Published in final edited form as:
Womens Health Issues. 2012 January ; 22(1): e1–e7. doi:10.1016/j.whi.2011.05.005.

Incidence of Sexually Transmitted Infections Among Hazardously-Drinking Women Following Incarceration

Michael D. Stein, MD[1,2], **Celeste M. Caviness, MA**[1], and **Bradley J. Anderson, PhD**[1]

Michael D. Stein: Michael_Stein@brown.edu; Celeste M. Caviness: ccaviness@butler.org; Bradley J. Anderson: bjanderson@butler.org

[1] Butler Hospital, Providence, RI 02906

[2] Warren Alpert Medical School of Brown University, Providence, RI 02912

Abstract

Introduction and background—At the time of incarceration, women have a high prevalence of sexually transmitted infections (STI). In the months following community release, women remain at high risk for new infections. This study assessed the rates and predictors of incident Chlamydia, Gonorrhea, and Trichomoniasis in a sample of hazardously-drinking women following incarceration.

Methods—Self-reported behavioral data were collected from 245 incarcerated women. Vaginal swabs were collected at baseline, 3-, and 6-month time-points and tested for Chlamydia, Gonorrhea, and Trichomoniasis. Treatment was provided for all positive tests.

Results—Participants' mean age was 34.1 years of age, 175 (71.4%) (n=175) were Caucasian, 47 (19.2%) were African-American, 17 (6.9%) were Hispanic and 6 (2.4%) were of other ethnic origins. The STI incidence rate was estimated to be 30.5 (95%CI 21.3 – 43.5) new infections per 100 person-years. Number of male sex partners reported during follow-up was a significant (z = 2.16, p = .03) predictor of STI; each additional male sex partner increased the estimated hazard of STI by 1.26.

Conclusions and discussion—Incarcerated women who are hazardous drinkers are at high risk for sexually transmitted infection in the months following their return to the community. In addition to testing and treatment during incarceration, post-release rescreening, education, partner treatment, and follow-up are recommended.

Keywords

Incidence; Sexually transmitted infections; incarceration; women

Introduction

In 2008, nearly 900,000 new cases of Chlamydia (CT) and nearly 200,000 new cases of Gonorrhea (GC) were reported to the Center for Disease Control (CDC) (Center for Disease

Corresponding Author: Michael D. Stein, M.D., Professor of Medicine & Community Health, General Medicine Research Unit, Butler Hospital, 345 Blackstone Blvd., Providence, RI 02906, Telephone: (401) 455-6646, FAX: (401) 455-6618, Michael_Stein@brown.edu.

Control and Prevention, November 2009). However, these data are thought to vastly underestimate the actual numbers of new cases of sexually transmitted infection (STI) every year in the United States, and do not include measures of incident Trichomoniasis (TV), one of the most common STIs (Van der Pol, 2007). Estimates have put actual incidence of curable STI closer to 2.8 million cases of CT, 718,000 cases of GC, and 7.4 million cases of TV per year (Weinstock, Berman, & Cates, 2004). Trends in reported STI in male and female young adult samples show STI tend to affect women at higher rates than men (Center for Disease Control and Prevention, November 2009; Datta, et al., 2007; Plitt, et al., 2005).

Left untreated, STI can have serious adverse consequences for women. Chlamydial and Gonorrheal infection can lead to pelvic inflammatory disease (PID), ectopic pregnancy, and infertility (Center for Disease Control and Prevention, 2007a, 2010) and recurrent Chlamydial infection has been shown to increase these risks (Hillis, Owens, Marchbanks, Amsterdam, & Mac Kenzie, 1997). GC also poses a risk to newborns, as the infection can be transmitted during childbirth leading to blindness and bloodstream infections (Center for Disease Control and Prevention, 2007a). TV increases the risk for preterm delivery, low infant birth weight, likelihood of concurrent STI, and has been noted to increase the susceptibility to and transmission of HIV (Allsworth, Ratner, & Peipert, 2009; Center for Disease Control and Prevention, 2007b; McClelland, et al., 2007; Shafir, Sorvillo, & Smith, 2009). The association between HIV transmission and TV is especially concerning given that TV is the most common non-viral STI in the United States, and has received limited public health attention (Van der Pol, 2007).

Longitudinal studies have provided STI incidence rates in some higher risk populations. Adolescents enrolled in an HIV intervention trial had incident STI rates between 2.1% (GC) and 10.4% (CT) (Crosby, et al., 2004), while female homeless adolescents had a CT annualized incidence of 12.1% (Noell, et al., 2001). Incident rates are higher at STI clinics with rates of CT ranging between 2.3%–13.4 when assessed using follow-up periods that span from 4 to 33 months (Burstein, et al., 2001; Rietmeijer, Van Bemmelen, Judson, & Douglas, 2002; Whittington, et al., 2001). Peterman et al., demonstrated that 25.5% of substance abusing women had an incident TV, GC, or CT infection over the course of one year after a baseline STI diagnosis (Peterman, et al., 2006). TV incidence was 31% in a sample of drug using women in New York City followed for at least one year (Miller, Liao, Gomez, Gaydos, & D'Mellow, 2008).

In addition to demonstrating high rates of incident STI in populations at increased risk, the above studies also suggest predictive factors for incident infection. In many studies, testing positive for an STI predicts subsequent STI infection (Crosby, et al., 2004; Helms, et al., 2008; Miller, et al., 2008; Peterman, et al., 2006; Rietmeijer, et al., 2002). Incident STI is also significantly associated with inconsistent condom use (Crosby, et al., 2004; Noell, et al., 2001; Rietmeijer, et al., 2002), number of sexual partners (Crosby, et al., 2004; Helms, et al., 2008; Miller, et al., 2008; Noell, et al., 2001; Peterman, et al., 2006; Skjeldestad, Marsico, Sings, Nordbo, & Storvold, 2009), and younger age (Burstein, et al., 2001; Peterman, et al., 2006; Rietmeijer, et al., 2002; Skjeldestad, et al., 2009). Women younger than twenty-five are disproportionately affected by CT and GC (Center for Disease Control and Prevention, 2009) while TV is more often diagnosed in women over 25 (Sutton, et al., 2007).

