Distribution Agreement

In presenting this thesis or dissertation as a partial fulfillment of the requirements for an advanced degree from Emory University, I hereby grant to Emory University and its agents the non-exclusive license to archive, make accessible, and display my thesis or dissertation in whole or in part in all forms of media, now or hereafter known, including display on the world wide web. I understand that I may select some access restrictions as part of the online submission of this thesis or dissertation. I retain all ownership rights to the copyright of the thesis or dissertation. I also retain the right to use in future works (such as articles or books) all or part of this thesis or dissertation.

Signature:

_____ _____

Kristen Cowan Date

Factors Associated with Sexually Transmitted Viral Infection in Young Men who have Sex with Men in the United States

By

Kristen Cowan

Master of Public Health

Global Epidemiology

Dr. Allison Chamberlain, PhD.

Committee Co-Chair

Dr. Jeb Jones, PhD.

Committee Co-Chair

Factors Associated with Sexually Transmitted Viral Infection in Young Men who have Sex with Men in the United States

By

Kristen Cowan

Bachelor of Science

The Ohio State University

2016

Thesis Committee Chairs: Allison Chamberlain, PhD., Jeb Jones, PhD.

An abstract of

A thesis submitted to the Faculty of the

Rollins School of Public Health of Emory University

in partial fulfillment of the requirements for the degree of

Master of Public Health

in Global Epidemiology

2018

Abstract

Factors Associated with Sexually Transmitted Viral Infection in Young Men who have Sex with Men in the United States

By Kristen Cowan

Men who have sex with men (MSM) are at a disproportionately higher risk of sexually transmitted infections compared to men who have sex with women and further research is needed to determine factors associated with contracting viral STIs; hepatitis, herpes simplex virus II, (HSV-2) genital warts and human papillomavirus (HPV.) Using data from a national cross-sectional survey of MSM in the U.S. in 2017, the aim of this study is to examine predictors of ever being diagnosed with a viral STI among MSM. Logistic regression models were conducted using SAS v9.4 to calculate unadjusted and adjusted odds ratios and 95% Wald Confidence limits for two models, measuring factors associated with being diagnosed with any viral STI among MSM ages 18-29. There were significant differences in prevalence of all viral STIs by HIV status so two models were conducted, one to discover trends among all MSM and another for HIV-negative MSM. Among all MSM, bacterial STI diagnoses (aPOR=2.29, 95% CI: 1.62-3.22) and being HIV positive (aPOR=2.82 95% CI: 1.47-5.42) were positively associated with being diagnosed with a viral STI. Being heterosexual or bisexual compared to homosexual was negatively associated with having a viral STI diagnosis. (aPOR=.58, 95% CI: .36-.93) Among men ages 18-29 who reported being HIV negative, PrEP use (aPOR=2.68, 95% CI: 1.84-3.91) and diagnosis of a bacterial STI (aPOR=2.63, 95% CI: 1.83-3.77) were positively associated with having a viral STI diagnosis. In conclusion, further research needs to be conducted to discover if these trends are generalizable to other men who did not participate in this survey and health care providers should continue to test MSM for viral STIs and to educate their patients, particularly those on PrEP, about the risks of viral STIs. Reduction of STI infection rates among MSM could aid in reducing the burden of disease associated with HIV and cancer that disproportionately affect MSM in the United States.

Factors Associated with Sexually Transmitted Viral Infection in Young Men who have Sex with Men in the United States

By

Kristen Cowan

Bachelor of Science

The Ohio State University

2016

Thesis Committee Co-Chairs: Allison Chamberlain, PhD., Jeb Jones, PhD.

