to clinically relevant binary outcomes for age younger than 45 years, white non-Hispanic race, and 10 or more sexual partners. Adjusted odds ratios were calculated for correlates with 95% CIs. We used SAS to do multivariate analysis without selection for predictors of not retrieving NAT results in logistic regression without selection. Response data from the satisfaction survey were analyzed by using descriptive statistics.

The cost of the program was estimated for the additional costs of the NAT, the additional laboratory staff, and the development of a functional Web site and maintenance of a voicemail system. The total cost of the program was then divided by the number of HIV cases found by NAT only to calculate the cost per additional HIV case identified by NAT.

Role of the Funding Source

This project was funded by the California HIV/AIDS Research Program and the National Institutes of Health. The funding sources did not have a role in the design, conduct, or analysis of the project.

Results

HIV Infections Detected

Data were cut off on 20 January 2009 and analyzed for all patients who been evaluated between 6 February 2007 and 1 January 2009. In this period, the total number of Early Test clients was 3344, and 3151 of these persons had complete data entry for test results, demographic characteristics, and risk behaviors. In these 3151 patients, 814 did not report income, and 85 had incomplete demographic information: 78 did not report ethnicity or race, 4 did not report age, and 4 did not report sex. Most Early Test clients were men ($n = 2563$), and most of these were MSM ($n = 1774$) (Table 1).

In these 3151 patients, 79 (2.5% [CI, 2.0% to 3.1%]) had newly diagnosed HIV infection. Of these 79 patients, 35 (44%) had acute and early HIV infection, and 44 (56%) had chronic HIV infection. Of the 35 patients with acute and early HIV, 15 (19% of all patients with HIV) had acute HIV infection (that is, positive NAT and negative RT results), and 20 had early HIV infection (positive RT and negative detuned EIA results). Use of nonpooled HIV NAT increased the overall yield of newly diagnosed HIV cases by 23%. The median viral load of the acute HIV infection detected was 127 000 copies/mL, with a range of less than 50 to 7 440 000 copies/mL, and the 5 cases with the lowest viral loads had 1340 or fewer copies/mL. The viral load of 1 patient with acute HIV infection was initially undetectable but reached the millions of copies/mL by the next week. One additional person who had positive NAT results initially but negative RT results later received a diagnosis of chronic infection on the basis of history, full evolution of the Western blot, positive serum EIA result, positive detuned EIA result, and an undetectable viral load. This person was a heterosexual man who tested with his female partner, who had positive RT and positive detuned EIA results. We suspected that these persons knew their HIV status and were receiving antiretroviral medication before testing and thus were not counted as having newly diagnosed HIV infection.

We found that MSM had the highest rate of overall HIV infection (4.1% infected of 1774 MSM [CI, 3.2% to 5.1%]) and NAT result positivity among persons with negative RT results (0.9% [CI, 0.5% to 1.4%]). A total of 1381 MSM enrolled while data were being collected on sexual risk factors in the previous year, with 1240 reporting insertive or receptive anal sex and 1369 reporting the number of male sexual partners. In the 1240

patients with responses for the previous year and data for all covariates, acute and early HIV infection was correlated in univariate analysis with a self-reported recent diagnosis of syphilis ($P = 0.044$), methamphetamine use ($P = 0.087$), and having 10 or more sexual partners in the past year ($P = 0.031$). After exact logistic regression, the strength of these associations became less significant, with an adjusted odds ratio for an association between acute and early HIV infection and syphilis of 3.8 (CI, 0.7 to 13.9) and between acute and early HIV infection and 10 or more male sexual partners of 2.8 (CI, 1.0 to 7.8). Other factors, such as unprotected anal sex, drug use, and race and ethnicity, were not significantly associated with acute and early HIV infection (Table 2).

During this 23-month study, the cost of laboratory and technician time for NAT was \$52 631, the cost of setting up the Web site that integrated data collection and of mediating Internet results was approximately \$100 000, and the cost of the voicemail system was \$11 500. Based on the total of these costs (\$164 131), the estimated cost per additional HIV case found by the NAT program was \$10 258.