Incarcerated women are at risk for STIs. Prevalence rates at intake screening and data collection as part of clinical trials at adult correctional facilities found CT prevalence between 2.5–13% and GC prevalence of 2.3–10% (Hardick, et al., 2003; Mertz, Voigt, Hutchins, & Levine, 2002; Willers, et al., 2008). Prevalence of TV ranged from 22–47% (Shuter, Bell, Graham, Holbrook, & Bellin, 1998; Willers, et al., 2008). High numbers of lifetime partners (Sutton, et al., 2007), concurrent partnerships (Gollub, et al., 2010), and sex

work (Willers, et al., 2008) are associated with higher STI prevalence. A study of syphilis incidence following release of jailed women found the incidence rate to be nearly 1000-fold that of the general population, and 10-fold that of persons seeking treatment at an STI clinic (Blank, et al., 1999). To our knowledge, incident rates of Chlamydia, Gonorrhea, and Trichomoniasis, have not been measured prospectively in a population of detained women following detention.

Alcohol is involved in a large proportion of women's crimes, and hazardous drinking is a common phenomenon in incarcerated female populations (Caviness, et al., 2009; Freudenberg, Moseley, Labriola, Daniels, & Murrill, 2007; Greenfeld & Snell, 1999). The role of alcohol use in risky sexual behavior has been studied extensively. There is a substantial literature suggesting alcohol use before sex contributes to riskier sexual encounters, especially with new or casual partners (Barta, et al., 2008; Kiene, Barta, Tennen, & Armeli, 2009; Stein, et al., 2009) and alcohol is often mixed with other drugs, including cocaine. Alcohol and cocaine are the two substances most frequently abused by incarcerated women (National Institute of Justice (U.S.), 2003). Given that jailed women have a far higher STI prevalence than the general population, it is important to understand the pattern of incident infection after release and during community re-integration. This study provides STI incidence data and examines predictors of incident STIs among hazardously-drinking incarcerated women who are returning to the community and are enrolled in brief motivational alcohol intervention study (Stein, Caviness, Anderson, Hebert, & Clarke, 2010).

Methods

Study Site

No county jails exist in the geographically small state of Rhode Island; instead all inmates are housed by the Rhode Island Department of Correction (RI DOC) at the Adult Correctional Institute (ACI). The ACI operates as a unified, centralized and comprehensive state correctional system, and encompasses all jail, prison and rehabilitative services, including community corrections (probation/parole). However, the Women's Facility functions like jails throughout the nation, with the majority of women returning to the community within 30 days of commitment (Hebert, et al., 2008).

Study Design

Participants—All newly incarcerated women over a 40-month period from February 2004 to June 2007 were eligible for screening. During the enrollment period, 1616 women were approached for screening and 201 refused. Of the 1415 women screened, 1133 were ineligible and 33 eligible women refused to participate leaving a final sample of 245 women who enrolled in a randomized clinical trial of a brief intervention to reduce alcohol use and HIV risk (Stein, et al., 2010). The trial protocol was approved by the Miriam Hospital Institutional Review Board, the Office for Human Research Protection, and the RI DOC's Medical Research Advisory Group. Additionally, a Certificate of Confidentiality was obtained from the federal government to further protect the information collected from study participants.

Procedure—Screening was conducted confidentially, without compensation, beginning with informed verbal consent. During the consent process, it was stressed that refusal to be screened would have no negative impact on future or current services or correctional disciplinary status. After providing verbal consent, screening questions were read to inmates and answers were recorded by the study research assistant (RA). Screening was conducted confidentially, in a private room without surveillance.

Participants were eligible for the trial if they 1) spoke English, 2) could provide adequate contact information for follow-up, 3) were likely to be released in the next 14 days, 4) endorsed having unprotected heterosexual sex at least three days in the previous three months, and 5) reported hazardous alcohol consumption, defined by NIAAA binge criteria (four or more drinks on one occasion), at least three times in the past three months, or a score of 8 or above on the Alcohol Use Disorders Identification Test (AUDIT) (Saunders, Aasland, Babor, De La Fuente, & Grant, 1993). Informed written consent was obtained from all participants and in accordance with the policies and guidelines of our institutional IRB.

After completion of the consent process, the RA read aloud and recorded answers for a 45-minute baseline survey. After the survey, respondents were asked to give vaginal swabs to test for Trichomoniasis, Gonorrhea and Chlamydia. If a participant tested positive to any of the STIs, they were treated using antibiotics as indicated by current CDC treatment guidelines (Center for Disease Control and Prevention, 2006). Participants were paid $20, in the form of a money order mailed to them upon release from the ACI, for their time.

Following the baseline interview, participants were randomized to one of two groups. The treatment group received a brief alcohol motivational intervention (approximately 60 minutes) on the same day as the baseline interview. A second, 30-minute follow up intervention was delivered 1-month after the participant was released from the ACI (see details in (Stein, et al., 2010). Follow up interviews either in the community or at the ACI were conducted at 1-, 3-, and 6- months, after baseline. The 3- and 6-month interviews included STI swabs. Participants were paid in cash, $30 for the 1-month, $40 for the 3-month and $50 for the 6-month visit. Complete details regarding study procedures are published elsewhere (See Hebert, et al., 2008; Stein, et al., 2010).

