Published in final edited form as:

Sex Transm Dis. 2010 December ; 37(12): 756–763. doi:10.1097/OLQ.0b013e3181e3d771.

Internet-based Screening for Sexually Transmitted Infections To Reach Nonclinic Populations in the Community: Risk Factors for Infection in Men

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Abstract

Background—Internet-based screening for sexually-transmitted infections (STIs) has been acceptable to women, and can reach high-risk populations. No prior literature describes internet-based screening for *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, and *Trichomonas vaginalis* in men. We studied whether internet-based screening was acceptable and reached a high-risk population, and what risk factors were associated with STI positivity.

Methods—The website, www.iwantthekit.org, encouraged men ≥ 14 years of age to request a home self-sampling kit and a questionnaire on risk factors and acceptability of internet-based screening. Penile swabs and urine samples were tested for *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, and *Trichomonas vaginalis* using a nucleic acid amplification test. Risk factors and acceptability were examined using chi-squared tests and logistic regression.

Results—Of 501 samples received for testing, 106 (21%) were positive for at least one STI, 64 (13%) for chlamydia, 4 (1%) for gonorrhea, and 49 (10%) for trichomonas. In multivariable analyses, age, race, household income, and frequency of condom use were independently associated with infection with at least one STI. Of respondents, 34% had a prior STI; 29% reported having a partner with an STI, but only 13% reported always using a condom. Seventy-seven percent of men preferred a self-administered specimen versus attending a clinic, 89% reported swab use was easy, and 89% would use internet-based screening again.

Conclusions—Men who access internet-based screening had known risk factors for STIs and had a high prevalence of infection. Internet-based screening was acceptable and could access these high-risk men, who might not otherwise be reached through traditional means.

Keywords

Sexually-transmitted infections; screening; internet; males; chlamydia; gonorrhea; trichomonas; NAATs

Introduction

Over 1.1 million cases of *Chlamydia trachomatis* and over 300,000 cases of *Neisseria gonorrhoeae* infection were reported nationwide in 2007, making chlamydia and gonorrhea the two most commonly reported infectious diseases in the United States ¹. These infections can lead to severe consequences. Pelvic inflammatory disease occurs in up to 40% of untreated women ², which can result in infertility, ectopic pregnancy, and chronic pelvic pain ¹. Chlamydial infection can also result in male infertility ³. Because chlamydial infections are usually asymptomatic, less than half of active infections are diagnosed ⁴. Both chlamydia and gonorrhea increase risk of human immunodeficiency virus (HIV) transmission ⁵.

Trichomonas vaginalis is the most prevalent non-viral sexually transmitted infection (STI) nationwide; approximately 8 million cases occur per year ⁶. *Trichomonas* infection can cause pregnancy complications ⁷ in women. *Trichomonas* infection increases the odds of HIV infection ^{8,9}, and can cause pelvic inflammatory disease in HIV-infected women ⁶. Up to one-third of infected women and most of infected men are asymptomatic ⁶.

Asymptomatic men increase the burden of STI sequelae in their female partners and screening specific high risk men can be cost-effective ¹⁰. Screening of sexually active women under age 26 has been recommended since 1993 ¹¹, but no guidelines for screening men exist. Some guidance documents support screening certain high-risk men ¹².

STI screening can reduce STI sequelae, including pelvic inflammatory disease, by 60% ¹³, but certain high risk groups such as young adults aged 15–24 face significant barriers to screening. Lack of transportation, cost, and confidentiality issues impede access to screening and treatment ^{14,15}.

A novel internet-based screening program targeting women began in 2004 ^{16,17}, which bypassed barriers to screening and accessed hard-to-reach high-risk women. Women found internet-based screening acceptable and self-collection of specimens preferable ¹⁴. Since September 2006, a new program began which targeted men. Because no prior literature exists on using internet-based screening in men for three prevalent STIs, we studied whether this method of screening was acceptable to men, whether internet-based screening reaches a high-risk population, and identified demographic and sexual behavior risk factors that place this population at risk for STIs.

