Prevalence and Correlates of *Trichomonas vaginalis* Among Incarcerated Persons Assessed Using a Highly Sensitive Molecular Assay

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Abstract: We describe the epidemiology of Trichomonas vaginalis (TV) among San Francisco County Jail inmates using APTIMA TV analyte-specific reagents on remnant urine. We detected TV in 15/713 (2.1%) men and 95/297 (32.0%) women. Among women, increased age was significantly associated with TV. The benefits of TV screening should be determined.

Trichomoniasis, caused by the parasitic protozoan *Trichomonas vaginalis* (TV), is the most common curable sexually transmitted infection (STI) worldwide.[1] In the United States, an estimated 7.4 million TV cases occur annually, compared with approximately 3 million *Chlamydia trachomatis* (CT) cases and 650,000 *Neisseria gonorrhoeae* (GC) cases.[1,2] Trichomoniasis has been associated with pelvic inflammatory disease,[3] cervical intraepithelial neoplasia,[4] vaginitis,[5] and adverse pregnancy outcomes among women[6–8] as well as prostatitis, urethritis, and infertility among men.[9,10] Despite the relative high burden of disease and associated adverse reproductive sequelae, including a 2- to 3-fold increased risk of human immunodeficiency virus acquisition,[11–13] TV receives limited public health attention.[14]

Prevalence estimates of TV have varied substantially, depending on the population studied and diagnostic methods used. TV prevalence has ranged from 3% to 12% among men attending STI clinics[15–17] and 3% to 54% among young sexually active women,[18–20] all using culture; from 37% to 47% among incarcerated women, using wet-mount microscopy and culture, respectively[21,22]; and 38% among black women who use recreational drugs, using polymerase chain reaction.[23]

Approximately 10% to 50% of TV infections are asymptomatic,[24] emphasizing the importance of screening and laboratory diagnosis in TV control. Conventional diagnostic modalities for TV, including culture and wet-mount microscopy, have low sensitivity, ranging from 40% to 80%.[24–26] Newer nucleic acid amplification tests, including those based on polymerase chain reaction and transcription-mediated amplification (TMA), have higher sensitivity, compared with traditional techniques.[20,27,28] The TMA-based APTIMA TV (ATV) assay (Gen-Probe, Inc., San Diego, CA) exhibits high sensitivity (96.7%) and specificity (97.5%).[29]

Absence of reporting requirements for TV, limited use of sensitive diagnostic tests,[30] and lack of routine screening programs have led to an incomplete understanding of TV epidemiology in the United States. Disproportionately affected by other STIs,[31–35] incarcerated populations might be at higher risk for TV, but few studies have investigated the burden of disease in this group. Our study used a highly sensitive TMA-based assay to assess prevalence and correlates of TV among incarcerated individuals in San Francisco.

Since 1996 the San Francisco Department of Public Health has conducted urine-based CT and GC screening in the San Francisco county jail for men ages 18 to 30 years and women ages 18 to 35 years. Diagnostic testing is also done, with no age restrictions.

We identified all first-catch urine specimens collected for CT and GC testing from incarcerated persons during January to April 2008. Samples were pipetted into urine specimen transport tubes (Gen-Probe, Inc.) ≤24 hours after collection, and sent to the San Francisco Department of Public Health Laboratory for CT and GC testing by using Gen-Probe APTIMA Combo 2 Assay (AC2) on the automated TIGRIS platform per standard laboratory protocol.

Data on age, gender, and race/ethnicity were recorded when specimens were collected. We assessed CT and GC infection history by querying San Francisco morbidity case reports. Subsequent to CT and GC testing, we stored remnant specimens at 5°C and removed identifying information.

Within 30 days from the collection date, we tested specimens for TV by using the Gen-Probe APTIMA *T. Vaginalis* (ATV) assay on the TIGRIS DTS (Direct Tube Sampling) system (Gen-Probe, Inc.). We used APTIMA general-purpose reagent kits and ATV analyte-specific reagents, including target capture, amplification, enzyme, and probe and selection reagents.