Measures

Sexually transmitted infection (STI): The primary outcome was a dichotomous indicator scored 1 if the participant tested positive for Trichomoniasis, Chlamydia, or Gonorrhea on a biological assay. CT and GC testing was performed using DNA amplification of endocervical swabs (Becton Dickinson BDProbe Tem™ ET; Becton, Dickinson and Company, Franklin Lakes, New Jersey). TV testing was performed using sterile cotton swab collection and InPouch™ culture (Biomed Diagnostics, White City, Oregon).

Time Varying Covariates

The *Timeline followback (TLFB) method* (Sobell & Sobell, 1996) was used to assess the frequency of alcohol use, frequency of heavy alcohol use (≥ 4 drinks/day), and frequency of unprotected sexual intercourse with main and casual partners (partner other than main) in the 90 days before baseline and at each follow up interview. This calendar based assessment procedure uses RA prompts of important dates, (e.g., birthdays or anniversaries) to elicit recall of behavioral health data. At each follow-up participants recalled their behaviors to the previous assessment. Unprotected sex was defined as vaginal or anal intercourse without use of a condom.

Using the Risk Assessment Battery (Metzger, Woody, & Navaline, 1993), and the Addiction Severity Index (McLellan, et al., 1992), participants were also asked to report the total number of male sex partners since their last assessment, whether they had exchanged sex for money, and use of cocaine during that interval.

Other covariates—Time-invariant predictors assessed at baseline included age in years, race, number of days on which cocaine was used in the 90 days prior to baseline, sex work

(1 if the participant reported exchanging sex for money in the 90 days prior to baseline), and history of STI (CT, GC, or TV; 1 if participant reported prior diagnosis of any of these STI).

Analytical Methods

Descriptive statistics are presented to summarize the baseline characteristics of this cohort. The mean number of days incarcerated at baseline was 2.13 (± 7.26, Median = 0, Range = 0 – 58). STI tests during follow up were conducted at the 3- and 6-month assessments. Unadjusted incidence rates (IR) were estimated using multiple event data in which time was calculated as the number of days between baseline and 3-month assessment, days between 3- and 6-month assessments, and, for those located at 6-months but not at 3-months, days between baseline and 6-month assessments. These estimates use all available data but likely underestimate the actual IR of STI in this population. Specifically, STI was assessed at the end of 3- and 6-months follow-ups while new infections may have been contracted at any time during the periods assessed. Three- and 6-month IR estimates are based on 17,290 and 18,554 person-days, respectively.

This cohort also spent significant periods of time incarcerated during the follow-up assessment periods. On average participants spent 26.9 (± 30.7) days incarcerated in the interval between baseline and 3-month assessment, and 17.4 (±29.5) days incarcerated between 3- and 6-month intervals. Days spent incarcerated are, presumably, days at which participants are not directly exposed to the risk of acquiring new STIs. Therefore, we also calculated adjusted IR estimates based on non-incarceration days. When calculating these rates we treated the first day of any new incarceration as a day at risk; this assumes persons may have been sexually active on the initial day of incarceration. Adjusted estimates of STI incidence rates were based on 11,323 and 15,536 non-incarcerated person days at 3- and 6-months, respectively. All incidence rate estimates are expressed as number of events per 100 person-years.

Cox proportion hazards regression models were used to estimate the bivariate association of background characteristics, indicators of substance use, and measures of risky sexual behaviors on the hazard of acquiring new STIs during follow-up. Predictors included both time-invariant and time-varying covariates. One time-varying covariate was change in alcohol use frequency between assessments. Indicators of substance use and sexual risk behaviors were evaluated both as time-invariant covariates assessed at baseline, and as time-varying covariates assessed during the time intervals corresponding to the assessment of STI during follow-up. All tests of significance and confidence interval estimates were based on Huber-White (Williams, 2000) robust standard errors that adjust for within subject clustering as implemented in Stata 10.1 (StataCorp, 2008).

Results

The age range was 18 to 56 with a mean of 34.1 (± 8.9) years (Table 1). About 71.4% (n=175) were Caucasian, 47 (19.2%) African-American, 17 (6.9%) Hispanic, and 6 (2.4%) were of other racial or ethnic origins. Twenty-six (10.6%) were homeless at baseline and 154 (62.9%) had completed high school. On average participants consumed alcohol on 51.8% (± 32.6) of days (in the past 90 days), and heavy quantities (≥ 4 drinks/day) of alcohol on 43.9% (± 33.7) of the 90-days prior to baseline assessment. Participants reported consuming an average of 11.3 (± 11.3; Median = 8.9) drinks per day on days when any alcohol was consumed. Nearly, 90% (n=220) of participants met DSM-IV criteria for the diagnosis of alcohol dependence in their lifetime.

Non-missing STI tests were available for 185 (75.5%) and 190 (77.6%) of women at 3- and 6-months, respectively Missing test results accounted for 10.4% of those excluded from

these analyses, the rest were due to attrition. Generally, missing tests were due to continuous incarceration, or participant refusal. Only 32 (13.1%) women were not tested at either follow up assessment. A total of 79.2% and 78.8% of women completed 3- and 6-month follow up interviews respectively. The likelihood of being lost to follow-up was not associated significantly with testing positive for STI at baseline (OR = 0.88, z = −0.29, p = .768), exchanging sex for money (OR = 1.12, z = 0.26, p = .791), number of male sex partners prior to baseline (OR = 0.94, z = −0.46, p = .646), proportion of days having unprotected sex with a main partner (OR = 0.54, z = −1.06, p = .289), or proportion of days having unprotected sex with casual partners (OR = 1.08, z = 0.07, p = .947).

