HHS Public Access

Author manuscript

Sex Transm Dis. Author manuscript; available in PMC 2023 July 01.

Published in final edited form as:

Sex Transm Dis. 2022 July 01; 49(7): 504–510. doi:10.1097/OLQ.0000000000001626.

Prevalence, anatomic distribution, and correlates of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infections among a cohort of men who have sex with men in Hanoi, Vietnam

Paul C. Adamson, MD MPH[1], **Ramona Bhatia, MD MS**[2], **Khoa D. C. Tran, MPH**[3], **Hao T. M. Bui, PhD**[3], **Diep Vu, PhD**[2], **Ray W. Shiraishi, PhD**[4], **Le Minh Giang, MD PhD**[3]

[1]Division of Infectious Diseases, David Geffen School of Medicine at UCLA, Los Angeles, CA

[2]Centers for Disease Control and Prevention, Vietnam

[3]Center for Training and Research on Substance Abuse and HIV, Hanoi Medical University, Vietnam

[4]Division of Global HIV & TB, Centers for Disease Control and Prevention, Atlanta, GA

Abstract

Background: *Neisseria gonorrhoeae* (NG) and *Chlamydia trachomatis* (CT) disproportionately affect men who have sex with men (MSM). Data on the prevalence, anatomical distribution, and correlates of NG and CT infections among MSM in Vietnam are limited.

Methods: Between July 2017 and April 2019, MSM 16 years or older, without HIV were enrolled into an observational cohort study. Baseline data, including sociodemographics, sexual behavior, and HIV status were collected. NG and CT testing were performed on urine, rectal, and pharyngeal specimens. Multivariate logistic regression models identified factors associated with NG and CT infections at baseline.

Results: In total, 1489 participants underwent NG/CT testing. The median age was 22 years (IQR: 20 – 26). There were 424 (28.5%) NG or CT infections; 322 (21.6%) with CT and 173 (11.6%) with NG. Rectal infections were most common for CT (73.9%), while pharyngeal infections were most common for NG (70.5%). Independent risk factors for CT or NG infection included: ≥2 sex partners in the prior month (adjusted odds ratio [aOR] = 2.04; 95% CI: 1.44, 2.91), condomless anal sex (aOR= 1.44, 95% CI: 1.12, 1.86), and meeting sex partners online (aOR= 1.35; 95% CI: 1.03, 1.76). Recent genitourinary or rectal symptoms were not associated with infections.

Corresponding Author: Le Minh Giang, MD PhD, Hanoi Medical University No. 1 Ton That Tung Street, Hanoi, Vietnam. Phone: +84 913 281 842; leminhgiang@hmu.edu.vn.

Conclusions: The overall and extragenital prevalence of NG and CT infections were high within this sample of young MSM without HIV in Hanoi. Testing limited to urethral specimens would have missed nearly three-quarters of CT and NG infections, supporting the need for routine testing at multiple anatomic sites.

Summary:

Among 1489 HIV-negative MSM in Hanoi, Vietnam, 28.5% had *Neisseria gonorrhoeae* or *Chlamydia trachomatis* infections; 73.9% of chlamydia infections were rectal and 70.5% of gonorrhea infections were oropharyngeal.

Keywords

Neisseria gonorrhoeae; Chlamydia trachomatis; rectal infections; pharyngeal infections; MSM

Introduction

Neisseria gonorrhoeae and *Chlamydia trachomatis* are the two most common bacterial sexually transmitted infections (STIs) worldwide, estimated to have caused 87 and 127 million infections, respectively, in 2016.(1) Men who have sex with men (MSM) are disproportionately affected by STIs, including *N. gonorrhoeae* and *C. trachomatis*.(2, 3) Infections by *N. gonorrhoeae* and *C. trachomatis* can increase the risk of HIV transmission and acquisition, mediated through ulceration and mucosal inflammation.(4)