A thesis submitted to the Faculty of the

Rollins School of Public Health of Emory University

in partial fulfillment of the requirements for the degree of

Master of Public Health

in Global Epidemiology

2018

Introduction:

Men who have sex with men (MSM) are at a disproportionately higher risk of sexually transmitted infections (STIs) compared to the general population of the United States.[1, 2] Substantial research shows that HIV positive MSM are at a higher risk of viral STIs, [3, 4] but there is little research regarding prevalence and correlates for viral STIs among MSM. In general, there is far less research on viral STIs than bacterial STIs. Viral STIs include hepatitis, herpes simplex virus II (HSV-2), genital warts, and human papillomavirus (HPV). [5]

Human papillomavirus (HPV) is the most common STI in the United States with an estimated prevalence of 42.5% among adults ages 18-59. [6] There are over 40 types of HPV however types 16 and 18 are the leading causes of anal cancers, it is estimated that 95% of anal cancer cases are caused by HPV. [7-9] HPV can also lead to genital warts and thoracic cancers. [10] HPV is not a nationally reportable condition therefore surveillance data are not available; however, the prevalence of HPV type 16 is estimated to be 38% among MSM and 24% among men who have sex with women (MSW); HPV type 18 has a prevalence of 24% in MSM compared to 13% in MSW. [7]

Another viral STI of concern due to its link to cancers is hepatitis. There are five types of hepatitis virus that can lead to cirrhosis or liver cancer, the most of which are hepatitis A, hepatitis B and hepatitis C. [11] In 2016 there was an estimated 4,000 cases of hepatitis A, (95% CI: 2,800-4,400) 20,900 cases of hepatitis B, (95% CI: 11,900-51,200) and 41,200 cases of hepatitis C (95% CI: 32,600-140,600). [12] The Centers for Disease Control and Prevention estimates that 10% of new hepatitis A cases and 20% of new hepatitis B

cases occur among MSM. [13] Because of these risks, it is recommended that MSM receive vaccinations for these types to reduce the likelihood of infection. [14]

Approximately 15.7% of adults ages 14-49 years old in the United States are living with HSV-2 [15]. Many people infected with HSV-2 are asymptomatic. HSV-2 increases HIV risk [10] and is more prevalent among MSM than among MSW. [16] While there is no cure for the disease, [17] antiviral medications can reduce the number of outbreaks and likelihood of transmission to others. [14]

Although it is known that MSM are at higher risk for viral STIs than their heterosexual counterparts, [18] additional research is needed to understand factors associated with viral STI infection. Many studies hypothesize that there is a complex combination of behavioral and sociocultural factors among MSM that increase their risk of STIs compared to other men.[19, 20] There is a high burden of HIV among MSM and, in particular, co-infection of STIs and HIV. Furthermore, racial disparities exist with higher prevalence of HIV and STIs among black MSM compared to white MSM. [18]

Identifying risk factors for viral STIs among MSM is important because many of these infections cannot be cured; prevention is necessary to reduce infection and associated cancer incidence. By identifying risk factors for viral STI infection among MSM, culturally appropriate medical practices and public health interventions can be tailored to populations that are at highest risk for viral STIs. Using data from a national cross-sectional survey of MSM in the U.S. in 2017, the aim of this study is to examine predictors of ever being diagnosed with a viral STI among MSM.

Methods:

We analyzed data from the 2017 cycle of the American Men's Internet Survey (AMIS), a cross-sectional, internet-based survey of MSM. Complete AMIS survey methods have been described previously. [21] Participants were recruited through banner ads on websites frequented by MSM, including social and sexual networking sites and email blasts to people who subscribe to certain websites. To be eligible, participants had to be at least 15 years old, identify as male and report having had oral or anal sex with a male in the past.

The survey included questions on demographics, sexual behavior, HIV/STI testing history, drug and alcohol use, and use of HIV prevention services. History of viral STIs was asked by the question "Has a doctor, nurse or other health care provider ever told you that you had any of the following?" Respondents could then check any or all of the following answer choices: hepatitis, genital warts, genital herpes, HPV, none of the above, prefer not to answer, or don't know.

Descriptive statistics of the study population were calculated. Bivariate analyses were conducted to assess associations between demographic and behavioral variables of interest and a history of viral STI diagnosis. Because HIV is an established risk factor for STIs, [22] we assessed the prevalence of ever being diagnosed with a viral STI by HIV status.