Predictors of Receiving NAT Results

Of the 3070 clients who had negative results for HIV by RT and NAT, 2105 (69%) accessed their negative NAT results by either the Internet or the voicemail system (Table 3). The Internet was the first choice for 1358 clients (65%). However, 94 clients who first accessed their results by voicemail also accessed their results via the Internet later. Most people who accessed their results did so a median of 1 time but ranged up to 99 times, and repeated access was usually done via the Internet. An analysis of the predictors of retrieving negative NAT results was performed in 2264 patients who had data for all predictors. After adjustment for covariates, the retrieval of negative NAT results by either Internet or voicemail was more likely in persons reporting MSM behavior, higher incomes, younger ages, no residence at substance abuse rehabilitation centers, no recent syphilis diagnosis, and no methamphetamine use (Table 4). A similar analysis was also performed in 1631 persons who retrieved their result and had all data elements to predict use of the Internet rather than voicemail. Internet use was more likely in persons reporting MSM behavior, income greater than \$1000 a month, and age younger than 45 years. African-American clients were the least likely to use the Internet for retrieval of negative NAT results compared with all other racial and ethnic groups. Intravenous drug users and patients attending inpatient rehabilitation centers were both less likely to use the Internet.

All clients with positive NAT results were contacted by using information provided at the initial testing within 30 minutes to 1 week after their NAT results were received. Most clients with positive results received these results within 24 hours; 100% of these clients were referred to HIV care, and they all attended their first visit.

Client Satisfaction With the Early Test and Internet Reporting

Starting from April 2008, the Internet-based survey was completed by 239 clients who retrieved their negative NAT results on the Internet system during the availability of the survey, and 235 clients completed demographic questions on sex and sexual orientation. Of these 235 respondents, 208 were men and 178 reported having a male sexual partner in the past month. Of the 235 respondents, 232 (98.7%) said it was “very important” to have testing available for acute and early HIV infection, 161 (69%) said they had already referred someone else to the Early Test program, and all but 1 (99.5%) said they would refer someone in the future. Consistent with the survey being online, 219 (93%) of respondents reported using the Internet on a daily basis, and 204 (87%) reported that they were “comfortable” or “very comfortable” with retrieving their results on the Internet.

Discussion

The identification of persons recently infected with HIV (that is, acute and early HIV infection) by using NAT has been proposed and evaluated as a way to reduce the incidence of HIV infection; however, its utility may be limited by costs. The largest study of HIV NAT (6), performed in North Carolina, reported a 3.3% increase in the state budget for HIV-related services when HIV NAT was added to routine HIV screening. This translated to an additional \$3.63 per person tested and \$17 515 per HIV infection that would not otherwise be diagnosed. We built on these and other pioneering efforts (8,9) by evaluating the effectiveness of an HIV testing program (the Early Test) that incorporated NAT into an HIV testing platform to identify clients who have acute and early HIV infection. Between February 2007 and January 2009, the Early Test program found 15 cases of HIV infection that would have been missed by HIV antibody testing alone, increasing case yield by 23%. The cost of finding these additional HIV cases in the Early Test program was \$10 248 per case, including the costs of building and operating the Internet and voicemail systems. Although the North Carolina study used a pooled NAT platform to reduce costs and the Early Test program used a nonpooled NAT platform, the North Carolina program cost about \$7000 more per additional HIV case identified than the Early Test program. This cost difference probably reflects differing laboratory and reporting costs and that the Early Test program operated in a relatively higher-risk setting (HIV prevalence of testing population for the North Carolina program vs. Early Test program, 0.6% vs. 2.5%) (6).