Extragenital chlamydia and gonorrhea infections are common among MSM and are of public health importance.(5, 6) Recent rectal gonorrhea or chlamydia infections have been associated with increased risk for HIV acquisition.(7) Pharyngeal *N. gonorrhoeae* infections are also important, as they can serve as a reservoir for antimicrobial resistance.(8) Extragenital infections are commonly asymptomatic and screening is necessary to make a diagnosis. The U.S. Centers for Disease Control and Prevention recommends at least annual screening for rectal and pharyngeal infections among sexually-active MSM.(9) The World Health Organization guidelines also support periodic screening for rectal and urethral infections among MSM.(10)

Data regarding extragenital *N. gonorrhoeae* and *C. trachomatis* infections are primarily from high-resource settings.(5) A recent meta-analysis of STIs in PrEP users found nearly one in four had chlamydia, gonorrhea, or syphilis at PrEP initiation. However, few reports from low-resource settings were included in that meta-analysis, highlighting the need for additional data from these settings.(11) In low-resource settings, there are significant infrastructure and cost barriers that limit the widespread availability of diagnostic tests (e.g., nucleic acid amplification tests [NAATs]) needed to screen for extragenital *N. gonorrhoeae and C. trachomatis*.(12) Understanding the burden of gonorrhea and chlamydia in low-resource settings is also important for HIV prevention, as it can often be an entry point into HIV pre-exposure prophylaxis (PrEP) programs that are being scaled up worldwide.(13)

In Vietnam, the 2013 HIV/STI Integrated Biological and Behavioral Surveillance (IBSS) sampled 1587 MSM across the country and found a 5% prevalence of urethral chlamydia

and <3% of urethral gonorrhea.(14) That report found a 10% prevalence of rectal chlamydia and <3% of rectal gonorrhea, but oropharyngeal testing was not performed.(14) Aside from that report, data regarding the prevalence and risk factors for extragenital chlamydia and gonorrhea infections among MSM in Vietnam are scarce. A better understanding of the prevalence and correlates of *N. gonorrhoeae* and *C. trachomatis* infections among MSM in Vietnam is needed to effectively plan for STI screening, diagnosis, and prevention programs in the setting of limited resources, especially in the context of the rapid scale-up of HIV PrEP programs.

The objectives of this study were to determine the baseline prevalence of urethral, rectal, and pharyngeal *N. gonorrhoeae* and *C. trachomatis* infections within a cohort of HIV-negative MSM in Hanoi, the capital and second-largest city in Vietnam, and to examine the factors associated with *N. gonorrhoeae* and *C. trachomatis* infections.

Methods:

Study population and procedures

Between July 2017 and April 2019, MSM were recruited to participate in the Health in Men (HIM)-Hanoi study, a prospective, observational cohort designed to investigate the prevalence and incidence of HIV and STIs, as well as the social and behavioral characteristics within this population. Participants were recruited from concurrent HIV and STI surveys among MSM that utilized time-location sampling, respondent-driven sampling, and internet-based sampling methods. Recruited individuals presented to the Sexual Health Promotion Clinic at Hanoi Medical University where informed consent and study enrollment were completed. Cohort inclusion criteria were: assigned male sex at birth, aged ≥ 16 years, having oral or anal sex with another man or transgender woman in the prior 12 months, living in Hanoi continuously for the prior 3 months and without a plan to move in the next two years, and serologically confirmed to be HIV-negative at baseline. At the time of the study, no participants were enrolled in a PrEP program, as PrEP was not available in Vietnam.

Data collection

Data collected at baseline in the sub-sample of HIV-negative MSM were used for this study. Socio-demographics, substance use, sexual practices, history of STIs, and history pertaining to HIV counseling, testing, treatment, and care services, were collected through audio computer-assisted self-administered interviewing (ACASI). Group sex was defined as more than one partner in a sexual encounter in the prior six months. Participants were asked about any rectal and genitourinary symptoms in the prior 6 months. Rectal symptoms were classified as any of the following: dyschezia, pruritis, bleeding, discharge, or ulcers. Genitourinary symptoms were classified as any of the following: dysuria, discharge, bleeding, pruritis, or ulcers. All participants received client-centered HIV and STI risk-reduction counseling.