After literature review of health literacy and behavioral factors predictive of STIs in MSM, specific survey variables were selected for inclusion in statistical models. These variables were race, ethnicity, age, education level, sexual identity, ever having had sex with a woman, HIV status, condom use in the past 12 months and diagnosis of a bacterial STI. Logistic regression was used to assess the association of these variables with ever having been diagnosed with a viral STI among men ages 18-29. Respondents under the age of 18 were excluded from analysis due to the low response rate among individuals in this age

category. Respondents older than 29 were excluded from analysis to reduce concerns about the temporal association between ever being diagnosed with a viral STI and survey responses about sexual behavior in the past 6 months.

We used a second logistic regression model to identify risk factors for being diagnosed with any viral STI among HIV negative men ages 18-29. The variables in this model were race, ethnicity, age, education level, condom use, sexual identity, ever having had sex with a woman, PrEP use, and diagnosis of a bacterial STI in the past 12 months. For each model, unadjusted and adjusted odds ratios and 95% Wald Confidence limits were estimated. All analyses were conducted in SAS v9.4 (SAS Institute, Cary, NC).

Results

In 2017, 10,049 MSM aged 15 or older were eligible to participate and completed the AMIS survey. The majority of respondents (71.3%) were between the ages of 18 and 53. Most (76.9%) of the participants were white, 7.0% were black or African American, 2.9% were Asian, and less than 1.0% were Native American or Native Hawaiian/Pacific Islander. The remaining participants reported more than one racial identity (4.8%) or some other race not listed or chose not to answer (7.4%). The majority of participants were homosexual or gay (74.3%); the remaining were bisexual (21.7%) or heterosexual/straight (1.5%). Overall, the majority of the study population had high education and income levels with over half completing college and a third reporting a household income greater than $75,000 (Table 1). Among men ages 53-65, 32.9% had ever been diagnosed with a viral STI. In contrast among men under 18 years old, only 1.6% had been diagnosed with a viral STI. Among those who identified as white, 20.2% have ever been diagnosed with a viral STI; among those who identified as black,19.9% have ever been diagnosed with a viral STI. Among Asian, Native

Hawaiian/Pacific Islander and Multiracial groups, the proportions who reported ever having had a viral STI were 15.3%, 9.1% and 14.9% respectively.

The proportion of those diagnosed with any viral STI significantly increased as age increased (P-value<.0001). Similarly, the proportions of those who had been diagnosed with a viral STI increased as education level increased ranging from 5.0% among those who completed less than high school to 23.8% among college graduates and higher. (p-value<.0001) Nearly a quarter (22.7%) of individuals who reported the highest level of annual household income (greater than $75,000) reported ever being diagnosed with a viral STI compared to 15.1% of individuals who reported the lowest level of income ($0-19,999). There were smaller but still significant differences among the proportions of those diagnosed with a viral STI by food insecurity (p-value=.03) or homelessness (p-value=.01).

There were significant differences in viral STI status by HIV status (p-value<.0001) and PrEP use in the past 12 months. (p-value<.0001) Among those who have had a positive HIV test result, 47.9% reported having been diagnosed with another viral STI compared to 18.9% who had a negative HIV test result. Among those who reported PrEP use in the past year, 29.3% had ever been diagnosed with a viral STI compared to 14.9% who had not used PrEP.

Regarding associations of specific viral STIs with HIV status, hepatitis had a prevalence of 20% (95% CI: 17%-23%) among HIV positive individuals and 6% (95% CI: 5%-6%) among HIV negative individuals. Similarly, the prevalence of genital herpes was 18%(95% CI: 15%-21%) among HIV positive individuals and 5% (95% CI: 5%-6%) among HIV negative individuals. Genital warts had a prevalence of 18% (95% CI: 15%-21%) among those who tested positive for HIV and 7% (95% CI: 7%-8%) among those who are

HIV negative. Human Papillomavirus (HPV) had a prevalence of 21% (95% CI: 18%-24%) among HIV positive men and 6% (95% CI: 6%-7%) among HIV negative men. There was a significant difference in prevalence by HIV status for each viral STI measured in this study.

