Trichomoniasis the Underestimated Sexually Transmitted Infection

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Abstract

This study interviewed 2,272 women from a low income community in California, USA who completed a questionnaire entitled Risk Behavior Assessment that captured risky drug and sexual behavior. The logistic regression model included gonorrhea, chlamydia, syphilis, warts, crack, and sex trading for money as well as racial and ethnic differences. It was evident that Trichomonas Vaginalis can co-exist with other infections among women who use illicit drugs and engage in risky sexual behavior. It can serve as an early indicator to prompt healthcare providers to test for the presence of STI co-infection that can be potentially fatal if not diagnosed and treated.

Keywords: Trichomonas Vaginalis, sexually transmitted infections, drugs, sexual behaviors.

1. Introduction

Trichomonas vaginalis (*T. vaginalis*) infection or Trichomoniasisis a highly prevalent, sexually transmitted infection (STI) which, in the past, has erroneously been considered as a nuisance infection which can be effectively treated, presents little if any health sequelae, and has limited associated costs. It has been given such labels as the "neglected STI" or the "silent STI", and as such, it is the STI which has received the least amount of public health attention and the least amount of resources for prevention and treatment(Van Der Pol, 2007). A great deal of this inattention can be attributed to a lack of understanding of the public health impact this disease can cause(Secor, Meites, Starr, & Workowski, 2014).In contrast to its former reputation, the data show that Trichomoniasis is one the most common parasitic infections in the United States and is the most prevalent non-viral STI in both the United States and worldwide(Van Der Pol, 2007).

It is estimated that the worldwide incidence of *T. vaginalis* infection is over 248 million new cases per year and that *T. vaginalis* infections are more common than *Chlamydia,* gonorrhea, and syphilis infections combined(Secor et al., 2014).In the US there are an estimated 1.1 million new *T. vaginalis* infections annually and an estimated 3.7 million people infected with this organism, including 2.3 million women and 1.4 million men (Meites, 2013; Secor et al., 2014). Although this infection can manifest itself in both genders, it is reported primarily in women. The women who are infected with *T. vaginalis* are typically asymptomatic; however they can have symptoms which appear weeks, months or years after initial infection. In men, the occurrence of symptomatic infections is rare compared to the estimated prevalence of infections in males. Despite the high incidence of this STI, research and control efforts have traditionally lagged far behind the efforts expended to control and prevent the other STIs (Secor et al., 2014).

Although *T. vaginalis* is the most common curable STI in the US, it continues to be the most overlooked, under diagnosed, and least-funded STI(Van Der Pol, 2007).Given the fact that *T. vaginalis* infection is a high prevalence disease in various populations of women relative to the other STIs, it should be imperative to aggressively prevent, screen and control. More epidemiologic studies have been called for to develop the evidence base for *T. vaginalis* infection (Hoots et al., 2013; Van Der Pol, 2007).

2. Background

STIs pose serious healthcare problems costing about 13 billion dollars annually to treat, however, very little of this cost is spent on *T. vaginalis* infections. It is known that men and women who contract STIs have a higher risk of reinfection and that after acquiring one STI, men and women are at increased risk of acquiring a non-curable STI such as human immunodeficiency virus (HIV). *T. vaginalis* infection is a risk factor for the acquisition and transmission of HIV and remains highly prevalent among HIV-infected women(Miller, Liao, Gomez, Gaydos, & D'Mellow, 2008; Muzny, Rivers, Austin, & Schwebke, 2013). There are some reports concerning risk factors for *T. vaginalis*and health disparities by sex, age, and race which are prominent in the epidemiology of *T. vaginalis*(Meites et al., 2013). In general, among metropolitan areas with high STI rates, *T. vaginalis* infection rates increase with age, in contrast to the other non-viral STIs. Infection peaks among 51 -60 year old women, followed by women who are greater than 60 years of age and then by women who are 41-50 years of age. Men also show a peak prevalence of infection at 51 – 60 years old. National estimates based on people under the age of 50 years most likely underestimate the number of *T. vaginalis* infections in the US(Secor et al., 2014).

The overall prevalence of *T. vaginalis* among reproductive age women (14-49 years old) in the United States in the National Health and Examination Survey (NHANES) has been reported to be 3.1%, however for non-Hispanic White women it was 1.3%; for Mexican American women, 1.8%; but for non-Hispanic Black women it increases drastically to 13.3%, which signifies a significant racial disparity. The prevalence of *T. vaginalis* among non-Hispanic Black women was 10.3 times higher than that among non-Hispanic White and Mexican-American women(Sutton et al., 2007). This is especially problematic given that untreated *T. vaginalis* is associated with serious health consequences in women which include preterm birth, low birth weight infants, infertility, and pelvic inflammatory disease (PID) (Javanbakht et al., 2013). In numerous studies assessing the prevalence and incidence of *T. vaginalis* infections in women, infections among African American women were more common, accounting for the prominent racial disparity feature of this infection (Gullette, Rooker, & Kennedy, 2009; Helms et al., 2008; Javanbakht et al., 2013; Meites et al., 2013; Miller et al., 2008; Secor et al., 2014; Sutton et al., 2007).