A major advance in HIV testing has been the adoption of RT, in which the follow-up visit can be eliminated. Loss to follow-up is prevented, and instant posttest counseling is provided to patients (4,11–13). However, not all HIV testing programs offer RT, and programs that use NAT to detect acute HIV do not have an available point-of-care NAT test (8,9,14,15). Therefore, the Early Test program reported negative test results by using automated Internet and voicemail systems, consistent with the role of new technologies in the prevention of HIV and other sexually transmitted infections (16–25), which were acceptable to clients and had high uptake. Overall, 69% of Early Test clients retrieved their negative NAT results by either Internet or voicemail systems, even though Early Test staff told them that they would be contacted if their NAT results required follow-up and they all had already received a negative antibody result by RT. Barriers to retrieving HIV-negative results included recent history of syphilis, methamphetamine use, and drug rehabilitation—characteristics that may signify reduced health care-seeking behavior (26–29). Further studies are needed to learn whether structural (that is, access to computers) versus individual (that is, motivation or self-efficacy) factors influence access of results. The demographic factors of age older than 45 years, African-American race, and lower income (all of which have been previously associated with less Internet use [30,31]) were also barriers to Internet use and retrieving NAT results. In addition, some clients accessed their results multiple times, perhaps as a way to gain repeated reassurance, which would not be possible in a standard face-to-face posttest counseling session. Of note, we did not report HIV-positive results on the automated systems, and these results were provided only by a trained counselor in a face-to-face session, as recommended by the Centers for Disease Control and Prevention (4).

Another advance in HIV testing has been fourth-generation HIV assays, which include an antibody assay with detection of P24 antigen and can identify 62% to 94% of acute infections that would otherwise be detected only by NAT (32–34). Fourth-generation HIV assays will probably still miss some very early HIV infections when the infection has a low initial viral load (that is, <25 000 HIV RNA copies/mL) or when testing occurs during the window of infection between loss of P24 antigen in the blood and emergence of a positive antibody test result (32,34,35). Testing persons during this very early period who have

corresponding low viral loads may also cause cases to be missed when pooled NAT approaches are used, which is done to reduce overall testing costs (6). In fact, the non-pooling NAT strategy of the Early Test detected some very acute HIV infections ($n = 5$) with initial low viral loads (1340, 1200, 544, 540, and <50 copies/mL) and that may not have been detected by pooled NAT or fourth-generation HIV assays. A comparative analysis of pooled and nonpooled NAT programs and fourth-generation HIV assays will probably be needed to better evaluate the cost and effectiveness of each strategy, and these outcomes may also differ depending on the testing setting (that is, high-risk vs. low-risk groups). Testing algorithms that incorporate more sensitive assays, like fourth-generation HIV assays or NAT, should become the standard of care because they are more effective at diagnosing HIV cases compared with oral RT alone (36).

A potential limitation of this study is whether our findings can be generalized to other populations and testing programs. San Diego is similar to many urban settings, particularly in the western United States, where MSM are the main risk group for HIV. The behavior reported in our study was consistent with population surveys of MSM in California (37,38). Other urban-based HIV testing programs that integrated HIV NAT for high-risk populations should see similar results. Despite these limitations, this study should motivate further research into the use of NAT in HIV testing programs with measurement of cost-effectiveness and prevention of HIV transmission.

Context

Community-based HIV testing programs generally use only HIV antibody testing. Nucleic acid testing (NAT) can detect the presence of HIV earlier than antibody testing.

Contribution

In an HIV testing program that incorporated NAT and automated reporting of negative NAT results, nearly one quarter of persons with identified cases had positive results only by NAT testing. More than two thirds of clients with negative NAT results retrieved them via the Internet or voicemail.

Caution

The study focused on urban clinics serving men who have sex with men. Findings may not be applicable to populations with lower HIV prevalence or less use of automated technologies.

Implication

Addition of NAT to HIV antibody testing in community-based programs may significantly improve case yield. Automated reporting of negative results may prove to be an acceptable alternative to face-to-face reporting.

