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***Trichomonas vaginalis* infection in men who submit self-collected penile swabs after internet recruitment**

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Abstract

Background—Submission of self-collected penile samples collected at home could remove barriers that men face in getting tested for sexually transmitted infections (STIs).

Methods—From December 2006 to July 2012, sexually active men aged 14 years were recruited by an educational internet program (<http://www.iwantthekit.org>) which offered free testing for *Trichomonas vaginalis* infection. Kits were ordered online and swabs were sent via US mail to the laboratory and tested by nucleic acid amplification tests. Demographics and sexual risk factors were accessed by questionnaires. Men called or were contacted to receive their results. Risk factors for trichomonas infection were determined by multivariate logistic regression

Results—Of 4398 men requesting kits, 1699 (38.6%) returned swabs by mail (55.4% returned in 2012). Forty-one percent of men were aged <25 years, 43% were black subjects and 45% were white. The overall prevalence for trichomonas in the 1699 men was 3.7%; the highest prevalence by age group was for men aged 40–49 years (5.2%) and, by year, 216 men screened in 2008 had the highest prevalence (12.5%). Risk factors for 919 men whose risk information was collected by questionnaire (prevalence 6.0%) indicated that 9.6% had a concurrent chlamydia infection. Significantly associated risks factors included: black race (adjusted OR 2.67), residence in Illinois (OR 12.02), age 30–39 years (OR 6.63) and age >40 years (OR 5.31).

Conclusions—A fairly high prevalence of trichomonas and sexual risk factors were demonstrated from internet recruitment of men. This method of engaging men to get screened for trichomonas may augment screening in STI clinics.

INTRODUCTION

Trichomonas infections caused by *Trichomonas vaginalis* (TV) are highly prevalent sexually transmitted infections (STIs) worldwide, with estimates of 7–8 million infections annually in the USA and 180 million globally.¹ They represent the most common curable STI in young sexually active men and women.^{2,3} However, few data are available for men. Miller *et al*⁴

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reported the prevalence of trichomonas in men aged 18–26 years in the National Longitudinal Study of Adolescent Health cohort as 1.7%.

Trichomonas infections in women have been associated with poor reproductive outcomes such as low birth weight (LBW) and premature birth.⁵⁶ Among 13 000 women, there was an attributable risk of trichomonas associated with LBW in black subjects of 11% compared with 1.6% in Hispanic subjects and 1.5% in white women.⁵ The National Health and Nutrition Examination Survey (NHANES) 2001–2004 estimated that 3.1% of women in the USA have TV.⁷ Data from NHANES also demonstrated that TV was associated with other STIs among women in the civilian US population in a sample of 3648 women representing a weighted sample of the experience of 65 563 298 women aged 14–49 years.⁸ The prevalence of trichomoniasis was 3.2%, with >80% of cases being asymptomatic. Public health wisdom assumes that men are the reservoir for trichomonas infections in women and vice versa.

More data and improved methods are needed to screen men for trichomonas. Submission of self-obtained penile samples collected at home could increase screening, as well as removing barriers that men face in getting tested for STIs. The purpose of this study was to provide trichomonas testing by nucleic acid amplification tests (NAATs) in men using self-collected penile-meatal swabs after internet recruitment to determine the prevalence and to ascertain risk factors associated with trichomoniasis.

METHODS

Sexually active men aged ≥14 years were recruited by an internet program (<http://www.iwantthekit.org>) which was educational for STIs and offered free testing from self-collected penile-meatal samples for trichomonas, chlamydia and gonorrhea from December 2006 to July 2012. Specific directions for sample collection were provided in each kit and on the website. The study was approved by the Institutional Review Board (IRB) with written consent. Kits were supplied free by ordering from the website with an option of a toll-free phone call. Swab samples were returned by mail in preaddressed postage-paid mailers to the testing laboratory. This program was active in Maryland, the District of Columbia, West Virginia, selected counties in Illinois, Denver Colorado and Alaska. Testing was performed by NAAT, APTIMA TV, analyte specific reagent assay (Gen-Probe, San Diego, California, USA). This assay is now cleared by the Food and Drug Administration for women (not men) and is commercially available.⁹

Men were instructed to call for results in 1–2 weeks and to give a preferred method (email, cell phone, letter or, recently, text message) for notification of results if they forgot to call. Infected men were offered free treatment at participating clinics.