Other risk factors associated with *T. vaginalis* infections in women are: incarceration(Javanbakht et al., 2013; Klausner, Baer, Contento, & Bolan, 1999; Meites, 2013), lower educational levels(Helms et al., 2008; Mitchell, Lewis, Marsh, & Hughes, 2013), douching, and higher numbers of lifetime sex partners(Secor et al., 2014). The number of sex partners in these studies is definedas male sex partners (Miller et al., 2008), and specifically those male sex partners who inject drugs (Plitt et al., 2005). Previous studies have reported a high prevalence of *T. vaginalis* infection among women at entry to and within US jails and state prisons which was much higher than in women in the general population(Javanbakht et al., 2013; Klausner et al., 1999). Additionally, studies have also reported a significant correlation with a lower household income (Freeman et al., 2010; Roth et al., 2011; Sutcliffe, Newman, Hardick, & Gaydos, 2010).

Reports of *T. vaginalis* infections being associated with both gonorrhea infection and *Chlamydia* infections are common (Helms et al., 2008; Javanbakht et al., 2013; Miller et al., 2008; Sutcliffe et al., 2010). A report from England shows significant association to not only gonorrhea and *Chlamydia,* but also with herpes, warts, bacterial vaginosis, and candidiasis (Mitchell et al., 2013).There have been several reports of an association with illicit drug use (Bachmann et al., 2000; Miller et al., 2008; Seth, Wingood, & DiClemente, 2008), and alcohol abuse (Seth et al., 2011). In a study of injecting drug users, it was found that there was a higher incidence of *T. vaginalis,* as well as hepatitis C and *Chlamydia*, in part, due to the fact that this population is frequently marginalized and seldom accessed health services for screening purposes(Bradshaw, Pierce, Tabrizi, Fairley, & Garland, 2004). Another study reported increased prevalence of *T. vaginalis* infections (47%), *Chlamydia* (2.3%), gonorrhea (1.6%), and syphilis (6%) among patients entering a residential drug treatment program. Most of the studies reporting on substance use did not specify which drugs were associated with *T. vaginalis* infection. Crack cocaine use was reported by 67% of the patients and multi-substance use was reported by 71% of the patients in the study of drug treatment patients, however associations with Trichomoniasis were not reported (Bachmann et al., 2000).

A California study reported a significant association of *T. vaginalis* infection with "substance use" defined as any use of cocaine, crack, heroin, marijuana, or methamphetamine, but this study combined all of the drugs together in a single variable (Javanbakht et al., 2013). An Alabama study only reported "illegal drug use, ever" as a combination variable without specifying which drugs had been included (Muzny et al., 2013). A New York study was an exception and reported a significant association between *T. vaginalis* infection prevalence and both crack and heroin use (Miller et al., 2008). An interesting study that took place in Georgia found an association with having sex while high on alcohol or drugs, which is the only study we have been able to find to report on the timing of the substance use in relation to the sexual behavior (Seth et al., 2011). The timing of substance use in relationship to risky sexual behavior has begun to be recognized as important (Cartier, Greenwell, & Prendergast, 2008; Fisher, Reynolds, Ware, & Napper, 2011; Reynolds, Fisher, Laurenceau, & Fortenberry, 2015).

In a study that looked at alcohol use and risky sexual behavior among women who had HIV, it was found that the women who scored high on an alcohol abuse screening instrument were more likely to test positive for *T. vaginalis* infections than those who scored low(Seth et al., 2008).In a study that investigated high alcohol consumption as a predictor of risky sexual behavior and STIs among adolescents, it was found that high quantity of alcohol use predicted positive *T. vaginalis* infection rates(Seth et al., 2011). There are very few studies that have investigated other co-infections in women who have *T. vaginalis* infections, such as herpes simplex virus (HSV), human papilloma virus (HPV) and genital Candidiasis (an inflammatory threat to tissue integrity). Additionally, we have only been able to find one study that specifically reported which illicit drug use was associated with *T. vaginalis* infection. The objective of this study was to provide a detailed and nuanced description of the associations between *T. vaginalis* infection and abuse of drugs, and co-infections with other STIs.

3. Methods

Data were obtained from 2,272 women from a low-income community located in Long Beach, California who attended the Center for Behavioral Research and Services (CBRS) for HIV and STI testing. CBRS also operated a food bank for homeless and indigent participants, as well as several HIV-prevention programs. Data were collected after permission was granted by the Institutional Review Board at California State University, Long Beach and after receiving written informed consent from the respondents. The Certificate of Confidentiality was explained and individual identification was concealed by aggregate reporting. Each respondent completed the Risk Behavior Assessment (RBA) data collection instrument. The RBA is a structured interview that captures risky drug and sexual behavior in the participants' lifetime as well as the risky behaviors that have occurred in the last 30 days prior to the interview (Dowling-Guyer et al., 1994; Needle et al., 1995).

