Prevalence and Risk Factors for Rectal and Urethral Sexually Transmitted Infections From Self-Collected Samples Among Young Men Who Have Sex With Men Participating in the *Keep It Up! 2.0* Randomized Controlled Trial

Brian Mustanski, PhD, Brian A. Feinstein, PhD,* Krystal Madkins, MPH,* Patrick Sullivan, DVM, PhD,† and Gregory Swann, MA**

Background: Despite recommendations that sexually active men who have sex with men be regularly tested for sexually transmitted infections (STIs) and that testing reflect anatomical sites of potential exposure, regular testing is not widely performed, especially for rectal STIs. As such, little is known about the prevalence of rectal and urethral STIs among young men who have sex with men (YMSM).

Methods: The current study examined the prevalence and risk factors for rectal and urethral chlamydia and gonorrhea in a sample of 1113 YMSM ages 18 to 29 years (mean, 24.07 years). Before participating in a randomized controlled trial for an online human immunodeficiency virus prevention program (Keep It Up! 2.0), participants completed self-report measures and self-collected urine and rectal samples. Participants mailed samples to a laboratory for nucleic acid amplification testing. Viability of self-collected samples was examined as a potential method to increase STI screening for MSM without access to STI testing clinics.

Results: Results indicated that 15.1% of participants tested positive for an STI, 13.0% for a rectal STI, 3.4% for a urethral STI, and 1.2% for both rectal and urethral STIs. Rectal chlamydia was significantly more common (8.8%) than rectal gonorrhea (5.0%). Rectal STIs were higher among black YMSM compared with white YMSM. Additionally, rectal STIs were positively associated with condomless receptive anal sex with casual partners.

Conclusions: Findings call attention to the need for health care providers to test YMSM for rectal STIs. This study also demonstrates the viability of including self-collected samples for STI testing in an eHealth program.

The Centers for Disease Control and Prevention (CDC) recommends that sexually active men who have sex with men (MSM) be regularly tested for chlamydia (CT) and gonorrhea (GC), and that testing reflect the anatomical sites of potential exposure.[1] Despite recommendations, regular sexually transmitted infection (STI) testing is not widely performed, particularly for rectal STIs. In a sample of human immunodeficiency virus (HIV)-positive MSM in 6 US cities, annual screening rates for STIs were 13.8% to 18.3% for urethral STIs and 2.3% to 8.5% for rectal STIs.[2] HIV-positive MSM receiving care are likely to have more access to STI testing, and as such, these rates may overestimate STI testing rates among all MSM. Further, young MSM (YMSM) are less likely than adult MSM to regularly test for STIs.[3] Given that YMSM have the highest rate of new HIV diagnoses among all age and risk groups[4] and that STIs are associated with HIV transmission risk,[5] research is needed to understand the prevalence of STIs and their risk factors in this population.

There is relatively limited data on the prevalence of rectal and urethral STIs among YMSM. In a 2014 sample of HIV-negative MSM across 26 STI clinics, prevalence was 5.7% for urethral CT, 7.5% for rectal CT, 8.6% for urethral GC, and 5.5% for rectal GC.[6] Prevalence was lower in a US national sample of HIV-negative MSM,[7] such that 1.4% tested positive for urethral CT, 4.4% for rectal CT, 0.5% for urethral GC, and 1.8% for rectal GC. In a community sample of HIV-negative MSM, rectal STIs were also more common than urethral STIs, and CT was more common than GC.[5]

In addition, few studies have examined risk factors for STIs among MSM. Grov and colleagues[7] found that younger MSM had greater odds of STIs compared with older MSM, and Latino MSM had greater odds of rectal STIs compared with white MSM. Number of male partners was a risk factor for both urethral and rectal STIs, whereas number of receptive/insertive anal sex acts and number of receptive condomless anal sex (CAS) acts were risk factors for rectal STIs only. Engaging in both insertive and receptive anal sex was associated with increased odds of rectal STIs (compared with insertive sex only) and urethral STIs (compared with receptive sex only). Kelley and colleagues[5] also found that prevalence of rectal CT/GC and urethral GC were higher for black MSM compared with white MSM.