Materials and Methods

We provided free kits, testing, and treatment to men ≥ 14 years, who resided in Baltimore (Maryland), Maryland (outside Baltimore), the District of Columbia (DC), West Virginia, selected counties of Illinois, and Denver (Colorado). We advertised the study through flyers in schools, hospitals, and the community, and through local radio station announcements. The institutional review boards of Johns Hopkins University, Baltimore City Health Department, and the State of Maryland approved the study for all study sites. Written collection instructions and diagrams showing how to collect the sample, were included in the kits and shown on the website.

Website Design and Development

The www.iwantthekit.org website for female screening was expanded to include a section for men (Fig. 1). Linked pages covered educational topics, written at an 8th-grade reading level, about STIs, testing, and treatment. A link initiated a confidential e-mail request for a kit, which was mailed by the study coordinator to a requestor's address.

Components of the Self-Collected Urine and Urethral Swab Kit

Pre-numbered kits included instructions, a male flocked swab (FS) (Copan Diagnostics, Inc., Murrieta, CA) ¹⁸, GenProbe (GenProbe, Inc., San Diego, CA) transport media in a Copan UriSwab urine collection kit, a contact form, a questionnaire, two consent forms, and a postage-paid return mailer. Participants were asked to complete the contact form as a reminder method in case a participant forgot to call for his results, which also collected basic demographic information without identifiers. Participants were instructed to both self-collect the penile swab by following the included male anatomy diagram for self-sampling the penile urethra and place it in the GenProbe specimen transport tube, and self-collect a urine sample on the Copan sponge-on-a-shaft and place it in another GenProbe transport tube. Participants were then asked to seal both transport tubes in plastic biohazard bags, and mail them to the laboratory in the provided envelope along with dated consent form, contact form, and completed questionnaire with the kit number.

Laboratory Methods

Urine and penile Copan swabs were tested by transcription-mediated amplification (TMA) (Gen Probe APTIMA Combo 2 [AC2], San Diego, CA), an FDA-approved nucleic acid amplification test for screening male urine and urethral samples for gonorrhea and chlamydia ¹⁹. Samples were also tested for trichomonas by an analyte specific reagent TMA (GenProbe), which has been verified against previously validated real-time PCR for trichomonas ^{20, 21}. For each STI, participants were considered positive if the urine sample was positive or if a positive penile sample was also positive on a confirmatory test using different NAAT primers for the organism.

Results and Treatment

When a participant called the toll-free number for results, he was required to give his kit number and password. The project coordinator helped infected men select a treatment clinic; results were faxed to the clinic and an appointment was scheduled. The coordinator contacted the clinic later to verify treatment. Contact form data were used to provide information for those men who forgot to call.

Cohort

Participants were included if they submitted a sample for testing and a signed consent form. Questionnaire submission was optional; those without a returned questionnaire had their questionnaire responses treated as missing data.

Statistical Analysis

Outcome was STI positivity, coded as a binary variable. Participants with a positive test result by either urine or penile swab for any one of chlamydia, gonorrhea, or trichomonas were considered positive for an STI. Participants with negative test results by urine and swab for all three STIs were considered negative. For bivariate analyses, all variables were treated as categorical variables, and dummy variables were used as needed. STI positivity was regressed on demographic and risk factor variables using logistic regression to determine unadjusted odds ratios.

Multivariable logistic regression was conducted using the *a priori* plausible risk factors age, race, and geographic location identified in the literature²², and also risk factors associated with the outcome in bivariate analyses with $p \leq 0.20$. For the multivariable model, age and age at first sex were entered as continuous variables. STI positivity was regressed on these risk factors to determine adjusted odds ratios. Interactions between risk factors were examined, and a parsimonious model with all predictors having a $p < 0.05$ was selected by lowest Akaike's information criteria²³ score. Goodness of model fit was tested using the Hosmer-Lemeshow method²⁴. Statistical analyses were performed using the software package Stata, version 10.1 (College Station, TX). P values of < 0.05 were considered significant.

Results

Kits Received for Testing

Between September 2006 and May 2009, 1644 male kits were requested online and 512 (31%) were returned for testing. Of the kits returned, six were missing signed consent forms, two kits were received from outside states, and three participants who were tested reported no prior sexual activity. These were therefore excluded from analyses, leaving 501 (98%) men for this study.