The first section of the interview asks for demographic information such as gender, age, years of education, and whether or not they are homeless. The other questions relevant to the current study include drug use and sexual activities in the lifetime and within the last 30 days. Respondents were asked what types of illicit drugs they have used, how many times they have used each drug in the last 30 days, and if they have injected drugs. They were also asked about how many sexual partners they had in the last 30 days, whether their sexual partner was likely to be an illicit drug injector, the different types of sex they engaged in, such as vaginal, oral, or anal, and how many times they had used a condom during sex. In addition, information was collected related to the number of times they had been tested for HIV as well as the number of times they returned to find out the test results.STI history was collected including gonorrhea (Paschane, Fisher, Cagle, & Fenaughty, 1998) and syphilis (Fisher, Reynolds, Creekmur, Johnson, & DeAugustine, 2007). Arrest and incarceration history was also included(Fisher, Reynolds, Wood, & Johnson, 2004).

4. Results

The majority of the participants were Black, followed by White, then Hispanic as shown in Table 1. Over a third was homeless and over ¾ was heterosexual. Only about a quarter of the participants had income from a paid job. Mean age of the sample was 38 y (*SD*=11.4). The lifetime use of crack and powdered cocaine were significantly associated with *T. vaginalis* infection. In addition, alcohol, marijuana, heroin, speedball (a combination of cocaine and heroin injected together), nonprescription methadone, and other opiates (such as OxyContin, Dilaudid etc.) were also associated. Sex trading for both money and drugs was highly associated, as well as having income from a paid job or salary which was inversely associated. The STIs which showed positive associations were gonorrhea, syphilis, warts, *Chlamydia*, herpes, yeast, and hepatitis B infections.

Table 2 shows the number of days used crack to be strongly associated with *T. vaginalis* infection, along with the number of sex partners in general, number of male sex partners, and number of sex partners who injected drugs, and older age. In addition, the drugs used before or during sex included alcohol, crack, and other opiates. These have been reported before by others. The association with times having had receptive anal sex is worrisome given the extent of the risk of this behavior. What is new is that the mean number of days incarcerated for those with *T. vaginalis* infection was over twice that of those without the infection. Table 3 shows the multivariate logistic regression model that includes the STIs of gonorrhea, *Chlamydia*, syphilis, and warts. In addition, the model includes crack, sex trading for money, and Black versus Hispanic. The inclusion of White versus Hispanic appears to be a new finding that we have not been able to find in the current literature.

5. Discussion

This paper is a study of factors associated with Trichomoniasis in a low-income community sample of women. The objectives of this study were to provide a detailed and nuanced description of the associations between *T. vaginalis* infection and abuse of drugs, and co-infections with other STIs. For alcohol, which is a legal drug, the women who reported infection with *T. vaginalis* were significantly more likely to report ever using alcohol, used alcohol more days in the last month, had a lower age of first use of alcohol, and used alcohol before or during sex more days in the last month. This is consistent with other reports (Seth et al., 2011; Seth et al., 2008). The women who reported *T. vaginalis* infection were more likely to have ever used marijuana, and to have a lower age of first use of marijuana which appears to be a novel finding. The only other drugs that we have found mentioned specifically in the literature to be associated with Trichomoniasis are crack and heroin use (Miller et al., 2008), and powder cocaine use (Bachmann et al., 2000; Nijhawan et al., 2012).

Again, our data corroborate these findings in that our women who reported Trichomoniasis were more likely to have ever used crack, used crack more days in the last month and used crack more often before or during sex. This was such a major finding in our data that crack was the only drug that was included in the multivariate logistic regression model. Powder cocaine is treated as a different drug in the drug abuse literature even though crack can be made from powder cocaine. Cocaine use was found to be associated with *T. vaginalis* infection in a Rhode Island study (Nijhawan et al., 2012). Cocaine use was also reported to be associated with STIs including *T. vaginalis* in an Alabama study (Bachmann et al., 2000). Our data corroborated both the Rhode Island and the Alabama studies with lifetime use of cocaine, and lower age of first use of cocaine among women who reported being infected with *T. vaginalis*. Heroin use measured only as ever/never used in lifetime showed a significant association, but not days used in last 30 days, nor use before sex. The fact that alcohol and illicit drug consumption is associated with failure to use sexual barrier methods in our sample and that the women chose sexual partners who are also engaged in risk behaviors such as injection drug use is worrisome.