Table 3 reports factors that are associated with ever being diagnosed with a viral STI among men ages 18-29. When controlling for other factors there does not appear to be a significant association between race, ethnicity or education and diagnosis of a viral STI. There is a protective association between being of a younger age group and being diagnosed with a viral STI. (adjusted prevalence odds ratio [aPOR] = 0.50, 95% CI: 0.36, 0.70) When controlling for race, ethnicity, age, education, sexual identity, HIV status, condom use and bacterial STI status, factors that appear to be significantly associated with ever being diagnosed with a viral STI among MSM ages 18-29 are sexual identity, HIV status and diagnosis of a bacterial STI. The odds of being diagnosed with a viral STI among those who identify as heterosexual or bisexual were almost half (aPOR = 0.58, 95% CI: 0.36, 0.93) the odds of a viral STI diagnosis among those who identify as homosexual or gay. Being HIV positive and ever having been diagnosed with a bacterial STI were also significant risk factors for a viral STI diagnosis; compared to HIV negative MSM, HIV positive MSM were significantly more likely to have had a viral STI diagnosis (aPOR 2.82; 95% CI: 1.47, 5.42). Compared to those without a history of bacterial STIs, those with a previous bacterial STI diagnosis were more likely to have had a viral STI as well (aPOR=2.29; 95% CI: 1.62, 3.22).

When controlling for race, ethnicity, age and condom use, PrEP use and having had a diagnosis of a bacterial STI were both significantly associated with having had a viral STI among HIV-negative MSM ages 18-29. Men who reported PrEP use in the past 12 months were 2.68 (95% CI: 1.84-3.91) times more likely to have been diagnosed with a viral STI

compared to those not using PrEP, and HIV negative men who have ever been diagnosed with a bacterial STI were 2.63 (95% CI: 1.83-3.77) times more likely to be diagnosed with a viral STI. Among men aged 18-29 who reported being HIV negative, race, ethnicity and education did not appear to be significantly associated with having a viral STI

Discussion

In this study, we assessed behavioral and demographic factors associated with a history of viral STI diagnosis (hepatitis, genital warts, HSV-2 or HPV) among MSM. Among those between the ages of 18-29, sexual identity, HIV status and having a diagnosis of a bacterial STI in the past 12 months were all significantly associated with having ever had a viral STI. Among HIV negative MSM aged 18-29, using PrEP or having a diagnosis of a bacterial STI in the past 12 months were significantly associated with history of diagnosis of a viral STI.

Because we were unable to assess temporality of various STI diagnoses, the conclusions that can be drawn from these analyses are limited, but the signals our data generate are important for future research and public health consideration. Because our results suggest that HIV and a history of bacterial STIs (such as gonorrhea, syphilis, or chlamydia) are both related to a history of viral STIs among MSM, healthcare providers may consider sharing these associations with their young MSM patients during conversations about STI risks. Similarly, because PrEP use in the past 12 months was also associated with having had a viral STI diagnosis providers may want to specifically encourage STI testing for men who are on PrEP.

There are many limitations that need to be addressed in this study including the convenience sampling used to recruit participants, self-reporting bias, possible misclassification of the outcome and temporality issues. AMIS participants are recruited via online advertisements and emails to previous survey participants. This type of internet-based recruitment may have biased the AMIS study sample towards those with higher levels of education and income, thus limiting generalizability to the broader population of MSM in the United States. To the extent that higher education and income are also associated with race, these may be important factors contributing to the lower numbers of minorities represented in the 2017 AMIS sample. This hypothesis is corroborated by at least one other study which found that found that black and Hispanic MSM are disproportionately affected by the HIV epidemic but under recruited in online research of MSM. [23] To control for this possible issue, education level was controlled for in our models. Further research should either consider additional non-internet-based recruitment strategies or methods to oversample lower income and minority MSM.