Demographic characteristics

Of the 501 participants in this study, 476 (95%) returned questionnaires. All questions had $\leq 10\%$ missing responses, except for presence of symptoms, prior use of internet-based screening, and prior testing for an STI (11–13% missing). Of the participants, 45% were black, 47% white, 2% Asian, and 6% other (Table 1); 93% were non-Hispanic. The median reported age was 24.5 (inter-quartile range 21–30) and the vast majority were single (84%). Over 75% of participants were from the Maryland-DC metropolitan area (Baltimore, Maryland outside Baltimore, District of Columbia, and West Virginia), since Illinois and Denver were added later in the program.

More than half of participants earned between \$10,000–\$49,999 (55%), and had current health insurance coverage (53%). Approximately one-third had at least a high school education (31%) or some college (31%), and one-quarter had at least a bachelor's degree (25%).

Results of Testing

Of the 501 men, 106 (21%) tested positive for at least one of *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, or *Trichomonas vaginalis* (Table 1). Of the 106 men who tested positive, 64 (13%) tested positive for chlamydia, 4 (1%) for gonorrhea, and 49 (10%) for trichomonas; nine men (8%) tested positive for chlamydia and trichomonas, and one man (1%) tested positive for all three. Men who tested positive for any STI were significantly more likely to report one or more symptoms ($p=0.003$), penile discharge ($p<0.001$), pain during urination ($p=0.049$), and penile itching ($p=0.032$). Chlamydia positivity varied by location; the highest prevalence was in Baltimore (18%), followed by Denver (17%), Maryland (13%), DC (8%), Illinois (7%), and West Virginia (2%). Penile swab sensitivity was higher than urine for both chlamydia (93% versus 78%) and trichomonas (82% versus 40%). All men testing positive for any STI were treated except one (99% treated). Time from sample collection to testing did not exceed the manufacturer's package insert recommendation for any of the samples.

Risk Factors for Infection

In bivariate analyses, race, geographic location, lower income, and lack of condom use were significantly associated with STI positivity (Table 2). Alcohol use before sex was associated with STI negativity. Black and “other” races, had 2.60 (95% CI 1.57–4.32) and 3.16 (95% CI 1.25–7.97) times greater odds of STI positivity compared to whites, respectively. Men from Maryland (OR 10.88, 95% CI 1.46–81.1), Baltimore City (OR 19.61, 95% CI 2.57–149.8), Illinois (OR 13.53, 95% CI 1.65–110.8), and Denver (OR 16.51, 95% CI 2.08–131.3) had significantly higher odds of STI positivity compared to West Virginia (Table 2). Less condom use and lower income were both associated with increasing odds of STI positivity. More men with multiple or new partners, and men who had sex with men, used condoms “Most of the time” and fewer used condoms “Never” as compared to men without these risk factors ($p \leq 0.01$). Prior treatment for an STI was not associated with STI positivity or condom use.

In multivariable analyses, age, race, and income were significantly associated with STI positivity after controlling for other factors in the model (Table 3). For every five year increase in age, odds of STI positivity decreased by 38% (95% CI 9%–57%). Compared to white, black and “other” races had 2.87 (95% CI 1.52–5.42) and 3.96 (95% CI 1.36–11.59) times greater odds of STI positivity, respectively. Compared to participants from West Virginia, men from Baltimore (OR 11.23, 95% CI 1.36–93.0), Illinois (OR 9.96, 95% CI 1.15–86.1), and Denver (OR 14.20, 95% CI 1.61–125.2) had significantly higher odds of STI positivity. A trend of lower income was significantly associated with higher risk of STI positivity, except for participants making $> \$100,000$.

Lack of condom use was also significantly associated with STI positivity. A trend in increased STI positivity was noted with decreased condom use, and men who reported never using condoms had 4.96 (95% CI 1.76–13.95) times greater odds of STI positivity.

Acceptability of Internet-based Screening

Most STI-negative (78%) and STI-positive (72%) participants preferred a self-administered specimen versus one conducted at a clinic (overall $p=0.283$). Both groups reported that penile swabs were safe (STI-negative 87%, STI-positive 84%, $p=0.806$) and very easy or easy to use (STI-negative 90%, STI-positive 87%, $p=0.368$). Although 12–14% of men had used internet-based screening previously, most had not (STI-negative 88%, STI-positive 86%, $p=0.739$). The vast majority in both groups stated they would use internet-screening again (STI-negative 90%, STI-positive 88%, $p=0.565$).