Regarding other contextual factors, there has been debate in the field regarding the association between CAS and meeting partners online or through apps,[8] but very little research has examined the association with STIs. One of the most frequently cited risk factors for CAS is drug use,[9] whereas results have been inconsistent for alcohol use.[10] One study found that methamphetamine use before sex was associated with self-reported STIs among adult MSM[11] and another study found that club drug use was associated with diagnoses of HIV and syphilis among MSM in China.[12] However, associations between substance use and diagnosed rectal and urethral CT/GC among YMSM remain unexamined.

From the *Department of Medical Social Sciences and Institute for Sexual and Gender Minority Health and Wellbeing, Northwestern University, Chicago, IL; and †Rollins School of Public Health, Emory University, Atlanta, GA

Conflicts of interest: none declared.

This study was supported by grants from the National Institute on Drug Abuse and National Institute of Mental Health (R01DA035145 and R01DA035145-02S1). The authors thank the CDC Division of STD Prevention Laboratory for performing the STI testing. The content of this article is solely the responsibility of the authors and does not necessarily reflect the view of the National Institutes of Health, National Institute on Drug Abuse, National Institute of Mental Health, or the Center for Disease Control and Prevention.

Correspondence: Brian Mustanski, PhD, Northwestern University, 625N, Michigan Ave, Chicago, IL 60611. E-mail: brian@northwestern.edu.

Received for publication December 1, 2016, and accepted March 30, 2017.
DOI: 10.1097/OLQ.0000000000000636

Despite increased research on STIs among MSM in recent years, several gaps remain. Although Grov and colleagues[7] provided the first national US data on STI prevalence among HIV-negative MSM, the average age of their sample was 40 years and the majority were identified as white. Given that younger, black, and Latino MSM have higher prevalence of STIs,[5,7] it is important to examine the prevalence among YMSM, including those of color. The current study examined (1) the prevalence of STIs in a large US sample of HIV-negative YMSM (ages 18–29 years) that included a large percentage of men of color (65.7%); and (2) demographic, behavioral, and contextual risk factors. Additionally, the current study examines the feasibility and acceptability of using remote self-collected testing for urethral and rectal STIs among YMSM. Prior studies suggest that self-collection is feasible and acceptable,[7] but it is unclear if this generalizes to YMSM.

MATERIALS AND METHODS

Study Design and Population

Keep It Up! 2.0 is a randomized controlled trial (RCT) of an online HIV prevention program for YMSM. Information about the intervention and the design of the RCT can be found in a previous articles.[13] Participants were recruited in-person in a Atlanta, Chicago, and New York City from HIV testing clinics, health department clinics, street outreach, and referrals from ongoing studies, as well as through online local and national advertisements.[13] In clinics, upon an HIV-negative test result, staff explained the study and offered an eligibility screener. For online recruitment, participants completed screeners online and provisionally eligible participants either obtained an HIV test at a participating site in Atlanta, Chicago, or New York City or were mailed an Food and Drug Administration (FDA)–approved at-home HIV test. Eligible participants were HIV-negative, aged 18 to 29 years, assigned a male sex at birth, currently identified as male, reported CAS with a man in the past 6 months, were not in a behaviorally monogamous relationship for longer than 6 months, were able to read English at an eighth grade level, and had a functioning email address.

The current study uses preintervention data from 1113 participants who completed the assessment between June 2013 and December 2015. Participants completed online self-report measures and self-collected samples for rectal/urethral CT/GC testing. Sample collection could be completed at a recruitment clinic or at home. Those who did it at home were mailed test kits with a placemat that identified all of the materials contained in the shipping container and provided instructions for sample collection (including a link to a video demonstrating collection) and how to return the samples to the laboratory using prepaid shipping containers. Participants who tested positive were provided with results via phone and/or through an encrypted and password protected email message and with local referrals for free or low cost treatment. Positive results were reported to the health department where the participant resided. Procedures were approved by the affiliated institutional review boards.