Statistical analyses were conducted with Stata 10 (Stata Corporation, College Station, TX). Univariate logistic regression analyses were used to assess associations between TV and potential risk factors. Separate models were constructed for men and women. We entered variables with $P < 0.20$ on univariate analyses into multivariate logistic regression models and used backward stepwise regression to arrive at a final model, retaining variables with $P < 0.05$. Because in multivar-

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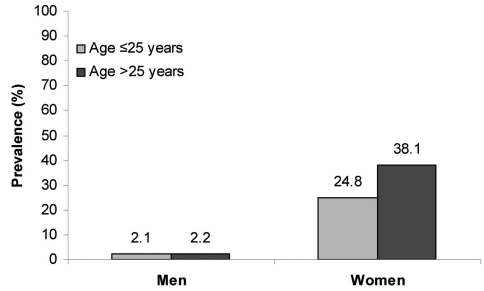

Note: Transgender persons (n = 5) not included. No transgender persons tested positive for *T. vaginalis*.

Figure. Prevalence of *Trichomonas vaginalis* by sex and age, San Francisco County Jail, 2008 (N = 1010).

iate analysis no factors were statistically significant for men and only age was statistically significant for women, the results of univariate analyses are presented here. The University of California San Francisco Committee on Human Research approved the study.

During the study period, we identified 1026 urine specimens collected from 713 men (69.5%), 297 women (28.9%), and 5 transgender persons (0.5%); 11 specimens (1.1%) tested for CT and GC could not be tested for TV because of insufficient fluid volume.

Overall, the prevalence of TV was 110/1015 (10.8%; 95% confidence interval [CI], 9.0%–12.9%). Stratified by gender, TV was present among 15/713 men (2.1%; 95% CI, 1.2%–3.4%), 95/297 women (32.0%; 95% CI, 26.7%–37.6%), and 0/5 transgender persons (0%; 95% CI, 0%–52%) (Figure).

Among men (n = 713), the median age was 25 years (range, 18–58 years). Among 684/713 men (95.9%) for whom race/ethnicity was known, the distribution was 48.3% black, 23.0% Hispanic, 21.5% white, 5.4% Asian, and 1.8% other. The prevalence of CT and GC was 4.3% and 1.1%, respectively. The median age among men positive for TV was 27 years (range, 20–52 years). No concurrent infections with CT or GC were detected. Age, race/ethnicity, and prior infection with GC or CT were not significantly associated with TV in univariate analyses (Table 1).

Among women (n = 297), the median age was 26 years (range, 18–57 years). Among 290/297 women (97.6%) for whom race/ethnicity was known, the distribution was 64.8% black, 17.2% white, 11.4% Hispanic, 3.1% Asian, and 3.4% other. The prevalence of CT and GC was 3.4% and 1.7%, respectively. The median age among women positive for TV was 30 years (range, 18–56 years). In univariate analyses, TV significantly increased with age. TV was detected in 24.8% (95% CI, 17.8%–32.9%) of women aged ≤25 years, compared with 38.1% (95% CI, 30.6%–46.1%) of women aged >25 years ($P = 0.015$). Race/ethnicity and current or prior infection with GC or CT were not significantly associated with TV (Table 2).

This study of TV prevalence and correlates among incarcerated individuals in San Francisco showed a high TV prevalence among women, particularly women aged >25 years. Consistent with previous studies,[12,27] TV was more prevalent among women than men. Among women of all ages, TV was by far the most common pathogen identified (32.0%), compared with CT (3.4%) and GC (1.7%). Among men of all ages, however, the prevalence of TV (2.1%) was comparable to CT (4.3%) and GC (1.1%).

In contrast with other STIs (e.g., CT and GC), which

TABLE 1. Prevalence and Univariate Odds Ratios (OR) of *Trichomonas vaginalis* (TV) Among Men, by Select Characteristics, San Francisco County Jail, 2008

Characteristic	TV neg No. (%)	TV pos No. (%)	Univariate OR (95% CI)	*P*
Total	698 (97.9)	15 (2.1)		
Age* (yr)				
≤25	378 (97.9)	8 (2.1)	Ref.	0.93
>25	318 (97.8)	7 (2.2)	1.05 (0.38–2.91)	
Race/ethnicity†				
White	146 (99.3)	1 (0.7)	Ref.	0.17
Asian	37 (100)	0 (0)	NA‡	
Black	319 (96.7)	11 (3.3)	5.03 (0.64–39.40)	
Hispanic	155 (98.7)	2 (1.3)	1.89 (0.17–21.01)	
Other	13 (100)	0 (0)	NA‡	
Concurrent infection(s)				
None	662 (97.8)	15 (2.2)	Ref.	1.00
CT only	28 (100)	0 (0)	NA‡	
GC only	5 (100)	0 (0)	NA‡	
CT and GC	3 (100)	0 (0)	NA†	
Prior infection(s)§				
None	538 (98.5)	8 (1.4)	Reference	0.08
CT only	70 (93.3)	5 (6.3)	4.55 (1.45–14.27)	
GC only	41 (97.6)	1 (2.3)	1.63 (0.20–13.30)	
CT and GC	34 (97.1)	1 (2.8)	1.95 (0.24–16.03)	