Discussion

To our knowledge, we report here the first internet-based screening program for three prevalent STIs in men. A prior report demonstrated that internet-based screening was feasible in low-risk men (chlamydia prevalence 4%)²⁵, but did not include gonorrhea or trichomonas, two highly prevalent STIs. As more individuals access the internet to obtain health information, conduct health transactions, and find sex partners, integrating testing of prevalent STIs into this medium may be increasingly important²⁶.

Similar to internet-based screening in women, internet-based screening in men also reached very high-risk men with a high prevalence of STIs (21%). Prevalence of chlamydia (13%) was greater than in high-risk men across the United States, including incarcerated young men (6.8–7.9%)^{22, 27} and male youth in inner-city schools (7.5–10.1%)^{15, 28}. Men in certain urban areas in this study, including Baltimore and Denver, had chlamydia prevalence (18% and 17%, respectively) equal to or higher than high-risk men in STI clinics²⁹.

Prevalence of trichomonas (10%) was only slightly higher in STI clinics (12–13%)^{29, 30}. Although gonorrhea prevalence (0.8%) was much higher in STI clinics (12.8%)³⁰, our prevalence was similar in community-dwelling men in the highest risk age-group nationwide (0.45%, ages 20–24). The lower prevalence of gonorrhea versus reported symptoms suggests we reached mostly high-risk, asymptomatic men, because in men gonorrhea is most often symptomatic, which leads them to be tested. Prevalence of co-infection with chlamydia was similar in female patients in emergency departments (8%)³¹.

In this study, men also had a high prevalence of prior STIs (34%). Although 29% of men reported having a partner who has had an STI, only 11% of those men reported always using a condom during sex, two synergistic high-risk behaviors. More than half of men reported a recent new partner and more than a third reported multiple partners in the past three months.

Certain demographic characteristics were associated with STI positivity. From STI surveillance data, males in their late teen-early 20s have the highest prevalence of chlamydia and gonorrhea¹, which is consistent with our finding that age was independently associated with STI positivity. After controlling for income, location, and age, and examining factors such as perceptions of testing confidentiality and insurance status, which can affect healthcare access³², Black Race was associated with increased STI prevalence, which is consistent with prior studies^{22, 27}. However, previously reported unmeasured factors, including perceptions of discrimination, lack of perception of risk, unavailability of services, and healthcare staff prejudices³², might help to partially explain this association.

Although few men reported race as “other”, those men had very high odds of STI positivity. The public health impact of this finding is unclear. Although smaller studies have not shown an association between poverty and STI prevalence³³, results from larger nationwide studies³⁴ agree with our finding that income is independently associated with STI positivity. The observed dose-response relationship of increased STI prevalence with decreased income provides greater evidence for this association. Not surprisingly, STI prevalence varied by geographic location, which has been previously reported¹.

Certain risk behaviors were also associated with STI positivity. As expected³⁵, lack of consistent and correct condom use was associated with increased STI positivity in a dose-response relationship, and the magnitude of the association (odd ratio 4.96 for the “Never” use category) is convincing of the efficacy of condoms against STI transmission. However, several known behavioral risk factors were not associated with STI positivity in our study, including multiple or new sex partners³⁶, male-to-male sex¹, and prior STIs¹⁰. The lack of association between increased STI positivity and these risk factors might be largely explained by condom use. Men with multiple or new partners, and men who had sex with men, reported using condoms significantly more frequently than those who did not report these risk factors. No association between prior STIs and STI positivity was found in this study; the other study examining internet-based testing found a similar lack of association²⁵.

Men who submitted a sample found internet-based screening acceptable. Penile swabs were perceived as safe, and the vast majority of men rated swabs as “Very easy” or “Easy” to self-collect. Seventy-seven percent of men preferred a self-administered STI specimen, suggesting that internet-based screening might capture a population that would otherwise not be tested. Importantly, the vast majority of men who submitted a sample would use internet-based screening again, suggesting its high overall acceptability. Although our study had a high return rate (31%) of samples for an internet-based service, the acceptability for men who did not submit a sample is unknown.