During the 90 days prior to baseline, just over two-thirds (67.8%) reported using cocaine on 1 or more days (Table 1); 101 (41.2%) reported having sex with 1 or more casual partners, 104 (42.5%) reported having sex with 2 or more male partners, and 66 (26.9%) said they had exchanged sex for money. One-hundred-sixteen (47.4%) participants self-reported ever testing positive for Chlamydia (n=83; 33.9%), Trichomoniasis (n=52; 21.2%), or Gonorrhea (n=55; 22.5%). At Baseline, 56 (22.9%) tested positive for one or more of these STIs.

Table 2 reports rates of STIs at baseline, and at 3- and 6-month assessments. At baseline, 7 (2.9%) participants tested positive for Chlamydia, 48 (20.5%) for Trichomoniasis, and 6 (2.5%) for Gonorrhea. Overall, 12 (6.5%) women were observed to have 1 or more new STIs at 3-months and 19 (10.0%) women had new infections when tested at 6-months. Trichomoniasis was the most frequently observed new infection during follow-up. Observed rates for specific infections are also presented in Table 2.

Table 3 reports the overall incidence rate of a new STI.. The incidence rate for any STI was 30.5 (95%CI 21.3 – 43.5) new infections per 100 person-years, 8.1, (95%CI 4.1 – 16.2) for Chlamydia, 7.1, (95%CI 3.4 – 14.9) for Gonorrhea, and 19.3 (95%CI 12.3 – 30.2) for Trichomoniasis. The adjusted incidence rate of any new STI was 36.2 (95%CI 24.8 – 52.8) per 100 person-years of risk exposure, 10.7, (95%CI 5.4 – 21.5) for Chlamydia, 9.4, (95%CI 4.5 – 19.7) for Gonorrhea, and 21.5, (95%CI 13.2 – 35.0) for Trichomoniasis.

The estimated bivariate effects of evaluated predictor variables on the hazard of testing positive for an STI at follow-up are reported in Table 4. Predictors include both time invariant predictors assessed at baseline and time-varying predictors assessed during the corresponding period of follow-up. None of the time-invariant baseline predictors were associated significantly with time to STI during follow-up. Participants who tested positive for STI at baseline (HR = 1.67, z = 1.40, p = .160) and those who self-reported a positive lifetime history of Gonorrhea, Chlamydia, or Trichomoniasis (HR = 1.56, z = 1.24, p = .215) tended to have higher rates of follow-up STI in this cohort. Time to new STI infection was not associated significantly with intervention (HR = 0.90, z = −0.31, p = .758).

Number of male sex partners reported during the corresponding follow-up period was a significant (z = 2.16, p = .030) predictor of STI; each additional male sex partner increased the expected hazard of STI by a factor of 1.26. Participants who reported any sex work during the follow-up period were also observed to have a higher hazard of testing positive for STI (HR = 1.97) though this effect was only marginally significant statistically (z = 1.85, p = .064). The likelihood of STI was also not associated significantly with change in the proportion of days participants reported using any alcohol (HR = 1.76, z = 1.28, p = .199) or using heavy quantities of alcohol (HR = 1.38, z = 0.69, p = .491) between assessments. Results were robust to definitions of time to event, Cox regression models predicting time to STI adjusted for days incarcerated, and logistic regression models predicting any new STI during follow-up produced results substantively and statistically consistent those reported in Table 4.

Discussion

To our knowledge, this is the first study to report on incident CT, GC, and TV infections in a population of recently incarcerated women. In this cohort of hazardously drinking incarcerated women, an overall incident rate for any STI was 30.5 infections per 100 person-years. Incident rates were 8.1, 7.1, and 19.3 per 100 person years for Chlamydia, Gonhorrhea, and Trichomoniasis respectively. Incident infection was associated with number of male sexual partners during the follow-up period.

Incident rates calculated for women in the general population based on reported cases of CT and GC are .584 cases per 100-women years and .119 cases per 100-women years respectively (reported as 583.8 and 119.4 cases per 100,000 population, respectively) (Center for Disease Control and Prevention, November 2009). Rates of STI incidence are significantly higher in specific populations such as those visiting STI clinics, 11.7/100 person-years (CT) (Rietmeijer, et al., 2002), African-American women who use drugs, (TV), 35.1/100 person-years (Miller, et al., 2008), and school age adolescents, 6.0/100 person-years (CT/GC) (Anschuetz, et al., 2009). The rates reported in our cohort are extremely high.

Our findings, along with those of other researchers suggest that having multiple sexual partners is a predictor of incident STI. Unlike other cohorts, baseline STI, condom use, and age did not significantly predict STI at follow-up. These findings are similar to those observed by Whittington et al (Whittington, et al., 2001), who found no significant predictors of incident STI in a sample of young women (age 14–34) who tested positive for CT at baseline. However, these findings should be interpreted cautiously given the low number of infections in our sample.

As evidenced by the increased risk of STI as number of partners increases, these women are in contact with infected, high-risk, partners. Even those women who have only a single partner may be at increased risk of STI if their partners have concurrent partnerships (Lichtenstein, Desmond, & Schwebke, 2008; Senn, Carey, Vanable, Coury-Doniger, & Urban, 2009) especially given that condom use with main partner was infrequent in this cohort.

This study has important strengths. First, incident rates of CT, GC, and TV have not been reported in this population. Second, participants testing positive at baseline were treated either at the ACI, or by the study physician, and women were again treated by research staff if they tested positive at the 3-month interview. From other reports, treatment failure rates would be less than 5% (Hillis, et al., 1998), therefore these findings provide an accurate picture of incident STI in this population. Finally, attrition was low, with 86.9% of participants having at least one valid STI test at 3- or 6 months.