Demographic characteristics and risk factors for trichomonas infection were accessed by self-administered questionnaires, which could be completed online or within the kit. Questionnaires and consent forms were discontinued in February 2011 in an effort to increase participation in the program, with IRB approval to designate the program as ‘public health’ and no longer ‘research’.

Questionnaire data missing for each variable ranged from 0.3% to 18.2%; most were <10% except for ethnicity, individual/ household income, health insurance and condom usage during oral sex or anal sex. Multiple imputation technique for missing values was performed in order to eliminate the bias due to dropping records with missing values. χ^2 tests were performed for bivariate analysis and logistic regression was performed using SAS V.9.3 (SAS Institute, Cary, North Carolina, USA) followed by multiple imputation. p Values of <0.05 were considered significant. Variables with a p value <0.2 in bivariate analysis and other variables a priori considered as potential important confounders were entered into a

full multiple logistic regression model for stepwise model selection approach for a final multivariate regression model.

RESULTS

A total of 1699 men requested kits and returned swabs by mail. Almost no kits were requested by telephone. The overall return rate for requested kits was 38.6%, with 55.4% in 2012; 9.1% were aged <20 years, 32.3% were 20–24 years, 20.7% were 25–29 years and 22.4% were 30–39 years (table 1). Almost half (44.9%) were white subjects and 42.7% were black; 68.6% were from Maryland (table 1). The prevalence of trichomonas was 3.7% overall. Figure 1 demonstrates the prevalence of TV infection by year in the 1699 men in the internet screening program. The prevalence was higher in 2008 than in other years ($p<0.05$). All men except one received treatment in participating clinics.

One thousand and nineteen participants completed questionnaires before they were discontinued and were included in the bivariate and multivariate analysis of the behavioural risk questionnaires. The prevalence of trichomonas was 6% (table 2); 11% of men were aged <20 years, 36.1% were 20–24 years, 20.2% were 25–29 years and 20.4% were 30–39 years; 46.4% were white subjects and 43.9% were black; 76.8% were single. No symptoms were reported by 56.6% and 10.3% reported penile discharge (table 2). Concurrent infection with chlamydia was demonstrated in 13.6% and with gonorrhoea in 1.3%. Bivariate analysis indicated race, ethnicity, age at first sex, calendar year of screening, participant's sex partner's sexual identification and urogenital symptoms were significantly associated with trichomonas infection (table 2).

Multivariate analysis for trichomonas infection indicated the following significant ($p<0.05$) risk factors: black race (OR 2.7), any age 30 years or older (OR age 30–39 years 6.63; OR age >40 years 5.31), residence in Illinois (OR 12.0), age of first sex <15 years (OR 1.8) and penile discharge (OR 2.3) (table 3).

DISCUSSION

Our internet-recruited population demonstrated a fairly high prevalence of trichomonas among men who submitted penile-meatal swabs self-collected at home, similar to a previously reported high prevalence of trichomonas in women in the program.¹⁰ Age was not associated with trichomonas infection in that study, although other studies have associated trichomonas infection with older age in women.⁴¹¹ In the current study, trichomonas infections were associated with older age in men. These data underscore the significance of prevalent trichomonas infections in older men, since the OR for men aged 40 years compared with men aged <20 years was 5.31. The highest OR was for men aged 30–39 years (OR 6.63). More trichomonas infection in older men may contribute to the reported higher rates of trichomoniasis in older women as well.¹¹

We cannot explain the higher prevalence in 2008 compared with other years. Fewer men were screened that year, but this does not appear to explain the 2008 prevalence spike. Similarly puzzling is the overall prevalence of trichomonas of 3.7% in the 1699 men for all years compared with a prevalence of 6.0% for the earlier time periods before the questionnaires were discontinued. Questionnaires were discontinued in early 2011 along with the consent form in an effort to improve volunteer rates, which did appear to improve participation rates. More at-risk non-symptomatic men may have decided to participate when there were fewer requirements for consent forms and questionnaires, which could have led to a lower prevalence overall whereas men who were symptomatic and more likely to be infected may have taken the time to fill out the required forms in the earlier years.

Black race was significantly associated with trichomonas infection in the female internet study (OR 2.69) with a prevalence of 13.2% compared with 5.6% in white subjects.⁴⁷¹¹ Similarly, in this study of trichomonas infection in men, black race was also statistically associated with trichomoniasis (OR 2.67).