Because AMIS is a completely self-reported survey, no biomarkers or medical records are available to verify reported STI diagnoses. Further, participants' responses might be subject to social desirability, a bias that may also affect assessment of behavioral risk factors like condom use. Individuals are not always forthright on surveys with their sexual behaviors [24]; however, we expect this effect to be attenuated somewhat because the survey was self-administered. In addition, misclassification of the outcome of a viral STI is possible in this study because many viral STIs like herpes and HPV can be asymptomatic [17, 25] and therefore unrecognized or undiagnosed. This issue would therefore result in nondifferential misclassification of the outcome for results among HIV negative men, and differential

misclassification of the outcome based on HIV status in the full analysis because men in care for HIV are more likely to receive testing for STIs.[26] In the case of nondifferential misclassification of the outcome, we expect our results are biased towards the null, suggesting that the true associations are stronger than observed. Additional research that includes diagnostic testing to verify STI status would help to clarify these issues.

As previously mentioned, the most important limitation of this study is related to the temporality of being diagnosed with a viral STI. Viral STI status was assessed in terms of *ever* receiving a diagnosis, but other variables such as PrEP use, bacterial STI testing, and sexual behaviors were assessed based on the past 12 months. For this reason, temporality cannot be established if the diagnosis of a viral STI came before or after certain behaviors. Furthermore, the older a man gets, the more opportunity he has to be exposed to and tested for STIs, including viral STIs. For this reason, analyses were restricted to men ages 18-29 to limit the amount of time between STI diagnosis and current reports of behavior. That is, it is more likely that the behaviors young men report having had in the past 12 months more closely approximate their behaviors at the time they received their viral STI diagnoses. It is also possible that men who have used PrEP in the past 12 months began using PrEP because they were diagnosed with a viral STI and they want to reduce their risk of HIV. For these reasons, caution should be observed when interpreting the relationships reported in this study.

In conclusion, further research should be conducted to discover if these trends are generalizable to other men who may not use the internet and of other age categories. Health care providers should continue to test MSM for viral STIs and educate their patients, especially those on PrEP, about the risks of viral STIs associated with unprotected sex.

Reducing STI infection rates among MSM could reduce HIV infection rates, cancers and other poor health outcomes that disproportionately affect MSM in the United States.

References:

1. Jaffe, H.W., R.O. Valdiserri, and K.M. De Cock, *The reemerging hiv/aids epidemic in men who have sex with men.* JAMA, 2007. **298**(20): p. 2412-2414.
2. Weston, E.J., et al., *Narrative Review: Assessment of Neisseria gonorrhoeae Infections Among Men Who Have Sex With Men in National and Sentinel Surveillance Systems in the United States.* Sexually Transmitted Diseases, 2018. **45**(4): p. 243-249.
3. van de Laar, T.J. and O. Richel, *Emerging viral STIs among HIV-positive men who have sex with men: the era of hepatitis C virus and human papillomavirus.* Sexually Transmitted Infections, 2016.
4. Hagan, H., et al., *Incidence of sexually-transmitted hepatitis C virus infection in HIV-positive men who have sex with men: A systematic review and meta-analysis.* AIDS (London, England), 2015. **29**(17): p. 2335-2345.
5. Prevention, C.f.D.C.a. *2016 Sexually Transmitted Disease Surveillance*. 2018 [cited 2018; Available from: https://www.cdc.gov/std/stats16/default.htm.
6. McQuillan, G., et al. , *Prevalence of HPV in Adults Aged 18-69: United States, 2011-2014.* NCHS Data Brief, 2017. **280**.
7. Patel, P., et al., *Prevalence, Incidence, and Clearance of Anal High-Risk Human Papillomavirus Infection Among HIV-Infected Men in the SUN Study.* The Journal of Infectious Diseases, 2018. **217**(6): p. 953-963.
8. Frisch , M., et al., *Sexually Transmitted Infection as a Cause of Anal Cancer.* New England Journal of Medicine, 1997. **337**(19): p. 1350-1358.
9. Institute, N.C. *HPV and Cancer*. 2015; Available from: https://www.cancer.gov/about-cancer/causes-prevention/risk/infectious-agents/hpv-fact-sheet.
10. Wald, A. and K. Link, *Risk of Human Immunodeficiency Virus Infection in Herpes Simplex Virus Type 2–Seropositive Persons: A Meta-analysis.* The Journal of Infectious Diseases, 2002. **185**(1): p. 45-52.
11. Prevention, T.C.f.D.C.a. *Viral Hepatitis* 2018; Available from: https://www.cdc.gov/hepatitis/index.htm.
12. Prevention, C.f.D.C.a. *Surveillance for Viral Heptatitis-United States, 2016*. 2018; Available from: https://www.cdc.gov/hepatitis/statistics/2016surveillance/commentary.htm.
13. Prevention, T.C.f.D.C.a. *Viral Hepatitis and Men Who Have Sex with Men*. 2015; Available from: https://www.cdc.gov/hepatitis/populations/msm.htm.