Laboratory procedures

Specimens were self-collected using the Aptima Urine and Unisex Swab Specimen Collection Kits and tested for CT/GC by the CDC Division of STD Prevention Laboratory using the Aptima Combo 2 CT/NG Assay (Hologic Gen-Probe, San Diego, CA). Specimens were analyzed on the Aptima Panther automated platform system, which has a sensitivity of 94.4% to 98.7% and specificity of 99.7% to 99.8% when male urine is tested for CT/GC.[14] A prior validation study by the laboratory indicated >95% sensitivity and >99% specificity for rectal swabs; values that are similar to prior validations studies.[15,16]

Measures

Demographics

Participants reported their age, race/ethnicity, sexual orientation, relationship status, and student/employment status.

Behavioral Characteristics

The HIV-Risk Assessment for Sexual Partnerships assessed sexual behaviors in the past 3 months on a partner-by-partner basis for the 3 most recent partners and in aggregate for additional partners.[17] Items used in the current study include number of partners with whom participants had CAS, count of insertive or receptive CAS acts with each partner, whether partners met online, and drug use before sex.

Frequency of drug use in the past 3 months was measured with an adaptation of the National Institute on Drug Abuse modified Alcohol, Smoking, and Substance Involvement Screening Test.[18] Preexposure prophylaxis (PrEP) use was measured with 1 question: "Have you taken anti-HIV medications in the past 3 months before engaging in high-risk sexual behavior (sometimes called PrEP, Truvada, 'taking a T' or using the 3 Vs)?" The wording of this question was finalized before PrEP received FDA approval, and the dosing schedule was determined. Participants were asked during their lifetime which (if any) STIs they were diagnosed with and how many times they were tested for HIV. To reduce the effects of possible spurious outliers, responses to number of past HIV tests were winsorized by transforming values above 3 standard deviations to that value. Frequency of condom failures in the past 3 months was measured with the condom failure subscale of an adapted version of the Condom Use Errors and Problems Questionnaire[19] (eg, "As a bottom during anal sex in the last 3 months, how often did the condom break during sex?"). Responses were on a 5-point scale (1, never; 5, always) and summed across items.

Analyses

We calculated the prevalence of urethral/rectal CT/GC and descriptive statistics for demographics and behavioral characteristics. Likelihood ratio confidence intervals (CI) for binomial proportions were calculated for STI prevalence. χ^2 tests and bivariate/multivariate logistic regressions were used to examine associations between demographics and behavioral characteristics and STIs. Analyses were run with 3 outcomes: (1) urethral STIs; (2) rectal STIs; and (3) total (urethral and rectal) STIs. Analyses were conducted in SPSS 24.

RESULTS

Demographic and behavioral characteristic data are presented in Tables 1 and 2. The average age of participants was 24.07 years (SD, 3.00). Of 1113 participants, 1001 returned the STI kits (89.9% overall return rate: 992 both rectal and urine, 3 rectal only, and 6 urine only). The STI prevalences are reported in Table 3. Of those with urethral STIs, 35.3% also had rectal STIs. Of those with rectal STIs, 9.3% also had urethral STIs. Overall, 1.2% (n = 12) tested positive for both rectal and urethral STIs. Chlamydia was more common than GC for rectal (8.8% vs 5.0%) and urethral (2.6% vs 0.9%) infections, and these differences were significant based on nonoverlapping 95% CIs.