Laboratory Methods

Urine samples, rectal swabs, and pharyngeal swabs were collected using cobas PCR urine sample kits and cobas PCR female swab collection kits (for pharyngeal and rectal swabs) and were tested for *N. gonorrhoeae* and *C. trachomatis* by NAAT on the cobas 4800 CT/NG v2.0 system (Roche Diagnostics, Branchburg, NJ, USA). Blood was collected for HIV testing and was performed on the ARCHITECT HIV Ag/Ab Combo (Abbott Laboratories, Wiesbaden, Germany). Serologic testing for syphilis was done using the Architect Syphilis TP assay (Abbott Laboratories, Wiesbaden, Germany), with positive samples undergoing rapid plasma reagin (RPR) testing (Spinreact, Barcelona, Spain or Monlab, Barcelona, Spain) and *Treponema pallidum* hemagglutination (TPHA), as indicated (Spinreact, Barcelona, Spain).

Data Analysis

All participants with a positive NAAT for *C. trachomatis* or *N. gonorrhoeae* were considered to have an infection. Test results for *C. trachomatis* or *N. gonorrhoeae* were classified as missing if a specimen was not available for testing or if the testing had inconclusive results. Those with a positive *T. pallidum*-specific antibody and a measurable RPR were considered to have a syphilis infection.

Descriptive statistics were applied to socio-demographic, behavioral, and clinical data. Predictive logistic regression modeling was used to evaluate factors associated with *N. gonorrhoeae* and *C. trachomatis* infections separately and the combined outcome of having either infection. Variables for consideration were selected a priori using an approach that included variables based on biologic basis, as well as known risk factors and confounders. The variables included in the bivariate analyses were: age, education, income, ATS use for sex, group sex, meeting sexual partners via mobile apps, prior diagnosis of STIs, and genitourinary or rectal symptoms. Symptom status was dichotomized for the logistic regression models. All variables in the bivariate analyses were also included in the multivariate analysis, with the exception of *any substance use in the prior 3 months* and *amphetamine-type stimulant (ATS) use in the prior 3 months*, which were excluded from the multivariate analysis due to high collinearity with *ATS use to enhance sexual performance in the prior 6 months*. Records with missing variable data were excluded from the logistic regression models. All data analyses were done using R version 3.61.

Ethics

This study was approved for human subjects research by institutional review boards at Hanoi Medical University (200/HMU-IRB) and the U.S. Centers for Disease Control and Prevention (CDC, #6905). All study participants provided written informed consent prior to enrollment.

Results

Participant Characteristics

There were 1498 participants in the baseline survey. Nine (0.6%) did not have any samples for *N. gonorrhoeae* and *C. trachomatis* testing and were excluded from the analysis. Among

the remaining 1489 participants, the median age was 22 years (interquartile range: 20 – 26). Income in the prior month was less than 5 million VND (approximately 220 USD) for 40.5% (582/1437) of participants and 30.8% (459/1489) had completed university education. Substance use (cannabis, cocaine, ATS, opioids, or hallucinogens) in the prior 3 months was reported by 8.3% (121/1455) of participants and 6.5% (96/1482) reported using ATS to enhance sexual performance in prior 6 months. Among those reporting anal sex in the prior 6 months, 32.1% (477/1485) had insertive sex, 30.0% (446/1485) had receptive sex, and 29.5% (438/1485) had both. Condomless anal intercourse in the prior 6 months was reported by 57.6% (829/1438) of participants. Anal sex with two or more partners in the prior month was reported by 31.8% (472/1485) of participants. Group sex in the prior 6 months was reported by 24.9% (370/1484) of participants. Over half of participants (54.1%; 800/1479) reported meeting sexual partners via websites or mobile apps in the prior 6 months. There were 841 participants (56.5%) who did not have genitourinary or rectal symptoms in the prior 6 months. There were 235 (15.8%) participants with a prior diagnosis of chlamydia, gonorrhea, or syphilis. The prevalence of syphilis was 18.3% (272/1489). (Table 1)