14. Prevention, T.C.f.D.C.a., *Sexually Transmitted Disease Treatment Guidelines, 2010.* Morbidity and Mortality Weekly Report, 2010. **59**(RR-12).
15. Bradley, H., et al., *Seroprevalence of Herpes Simplex Virus Types 1 and 2—United States, 1999–2010.* The Journal of Infectious Diseases, 2014. **209**(3): p. 325-333.
16. Bohl, D.D., et al., *Prevalence and Correlates of Herpes Simplex Virus Type-2 Infection Among Men Who Have Sex With Men, San Francisco, 2008.* Sexually Transmitted Diseases, 2011. **38**(7): p. 617-621.
17. Prevention, C.f.D.C.a. *Genital Herpes-CDC Fact Sheet (Detailed)*. 2017; Available from: https://www.cdc.gov/std/herpes/stdfact-herpes-detailed.htm#ref2.
18. Mayer, K.H., *Sexually Transmitted Diseases in Men Who Have Sex With Men.* Clinical Infectious Diseases, 2011. **53**(suppl_3): p. S79-S83.
19. Scott, H.M., et al., *Age, Race/Ethnicity, and Behavioral Risk Factors Associated with Per-Contact Risk of HIV Infection Among Men Who Have Sex with Men in the United States.* Journal of acquired immune deficiency syndromes (1999), 2014. **65**(1): p. 115-121.
20. Boyer, C.B., et al., *Sexual Partner Characteristics, Relationship Type, and HIV Risk Among a Community Venue–Based Sample of Urban Adolescent and Young Adult Men Who Have Sex With Men.* Youth & Society, 2016: p. 0044118X16669259.
21. Zlotorzynska, M., P. Sullivan, and T. Sanchez, *The Annual American Men's Internet Survey of Behaviors of Men Who Have Sex With Men in the United States: 2015 Key Indicators Report.* JMIR Public Health and Surveillance, 2017. **3**(1): p. e13.
22. Galvin, S.R. and M.S. Cohen, *The role of sexually transmitted diseases in HIV transmission.* Nature Reviews Microbiology, 2004. **2**: p. 33.
23. Sullivan, P.S., et al., *Bias in Online Recruitment and Retention of Racial and Ethnic Minority Men Who Have Sex With Men.* Journal of Medical Internet Research, 2011. **13**(2): p. e38.
24. Weinhardt, L.S., et al., *Reliability and Validity of Self-Report Measures of HIV-Related Sexual Behavior: Progress Since 1990 and Recommendations for Research and Practice.* Archives of sexual behavior, 1998. **27**(2): p. 155-180.
25. Prevention, C.f.D.C.a. *Human Papillomavirus (HPV)*. 2016; Available from: https://www.cdc.gov/hpv/parents/whatishpv.html.
26. Landovitz, R.J., J.L. Gildner, and A.A. Leibowitz, *Sexually Transmitted Infection Testing of HIV-Positive Medicare and Medicaid Enrollees Falls Short of Guidelines.* Sexually Transmitted Diseases, 2018. **45**(1): p. 8-13.