Results of χ^2 tests for demographic and categorical predictors of rectal STIs are presented in Tables 1 and 2. Results are only reported for rectal STIs, because there were no significant associations for urethral or total STIs. The only significant predictor was

TABLE 1. Demographic Associations With Rectal STI Prevalence Among YMSM Aged 18–29 Years Participating in the Keep It Up! RCT, United States, 2013–2015

		Total	Negative	Positive		
		N (%)	N (%)	N (%)	χ^2	*P*
Age	18–24	529 (53.2)	451 (85.3)	78 (14.7)	3.17	0.075
	25–29	466 (46.8)	415 (89.1)	51 (10.9)		
Sexual Orientation	Gay	860 (86.4)	747 (86.9)	113 (13.1)	1.42	0.493
	Bisexual	113 (11.4)	98 (86.7)	15 (13.3)		
	Other	22 (2.2)	21 (95.5)	1 (4.5)		
Race/ethnicity	White	349 (35.1)	315 (90.3)	34 (9.7)	5.68	0.129
	Black	249 (25.0)	213 (85.5)	36 (14.5)		
	Latino/Hispanic	300 (30.2)	253 (84.3)	47 (15.7)		
	Other/multiracial	97 (9.7)	85 (87.6)	12 (12.4)		
Relationship status	Casual partner/single	800 (80.6)	692 (86.5)	108 (13.5)	0.94	0.331
	Serious partner	193 (19.4)	172 (89.1)	21 (10.9)		
Student/employment status	Student + employed	255 (25.7)	225 (88.2)	30 (11.8)	0.86	0.834
	Employed	524 (52.7)	457 (87.2)	67 (12.8)		
	Student	110 (11.1)	95 (86.4)	15 (13.6)		
	Neither	105 (10.6)	89 (84.8)	16 (15.2)		

CAS in the previous 3 months. Rectal STIs were higher among those who had receptive CAS only (19.4%) compared with those who had both receptive and insertive CAS (12.6%), those who did not have CAS in the previous 3 months (but engaged in CAS sometime in the previous 6 months to be eligible for Keep It Up 2.0) (11.8%), and those who had insertive CAS only (8.2%). There were no significant differences in the χ^2 models based on participant age, sexual orientation, race/ethnicity, relationship status, student/employment status, PrEP use, meeting sexual partner online, previous STI diagnosis, or drug use before sex.

Bivariate logistic regression results for continuous predictors of rectal STIs are in Table 4. Older participants were significantly less likely to have a rectal STI, with each year of age decreasing the odds by 6% (OR, 0.94; CI, 0.88–1.00). Marijuana use in the previous 3 months (OR, 1.09; CI, 1.01–1.18) was significantly associated with higher odds of rectal STIs. Sensitivity analyses were conducted to examine nonlinear effects of independent variables at theoretically meaningful cutpoints (e.g., any drug use versus number of drugs), and results were consistent.

Results for all independent variables in a multivariate logistic regression model are in Table 5. Rectal STIs were significantly higher for black compared with white YMSM (OR, 1.74; CI, 1.00–3.02). This effect was not significant in bivariate analyses and only emerged as significant in the multivariable analysis that included other cofactors. Receptive CAS with a casual partner was significantly associated with higher odds of rectal STIs (OR, 1.60; CI, 1.05–2.46), whereas insertive CAS with a casual partner was significantly associated with lower odds of rectal STIs (OR, 0.60; CI, 0.40–0.92). No other effects were significant in the multivariable analysis.

DISCUSSION

We found a high prevalence of STIs in our sample, most of which were rectal. Our prevalence was slightly higher than previous studies,[6,7] which is likely due to our study requiring participants to have recently engaged in CAS. Our sample was also younger and had a higher proportion of racial minorities, both of which are risk factors for rectal STIs.[5,7] Consistent with this, the prevalence of rectal STIs in our sample was higher among younger and Black participants. Also consistent with previous studies of MSM,[5,7] Chlamydia was more common than GC, and rectal STIs were more common than urethral STIs. Such high prevalence of rectal STIs are concerning given that regular STI testing is not widely performed, especially for rectal STIs,[2] and that younger MSM are also less likely to regularly test for STIs.[3] This puts YMSM at higher risk for having an unknown rectal STI, contributing to forward transmission to partners.