CT and NG infections

In total, 21.6% (322/1489) participants had *C. trachomatis* infections and 11.6% (173/1489) had *N. gonorrhoeae* infections; 28.5% (424/1489) of participants had either *N. gonorrhoeae* or *C. trachomatis* infections (Table 1). Among all participants, 4.8% (71/1489) had both *N. gonorrhoeae* and *C. trachomatis* infections (data not shown). Among the 424 participants with *C. trachomatis* or *N. gonorrhoeae* infections, 210 (49.5%) did not report genitourinary or rectal symptoms in the prior 6 months. Among participants who did not report symptoms in the prior 6 months, the prevalence of *N. gonorrhoeae* was 9.3% (78/841), *C. trachomatis* was 19.3% (162/841), and 25.0% for either infection (210/841). The prevalence of infections was higher among those reporting genitourinary, rectal, and both genitourinary and rectal symptoms (Table 1).

The prevalence of infections by different anatomic sites are shown in Table 2. Among those with *C. trachomatis* infections, 238 (73.9%) had rectal infections, 105 (32.6%) had urethral infections, and 60 (18.6%) had pharyngeal infections. Among the 173 participants with *N. gonorrhoeae* infections, 122 (70.5%) had pharyngeal infections, 83 (48.0%) had rectal infections, and 19 (11.0%) had urethral infections. Among those with either *N. gonorrhoeae* or *C. trachomatis* infections, 29.5% (125/424) had an infection at more than one anatomic site and 4% (17/424) had infections at all three anatomic sites. The distribution of either *N. gonorrhoeae* or C*. trachomatis* infections by anatomic site are shown in Figure 1.

Correlates of N. gonorrhoeae and C. trachomatis infections

There were 1378 participants included in the analyses of factors associated with *N. gonorrhoeae*, C*. trachomatis,* or either *N. gonorrhoeae* or *C. trachomatis* infection, excluding those with missing variable data (n=111). (Table 3) In the multivariable analysis of the combined *N. gonorrhoeae* or *C. trachomatis* outcome, those aged 25–34 years had lower odds of infection compared to those with ages 16–24 years (aOR = 0.68, 95% CI: 0.49, 0.94). This was largely contributed to by *C. trachomatis* infection (25–34 years vs ref [aOR

0.64; 95% CI: 0.45, 0.92]). Other independent factors associated with having either *N. gonorrhoeae* or *C. trachomatis* infections included having two or more recent sex partners (aOR = 2.04; 95% CI: 1.44, 2.91), condomless anal intercourse in the prior six months (aOR= 1.44, 95%CI: 1.12, 1.86), which was driven by *C. trachomatis* (aOR= 1.34, 95% CI: 1.02, 1.78), and meeting sexual partners via mobile apps or the internet (aOR= 1.35; 95% CI: 1.03, 1.76), which was driven by *N. gonorrhoeae* (aOR 1.47, 95% CI: 1.00, 2.16). Genitourinary or rectal symptoms in the prior 6 months and group sex were associated with infections in bivariate analysis, but not in the multivariate model. A prior STI diagnosis and ATS use to enhance sexual performance were not associated with any infections in the multivariable models. (Table 3).

Discussion

In this study of young, HIV-negative MSM in Hanoi, Vietnam, we found a high prevalence of *N. gonorrhoeae* (11.6%) and *C. trachomatis* (21.6%) infections with more than one in four participants (28.5%) having one of these infections at baseline. Rectal infections occurred in 73.9% of those with chlamydia and 70.5% of gonorrhea infections occurred in the oropharynx. Limiting testing to the urethral site would have missed nearly three-quarters of *C.trachomatis* or *N. gonorrhoeae* infections within this cohort, as 27.4% of infections occurred in the urethra. Half of all persons with chlamydia or gonorrhea were asymptomatic, and reporting genitourinary or rectal symptoms were not associated with infections, highlighting the need for routine screening in this population.