The novel findings were for amphetamine, other opiates, speedball, and nonprescription methadone. This list includes four drugs that have not previously been reported to be associated with *T. vaginalis* infection. All of these except speedball (which is a combination of heroin and cocaine) and amphetamine are opiates, and the previous literature has predominantly reported use of stimulants to be associated with *T. vaginalis* infection. As far as race findings in the literature are concerned, two points need to be made. The first point is that Black women have been consistently reported in multiple studies to have a higher prevalence of *T. vaginalis* infection (Meites, 2013; Meites et al., 2013; Muzny et al., 2013; Sutton et al., 2007). Our data corroborate this finding only as Black is compared to Hispanic women in our multivariate model. The second point about race is that there are some reports that Hispanic women have higher prevalence than Whites (Meites, 2013; Sutton et al., 2007), and some reports that the prevalence of *T. vaginalis* infections of Hispanic women are not significantly different than White women (Meites et al., 2013).

Our data have different findings in that the Hispanic women were the lowest on *T. vaginalis* infection and our multivariate model had Black compared to Hispanic, and White compared to Hispanic as being higher, with the referent group being the Hispanic women. Sexual behavior associated with *T. vaginalis* infection included giving sex to get money and giving sex to get drugs in vicariate analysis. In the multivariate model only giving sex to get money was significant, in part because of some overlap between the two behaviors. The distinction between sex trading for drugs compared to sex trading for money is beginning to be seen as an important distinction (Clingan, Fisher, & Reynolds, 2015; Dunne et al., 2014; Kwiatkowski & Booth, 2000). A study of newly incarcerated women found an association between *T. vaginalis* infection and trading sex for drugs or money (Nijhawan et al., 2012).

A good review of sex trading and STIs has been published (Cwikel, Lazer, Press, & Lazer, 2008). In contrast to our findings, a study among federal prison inmates failed to find a significant association between sex trading and *T. vaginalis* infection (Sutcliffe et al., 2010). Many studies have reported that the number of sex partners was greater in those who reported *T. vaginalis* infection (Miller et al., 2008; Seth et al., 2011; Sutton et al., 2007), however there is a particular worrisome behavior that has been pointed out in a Baltimore study that found an association between *T. vaginalis* infection and sex with a partner who has injected illicit drugs (Plitt et al., 2005). Another problematic behavior associated with *T. vaginalis* infection is receptive anal sex (Plitt et al., 2005; Seth et al., 2011). Our data also show that women who reported *T. vaginalis* infection had sex with a significantly higher number of sex partners who had injected drugs, and had receptive anal sex significantly more times. Heterosexual anal sex is a very high risk behavior for either men or women and more research is being carried out on this important topic (Reynolds, Fisher, Laurenceau, et al., 2015; Reynolds, Fisher, & Rogala, 2015; Reynolds, Latimore, & Fisher, 2008).

Several reports have documented an association between gonorrhea and Trichomoniasis, and *Chlamydia trachomatis* infection and *T. vaginalis* infection (Helms et al., 2008; Javanbakht et al., 2013; Miller et al., 2008; Mitchell et al., 2013; Sutcliffe et al., 2010). Our data also corroborate this with both bivariate and multivariate analyses. What appears to be novel in our data are associations with syphilis, genital warts, herpes, and yeast infection, although none of these co-infections were retained in our multivariate model.The co-infection with genital warts (human papillomavirus of HPV) is particularly alarming due to the fact that prevalent strains such as HPV 16/18 and HPV 31/33/45/52/58 have been found to be precursors to cervical cancer (Saraiya et al., 2015; Thaxton & Waxman, 2015). A lack of financial resources and health care availability suggest that the women in our sample may have been unlikely to have had interval, surveillance Pap smears that could detect the persistence of HPV strains that can lead to cervical cancer(Xandre, 2015).Preventive health care is not a priority in illicit drug using populations (Bradshaw et al., 2004).

Also a concern is the co-infection with Candidiasis (overgrown yeast) which causes inflammation and potential breaks in the integrity of the skin in the vagina. This can predispose a woman to HIV infection(Hester & Kennedy, 2003; van de Wijgert et al., 2008). We also had significant bivariate associations with hepatitis B that was for both self-report and for laboratory test results. Hepatitis self-report has been reported to have very good reliability and acceptable validity (Fisher, Kuhrt-Hunstiger, Orr, & Davis, 1999; Schlicting et al., 2003). A final important point is the incarceration history of those who reported having Trichomoniasis. Several reports have investigated *T. vaginalis* infections in correctional institutions and have found the prevalence to be high (Freeman et al., 2010; Javanbakht et al., 2013; Klausner et al., 1999; Sutcliffe et al., 2010; Willers et al., 2008). The association between *T. vaginalis* infection and incarceration has been reported with the additional finding that half of the women with *T. vaginalis* infection had been incarcerated more than once (Nijhawan et al., 2011). Our data had a slightly different approach to incarceration in that women in the current study who reported *T. vaginalis* infection had over twice the number of days incarcerated in their lifetime than those who did not report the infection. This finding lends additional support to the potential for case finding in correctional populations.