TABLE 2. Bivariate Associations With Rectal STI Prevalence Among YMSM Aged 18–29 Years Participating in the Keep It Up! RCT, United States, 2013 – 2015

		Total	Negative	Positive		
		N (%)	N (%)	N (%)	χ^2	*P*
Met partner online	Yes	696 (69.9)	606 (87.1)	90 (12.9)	0.00	0.961
	No	299 (30.1)	260 (87.0)	39 (13.0)		
PrEP before risky sex (last 3 mo)	Yes	103 (10.4)	91 (88.3)	12 (11.7)	0.18	0.675
	No	892 (89.6)	775 (86.9)	117 (13.1)		
Previous STI (self-report)	Yes	453 (45.6)	401 (88.5)	52 (11.5)	1.66	0.198
	No	541 (54.4)	464 (85.8)	77 (14.2)		
CAS (last 3 mo)	No CAS	238 (26.0)	210 (88.2)	28 (11.8)	12.21	0.007
	Receptive	206 (22.5)	166 (80.6)	40 (19.4)		
	Insertive	208 (22.8)	191 (91.8)	17 (8.2)		
	Receptive + insertive	262 (28.7)	229 (87.4)	33 (12.6)		
Drugs before sex (last 3 mo, Dich)	Yes	292 (29.3)	250 (85.6)	42 (14.4)	0.74	0.391
	No	703 (70.7)	616 (87.6)	87 (12.4)		

Dich, dichotomous.

TABLE 3. STI Prevalence Among YMSM Aged 18–29 Years Participating in the Keep It Up! RCT, United States, 2013–2015

	Negative	Positive	95% CI	
	N (%)		Lower	Upper
Any STI	850 (84.9)	151 (15.1)	12.9	17.3
Rectal STI	866 (87.0)	129 (13.0)	10.9	15.1
Rectal CT	907 (91.2)	88 (8.8)	7.2	10.8
Rectal GC	945 (95.0)	50 (5.0)	3.7	6.4
Urethral STI	964 (96.6)	34 (3.4)	2.4	4.7
Urethral CT	972 (97.4)	26 (2.6)	1.7	3.7
Urethral GC	989 (99.1)	9 (0.9)	0.4	1.6

Several potential explanations have been proposed for why rectal STIs are more common than urethral STIs among MSM.[7] First, YMSM may not recognize that they have rectal STIs, because they are often asymptomatic or symptoms are less noticeable than with urethral STIs.[20] Second, providers and patients may be uncomfortable with rectal STI testing.[21] Third, YMSM may have a misconception that urine/blood tests for other STIs will detect STIs at all anatomical sites.[22] Fourth, nucleic acid amplification tests for extragenital CT/GC have not been FDA-approved despite CDC recommendations for their use,[23] so providers need to use laboratories that performed a validation study demonstrating acceptable sensitivity/specificity for the testing of rectal swabs.

The prevalence of rectal STIs was higher among black compared with white MSM in our sample and previous research.[5,7] There was also a trend for a higher prevalence among Latinos. Black MSM have the highest prevalence of new HIV diagnoses, and the rate is increasing for Latino MSM.[4] Given the established association between STIs and HIV transmission risk,[5] detecting and treating rectal STIs may reduce racial disparities in HIV. Although population-based STI treatment among heterosexuals in Africa was not found to decrease HIV transmission,[24] populations with high-risk behaviors and high prevalence of STIs may benefit more than populations with generalized epidemics.[25] A simulation estimated that 14.6% of HIV infections among YMSM were due to CT/GC, with the majority attributed to rectal infections.[26] Another study estimated that nearly 15% of HIV infections may have been prevented if rectal STIs had not occurred.[5] Thus, identifying risk factors for rectal STIs has the potential to inform prevention efforts, promote detection and treatment, and reduce STI/HIV transmission. Screening MSM for rectal STIs has been shown to be cost-effective (or cost-saving depending on assumptions), based on its impact in averting new HIV infections.[27]

Consistent with Grov and colleagues,[7] we found that receptive CAS was associated with rectal STIs. In fact, 19.4% of YMSM who reported receptive CAS had rectal STIs. Prevalence of rectal STIs was also high among those who did not report recent CAS in the previous 3 months (11.8%) and those who only reported insertive CAS (8.2%), suggesting that recent receptive CAS should not be the sole criterion for rectal STI testing. The small number of urethral STIs may have limited our ability to detect similar significant associations between CAS and urethral STIs.