Prior surveys of urethral chlamydia or gonorrhea in Vietnam found a similar prevalence of *C. trachomatis* (3–5%) and *N. gonorrhoeae* (<1.0%), compared to the overall urethral prevalence of 7.1% and 1.3%, respectively, we reported here.(14, 15) While data on extragenital chlamydia and gonorrhea within Vietnam are very limited, surveys from Ho Chi Minh City, Hanoi, and Nha Trang including urethral, rectal, and pharyngeal testing among HIV-negative male sex workers, many of whom are MSM, found a high overall prevalence of *N. gonorrhoeae,* up to 29%, and up to 17% for *C. trachomatis*, although data stratified by anatomical site were not reported.(16, 17) One limitation of this report is the study population consisted of HIV-negative MSM in Hanoi enrolled into a cohort study and is not necessarily representative of the community prevalence among MSM in Hanoi or other cities in Vietnam.

Our finding of high rates of extragenital infections is also consistent with regional reports from Thailand. Among a cohort of MSM in Thailand, including those living with HIV, rectal infections accounted for nearly 70% of *C. trachomatis* infections and approximately 60% of *N. gonorrhoeae* infections, while 40% of *N. gonorrhoeae* infections involved the oropharynx.(18) In another report of HIV-negative MSM in Bangkok, approximately 65% of *C. trachomatis* and 80% of *N. gonorrhoeae* infections were extragenital.(19) Elsewhere in the region, prevalence among MSM, including those living with HIV, was lower: in Guangzhou, the overall prevalence of rectal *C. trachomatis* was 11.2% and rectal *N. gonorrhoeae* was 6.1%, and in Kunming, the anatomic site with the highest prevalence of *C. trachomatis* was the rectum at 15.5% and the prevalence of *N. gonorrhoeae* was highest in the oropharynx at 8.1%.(20, 21) While direct comparisons between other studies and ours

are limited due to different study populations, recruitment methods, and testing strategies, the relatively higher rate of *N. gonorrhoeae* infections involving the oropharynx observed here is particularly concerning given this is a potential reservoir for antimicrobial resistance.(22)

The overall high prevalence of chlamydia and gonorrhea observed in our study might reflect an increase in rates of STIs within MSM communities in Vietnam. Testing at three anatomic sites also likely contributed to the high prevalence observed in our study. However, increasing rates of STIs among MSM is a trend observed globally and one that is often driven by stigma, discrimination, and limited access to healthcare.(23, 24) Few of the study participants with CT or NG infections reported a prior diagnosis of an STI, likely reflecting limited access and engagement with appropriate sexual health services, including HIV services, observed among MSM in Vietnam. (25, 26) High levels of stigmatisation and low levels of STI knowledge are structural and individual barriers that can lead to alienation of MSM from sexual health services in Vietnam.(27) A clinic-based, sexual health promotion intervention using health educators among male sex workers, a subgroup of MSM, in Vietnam was effective at increasing testing and treatment for STIs, increasing their knowledge of HIV/STI transmission risk, and health-seeking intention.(17, 28) More efforts are needed to expand such measures among MSM in Vietnam, as well as other settings seeking to promote engagement with sexual health services.

We found that half of all infections were asymptomatic, although it should be noted that oropharyngeal symptoms were not assessed by the study's survey instruments, which might lead to an under-estimation of symptoms reported here. Nevertheless, the data shown here support routine triple-site testing for *N. gonorrhoeae* and *C. trachomatis* among MSM in Hanoi. Yet in Vietnam, as well as many other low- and middle-income countries, the cost of NAATs for *C. trachomatis* and *N. gonorrhoeae* is prohibitive and is a primary barrier limiting the widespread availability of these tests.(12, 13) Many other barriers to diagnosing STIs in low-resource settings also exist, including availability of laboratory equipment and infrastructure, as well as limited availability of trained personnel.(12, 29)