Internet-based screening, especially if provided free of charge, may overcome barriers to STI testing for multiple high-risk populations who might not otherwise be tested. Over 45% of the men accessing internet-based screening had no health insurance, a known barrier to STI testing³². Youth can lack money and fear breach of privacy. Youth comprised 11% of men who accessed internet-based screening and 70% of participants felt internet-based screening was private. Low-income Blacks, an underserved population for STI screening³², were reached in large proportions. Screening for STIs can be cost-effective in high-risk men³⁷, and the prevalence of chlamydia in this study (13%) was even higher than in high-risk groups (2.3%–3.2%). Self-testing costs appear to be lower than clinic testing costs, even accounting for partial kit return rates. Using estimated indirect costs for clinic testing of chlamydia and gonorrhea (\$62/visit³⁸), provider costs (\$25/visit), direct costs for testing in our laboratory (\$30/test), direct costs of our mailed kits (\$10/kit), and the 31% kit return rate, we estimated total costs for clinic testing to be \$117/test, and for self-testing, \$62/test. We estimated self-testing yielded a net savings of \$55/test.

Several limitations to our findings exist. Because internet-based screening was voluntary and is inherently targeted to individuals who use the internet, self-selection might have biased the results. Men who use the internet to find sex partners³⁹ are at higher risk for having an STI, which might have led to false associations. However, this effect was likely minimal, because risk factors reported in this study are well-established. In fact, a newer report suggests no association between having sex partners found on the internet and STI prevalence²⁶, perhaps because internet use for all types of activities, including finding sex partners, has become normalized across many populations. Because risk factors were self-reported, recall difficulties might have introduced reporting errors. While some data were missing, their effect was likely minimal because few (9%) individuals were excluded in the final multivariable model.

Lack of access to computers due to low income and low educational level could challenge the effectiveness of internet-based screening. However, recent evidence suggests most adults living in public housing have access to a computer, and disparities are narrowing⁴⁰. Although internet-based screening for STIs such as syphilis and HIV cannot be easily be conducted, these STIs are far less prevalent nationwide than chlamydia, gonorrhea, and trichomonas.

AC2 TMA testing was recently reported to have less sensitivity for chlamydia and gonorrhea in self-collected glans specimens⁴¹. However, AC2 testing was more sensitive in male penile swabs in our study compared to first-catch urine. We do not have an explanation for these differences. Additional characterization of AC2 performance in male penile and glans swabs is needed.

Internet-based screening can reach a high-risk population for STI testing and treatment. Risk factors for STIs in this population reflect known STI risk factors. Because persons at greatest risk for STIs face barriers and have a high preference for self-testing, internet-based screening has the potential to reach populations which might not otherwise access STI testing. While internet-based screening is likely cost-saving, detailed, additional cost effectiveness studies will be needed and certain measures, such as implementation of secure web-based result notification, could increase efficiency. With additional data in this nascent area, more data might provide further clarification on the role of STI screening in men to inform future guidelines. In an era of healthcare reform and transition, internet-based services could provide additional options to provide low-cost, accessible healthcare.

Acknowledgments

Sources of support: NIBIB, NIH U54-EB007958

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Figure 1.
Homepage of www.iwantthekit.org.

Table 1

Basic demographic characteristics, reported symptoms, and screening results – Internet-based screening cohort of men (N=501).

Risk factor	Characteristic	n (%)
Age (years)		
	15–19	55/486 (11)
	20–24	188/486 (39)
	25–29	108/486 (22)
	≥30	135/486 (28)
Race [§]		
	Caucasian	219/468 (47)
	African American	209/468 (45)
	Asian	9/468 (2)
	American Indian/Alaskan Native	1/468 (0)
	Native Hawaiian/Pacific Islander	4/468 (1)
	Other	26/468 (6)
Ethnicity		
	Non-Hispanic	431/463 (93)
	Hispanic	32/463 (7)
Marital status		
	Single	390/463 (84)
	Married	39/463 (8)
	Separated	13/463 (3)
	Divorced	21/463 (5)
State [§]		
	West Virginia	47/473 (10)
	Maryland	230/473 (49)
	Baltimore	87/473 (18)
	District of Columbia	12/473 (3)
	Illinois	44/473 (9)
	Denver	53/473 (11)
Income [§]		
	<\$10,000	68/462 (15)
	\$10,000–\$49,999	252/462 (55)
	\$50,000–\$99,999	82/462 (18)
	>\$100,000	12/462 (3)
	Not sure	48/462 (10)
Health insurance		
	Without insurance	210/449 (47)
	With insurance	239/449 (53)
Education		
	Less than high school	22/455 (5)