Although we found a significant bivariate association between marijuana use and rectal STIs, it became nonsignificant in a multivariable analysis, and we did not find a significant association between polydrug use and STIs. The reduced effect of marijuana use in the multivariable analysis implies a potential indirect effect via receptive CAS that should be investigated in future longitudinal studies that can test mediation. Similarly, Grov and colleagues found that the association between drug use and rectal STIs became nonsignificant after accounting for demographics.

The current findings have important implications for clinical practice and future research. Given that most of the STIs in our sample were rectal, providers who only use urine-based testing will miss the majority of CT/GC among YMSM. If we had only used urine-based testing, we would have missed 117 people who tested positive for rectal STIs, but negative for urethral STIs (77.5% of those who tested positive for any STI). Some participants denied recent receptive anal sex, but tested positive for rectal STIs. These participants may be more likely to underreport their behavior, or may have acquired a rectal STI before the past 3 months, given that rectal STIs may persist for a year without treatment.[28] The cross-sectional nature of our study limited our ability to test temporality. It will be important for future research to use longitudinal designs to test whether the risk factors are associated with incident STI diagnoses over time. It is also possible that some men felt uncomfortable disclosing that they had engaged in receptive anal sex even in our online survey. If true, it is likely that they will be even less comfortable disclosing this to a clinician. Clinicians are encouraged to create a nonjudgmental environment to facilitate discussions of sexual health by including questions about sexual orientation and behavior on intake forms and initiating these conversations. When assessing sexual health, all men should be asked about insertive and receptive sexual behavior with male and female partners. For researchers, it is important to separate insertive and receptive anal sex in analyses. We found that they had opposite associations with rectal STIs, which would have been overlooked if they were not separated or we focused on broad measures like number of CAS partners.

Our study demonstrated that distance self-collection of specimens for STI testing is feasible, which is important because it provides an opportunity to increase the coverage of STI screening for MSM, including rural MSM and MSM who do not have access to clinics offering rectal testing. Rectal STI screening has been found to be acceptable in a large cohort of urban MSM provided with collection kits at clinic visits[5] and in a national online

TABLE 4. Bivariate Associations With Rectal STI Prevalence Among YMSM Aged 18–29 Years Participating in the Keep It Up! RCT, United States, 2013–2015

			95% CI	
	P	OR	Lower	Upper
Age (range, 18–29)	0.048	0.94	0.88	1.00
Condom Failure Scale (range, 0–11)	0.550	1.08	0.84	1.40
No. lifetime HIV tests (range, 0–46)	0.428	0.99	0.97	1.01
Marijuana (no. times used in last 3 mo; range, 0–6)	0.038	1.09	1.01	1.18
Polydrug (no. unique illicit drugs used in last 3 mo; range, 0–5)	0.284	1.10	0.92	1.32
No. CAS partners (last 3 mo; range, 0–43)	0.999	1.00	0.95	1.06
Drugs before sex (last 3 mo; mean score, range, 0–4)	0.658	1.05	0.86	1.28

TABLE 5. Multivariable Associations of Rectal STI Prevalence Among YMSM Aged 18–29 Years Participating in the Keep It Up! RCT, United States, 2013–2015