—The Editors

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EIA = enzyme-linked immunoassay; HCV = hepatitis C virus; ID = identification; IFA = immunofluorescent assay; NAT = nucleic acid test. RT = rapid test.

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Table 1

Demographic Characteristics of 3151 Early Test Clients in San Diego*

Characteristic	Men Who Have Sex With Women	Women Who Have Sex With Men	Men Who Have Sex With Men
Total, n	789	575	1774
Age group, n (%)			
≤24 y	141 (18)	118 (21)	289 (16)
25–34 y	225 (29)	192 (33)	664 (37)
35–44 y	211 (27)	121 (21)	524 (30)
≥45 y	212 (32)	144 (25)	297 (17)
Race/ethnicity, n (%)			
Asian/Pacific Islander/Hawaiian	30 (4)	25 (4)	120 (7)
Hispanic	226 (29)	180 (31)	441 (25)
White	407 (52)	261 (45)	1029 (58)
African American	89 (11)	63 (11)	78 (4)
Other	30 (4)	40 (7)	98 (6)
Monthly income, n (%)			
<\$1000	201 (38)	217 (64)	248 (17)
\$1000–\$3999	138 (26)	96 (28)	754 (52)
≥\$4000	138 (26)	27 (8)	458 (31)
HIV infection detected by rapid test or NAT, n (%)[†]	4 (0.6)	2 (0.3)	72 (4.1)
Persons with HIV infection detected by NAT only, n (%)	0 (0)	0 (0)	15 (21.0)
Persons with acute and early HIV infection, n (%)	1 (20.0)	1 (33.3)	33 (46.0)

NAT = nucleic acid test.

* Does not include 9 transgender persons (1 with chronic HIV infection) and 4 persons with no specified sex.

[†] Newly diagnosed HIV. NAT only = positive NAT and negative enzyme-linked immunoassay results; acute and early HIV infection = positive NAT results only and positive detuned enzyme-linked immunoassay results consistent with HIV infection of less than 133 d.

Table 2Factors Associated With Acute or Early HIV Infection in Men Who Have Sex With Men^{*}

Predictor	Total Persons, <i>n</i> (%)	Persons With Acute and Early HIV Infection, <i>n</i> (%)	Adjusted Odds Ratio (95% CI)	<i>P</i> Value
Total participants	1240 (100)	19 (1.5)		
Age				
≤44 y	1054 (85)	18 (1.7)	4.2 (0.6–176.5)	0.214
≥45 y	186 (15)	1 (0.5)		
Race				
Non-Hispanic white	719 (58)	11 (1.5)	1.0 (0.4–2.7)	1.000
Nonwhite or Hispanic	521 (42)	8 (1.5)		
Syphilis				
Syphilis with or without chlamydia or gonorrhea	53 (4)	3 (5.6)	3.8 (0.7–13.9)	0.127
No syphilis, chlamydia, or gonorrhea	1187 (96)	16 (1.3)		
Drug use				
Methamphetamine	119 (10)	4 (3.4)	1.2 (0.3–4.8)	0.954
No methamphetamine	1121 (90)	15 (1.3)		
Other drugs [†]	232 (19)	5 (2.2)	1.0 (0.3–3.4)	1.000
No other drugs	1008 (81)	14 (1.4)		
Condom use[‡]				
Never or sometimes	787 (63)	13 (1.7)	1.3 (0.5–4.0)	0.737
Usually or always	453 (37)	6 (1.3)		
Male sexual partners[‡]				
≥10	428 (35)	11 (2.6)	2.8 (1.0–7.8)	0.040
0–9	812 (65)	8 (1.0)		

* Predicting acute or early HIV infection (i.e., <133-d duration of infection) compared with persons who are HIV-uninfected in exact multivariate logistic regression. All variables are self-reported for the previous year.

[†] Cocaine, crack, heroin, γ -hydroxybutyrate, ketamine, nitrates, and ecstasy (not alcohol or marijuana).

[‡] In either receptive or insertive anal sex.