Demographic factors showed that nearly half (46.8%) of men had insurance, that 76.8% were single and 5% had less than a high school education, with many having at least a college degree (25.8%) and 49.9% having an income of \$10 000–49 999/year. Taken together, one could postulate that many of these men could have attended clinics for the diagnosis of trichomoniasis or other STIs. However, if such infections are asymptomatic or only mildly symptomatic, they may not attend the clinics. Home collection of genital samples appears to be a highly desirable and convenient method for screening for STIs, at least in women^{12–15} in whom it has been shown to be potentially cost saving.¹⁶¹⁷ Further study will be required to establish whether internet recruitment and home collection will facilitate more testing and more treatment for prevalent trichomonas and other STIs in men.

We acknowledge that a limitation of our study was that only 38.6% of men who ordered kits returned them, so we are unable to estimate the acceptability of collecting penile-meatal swab samples at home to those men who did not return the kits. One caveat is that the return rate has improved over time, especially after the requirements for a consent form and questionnaire were dropped. The return rate for men was only 15.3% in 2006 but increased to 55.4% in 2012. Uptake in our comparable women's study in 2012 was approximately the same (50.2%). A home screening randomised controlled trial in women for chlamydia and gonorrhoea demonstrated that home screening was acceptable to women and showed that women who received a home testing intervention option completed significantly more STI tests overall.¹⁵ Another study has reported that 75.7% of women given a choice in a 1-year follow-up contraceptive study that screened for STIs chose the home collection method over visiting a clinic or their own doctor.¹⁴ The authors recommended that future interventions to increase screening for STIs should consider home-based or patient-controlled testing.¹⁴ As a result of our study in men, we believe that home testing for trichomonas, as well as for chlamydia and gonorrhoea, should be recommended for men as another option to clinic-based testing to increase STI testing rates. Whether the internet method will translate into increased male testing through home collection is unknown at present, but an earlier study comparing urine with penile-meatal swab testing found high acceptability for home collection of either sample type in men.¹⁸

While 56.6% of men reported no symptoms in our study (prevalence 5.6%), only 10.3% reported penile discharge but their prevalence for trichomonas was 11.6%; 12.6% reported pain during urination and had a prevalence of 4.3%. As other STIs such as chlamydia and gonorrhoea were also being tested and were also prevalent, it is uncertain which symptoms were only due to trichomonas infection. It is interesting that in multivariate analysis in our study that penile discharge was associated with trichomoniasis, in addition to black race and age ≥ 30 years. The association of trichomonas infection with older age in men is not fully understood, but is similar to studies in women.⁴⁹ The association of trichomonas infection with black race has been well documented in women.⁴⁹¹⁰

Recruitment via the internet and self-collection of samples at home may facilitate easy public health screening for trichomonas and internet programs can also be educational. Many public health officials say we cannot continue to ignore trichomonas infections.^{19–20} Many recent reports have associated TV with HIV transmission and acquisition; most have been for women.^{621–23} Recent studies have demonstrated that the estimated annual number of new HIV transmissions in the USA attributable to a trichomonas cofactor effect may represent a 2–5-fold increased risk.²⁴²⁵ Anderson *et al*²⁶ demonstrated that treatment for

trichomonas can reduce the genital HIV shedding burden in women who were not receiving antiretroviral therapy. The increasing associations with HIV make a public health initiative for trichomonas difficult to ignore. New optimal prevention, diagnosis and control strategies for trichomonas are imperative for men, as well as for women, and may have the ability to decrease racial differences due to these infections.⁷

Evidence from a recent clinical trial for home versus clinic-based screening for STIs demonstrated that men were 60% more likely to complete screening if they were assigned to home-based screening.²⁷

In summary, we have demonstrated that internet recruitment and self-collection of penile-meatal specimens can serve as another tool in expanding public health screening for trichomonas, and that men who use such a program have a moderately high prevalence of trichomonas.

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Key messages

- ▶ A fairly high prevalence of trichomonas (3.7–6%) and high sexual risk factors were demonstrated from internet recruitment of men for screening by home collection of penile-meatal samples.
- ▶ The highest prevalence of trichomonas was observed in men aged 30–49 years.
- ▶ Reaching men by internet recruitment to get screened for trichomonas may augment screening in STI and other clinics.
- ▶ It will be important to screen and treat men for trichomonas infections, as well as women.