This study also has limitations. This study included only hazardously drinking incarcerated women who engaged in heterosexual sex. Although jailed women are often heavily alcohol involved (Caviness, et al., 2009; Freudenberg, et al., 2007), these results may not generalize to incarcerated women who do not engage in hazardous drinking, or to men. Second, predictor variables, with the exception of STI at baseline, were based on self-report. TLFB is retrospective and recall error may have occurred despite our use of techniques to minimize error and bias (Schroder, Carey, & Vanable, 2003). Third, women who have sex with women exclusively or who were not sexually active were not included in the study. Finally, days incarcerated were considered non-risk days and were not included in the adjusted incident rate. It is possible women acquired an STI while in prison, from sexual contact with other prisoners or correctional staff; however, we expect this rate would be very low, therefore the adjusted STI exposure is likely the least biased estimate.

Findings from this study highlight the high incidence rates of STI in a sample of hazardously-drinking incarcerated women, and their increased vulnerability to recurrent STI with multiple partnerships. Although many correctional facilities do test for and treat STI at admission this high risk population often does not receive regular primary or gynecological care, so follow-up testing is critical (Barry, Kent, Scott, Goldenson, & Klausner, 2009). These women may be part of a 'core transmitter' sexual network, a group of individual with high rates of STI and multiple risky partnerships (Gunn, Fitzgerald, & Aral, 2000). STIs are particularly concentrated in these types of sexual networks and mean a small number of individuals have a chance to infect many people outside the network. As potential core transmitters, this population may be worthy of significant additional public health resources including treatment planning, partner notification, sexual health education, and post-release follow-up. These additional services may have a disproportionate positive impact on public health. The majority of inmate education and prevention programs have focused on HIV risk reduction and prevention (Bond & Semaan, 1996; Braithwaite & Arriola, 2003; Desai, Latta, Spaulding, Rich, & Flanigan, 2002; Robillard, et al., 2003), largely ignoring other treatable STIs, or not testing for them over time. Other STIs pose significant health risks, especially among women. These risks include PID, pregnancy complications, and increased susceptibility to and transmission of HIV (Center for Disease Control and Prevention, 2007a, 2007b; Hillis, et al., 1997; McClelland, et al., 2007).

Given the high rates of STI in incarcerated women and their medical complications, more research into effective treatment and prevention programs are needed. Systematic screening and clinical care during incarceration may have a large public health impact. As jailed women are arrested and released back to the community quickly (Hebert, et al., 2008), post-release follow-up, partner notification, STI education, and rescreening are recommended, especially given the high rate of incident STI found in the current study.

Acknowledgments

This study was funded by the National Institute on Alcoholism and Alcohol Abuse AA 014495. Dr. Stein is a recipient of NIDA Award K24 DA000512. Dr. Stein had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

References

Allsworth JE, Ratner JA, Peipert JF. Trichomoniasis and other sexually transmitted infections: results from the 2001–2004 National Health and Nutrition Examination Surveys. Sexually Transmitted Diseases. 2009; 36(12):738–744. [PubMed: 19734826]

Anschuetz GL, Beck JN, Asbel L, Goldberg M, Salmon ME, Spain CV. Determining risk markers for gonorrhea and chlamydial infection and reinfection among adolescents in public high schools. Sexually Transmitted Diseases. 2009; 36(1):4–8. [PubMed: 18813031]

Barry PM, Kent CK, Scott KC, Goldenson J, Klausner JD. Is jail screening associated with a decrease in Chlamydia positivity among females seeking health services at community clinics?-San francisco, 1997–2004. Sexually Transmitted Diseases. 2009; 36(2 Suppl):S22–28. [PubMed: 18418298]

Barta WD, Portnoy DB, Kiene SM, Tennen H, Abu-Hasaballah KS, Ferrer R. A daily process investigation of alcohol-involved sexual risk behavior among economically disadvantaged problem drinkers living with HIV/AIDS. AIDS and Behavior. 2008; 12(5):729–740. [PubMed: 18071894]

Blank S, Sternberg M, Neylans LL, Rubin SR, Weisfuse IB, St Louis ME. Incident syphilis among women with multiple admissions to jail in New York City. J Infect Dis. 1999; 180(4):1159–1163. [PubMed: 10479143]

Bond L, Semaan S. At risk for HIV infection: incarcerated women in a county jail in Philadelphia. Women and Health. 1996; 24(4):27–45.

Braithwaite RL, Arriola KR. Male prisoners and HIV prevention: a call for action ignored. American Journal of Public Health. 2003; 93(5):759–763. [PubMed: 12721138]

Burstein GR, Zenilman JM, Gaydos CA, Diener-West M, Howell MR, Brathwaite W, et al. Predictors of repeat Chlamydia trachomatis infections diagnosed by DNA amplification testing among inner city females. Sex Transm Infect. 2001; 77(1):26–32. [PubMed: 11158688]

Caviness CM, Hatgis C, Anderson BJ, Rosengard C, Kiene SM, Friedmann PD, et al. Three brief alcohol screens for detecting hazardous drinking in incarcerated women. Journal of Studies on Alcohol and Drugs. 2009; 70(1):50–54. [PubMed: 19118391]

Center for Disease Control and Prevention. Sexually Transmitted Diseases Treatment Guidelines, 2006. Morbidity and Mortality Weekly Report. 2006; 55(RR-11):1–94. (Corrected September, 2006). [PubMed: 16410759]

Center for Disease Control and Prevention. CDC Fact Sheet: Gonorrhea. Atlanta, GA: 2007a.

Center for Disease Control and Prevention. CDC Fact Sheet: Trichomoniasis. Atlanta, GA: 2007b.

Center for Disease Control and Prevention. Trends in reportable sexually transmitted diseases in the United States, 2007. Atlanta, GA: 2009.

Center for Disease Control and Prevention. CDC Fact Sheet: Chlamydia. Atlanta, GA: 2010.