Risk factor	Characteristic	n (%)
	High school	143/455 (31)
	Community college	61/455 (13)
	Some college	80/455 (18)
	Bachelors	85/455 (19)
	Masters	26/455 (6)
	Doctoral	5/455 (1)
	Other	33/455 (7)
Symptoms (one or more) [‡]		
	Any ^{§§}	171/447 (38)
	Penile discharge [§]	59/447 (13)
	Pain/burning during urination [§]	59/447 (13)
	Penile itching [§]	57/447 (13)
	Penile rash/ulcers/sores	30/447 (7)
	Pain during intercourse	12/447 (3)
	Groin or testes pain	51/447 (11)
	None [§]	276/447 (62)
Infection type		
	Any STI [†]	106/501 (21)
	<i>Chlamydia trachomatis</i>	64/501 (13)
	<i>Neisseria gonorrhoeae</i>	4/501 (1)
	<i>Trichomonas vaginalis</i>	49/501 (10)

* χ^2 test

[†] Sexually Transmitted Infection

[‡] Symptom prevalence by STI status

[§] p<0.05

Table 2

Bivariate logistic regression of sexually transmitted infection status on risk factors for infection – Internet-based screening cohort of men (N=501).

Risk factor	Characteristic	STI negative [†] prevalence by risk factor (%)	STI positive [†] prevalence by risk factor (%)	Unadjusted OR for STI positivity (95% CI)
Age (years)				
	15–19	44/55 (80)	11/55 (20)	Ref.
	20–24	137/188 (73)	51/188 (27)	1.49 (0.71–3.10)
	25–29	89/108 (82)	19/108 (18)	0.85 (0.37–1.95)
	≥30	117/135 (87)	18/135 (13)	0.62 (0.27–1.41)
Race [§]				
	White	192/219 (88)	27/219 (12)	Ref.
	Black [§]	153/209 (73)	56/209 (27)	2.60 (1.57–4.32)
	Asian	8/9 (89)	1/9 (11)	0.89 (0.11–7.39)
	American Indian/Alaskan Native	1/1 (100)	0/1 (0)	0.00 (0.00)
	Native Hawaiian/Pacific Islander [§]	2/4 (50)	2/4 (50)	7.11 (0.96–52.60)
	Other [§]	18/26 (69)	8/26 (31)	3.16 (1.25–7.97)
Ethnicity				
	Hispanic	344/431 (80)	87/431 (20)	Ref.
	Non-Hispanic	25/32 (78)	7/32 (22)	1.11 (0.46–2.64)
Marital status				
	Single	302/390 (77)	88/390 (23)	Ref.
	Married	33/39 (85)	6/39 (15)	0.62 (0.25–1.54)
	Separated	12/13 (92)	1/13 (8)	0.29 (0.04–2.23)
	Divorced	20/21 (95)	1/21 (5)	0.17 (0.02–1.30)
State [§]				
	West Virginia	46/47 (98)	1/47 (2)	Ref.
	Maryland [§]	186/230 (81)	44/230 (19)	10.88 (1.46–81.1)
	Baltimore [§]	61/87 (70)	26/87 (30)	19.61 (2.57–149.8)
	District of Columbia	11/12 (92)	1/12 (8)	4.18 (0.24–72.2)
	Illinois [§]	34/44 (77)	10/44 (23)	13.53 (1.65–110.8)
	Denver [§]	39/53 (74)	14/53 (26)	16.51 (2.08–131.3)