6. Limitations

There are several limitations that need to be mentioned. The first is that the *T. vaginalis* infection was self-reported by the participants and the question was whether a doctor or a nurse had ever told the participant that they had Trichomonas. Not only do participants get confused or have memory problems of what actually had occurred in their history, but the availability of publicly funded treatment has been severely limited, especially since the economic downturn of 2008. This means that even women who had symptoms may not have received treatment for their symptoms because of a lack of treatment availability. Hopefully, the Affordable Care Act will alleviate this problem in the future. The second limitation is that the data were collected from an impoverished area of Los Angeles County California. This population, by and large, had low income, low education, high illicit drug use, and high history of sex trading for either drugs or money. Therefore these findings may not generalize to samples without these characteristics.

7. Conclusions

The current study was mostly consistent with published literature when variables that had been reported by others to be associated with *T. vaginalis* infection were also included in our data. The one exception is that others have reported Hispanic women to have higher prevalence than White women.

Our data showed the opposite in that Hispanic women had lower prevalence than White women. It is obvious that more studies need to be conducted among Hispanic women regarding the prevalence of Trichomoniasis in order to resolve the current conflicting results. The current study makes contributions to new knowledge in showing that the illicit drugs of amphetamine, other opiates, speedball, and nonprescription methadone were associated with *T. vaginalis* infection. Other novel findings included associations with syphilis, genital warts, herpes, yeast infection, and hepatitis B infection. Finally, our data support case finding in correctional institutions in a different way than previously reported.

Without doubt, women such as those who comprised the sample of this study have many complicated social and health problems which co-exist. Sadly, many of the health problems are serious enough to be fatal if left undetected and untreated. We have shown that Trichomoniasis co-exists with many other STIs and can actually be an early indicator of other virulent or fatal infections in the host. Detection of *T. vaginalis* is simple and treatment is effective and low cost. Instead of being the neglected nuisance STI, it should be considered an STI which signals the possible presence of extremely dangerous, communicable co-infections which can threaten life. Educational outreach to women is a crucial element to combat this problem. There have been extensive educational programs regarding the other STIs but they exclude *T. vaginalis*. STI screening programs need to include *T. vaginalis* in a standard screening procedure with all other STIs.

References

Bachmann, L. H., Lewis, I., Allen, R., Schwebke, J. R., Leviton, L. C., Siegal, H. A., & Hook, E. W. (2000). Risk and prevalence of treatable sexually transmitted diseases at a Birmingham substance abuse treatment facility. *American Journal of Public Health, 90*(10), 1615-1618.

Bradshaw, C. S., Pierce, L. I., Tabrizi, S. N., Fairley, C. K., & Garland, S. M. (2004). Screening injecting drug users for sexually transmitted infections and blood borne viruses using street outreach and self collected sampling. *Sexually Transmitted Infections, 81*, 53-58.

Cartier, J. J., Greenwell, L., & Prendergast, M. L. (2008). The persistence of HIV risk behaviors among methamphetamine-using offenders. *Journal of Psychoactive Drugs, 40*(4), 437-446.

Clingan, S. E., Fisher, D. G., & Reynolds, G. L. (2015). *Impulsiveness and sex trading for drugs, money, both or neither*. Paper presented at the 77th Annual Meeting of the College on Problems of Drug Dependence, Phoenix, AZ.

Cwikel, J. G., Lazer, T., Press, F., & Lazer, S. (2008). Sexually transmissible infections among female sex workers: An international review with an emphasis on hard-to-access populations. *Sexual Health, 5*, 1-8.

Dowling-Guyer, S., Johnson, M. E., Fisher, D. G., Needle, R., Watters, J., Andersen, M., . . . Tortu, S. (1994). Reliability of drug users' self-reported HIV risk behaviors and validity of self-reported recent drug use. *Assessment, 1*(4), 383-392.

Dunne, E. M., Dyer, T. P., Khan, M. R., Cabanaugh, C. E., Mulnihov, A., & Latimer, W. W. (2014). HIV prevalence and risk behaviors among African American women who trade sex for drugs versus economic resources. *AIDS and Behavior, 18*, 1288-1292.

Fisher, D. G., Kuhrt-Hunstiger, T. I., Orr, S., & Davis, D. C. (1999). Hepatitis B validity of drug users' self-report. *Psychology of Addictive Behaviors, 13*(1), 33-38.

Fisher, D. G., Reynolds, G. L., Creekmur, B., Johnson, M. E., & DeAugustine, N. (2007). Reliability and criterion-related validity of self-report of syphilis. *Sexually Transmitted Diseases, 34*(8), 389-391.

Fisher, D. G., Reynolds, G. L., Ware, M. R., & Napper, L. E. (2011). Methamphetamine and Viagra use: Relationship to sexual risk behaviors. *Archives of Sexual Behavior, 40*(2), 273-279.