Figure 1.
Prevalence of *Trichomonas vaginalis* infection in 1699 men who participated in the internet screening program.

Table 1

Prevalence of *Trichomonas vaginalis* infection by demographics in 1699 male participants in the internet screening program

Characteristics	Categories	Number (n=1699)	Number (%) positive
Overall		1699	62 (3.7)
Age (years)	<20	155	3 (1.9)
	21–24	548	23 (4.2)
	25–29	351	11 (3.1)
	30–39	381	15 (3.9)
	40–49	153	8 (5.2)
	50	91	2 (2.2)
	Unknown	20	0 (0.0)
Race *	Black	726	43 (5.9)
	Asian	43	0 (0.0)
	Native Hawaiian	7	0 (0.0)
	Native American	15	0 (0.0)
	White	763	16 (2.1)
	Multirace	53	1 (1.9)
	Other	76	2 (2.6)
	Unknown	16	0 (0.0)
Ethnicity *	Hispanic	111	0 (0.0)
	Non-Hispanic	1526	56 (3.7)
	Unknown	62	6 (9.7)
Calendar year †*	2007	143	3 (2.1)
	2008	216	27 (12.5)
	2009	369	21 (5.7)
	2010	154	3 (2.0)
	2011	468	4 (0.9)
	2012	349	4 (1.2)
Residential area *	Alaska	72	0 (0.0)
	Maryland (Baltimore City)	336	31 (3.7)
	Maryland (other)	829	12 (3.6)
	District of Columbia	71	1 (1.4)
	Colorado	149	5 (3.4)
	Illinois	81	8 (9.9)
	West Virginia	105	0 (0.0)
	Other	7	0 (0.0)
	Unknown	49	5 (10.2)

* p<0.05.

† Calendar year 2007 includes 19 individuals participating in late 2006; calendar year 2012 includes participants from 1 January 2012 to 31 July 2012.

Table 2

Bivariate analysis of *Trichomonas vaginalis* infection status on risk factors for infection in men who participated in the internet-based screening program (N=919).

Risk factor	Characteristic	N	<i>T vaginalis</i> prevalence (%)
Overall		919	55 (6.0)
Age (years)	15–19	101	2 (2.0)
	20–24	332	22 (6.6)
	25–29	186	8 (4.3)
	30–39	187	15 (8.0)
	40–49	78	6 (7.7)
	50	35	2 (5.7)
Race *	White	426	15 (3.5)
	Black	403	37 (9.2)
	Asian	17	0 (0.0)
	Other	70	3 (4.3)
	Missing	3	0 (0.0)
Ethnicity *	Hispanic	69	0 (0.0)
	Non-Hispanic	811	49 (6.0)
	Missing	105	6 (15.4)
Calendar year *	2006–2007	143	3 (2.1)
	2008	216	27 (12.5)
	2009	369	21 (5.7)
	2010	154	3 (2.0)
	2011	37	1 (2.7)
	Missing	0	0 (0.0)
State	West Virginia	78	0 (0.0)
	Maryland	392	24 (6.1)
	Baltimore	190	12 (6.3)
	District of Columbia	32	1 (3.1)
	Illinois	68	8 (11.8)
	Colorado	110	5 (4.6)
	Other states	2	0 (0.0)
	Missing	47	5 (10.6)
	Missing	47	5 (10.6)
Marital status	Single	706	45 (6.4)
	Married	72	3 (4.2)
	Separated	22	1 (4.6)
	Divorced	47	1 (2.1)
	Missing	72	5 (6.9)
Income	<\$10000	113	12 (10.6)
	\$10000–\$49999 [‡]	459	28 (6.1)
	\$50000–\$99999 [‡]	150	6 (4.0)
	>\$100000	29	0 (0.0)