Risk factor	Characteristic	STI negative [†] prevalence by risk factor (%)	STI positive [†] prevalence by risk factor (%)	Unadjusted OR for STI positivity (95% CI)
Income [§]	<\$10,000	45/68 (66)	23/68 (34)	Ref.
	\$10,000–\$49,999 [§]	198/252 (79)	54/252 (22)	0.53 (0.30–0.96)
	\$50,000–\$99,999 [§]	74/82 (90)	8/82 (10)	0.21 (0.09–0.51)
	>\$100,000	11/12 (92)	1/12 (8)	0.18 (0.02–1.46)
	Not sure	38/48 (79)	10/48 (21)	0.51 (0.22–1.22)
Health insurance	With	162/210 (77)	48/210 (23)	Ref.
	Without	195/239 (82)	44/239 (18)	0.76 (0.48–1.21)
Education	Less than high school	17/22 (77)	5/22 (23)	Ref.
	High school	107/143 (75)	36/143 (25)	1.14 (0.39–3.32)
	Community college	47/61 (77)	14/61 (23)	1.01 (0.32–3.24)
	Some college	59/80 (74)	21/80 (26)	1.21 (0.40–3.69)
	Bachelors	74/85 (87)	11/85 (13)	0.51 (0.16–1.65)
	Masters	25/26 (96)	1/26 (4)	0.14 (0.01–1.27)
	Doctoral	5/5 (100)	0/5 (0)	0.00 (0.00)
	Other	27/33 (82)	6/33 (18)	0.76 (0.20–2.87)
Age had first sex (years) [§]	5–9	5/7 (71)	2/7 (29)	Ref.
	10–14	80/108 (74)	28/108 (26)	0.88 (0.16–4.77)
	15–19	239/295 (81)	56/295 (19)	0.59 (0.11–3.10)
	20–24	31/33 (94)	2/33 (6)	0.16 (0.02–1.42)
	25–29	5/5 (100)	0/0 (0)	0.00 (0.00)
Partners	None	6/6 (100)	0/0 (0)	0.00 (0.00)
	1	93/116 (80)	23/116 (20)	Ref.
	2–4	182/224 (81)	42/224 (19)	0.93 (0.53–1.64)
	5–9	56/79 (71)	23/79 (29)	1.66 (0.85–3.23)
	10–15	17/19 (89)	2/19 (11)	0.48 (0.10–2.21)

Risk factor	Characteristic	STI negative [†] prevalence by risk factor (%)	STI positive [†] prevalence by risk factor (%)	Unadjusted OR for STI positivity (95% CI)
	>16	14/18 (78)	4/18 (22)	1.16 (0.35–3.84)
New partner within past 3 months	No	178/225 (79)	47/225 (21)	Ref.
	Yes	191/238 (80)	47/238 (20)	0.93 (0.59–1.47)
>1 partner last 3 months	No	232/289 (80)	57/289 (20)	Ref.
	Yes	134/171 (78)	37/171 (22)	1.12 (0.71–1.79)
Current sex within past 3 months [§]	No	39/43 (91)	4/43 (9)	Ref.
	Yes	330/420 (79)	90/420 (21)	2.66 (0.93–7.64)
Sex with men	No	322/411 (78)	89/411 (22)	Ref.
	Yes	48/55 (87)	7/55 (13)	0.53 (0.23–1.21)
Condom use with any sex [§]	Always	55/62 (89)	7/62 (11)	Ref.
	Most of the time	154/188 (82)	34/188 (18)	1.73 (0.73–4.14)
	Some of the time	108/137 (79)	29/137 (21)	2.11 (0.87–5.12)
	Never [§]	56/81 (69)	25/81 (31)	3.51 (1.40–8.78)
Oral sex	No	15/16 (94)	1/16 (6)	Ref.
	Yes	359/452 (79)	93/452 (21)	3.89 (0.51–29.80)
Anal sex	No	165/203 (81)	38/203 (19)	Ref.
	Yes	208/264 (79)	56/264 (21)	1.17 (0.74–1.85)
Ever tested for STI [†]	No	143/181 (79)	38/181 (21)	Ref.
	Yes	200/247 (81)	47/247 (19)	0.88 (0.55–1.42)
	Don't know	8/10 (80)	2/10 (20)	0.94 (0.18–4.61)
Ever treated for STI [†]	No	240/301 (80)	61/301 (20)	Ref.