Center for Disease Control and Prevention. Sexually Transmitted Disease Surveillance, 2008. Atlanta, GA: November. 2009

Crosby RA, DiClemente RJ, Wingood GM, Salazar LF, Rose E, Levine D, et al. Associations between sexually transmitted disease diagnosis and subsequent sexual risk and sexually transmitted disease incidence among adolescents. Sexually Transmitted Diseases. 2004; 31(4):205–208. [PubMed: 15028932]

Datta SD, Sternberg M, Johnson RE, Berman S, Papp JR, McQuillan G, et al. Gonorrhea and chlamydia in the United States among persons 14 to 39 years of age, 1999 to 2002. Annals of Internal Medicine. 2007; 147(2):89–96. [PubMed: 17638719]

Desai AA, Latta ET, Spaulding A, Rich JD, Flanigan TP. The importance of routine HIV testing in the incarcerated population: the Rhode Island experience. AIDS Education and Prevention. 2002; 14(5 Suppl B):45–52. [PubMed: 12413192]

Freudenberg N, Moseley J, Labriola M, Daniels J, Murrill C. Comparison of health and social characteristics of people leaving New York City jails by age, gender, and race/ethnicity: implications for public health interventions. Public Health Reports. 2007; 122:733–743. [PubMed: 18051666]

Gollub EL, Armstrong K, Boney T, Mercer D, Chhatre S, Fiore D, et al. Correlates of Trichomonas Prevalence Among Street-Recruited, Drug-Using Women Enrolled in a Randomized Trial. Subst Use Misuse. 2010

Greenfeld, L.; Snell, T. Women offenders. (NCJ 175688). Washington, DC: Bureau of Justice Statistics; 1999.

Gunn RA, Fitzgerald S, Aral SO. Sexually transmitted disease clinic clients at risk for subsequent gonorrhea and chlamydia infections: possible ‘core’ transmitters. Sexually Transmitted Diseases. 2000; 27(6):343–349. [PubMed: 10907910]

Hardick J, Hsieh YH, Tulloch S, Kus J, Tawes J, Gaydos CA. Surveillance of Chlamydia trachomatis and Neisseria gonorrhoeae infections in women in detention in Baltimore, Maryland. Sexually Transmitted Diseases. 2003; 30(1):64–70. [PubMed: 12514445]

Hebert MR, Clarke JG, Caviness CM, Ray MK, Friedmann PD, Stein MD. Feasibility of gaining access to women in jail for health interventions. Women and Health. 2008; 47(3):79–93.

Helms DJ, Mosure DJ, Metcalf CA, Douglas JM Jr, Malotte CK, Paul SM, et al. Risk factors for prevalent and incident Trichomonas vaginalis among women attending three sexually transmitted disease clinics. Sexually Transmitted Diseases. 2008; 35(5):484–488. [PubMed: 18360314]

Hillis SD, Coles FB, Litchfield B, Black CM, Mojica B, Schmitt K, et al. Doxycycline and azithromycin for prevention of chlamydial persistence or recurrence one month after treatment in women. A use-effectiveness study in public health settings. Sexually Transmitted Diseases. 1998; 25(1):5–11. [PubMed: 9437777]

Hillis SD, Owens LM, Marchbanks PA, Amsterdam LF, Mac Kenzie WR. Recurrent chlamydial infections increase the risks of hospitalization for ectopic pregnancy and pelvic inflammatory disease. Am J Obstet Gynecol. 1997; 176(1 Pt 1):103–107. [PubMed: 9024098]

Kiene SM, Barta WD, Tennen H, Armeli S. Alcohol, helping young adults to have unprotected sex with casual partners: findings from a daily diary study of alcohol use and sexual behavior. Journal of Adolescent Health. 2009; 44(1):73–80. [PubMed: 19101461]

Lichtenstein B, Desmond RA, Schwebke JR. Partnership concurrency status and condom use among women diagnosed with Trichomonas vaginalis. Women's Health Issues. 2008; 18(5):369–374.

McClelland RS, Sangare L, Hassan WM, Lavreys L, Mandaliya K, Kiarie J, et al. Infection with Trichomonas vaginalis increases the risk of HIV-1 acquisition. J Infect Dis. 2007; 195(5):698–702. [PubMed: 17262712]

McLellan AT, Kushner H, Metzger D, Peters R, Smith I, Grissom G, et al. The Fifth Edition of the Addiction Severity Index. J Subst Abuse Treat. 1992; 9(3):199–213. [PubMed: 1334156]

Mertz KJ, Voigt RA, Hutchins K, Levine WC. Findings from STD screening of adolescents and adults entering corrections facilities: implications for STD control strategies. Sexually Transmitted Diseases. 2002; 29(12):834–839. [PubMed: 12466728]

Metzger, D.; Woody, G.; Navaline, H. The Risk Assessment Battery: validity and reliability. Presented at the 6th Annual Meeting of the National Cooperative Vaccine Development Groups for AIDS; Alexandria, VA. 1993.

Miller M, Liao Y, Gomez AM, Gaydos CA, D'Mellow D. Factors associated with the prevalence and incidence of Trichomonas vaginalis infection among African American women in New York city who use drugs. J Infect Dis. 2008; 197(4):503–509. [PubMed: 18275272]

National Institute of Justice (U.S.). 2000 arrestee drug abuse monitoring: annual report (NIJ193013). Washington, DC: 2003.