			95% CI	
	P	**OR**	**Lower**	**Upper**
Age	0.213	0.96	0.89	1.03
Sexual orientation				
Bisexual/other*	—	—	—	—
Gay	0.760	1.10	0.60	2.02
Race/ethnicity				
White*	—	—	—	—
Black	0.050	1.74	1.00	3.02
Latino	0.100	1.53	0.92	2.54
Other	0.356	1.41	0.68	2.90
Relationship status				
Single/casual partner*	—	—	—	—
Serious partner	0.652	0.88	0.51	1.53
Previous STI (self-report, dichotomous)	0.402	0.83	0.54	1.28
No. lifetime HIV tests (range, 0–46)	0.969	1.00	0.98	1.03
PrEP before risky sex (last 3 mo, dichotomous)	0.969	0.99	0.50	1.95
Met partner online (dichotomous)	0.685	1.10	0.89	1.38
Marijuana (no. times used in last 3 mo; range, 0–6)	0.278	1.06	0.95	1.19
Polydrug (no. unique illicit drugs used in last 3 mo; range, 0–5)	0.353	1.11	0.89	1.38
Drugs before sex (last 3 mo, dichotomous)	0.934	0.98	0.56	1.69
Condom Failure Scale (range, 0–11)	0.746	1.05	0.80	1.37
Receptive CAS acts (nonserious, dichotomous)	0.031	1.60	1.05	2.46
Insertive CAS acts (nonserious, dichotomous)	0.017	0.60	0.40	0.92

* Reference group.

sample of MSM,[7] but our data provide additional validation that the method is acceptable to young MSM. Our study did not test for pharyngeal STIs because they have less implications for susceptibility to HIV infection.[29] However, pharyngeal specimen collection has been demonstrated to be acceptable to MSM[30] and could readily be added to future studies of self-collected specimens for STI testing among YMSM.

The current findings call attention to the high prevalence of rectal STIs among YMSM and the need for health care providers to screen and test for them. They also point to risk factors that can be targeted by prevention programs to reduce incident STIs. Additionally, our study demonstrates the feasibility and acceptability of using self-collected samples for urethral/rectal STI testing among YMSM in the context of an eHealth intervention. It also demonstrates how home-based sample collection can be used to deliver STI testing without geographic boundaries as part of an eHealth program.

REFERENCES

1. CDC. CDC fact sheet: What gay, bisexaul and other men who have sex with men need to know about sexually transmitted diseases. 2015; http://www.cdc.gov/std/life-stages-populations/stdfact-msm.htm. Accessed 3/9/16, 2016.
2. Hoover KW, Butler M, Workowski K, et al. STD screening of HIV-infected MSM in HIV clinics. Sex Transm Dis 2010; 37(12):771–776.
3. Frankis J, Goodall L, Clutterbuck D, et al. Regular STI testing amongst men who have sex with men and use social media is suboptimal—A cross-sectional study. Int J STD AIDS 2016.
4. CDC. HIV Surveillance—Men who have sex with men (MSM). 2016. http://www.cdc.gov/hiv/library/slideSets/index.html. Accessed 4 May 2016.
5. Kelley CF, Vaughan AS, Luisi N, et al. The effect of high rates of bacterial sexually transmitted infections on HIV incidence in a cohort of black and white men who have sex with men in Atlanta. AIDS Res Hum Retroviruses 2015; 31:587–592.
6. CDC. *Sexually Transmitted Disease Surveillance 2014*. Atlanta: U.S.: Department of Health and Human Services; 2015.
7. Grov C, Cain D, Rendina HJ, et al. Characteristics associated with urethral and rectal gonorrhea and chlamydia diagnoses in a US National Sample of gay and bisexual men: results from the one thousand strong panel. Sex Transm Dis 2016; 43:165–171.
8. Grov C, Breslow AS, Newcomb ME, et al. Gay and bisexual men's use of the Internet: Research from the 1990s through 2013. J Sex Res 2014; 51:390–409.
9. Lacefield K, Negy C, Schrader RM, et al. Comparing psychosocial correlates of condomless anal sex in HIV-diagnosed and HIV-nondiagnosed men who have sex with men: A series of meta-analyses of studies from 1993–2013. LGBT health 2015; 2:200–220.
10. Vosburgh HW, Mansergh G, Sullivan PS, et al. A review of the literature on event-level substance use and sexual risk behavior among men who have sex with men. AIDS Behav 2012; 16:1394–1410.
11. Hirshfield S, Remien RH, Walavalkar I, et al. Crystal methamphetamine use predicts incident STD infection among men who have sex with men recruited online: A nested case-control study. J Med Internet Res 2004; 6:e41.
12. Chen X, Li X, Zheng J, et al. Club drugs and HIV/STD infection: An exploratory analysis among men who have sex with men in Changsha, China. PLoS One 2015; 10:e0126320.
13. Mustanski B, Madkins K, Greene GJ, et al. Internet-based HIV prevention with at-home sexually transmitted infection testing for young men having sex with men: study protocol of a randomized controlled trial of Keep It Up! 2.0. JMIR Res Protoc 2017; 6:e1.
14. Aptima Combo 2 Assay for Panther System Package Insert. San Diego, CA: Gen-Probe Incorporated, 2016.
15. Bachmann LH, Johnson RE, Cheng H, et al. Nucleic acid amplification tests for diagnosis of *Neisseria gonorrhoeae* and *Chlamydia trachomatis* rectal infections. J Clin Microbiol 2010; 48:1827–1832.
16. Cosentino LA, Campbell T, Jett A, et al. Use of nucleic acid amplification testing for diagnosis of anorectal sexually transmitted infections. J Clin Microbiol 2012; 50:2005–2008.
17. Mustanski B, Starks T, Newcomb ME. Methods for the design and analysis of relationship and partner effects on sexual health. Arch Sex Behav 2014; 43:21–33.
18. NIDA. NIDA-Modified ASSIST V2.0. http://www.drugabuse.gov/sites/default/files/pdf/nmassist.pdf. Accessed 6/3/16.
19. Crosby RA, Sanders SA, Yarber WL, et al. Condom use errors and problems among college men. Sex Transm Dis 2002; 29:552–557.