Risk factor	Characteristic	N	<i>T vaginalis</i> prevalence (%)
Health insurance	Missing	168	9 (5.4)
	With	430	18 (4.2)
	Without	393	30 (7.6)
Education	Missing	96	7 (7.3)
	Less than high school	46	1 (2.2)
	High school	265	20 (7.6)
	Community college	114	7 (6.1)
	Some college	152	10 (6.6)
	Bachelors	179	7 (3.9)
	Masters	50	0 (0.0)
	Doctoral	8	1 (12.5)
	Other	29	2 (6.9)
	Missing	76	7 (9.2)
Age had first sex (years) *	5–9	10	2 (20.0)
	10–14	219	18 (8.2)
	15–19	531	25 (4.7)
	20–24	61	1 (1.6)
	25	9	0 (0.0)
	Missing	89	9 (10.1)
Number of partners in the last year	None	15	1 (6.7)
	1	208	13 (6.3)
	2–4	405	23 (5.7)
	5–9	153	11 (7.2)
	10–15	43	0 (0.0)
	16	31	1 (3.2)
	Missing	64	6 (7.6)
New partner within past 3 months	No	405	27 (6.7)
	Yes	450	22 (4.9)
	Missing	64	6 (9.4)
>1 partner last 3 months	No	533	32 (6.0)
	Yes	320	17 (5.3)
	Missing	66	6 (9.1)
Partner's sex *	Men only	80	0 (0.0)
	Women only	750	48 (6.4)
	Men and women	32	1 (3.1)
	Missing	57	6 (10.5)
Vaginal sex	No	64	0 (0.0)
	Yes	792	49 (6.2)
	Missing	63	6 (9.5)
Oral sex	No	37	3 (8.1)
	Yes	826	47 (5.7)

Risk factor	Characteristic	N	<i>T vaginalis</i> prevalence (%)
Anal sex	Missing	56	5 (8.9)
	No	375	17 (4.5)
	Yes	485	32 (6.6)
Condom use with vaginal sex	Missing	59	6 (10.2)
	Always	114	5 (4.4)
	Most of the time	340	14 (4.1)
	Some of the time	271	17 (6.3)
	Never	136	14 (10.3)
	Missing	58	5 (8.6)
	Always	66	2 (3.0)
Condom use with oral or anal sex	Most of the time	142	6 (4.2)
	Some of the time	178	12 (6.7)
	Never	373	24 (6.4)
	Missing	160	11 (6.9)
	No	244	17 (7.0)
Drink before sex	Yes	599	33 (5.5)
	Missing	76	5 (6.6)
	No	327	19 (5.8)
Ever tested for STI	Yes	480	31 (6.5)
	Don't know	25	0 (0.0)
	Missing	87	5 (5.8)
	No	543	27 (5.0)
Ever treated for STI	Yes	303	22 (7.3)
	Don't know	11	0 (0.0)
	Missing	62	6 (9.7)
	No	155	13 (8.4)
Partner had STI	Yes	271	15 (5.5)
	Don't know	436	22 (5.1)
	Missing	57	5 (8.8)
	No	790	47 (6.0)
Having trichomoniasis in the past	Yes	56	2 (3.6)
	Missing	73	6 (8.2)
	No	520	29 (5.6)
Urogenital symptoms [†]	None	520	29 (5.6)
	Penile discharge [*]	95	11 (11.6)
	Pain during urination	116	5 (4.3)
	Penis itching	110	7 (6.4)
	Rash/ulcers/sores	54	3 (5.6)
	Pain during intercourse	18	1 (5.6)
	Groin/testes pain	85	5 (5.9)
	Missing	81	7 (8.6)
Concurrent chlamydial infection [*]	No	794	43 (5.4)

Risk factor	Characteristic	N	<i>T vaginalis</i> prevalence (%)
Concurrent gonococcal infection	Yes	125	12 (9.6)
	No	907	54 (6.0)
	Yes	12	1 (8.3)

*
p<0.05.

[†]Not mutually exclusive.

[‡]US Dollars.

STI, sexually transmitted infections.

Table 3

Risk factors associated with prevalence of *Trichomonas vaginalis* infection in 919 men who participated in the internet screening program *

Characteristics	Categories	OR (95% CI)
Age (years)	<20	1.00
	20–24	4.39 (0.99 to 19.34)
	25–29	3.31 (0.67 to 16.28)
	30–39	6.63 (1.45 to 30.35)
	40	5.31 (1.06 to 26.46)
Race	African-American	2.67 (1.38 to 5.12)
	Other	1.00
Residential state	Illinois	12.02 (1.14 to 127.11)
	Maryland and DC	3.71 (0.39 to 35.48)
	Colorado, West Virginia	1.00
Age when first having sex (years)	<15	1.82 (1.00 to 3.33)
	15	1.00
Urogenital symptom (penis discharge)	Yes	2.25 (1.03 to 4.89)
	No	1.00

* Multivariate logistic regression after performing multiple imputation procedure for missing data.