Fisher, D. G., Reynolds, G. L., Wood, M. M., & Johnson, M. E. (2004). Reliability of arrest and incarceration questions on the Risk Behavior Assessment. *Crime and Delinquency, 50*(1), 24-31.

Freeman, A. H., Katz, K. A., Pandori, M. W., Rauch, L. M., Kohn, R. P., Liska, S., . . . Klausner, J. D. (2010). Prevalence and correlates of Trichomonas vaginalis among incarcerated persons assessed using a highly sensative molecular assay. *Sexually Transmitted Diseases, 37*(3), 165-168.

Gullette, D. L., Rooker, J. L., & Kennedy, R. L. (2009). Factors associated with sexually transmitted infections in men and women. *Journal of Community Health Nursing, 26*(3), 121-130.

Helms, D. J., Mosure, D. J., Metcalf, C. A., Douglas, J. M., Malotte, C. K., Paul, s. M., & Peterman, T. A. (2008). Risk factors for prevalent and incident *Trichomonas vaginalis* among women attending three sexually transmitted disease clinics. *Sexually Transmitted Diseases, 35*(5), 484-488.

Hester, R. A., & Kennedy, S. B. (2003). Candida infection as a risk factor for HIV transmission. *Journal of Women's Health, 12*(5), 487-494.

Hoots, B. E., Peterman, T. A., Torrone, E. A., Weinstock, H. S., Meites, E., & A., B. G. (2013). A Trich-y question: Should Trichomonas vaginalis infection be reportable? *Sexually Transmitted Diseases, 40*(2), 113-116.

Javanbakht, M., Stirland, A., Stahlman, S., Smith, L. V., Chien, M., Torres, R., & Guerry, S. (2013). Prevalence and factors associated with Trichomonas vaginalis infection among high-risk women in Los Angeles. *Sexually Transmitted Diseases, 40*(10), 804-807.

Klausner, J. D., Baer, J. T., Contento, K. M., & Bolan, G. (1999). Investigation of a suspected outbreak of vaginal Trichomoniasis among female inmates. *Sexually Transmitted Diseases, 26*(6), 335-338.

Kwiatkowski, C. F., & Booth, R. (2000). Differences in HIV risk behaviors among women who exchange sex for drugs, money, or both drugs and money. *AIDS and Behavior, 4*(3), 233-240.

Meites, E. (2013). Trichominiasis: The "neglected" sexually transmitted disease. *Infectious Disease Clinic of North America, 27*, 755-764.

Meites, E., Llata, E., Braxton, J., Schwebke, J. R., Bernstein, K. T., Pathela, P., . . . Weinstock, H. S. (2013). Trichomonas vaginalis in selected US sexually transmitted disease clinics: Testing, screening, and prevalence. *Sexually Transmitted Diseases, 40*(11), 865-869.

Miller, M., Liao, Y., Gomez, A. M., Gaydos, C. A., & D'Mellow, D. (2008). Factors associated with the prevalence and incidence of Trichomonas vaginalis infection among African American women in New York City who use drugs. *The Journal of Infectious Diseases, 197*, 503-509.

Mitchell, H. D., Lewis, D. A., Marsh, K., & Hughes, G. (2013). Distribution and risk factors of *Trichomonas vaginalis* infection in England: An epidemiological study using electronic health records from sexually transmitted infection clinics, 2009-2011. *Epidemiology and Infection, 142*(8), 1678-1687.

Muzny, C. A., Rivers, C. A., Austin, E. L., & Schwebke, J. R. (2013). *Trichomonas vaginalis* infection among women receiving gynaecological care at an Alabama HIV clinic. *Sexually Transmitted Infections, 89*, 514-518.

Needle, R., Fisher, D. G., Weatherby, N., Chitwood, D., Brown, B., Cesari, H., . . . Braunstein, M. (1995). The reliability of self-reported HIV risk behaviors of drug users. *Psychology of Addictive Behaviors, 9*(4), 242-250.

Nijhawan, A. E., Chapin, K. C., Salloway, R., Andrea, S., Champion, J., Roberts, M., & Clarke, J. G. (2012). Prevalence and predictors of Trichomonas infection in newly incarcerated women. *Sexually Transmitted Diseases, 39*(12), 1-14.

Nijhawan, A. E., DeLong, A. K., Celentano, D. D., Klein, R. S., Sobel, J. D., Jamieson, D. J., & Cu-Uvin, S. (2011). The association between Trichomonas infection and incarceration in HIV-seropositive and at-risk HIV-seronegative women. *Sexually Transmitted Diseases, 38*(12), 1094-1100.

Paschane, D. M., Fisher, D. G., Cagle, H. H., & Fenaughty, A. M. (1998). Gonorrhea among drug users: An Alaskan versus a national sample. *American Journal of Drug and Alcohol Abuse, 24*(2), 285-297.