Table 1. Demographic Information of 10,049 Men who have Sex with Men who participated in the 2017 American Men's Internet Survey

	Total	Ever diagnosed with any viral STI		Never diagnosed with a viral STI		P-Value*
	N	N	%	N	%	
Age						**<.0001**
<18	446	7	1.57	439	98.43	
18-24	2,280	111	4.87	2169	95.13	
24-36	2,406	393	16.33	2013	83.67	
36-53	2,481	621	25.03	1860	74.97	
53-65	1,758	579	32.94	1179	67.06	
>65	678	210	2.09	468	69.03	
Race						**<.0001**
American Indian/Alaskan Native	90	14	15.56	76	84.44	
Asian	288	44	15.28	244	84.72	
Black or African American	699	139	19.89	560	80.11	
Native Hawaiian or Other Pacific Islander	22	2	9.09	20	90.91	
White	7,724	1562	20.22	6162	79.78	
Mutiracial	482	72	14.94	410	85.06	
Other/Prefer not to answer	744	88	11.83	656	88.17	
Ethnicity						**<.0001**
Hispanic	1,538	177	11.51	1361	88.49	
Not Hispanic	8,436	1735	20.57	6701	79.43	
Other	75	9	12.00	66	88.00	
Sexual Identity						**<.0001**
Heterosexual or Straight	147	14	9.52	133	90.48	
Homosexual or Gay	7464	1572	21.06	5892	78.94	
Bisexual	2176	299	13.74	1877	86.26	
Other/Prefer not to answer	170	19	11.18	151	88.82	
Missing	92	17	18.48	75	81.52	
Education level						**<.0001**
Less than high school/Some high school	419	21	5.01	398	94.99	
High School Diploma or GED	1149	120	10.44	203	89.59	

Some College, Associate's Degree, or Technical Degree	2954	480	16.25	2474	83.75	
College, Post graduate or Professional school	5391	1284	23.82	4107	76.18	
Missing	136	16	11.76	120	88.24	
Annual Household Income						**<.0001**
$0-$19,999	1059	160	15.11	899	84.89	
$20,000-$39,999	1537	253	16.46	1284	83.54	
$40,000-$74,999	2236	440	19.68	1796	80.32	
$75,000 or more	3304	750	22.70	2554	77.30	
Missing	1913	318	16.65	1595	83.38	
Ever experienced food insecurity in the Past 12 Months						**0.03**
Yes	1591	278	17.47	1313	82.53	
No	8210	1607	19.57	6603	80.43	
Missing	248	36	14.52	212	85.48	
Ever experienced homelessness in the past 12 months						**0.01**
Yes	631	107	16.96	524	83.04	
No	8537	1616	18.93	6291	81.07	
Missing	881	198	22.47	683	77.53	
Ever had sex with a woman						**<.0001**
Yes	4291	1106	22.48	3815	77.52	
No	5108	811	15.88	4297	84.12	
Missing	20	4	20.00	16	80.00	
Result of Last HIV test						**<.0001**
Positive	886	424	47.86	462	52.14	
Negative	7229	1369	18.94	5860	81.06	
Don't know	117	24	20.51	93	79.49	
Missing	1817	104	5.74	1713	94.28	
Used PrEP in the past 12 Months						**<.0001**
Yes	1156	339	29.33	817	70.67	
No	5203	760	14.91	4443	85.39	
Missing	3690	822	22.28	2868	77.72	
* P-values calculated using Chi-square tests and Fisher exact test for those with at least one cell less than 5 observations						

Table 2.Prevalence and 95% Confidence Intervals of viral STIs by HIV status

	Hepatits (All types)*	Genital Herpes*	Genital Warts*	Human Papilomavirus (HPV)*	Don't know their STI status
HIV Positive (n=964)	.20 (.17-.23)	.16 (.14-.19)	.18 (.15-.21)	.21 (.18-.24)	.01 (.00-.01)
HIV Negative (n=7180)	.06 (.05-.06)	.05 (.05-.06)	.07 (.07-.08)	.06 (.06-.07)	.01 (.01-.01)