Noell J, Rohde P, Ochs L, Yovanoff P, Alter MJ, Schmid S, et al. Incidence and prevalence of chlamydia, herpes, and viral hepatitis in a homeless adolescent population. Sexually Transmitted Diseases. 2001; 28(1):4–10. [PubMed: 11196044]

Peterman TA, Tian LH, Metcalf CA, Satterwhite CL, Malotte CK, DeAugustine N, et al. High incidence of new sexually transmitted infections in the year following a sexually transmitted infection: a case for rescreening. Annals of Internal Medicine. 2006; 145(8):564–572. [PubMed: 17043338]

Plitt SS, Garfein RS, Gaydos CA, Strathdee SA, Sherman SG, Taha TE. Prevalence and correlates of chlamydia trachomatis, neisseria gonorrhoeae, trichomonas vaginalis infections, and bacterial vaginosis among a cohort of young injection drug users in Baltimore, Maryland. Sexually Transmitted Diseases. 2005; 32(7):446–453. [PubMed: 15976603]

Rietmeijer CA, Van Bemmelen R, Judson FN, Douglas JM Jr. Incidence and repeat infection rates of Chlamydia trachomatis among male and female patients in an STD clinic: implications for screening and rescreening. Sexually Transmitted Diseases. 2002; 29(2):65–72. [PubMed: 11818890]

Robillard AG, Gallito-Zaparaniuk P, Arriola KJ, Kennedy S, Hammett T, Braithwaite RL. Partners and processes in HIV services for inmates and ex-offenders. Facilitating collaboration and service delivery. Eval Rev. 2003; 27(5):535–562. [PubMed: 14531318]

Saunders J, Aasland O, Babor T, De La Fuente J, Grant M. Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption-II. Addiction. 1993; 88:791–804. [PubMed: 8329970]

Schroder KE, Carey MP, Vanable PA. Methodological challenges in research on sexual risk behavior: II. Accuracy of self-reports. Annals of Behavioral Medicine. 2003; 26(2):104–123. [PubMed: 14534028]

Senn TE, Carey MP, Vanable PA, Coury-Doniger P, Urban M. Sexual partner concurrency among STI clinic patients with a steady partner: correlates and associations with condom use. Sex Transm Infect. 2009; 85(5):343–347. [PubMed: 19204019]

Shafir SC, Sorvillo FJ, Smith L. Current issues and considerations regarding trichomoniasis and human immunodeficiency virus in African-Americans. Clin Microbiol Rev. 2009; 22(1):37–45. Table of Contents. [PubMed: 19136432]

Shuter J, Bell D, Graham D, Holbrook KA, Bellin EY. Rates of and risk factors for trichomoniasis among pregnant inmates in New York City. Sexually Transmitted Diseases. 1998; 25(6):303–307. [PubMed: 9662764]

Skjeldestad FE, Marsico MA, Sings HL, Nordbo SA, Storvold G. Incidence and risk factors for genital Chlamydia trachomatis infection: a 4-year prospective cohort study. Sexually Transmitted Diseases. 2009; 36(5):273–279. [PubMed: 19265733]

Sobell, L.; Sobell, M. Timeline Followback User's Guide: A Calendar Method for Assessing Alcohol and Drug Use. Toronto, Ontario, Canada: Addiction Research Foundation; 1996.

StataCorp. Stata Statistical Software: Release 10.1. College Station, TX: StataCorp LP; 2008.

Stein M, Anderson B, Caviness C, Rosengard C, Kiene S, Friedmann P, et al. Relationship of alcohol use and sexual risk taking among hazardously drinking incarcerated women: an event-level analysis. Journal of Studies on Alcohol and Drugs. 2009; 70(4):508–515. [PubMed: 19515290]

Stein M, Caviness C, Anderson B, Hebert M, Clarke J. A brief alcohol intervention for hazardously-drinking incarcerated women. Addiction. 2010; 105(3):466–475. [PubMed: 20402990]

Sutton M, Sternberg M, Koumans EH, McQuillan G, Berman S, Markowitz L. The prevalence of Trichomonas vaginalis infection among reproductive-age women in the United States, 2001–2004. Clin Infect Dis. 2007; 45(10):1319–1326. [PubMed: 17968828]

Van der Pol B. Trichomonas vaginalis infection: the most prevalent nonviral sexually transmitted infection receives the least public health attention. Clin Infect Dis. 2007; 44(1):23–25. [PubMed: 17143810]

Weinstock H, Berman S, Cates W. Sexually transmitted diseases among American youth: incidence and prevalence estimates 2000. Perspectives on Sexual and Reproductive Health. 2004; 36(1):6–10. [PubMed: 14982671]

Whittington WL, Kent C, Kissinger P, Oh MK, Fortenberry JD, Hillis SE, et al. Determinants of persistent and recurrent Chlamydia trachomatis infection in young women: results of a multicenter cohort study. Sexually Transmitted Diseases. 2001; 28(2):117–123. [PubMed: 11234786]

Willers DM, Peipert JF, Allsworth JE, Stein MD, Rose JS, Clarke JG. Prevalence and predictors of sexually transmitted infection among newly incarcerated females. Sexually Transmitted Diseases. 2008; 35(1):68–72. [PubMed: 18090178]

Williams RL. A note on robust variance estimation for cluster-correlated data. Biometrics. 2000; 56(2):645–646. [PubMed: 10877330]

Biographies

Michael Stein, M.D., Professor of Medicine & Community Health at Brown University has spent the past twenty years developing and testing HIV prevention interventions related to sexual and drug risk-taking.

Celeste Caviness, M.A., is a Project Manager in the General Medicine Research Unit at Butler Hospital in Providence, RI. Her research interests include substance use and sexual risk behavior in vulnerable populations.

Bradley Anderson, Ph.D., is senior research methodologist and statistician in General Medicine Research at Butler Hospital in Providence, RI. His research program has focused on injection and sexual risk behaviors in substance using populations.

Table 1

Background Characteristics (n = 245).