Plitt, S. S., Garfein, R. S., Gaydos, C. A., Strathdee, S. A., Sherman, S. G., & Taha, T. E. (2005). Prevalence and correlates of chlamydia trachomatis, Neisseria gonorrhoeae, Trichomas vaginalis infections, and bacterial vaginosis among a cohort of young inection drug users in Baltimore, Maryland. *Sexually Transmitted Diseases, 32*(7), 446-453.

Reynolds, G. L., Fisher, D. G., Laurenceau, J. P., & Fortenberry, J. D. (2015). An electronic daily diary study of anal intercourse in drug-using women. *AIDS and Behavior*.

Reynolds, G. L., Fisher, D. G., & Rogala, B. (2015). Why women engage in anal intercourse: Results from a qualitative study. *Archives of Sexual Behavior, 44*(4), 983-995.

Reynolds, G. L., Latimore, A. D., & Fisher, D. G. (2008). Heterosexual anal sex among female drug users: U.S. national compared to local Long Beach, California data. *AIDS and Behavior, 12*(5), 796-805.

Roth, A. M., Williams, J. A., Ly, R., Curd, K., Brooks, D., Arno, J., & Van Der Pol, B. (2011). Changing sexually transmitted infection screening protocol will result in improved case finding for Trichomas vaginalis among high-risk female populations. *Sexually Transmitted Diseases, 38*(5), 398-400.

Saraiya, M., Unger, E. R., Thompson, T. D., Lynch, C. F., Hernandez, B. Y., Lyu, C. W., . . . Goodman, M. T. (2015). US assessment of HPV types in cancers: Implications for current and 9-valent HPV vaccines. *Journal of the National Cancer Institute, 107*(6).

Schlicting, E. G., Johnson, M. E., Brems, C., Wells, R. S., Fisher, D. G., & Reynolds, G. L. (2003). Validity of injecting drug users' self report of hepatitis A, B, and C. *Clinical Laboratory Science, 16*(2), 99-106.

Secor, W. E., Meites, E., Starr, M. C., & Workowski, K. A. (2014). Neglected parasitic infections in the United States: Trichomoniasis. *American Journal of Tropical Medicine and Hygiene, 90*(5), 800-804.

Seth, P., Sales, J. M., DiClemente, R. J., Wingood, G. M., Rose, E., & Patel, S. N. (2011). Longitudinal examination of alcohol use: A predictor of risky sexual behavior and *Trichomonas vaginalis* among African-American female adolescents. *Sexually Transmitted Diseases, 38*(2), 96-101.

Seth, P., Wingood, G. M., & DiClemente, R. J. (2008). Exposure to alcohol problems and its assication with sexual behavior and biologically confirmed *Trichomonas vaginalis* among women living with HIV. *Sexually Transmitted Infections, 84*, 390-392.

Sutcliffe, S., Newman, S. B., Hardick, A., & Gaydos, C. A. (2010). Prevalence and correlates of Trichomonas vaginalis infection among female US federal prison inmates. *Sexually Transmitted Diseases, 37*(9), 585-590.

Sutton, M., Sternberg, M., Koumans, E. H., McQuillan, G., Berman, S., & Markowitz, L. (2007). The prevalence of Trichomonas vaginalis infection among reproductive-age women in the United States, 2001-2004. *Clinical Infectious Diseases, 43*, 1319-1326.

Thaxton, L., & Waxman, A. G. (2015). Cervical cancer prevention: Immunization and screening 2015. *Medical Clinics of North America, 99*(3), 496-477.

van de Wijgert, J., Morrison, C. S., Cornelisse, P. G. A., Munjoma, M., Moncada, J., Awio, P., . . . Padian, N. S. (2008). Bacterial vaginosis and vaginal yeast, but not vaginal cleansing, increase HIV-1 acquisition in African women. *Journal of Acquired Immune Deficiency Syndromes, 48*(2), 203-210.

Van Der Pol, B. (2007). Trichomonas vaginalis infection: The most prevalent nonviral sexually transmitted infection receives the least public health attention. *Clinical Infectious Diseases, 44*, 23-25.

Willers, D. M., Peipert, J. F., Allsworth, J. E., Stein, M. D., Rose, J. S., & G., C. J. (2008). Prevalence and predictors of sexually transmitted infection among newly incarcerated females. *Sexually Transmitted Diseases, 35*(1), 68-72.

Xandre, P. E. (2015). Reducing unnecessary Pap smears in a community clinic: Is the U.S. still over-screening for cervical cancer? . *Clinical Nursing Studies, 3*(4), 53-59.