*Statistically significant difference between prevalence by HIV status at a p-value of <.0001

Table 3.Modeling factors associated with ever being diagnosed with a viral STI among men ages 18-29

	Unadjusted OR	95% confidence interval		Adjusted OR	95% Confidence Interval	
Race						
Asian	1.21	0.67	2.18	1.13	0.72	1.83
Black/African American	1.06	0.63	1.79	0.94	0.51	1.74
Multiracial/other race	0.99	0.72	1.38	1.15	0.72	1.83
White	Ref			Ref		
Ethnicity						
Hispanic	0.79	0.62	1.01	0.80	0.57	1.11
Not Hispanic	Ref			Ref		
Age						
18-24	0.32	0.25	0.41	0.50	0.36	0.70
25-29	Ref			Ref		
Education						
Some high school/completed high school	0.69	0.30	1.62	0.65	0.15	2.86
Some college, associate's degree or technical degree	0.53	0.40	0.71	0.66	0.47	0.93
College, Post Graduate or Professional school	Ref			Ref		
Sexual Identity						
Heterosexual or Bisexual	0.55	0.39	0.78	0.58	0.36	0.92
Homosexual or gay	Ref			Ref		
Ever had sex with a woman						
Yes	1.17	0.99	1.38	1.22	0.98	1.51
No	Ref			Ref		
HIV Status						
Positive	3.72	2.21	6.26	2.82	1.47	5.42
Negative	Ref			Ref		

Had sex without condom in past 12 months						
Yes	1.56	1.10	2.22	1.34	0.87	2.05
No	Ref			Ref		
Diagnosis of a bacterial STI in past 12 months						
Yes	3.89	2.91	5.20	2.29	1.62	3.22
No	Ref			Ref		

Table 4.Modeling factors associated with ever being diagnosed with a viral STI among HIV negative MSM ages 18-29, while controlling for race, ethnicity, age, education and condom use

	Unadjusted OR	95% confidence interval		Adjusted OR	95% Confidence Interval	
Race						
Asian	1.01	0.51	1.97	1.11	0.55	2.23
Black/African American	0.75	0.40	1.42	0.93	0.48	1.78
Multiracial/other race	0.95	0.65	1.38	1.22	0.77	1.93
White	Ref			Ref		
Ethnicity						
Hispanic	0.79	0.60	1.05	0.72	0.45	1.13
Not Hispanic	Ref			Ref		
Age						
18-24	0.37	0.28	0.50	0.49	0.35	0.68
25-29	Ref			Ref		
Education						
Some high school/completed high school	0.68	0.20	2.24	0.51	0.07	3.92
Some college, associate's degree or technical degree	0.48	0.34	0.67	0.66	0.46	0.95
College, Post Graduate or Professional school	Ref			Ref		
Has had sex without a condom in the past 12 months						
Yes	1.41	0.95	2.10	1.59	1.01	2.49
No	Ref			Ref		
Sexual Identity						
Heterosexual or Bisexual	0.54	0.36	0.82	0.64	0.39	1.05
Homosexual or gay	Ref			Ref		

Ever had sex with a woman						
Yes	1.12	0.93	1.35	1.17	0.95	1.45
No	Ref			Ref		
Prep Use in the Past 12 months						
Yes	3.42	2.42	4.85	2.68	1.84	3.91
No	Ref			Ref		
Met a sexual partner online in the past 12 months						
Yes	1.79	1.00	3.22	1.90	1.01	3.56
No	Ref			Ref		
Diagnosis of a Bacterial STI in past 12 months						
Positive	2.96	2.12	4.13	2.63	1.83	3.76
Negative	Ref			Ref		
PEP use in the past 12 months						
Yes	1.09	0.76	1.55	1.20	0.73	1.99
No	Ref			Ref		