Risk factor	Characteristic	STI negative [†]	prevalence by risk factor (%)	STI positive [†]	prevalence by risk factor (%)	Unadjusted OR for STI positivity (95% CI)
Partner had STI [†]	Yes	125/158 (79)		33/158 (21)		1.04 (0.65–1.67)
	Don't know	8/9 (89)		1/9 (11)		0.49 (0.06–4.01)
	No	67/87 (77)		20/87 (23)		Ref.
	Yes	108/137 (79)		29/137 (21)		0.90 (0.47–1.72)
Drink before sex [§]	Don't know	198/243 (81)		45/243 (19)		0.76 (0.35–1.38)
	No	96/131 (73)		35/131 (27)		Ref.
	Yes	279/339 (82)		60/339 (18)		0.59 (0.37–0.95)

[†] Sexually Transmitted Infection

[§] p<0.05

Table 3

Multivariable logistic regression of sexually transmitted infection status on risk factors for infection – Internet-based screening cohort of men (N=423).

Risk factor	Characteristic	Adjusted OR (95% CI)[†]	p-value[*]
Age	Per 5 year increase	0.62 (0.43–0.91)	0.013
Race	Caucasian	Ref	0.014
	African American [§]	2.87 (1.52–5.42)	
	Asian	1.00 (0.11–9.26)	
	American Indian/Alaskan Native	0.00 (0.00)	
	Native Hawaiian/Other Pacific Islander	4.29 (0.43–42.49)	
	Other [§]	3.96 (1.36–11.59)	
Income	<\$10,000	Ref.	0.007
	\$10,000–\$49,999 [§]	0.47 (0.24–0.91)	
	\$50,000–\$99,999 [§]	0.24 (0.09–0.64)	
	>\$100,000	0.34 (0.04–3.15)	
	Not sure [§]	0.18 (0.06–0.53)	
State	West Virginia	Ref.	0.089
	Maryland	6.63 (0.85–52.0)	
	Baltimore	11.23 (1.36–93.0)	
	District of Columbia	3.35 (0.18–62.8)	
	Illinois [§]	9.96 (1.15–86.1)	
	Denver [§]	14.20(1.61–125.2)	
Condom use	Always	Ref.	0.003
	Most of the time	1.44 (0.56–3.69)	
	Some of the time	1.70 (0.64–4.49)	
	Never [§]	4.96 (1.76–13.95)	

^{*} χ^2 test

⁷ Adjusted for all other listed risk factors
[§] $p < 0.05$

Table 4

Acceptability of internet-based screening by sexually transmitted infection status – Internet-based screening cohort of men (N=501).

Factor	Characteristic	Total n/N (%)	STI negative [†] (N=325) n/N (%)	STI positive [†] (N=98) n/N (%)	p-value [*]
Preferred sample method	Clinic	63/399 (16)	47/310 (15)	16/89 (18)	0.283
	Self-administered	307/399 (77)	243/310 (78)	64/89 (72)	
	Either	29/399 (7)	20/310 (6)	9/89 (10)	
Self obtained penis swab safe	No	7/396 (2)	5/310 (2)	2/86 (2)	0.806
	Yes	342/396 (86)	270/310 (87)	72/86 (84)	
	Not sure	47/396 (12)	35/310 (11)	12/86 (14)	
Ease of swab use	Very easy	181/376 (48)	139/293 (47)	42/83 (51)	0.368
	Easy	155/376 (41)	125/293 (43)	30/83 (36)	
	Not sure	19/376 (5)	15/293 (5)	4/83 (5)	
	Hard	17/376 (5)	12/293 (4)	5/83 (6)	
	Very hard	4/376 (1)	2/293 (1)	2/83 (2)	
Ever used self-administered swab	No	319/363 (88)	251/284 (88)	68/79 (86)	0.739
	Yes	44/363 (12)	33/284 (12)	11/79 (14)	
Use internet based screening again	No	9/400 (2)	6/311 (2)	3/89 (3)	0.565
	Yes	357/400 (89)	279/311 (90)	78/89 (88)	
	Not sure	34/400 (9)	26/311 (8)	8/89 (9)	

[†] Sexually Transmitted Infection

^{*} χ^2 test