Table 1: Categorical Variables Associated with Trichomonas Infection

Variable	No Trichomonas n (%)	Yes Trichomonas n (%)	$\chi 2$	df	p
Ever used alcohol	1784 (93)	308 (97)	6.6	1	.0101
Ever used marijuana	1551 (81)	285 (90)	14.1	1	.0002
Ever used crack	864 (45)	240 (76)	100.8	1	.0001
Ever used cocaine	852 (45)	190 (60)	25.6	1	.0001
Ever used heroin	519 (27)	115 (36)	11.0	1	.0009
Ever used speedball	340 (18)	83 (26)	12.3	1	.0004
Ever used nonprescription methadone	132 (7)	32 (10)	4.0	1	.0450
Ever used other opiates	447 (23)	101 (32)	10.4	1	.0013
Ethnicity			52.7	2	.0001
Black Not Hispanic	837 (44)	202 (64)			
White Not Hispanic	612 (32)	85 (27)			
Hispanic	457 (24)	29 (9)			
Homeless	619 (33)	154 (49)	30.5	1	.0001
Ever given sex to get drugs	486 (26)	179 (57)	125.4	1	.0001
Ever given sex to get money	620 (33)	210 (66)	132.2	1	.0001
Sexual Preference			13.8	3	.0032
Heterosexual	1318 (87)	203 (13)			
Gay/Lesbian	10 (83)	2 (17)			
Bisexual	387 (81)	90 (19)			
Other	188 (91)	19 (9)			
Ever had hepatitis B	100 (5)	34 (11)	14.3	1	.0002
Ever had gonorrhea	221 (12)	135 (43)	194.1	1	.0001
Ever had syphilis	81 (4)	57 (18)	89.1	1	.0001
Ever had genital warts	118 (6)	45 (14)	26.1	1	.0001
Ever had Chlamydia	356 (19)	130 (41)	80.7	1	.0001
Ever had herpes	67 (4)	29 (9)	21.0	1	.0001
Ever had yeast infection	899 (48)	235 (76)	84.9	1	.0001
Hepatitis B laboratory positive	180 (16)	62 (31)	24.9	1	.0001
Income from paid job, salary,	502 (26)	51 (16)	15.4	1	.0001

Table 2: Continuous Variables Related to Trichomonas Infection

Variable	No Trichomonas M (*SD*)	Yes Trichomonas M (*SD*)	*t*	df	*p*
Age 1st Marijuana Use	15.7 (5.07)	15.1 (4.23)	2.03	1827	.0422
Age 1st Alcohol Use	16.0 (3.88)	15.5 (4.32)	2.11	1832	.0346
Days Used Alcohol, 30 days	4.9 (8.44)	6.6 (9.97)	3.30	2216	.0010
Days Used Marijuana, 30 days	3.7 (8.63)	4.9 (9.86)	2.35	2222	.0186
Days Used Crack, 30 days	1.9 (6.40)	4.2 (8.62)	5.31	2222	.0001
Days Had Sex, 30 days	6.2 (8.76)	7.4 (9.15)	2.07	2213	.0385
Number of different people had sex with	1.6 (5.45)	2.7 (7.04)	3.24	2219	.0012
Number of sex partners who used drugs	0.4 (1.42)	0.8 (3.52)	4.05	2163	.0001
Number of male sex partners, 30 days	1.3 (5.01)	2.4 (6.69)	3.22	2219	.0013
Days in jail lifetime	520.7 (1374.3)	1196.9 (1985.3)	7.38	2130	.0001
Times used alcohol with sex, 30 days	3.7 (8.72)	5.6 (9.37)	2.62	1211	.0088
Times used crack with sex, 30 days	2.3 (8.39)	4.8 (9.31)	3.17	816	.0016
Times used other opiates with sex, 30 days	0.4 (2.72)	1.1 (5.98)	2.14	760	.0327
Times had receptive anal sex, 30 days	0.6 (3.02)	1.3 (6.45)	2.92	2224	.0036
Age in years	37.3 (11.58)	42.4 (9.02)	7.45	2126	.0001

Tabel 3: Multivariate Logistic Regression Predicting Trichomonas Infection[a] (*n*=2209)

Variable	***B***	***SE***	***Wald***	***OR***	***95% CI[b]***	***p***
Ever had gonorrhea	1.0666	0.1521	49.153	2.9	2.15-3.91	0.0001
Black vs. Hispanic	0.9886	0.2200	20.188	2.7	1.75-4.14	0.0001
Ever Use Crack	0.8837	0.1622	29.666	2.4	1.76-3.33	0.0001
Ever had *Chlamydia*	0.7751	0.1446	28.734	2.2	1.64-2.88	0.0001
Ever had syphilis	0.5910	0.2144	7.599	1.8	1.19-2.75	0.0058
White vs. Hispanic	0.5537	0.2366	5.475	1.7	1.09-2.77	0.0193
Ever given sex for money	0.4947	0.1553	10.144	1.6	1.21-2.22	0.0014
Ever had warts	0.4602	0.2215	4.316	1.6	1.03-2.45	0.0378

Note.[a]Dependent variable = Trichomonas infection coded as 1. [b]95%CI = 95% confidence interval.

Hosmer Lemeshow Goodness-of-Fit χ^2 (8) = 7.9386, p = .4395.