*Data missing for 2 men.
†Data missing for 29 men.
‡NA = Estimates of OR not available because cell value = 0.
§Data missing for 15 men.

exhibit peak prevalence among adolescents and young adults, TV has been documented to be equally or more prevalent among sexually active women of older age groups.[12,36–38] This trend was consistent with our findings. We determined that age >25 years was significantly associated with TV among women but not men. Infection among older women might be a result of persistent infection. The Centers for Disease Control and Prevention recommends CT screening for women aged <26 years and older women with risk factors (e.g., multiple sex partners or a new sex partner).[39] If existing CT and GC screening programs consider incorporating screening for TV, a substantial number of TV cases among older women might not be identified.

Although concomitant STIs, especially GC,[36,40] have been reported to be common among persons presenting with TV,[41] we did not find prior infection or coinfection with CT or GC to be significantly associated with TV among women or men. Among men with TV, no CT or GC coinfections were identified. Race/ethnicity was not significantly associated with TV among men or women.

Unlike nucleic acid amplification tests for CT and GC diagnosis,[30] ATV for TV diagnosis is not FDA cleared, is only available as an analyte-specific reagent test, and is not widely used by US public health laboratories. However, ATV testing might be useful for TV diagnosis among certain populations. The ATV test, when automated on the TIGRIS platform, provides a uniform testing platform for CT, GC, and TV testing from a single noninvasively collected urine specimen. Target populations might differ for screening for TV compared with CT and GC, however, limiting the practical utility of simultaneously screening for all 3 infections.

Our study had certain limitations. We did not know the proportion of specimens submitted for screening compared

TABLE 2. Prevalence and Univariate Odds Ratios (ORs) of *Trichomonas vaginalis* (TV) Among Women, by Select Characteristics, San Francisco County Jail, 2008

Characteristics	TV neg No. (%)	TV pos No. (%)	Univariate OR (95% CI)	*P*
Total	202 (68.0)	95 (32.0)		
Age (yr)				
≤25	103 (60.2)	34 (24.8)	Ref.	0.02
>25	99 (61.9)	61 (38.1)	1.87 (1.13–3.08)	
Race/ethnicity*				
White	40 (80.0)	10 (20.0)	Ref.	0.12
Asian	5 (55.6)	4 (44.4)	3.21 (0.72–14.1)	
Black	121 (64.4)	67 (35.6)	2.21 (1.04–4.71)	
Hispanic	23 (69.7)	10 (30.3)	1.74 (0.63–4.80)	
Other	10 (100)	0 (0)	NA†	
Concurrent infection(s)				
None	191 (67.5)	92 (32.5)	Ref.	0.34
CT only	8 (88.9)	1 (11.1)	0.26 (0.03–2.11)	
GC only	2 (50.0)	2 (50.0)	2.08 (0.29–14.98)	
CT and GC	1 (100)	0 (0)	NA†	
Prior infection(s)‡				
None	128 (71.5)	51 (28.5)	Ref.	0.26
CT only	20 (54.1)	17 (45.9)	1.15 (0.60–2.23)	
GC only	3 (25.0)	9 (75.0)	1.88 (0.74–4.74)	
CT and GC	7 (28.0)	18 (72.0)	1.81 (0.91–3.59)	

*Data missing for 7 women.
†NA = Estimates of OR not available because cell value = 0.
‡Data missing for 44 women.

with diagnostic testing. We lacked data on participant characteristics, including gender and numbers of sex partners and symptom status. This study has limited generalizability to other incarcerated populations. Strengths of the study included a substantial sample among a group at high risk and use of a highly sensitive molecular test for detecting TV among men and women.

As the most prevalent curable STI in the United States,[1] TV has important public health implications. Given the availability of sensitive diagnostic tests, inexpensive and effective treatment, and the well-described adverse health outcomes associated with TV, routine screening among incarcerated populations and other groups at high-risk merits serious further consideration. Additional studies using highly sensitive and specific molecular methods to characterize further the epidemiology of TV among various high- and low-risk populations can help target prevention and treatment efforts to maximize use of our limited public health resources.

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