Table 3

Use of the Internet or Voicemail for Receiving HIV Testing Results*

Characteristic	Men Who Have Sex With Women	Women Who Have Sex With Men	Men Who Have Sex With Men
Total, <i>n</i>	784	572	1702
Persons who accessed NAT results, <i>n</i> (%)			
Accessed	441 (56)	243 (42)	1411 (83)
Did not access	343 (44)	329 (58)	291 (17)
Persons who used either system first, <i>n</i> (%)			
Internet	230 (52)	85 (35)	1036 (73)
Voicemail	211 (48)	158 (65)	375 (27)
Persons who used either system at least once, <i>n</i> (%)			
Internet	252 (57)	88 (36)	1106 (78)
Voicemail	246 (56)	167 (69)	462 (33)
Median uses of either system (range), <i>n</i>			
Internet	2 (1–73)	1 (1–13)	1 (1–58)
Voicemail	1 (1–55)	1 (1–12)	1 (1–26)
Median total times a system was accessed (range), <i>n</i>	1 (1–99)	1 (1–14)	1 (1–65)

NAT = nucleic acid test.

* Does not include 8 transgender HIV-uninfected persons and 4 persons with no specified sex. All numbers out of 3070 total persons with negative HIV results by rapid test who would be eligible to receive NAT results.

Table 4

Factors Associated With Retrieving Negative Nucleic Acid Testing Results by the Internet or Voicemail*

Predictor	Retrieved Result	Adjusted Odds Ratio (95% CI)	P Value
Total, n (%)[†]	1631 (72)		
Sexual partner, n (%)			
Women who have sex with men	152 (45)	Referent	Referent
Men who have sex with women	320 (61)	1.3 (0.9–1.7)	0.146
Men who have sex with men	1159 (83)	2.0 (1.4–2.8)	<0.001
Age, n (%)			
<25 y	252 (70)	1.3 (0.9–1.8)	0.150
25–34 y	590 (75)	1.4 (1.1–1.9)	0.013
35–44 y	460 (73)	1.3 (1.0–1.7)	0.074
≥45 y	329 (67)	Referent	Referent
Monthly income, n (%)			
<\$1000	345 (53)	Referent	Referent
\$1000–\$4000	769 (77)	1.2 (1.0–1.6)	0.097
>\$4000	517 (84)	1.7 (1.3–2.4)	<0.001
Race/ethnicity, n (%)			
Asian/Pacific Islander/Hawaiian	100 (78)	1.1 (0.6–1.9)	0.92
Hispanic	401 (71)	1.0 (0.7–1.6)	0.94
White	941 (73)	1.1 (0.7–1.6)	0.85
African American	97 (66)	Referent	Referent
Other	92 (71)	1.0 (0.6–1.8)	0.99
Sexually transmitted infections, n (%)			
Any syphilis	31 (57)	0.4 (0.2–0.8)	0.004
Any chlamydia or gonorrhea	106 (70)	0.8 (0.5–1.2)	0.21
Drug use, n (%)			
Methamphetamine	187 (47)	0.7 (0.5–1.0)	0.057
Cocaine/crack	162 (57)	0.8 (0.6–1.1)	0.26
Other club drug [‡]	171 (73)	1.0 (0.7–1.5)	0.85
Heroin	20 (25)	0.5 (0.2–0.9)	0.018

Predictor	Retrieved Result	Adjusted Odds Ratio (95% CI)	P Value
Any intravenous drug use	46 (35)	0.9 (0.5–1.5)	0.62
Testing site, n (%)[§]			
Inpatient rehabilitation	163 (36)	0.3 (0.2–0.4)	<0.001

* Predicting the retrieval of HIV-negative nucleic acid test results via voicemail or Internet at least once compared with persons who never retrieved results by either method.

[†] Out of 2264 persons.

[‡] γ -Hydroxybutyrate, ketamine, nitrates, and ecstasy.

[§] Inpatient substance abuse rehabilitation center compared with other HIV testing sites.