	Mean (SD)	n (%)
Age in Years	34.07 (8.86)	
Ethnicity		
Caucasian		175 (71.4%)
African-American		47 (19.2%)
Hispanic		17 (6.9%)
Other Ethnic Origin		6 (2.4%)
Completed High School/GED (Yes)		154 (62.9%)
Homeless (Yes)		26 (10.6%)
% Days Consumed Alcohol[a]	51.76 (32.60)	
% Days Consumed ≥ 4 Drinks[a]	43.88 (33.74)	
Recent (90-Days) Cocaine Use (Yes)		166 (67.8%)
Any Casual Sex Partners		101 (41.2%)
Multiple Male Sex Partners (Yes)		104 (42.5%)
Any Sex Work (Yes)		66 (26.9%)
Lifetime STI – Self Reported (Yes)[b]		116 (47.4%)
Tested STI+ at Baseline (Yes)[c]		56 (22.9%)
Randomized to Intervention (Yes)		125 (51.0%)

[a] 90 days prior to baseline incarceration

[b] Self-reported history of ever testing positive for Chlamydia, Trichomoniasis, or Gonorrhea.

[c] Tested positive for Chlamydia, Trichomoniasis, or Gonorrhea at baseline.

Table 2

Rates of Chlamydia, Trichomoniasis, and Gonorrhea at Baseline, 3-Month, and 6-Month Assessments.

	Baseline	3-Months	6-Months
STI	**n/N[a] (%) Positive**	**n/N[a] (%) Positive**	**n/N[a] (5) Positive**
Any STI+[b]	56/244[c] (23.0%)	12/185[d] (6.5%)	19/190[e] (10.0%)
Chlamydia+	7/241 (2.9%)	1/183 (0.6%)	7/189 (3.7%)
Trichomoniasis+	48/234 (20.5%)	9/175 (5.1%)	10/169 (5.9%)
Gonorrhea+	6/241 (2.5%)	3/183 (1.6%)	4/189 (2.1%)

[a] Number of positive tests/number of non-missing tests.

[b] Positive for Chlamydia, Trichomoniasis, and/or Gonorrhea.

[c] Five participants were positive for multiple STIs.

[d] One participant was positive for multiple STIs.

[e] Two participants were positive for multiple STIs.

Table 3

Estimated Incidence Rate of New STI Infection/100 Person-Years.

	Full Follow Up	3-Months	6-Months
Exposure Time	**IR (95% CI)**	**IR (95% CI)**	**IR (95% CI)**
Unadjusted[a]			
Any STI[b]	30.5 (21.3; 43.5)	25.4 (14.4; 44.6)	35.4 (22.3; 56.2)
Chlamydia	8.1 (4.1; 16.2)	2.1 (0.3; 15.0)	13.8 (6.6; 28.9)
Gonorrhea	7.1 (3.4; 14.9)	6.3 (2.0; 19.6)	7.9 (3.0; 21.0)
Trichomoniasis	19.3 (12.3; 30.2)	19.0 (9.9; 36.5)	19.7 (10.6; 36.6)
Adjusted for Incarceration[c]			
Any STI[b]	36.2 (24.8; 52.8)	29.0 (15.1; 55.8)	40.7 (25.7; 64.6)
Chlamydia	10.7 (5.4; 21.5)	3.2 (0.5, 22.9)	15.8 (7.5; 33.2)
Gonorrhea	9.4 (4.5, 19.7)	9.7 (3.1; 30.0)	9.0 (3.4; 24.1)
Trichomoniasis	21.5 (13.2; 35.0)	19.4 (8.7; 43.1)	22.6 (12.2; 42.0)

[a] Time to event calculated as the total number of days between assessments.

[b] Testing positive for multiple infections at the same assessment was treated as a single positive test when estimating the overall incidence of infection.

[c] Time to event was calculated as the total number of non-incarceration days between assessments. The first day of any incarceration was assumed to be a day at risk.

Table 4

Bivariate Predictors of Time to STI Infection[a] Effects Were Estimated Using Multiple-Event Cox Regression Models (n = 211 Subjects Observed on 363 Occasions).

		95% CI	
Baseline Predictors	**HR**	**LCL**	**HCL**
Years Age	0.99	0.95	1.03
Race/Ethnicity			
Caucasian	0.94	0.23	3.80
African-American	1.81	0.43	7.61
Other Ethnicity [REFERENCE CATEGORY]			
Completed High School/GED (Yes)	1.07	0.53	2.18
Homeless (Yes)	1.28	0.52	3.16
STI+ at Baseline (Yes)	1.67	0.82	3.40
Self-Reported Lifetime History of STI (Yes)	1.56	0.77	3.17
Intervention (Yes)	0.90	0.45	1.78
Number of Male Partners at Baseline	1.09	0.87	1.34
Sex Work at Baseline (Yes)	1.23	0.61	2.50
Proportion of Days Heavy Alcohol use at Baseline	1.12	0.39	3.18
Cocaine Use 90-Days Prior to Baseline (Yes)	1.12	0.53	2.37
Time-Varying Predictors			
Number of Male Sex Partners	1.26*	1.02	1.56
Sex Work (Yes)	1.97	0.96	4.05
Proportion of Days Unprotected Sex w Main Partners	1.08	0.46	2.52
Proportion of Days Unprotected Sex w Casual Partners	0.92	0.12	6.92
Change Proportion Alcohol Use Days	1.76	0.74	4.19
Change Proportion Heavy Alc. Days	1.38	0.55	3.44
Any Cocaine Use (Yes)	1.15	0.57	2.31

* $p < .05$;

** $p < .01$

[a] Time to new STI was estimated as number of days between assessments. Cox regression models adjusting for days incarcerated and logistic regression models predicting any new STI infection during follow-up generated results substantively and statistically consistent with those we report here.