20. Whitlow CB. Bacterial sexually transmitted diseases. Clin Colon Rectal Surg 2004; 17:209–214.
21. Carter JW Jr, Hart-Cooper GD, Butler MO, et al. Provider barriers prevent recommended sexually transmitted disease screening of HIV-infected men who have sex with men. Sex Transm Dis 2014; 41:137–142.
22. Dodge B, Van Der Pol B, Rosenberger JG, et al. Field collection of rectal samples for sexually transmitted infection diagnostics among men who have sex with men. Int J STD AIDS 2010; 21:260–264.
23. Centers for Disease Control and Prevention. Recommendations for the laboratory-based detection of *Chlamydia trachomatis* and *Neisseria gonorrhoeae*—2014. MMWR Recomm Rep 2014; 63(RR-02):1–19.
24. Ng BE, Butler LM, Horvath T, et al. Population-based biomedical sexually transmitted infection control interventions for reducing HIV infection. Cochrane Database Syst Rev 2011:CD001220.
25. Korenromp EL, White RG, Orroth KK, et al. Determinants of the impact of sexually transmitted infection treatment on prevention of HIV infection: A synthesis of evidence from the Mwanza, Rakai, and Masaka intervention trials. J Infect Dis 2005; 191(Suppl 1):S168–S178.
26. Beck EC, Birkett M, Armbruster B, et al. A data-driven simulation of HIV spread among young men who have sex with men: role of age and race mixing and STIs. J Acquir Immune Defic Syndr 2015; 70:186–194.
27. Chesson HW, Bernstein KT, Gift TL, et al. The cost-effectiveness of screening men who have sex with men for rectal chlamydial and gonococcal infection to prevent HIV Infection. Sex Transm Dis 2013; 40: 366–371.
28. Chow EP, Camilleri S, Ward C, et al. Duration of gonorrhoea and chlamydia infection at the pharynx and rectum among men who have sex with men: A systematic review. Sex Health 2016.
29. Morris SR, Klausner JD, Buchbinder SP, et al. Prevalence and incidence of pharyngeal gonorrhea in a longitudinal sample of men who have sex with men: The EXPLORE study. Clin Infect Dis 2006; 43: 1284–1289.
30. Siegler A, Liu A, Mayer KH, et al. An exploratory assessment of the feasibility and acceptability of home-based support to streamline HIV pre-exposure prophylaxis (PrEP) delivery. J Int AIDS Soc 2016; 19(Suppl 5):110.