Expanding access to testing can not only improve the diagnosis and treatment of STIs but also help to identify those at risk for HIV who can benefit from PrEP.(30) While PrEP was not yet available in Vietnam at the time of this study, a free-of-charge PrEP program has since been implemented in Vietnam and has engaged more than 32,000 people by the end of 2021, mostly MSM. There is considerable need for PrEP among MSM in Vietnam, and increasing funding and access to STI diagnostics and treatment are important components of scaling up PrEP recruitment and routine PrEP care.(30, 31s) Further research is needed to optimize STI screening among MSM in low-resource settings, including assessments of diagnostic testing strategies (e.g., pooled sampling, integration of point-of-care tests, testing frequency, anatomic site[s] of screening, and cost-effectiveness of screening programs).(13)

Frequently observed risk factors for STIs, such as younger age, condomless anal intercourse, and having two or more recent sex partners were independently associated with gonorrhea or chlamydia in this cohort at baseline. In addition, meeting sex partners via mobile apps or the internet was associated with *N. gonorrhoeae* or C*. trachomatis*. The use of the internet

or mobile apps to meet sex partners has been associated with behaviors that can increase risk for STIs, including HIV, as users tend to have greater frequency of condomless anal intercourse and more sexual partners.(32s, 33s) However, mobile app use was associated with infections independent of those factors, suggesting an additional mechanism; one plausible explanation could be related to the sexual networks of mobile app users.(34s) Determining causality of mobile app use is difficult, as it is not clear if meeting partners online or via mobile apps increases the risk of STIs or is a behavior of an individual who is already at higher risk for STIs. Nevertheless, the internet or mobile apps are becoming increasingly common ways to meet sexual partners worldwide, including in Vietnam, where a recent survey of MSM found that over three-quarters reported meeting their partners online.(35s, 36s) Given their widespread use, internet and mobile apps should be leveraged to deliver targeted sexual health interventions aimed at improving diagnosis, treatment, and prevention of STIs, among MSM in Vietnam.(37s, 38s, 39s) One limitation of our report was that all behaviors and symptoms were self-reported and might be subject to recall or social desirability biases, although the use of ACASI for the questionnaire would be expected to limit the latter.

In summary, our report comprehensively documents the prevalence of *N. gonorrhoeae* and *C. trachomatis* infections at urethral, rectal, and oropharyngeal sites among a cohort of HIV-negative MSM living in Hanoi and adds to the body of recent evidence demonstrating the high burden of STIs within MSM populations globally.(23) Most of these infections are extragenital and asymptomatic, supporting routine screening at multiple anatomic sites. However, multilevel barriers exist that limit access to sexual health services and diagnostic testing for CT and NG in Vietnam, which include costs and availability of tests, stigma, education, and other individual and systemic barriers. Efforts are urgently needed to address these barriers in order to increase access to STI testing and treatment for MSM in Hanoi.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements

The research was supported by a grant of no charge materials from Abbott Molecular.

Sources of Support:

This research publication has been supported by the President's Emergency Plan for AIDS Relief (PEPFAR) through the Centers for Disease Control and Prevention (CDC) under the terms of GH002150. PCA is supported by the National Institutes of Health (grant number T32MH080634 and K01TW012170).

References

1. Rowley J, Vander Hoorn S, Korenromp E, et al. Chlamydia, gonorrhoea, trichomoniasis and syphilis: global prevalence and incidence estimates, 2016. Bull World Health Organ; 2019:548–62P.
2. Centers for Disease Control and Prevention. Sexually Transmitted Disease Surveillance 2018. Atlanta: US Department of Health and Human Services; 2019.
3. World Health Organization. Report on global sexually transmitted infection surveillance. https://www.who.int/reproductivehealth/publications/stis-surveillance-2018/en/. Geneva; 2018.

4. Cohen MS, Council OD, Chen JS. Sexually transmitted infections and HIV in the era of antiretroviral treatment and prevention: the biologic basis for epidemiologic synergy. J. Int. AIDS Soc. 2019;22(S6).
5. Chan PA, Robinette A, Montgomery M, et al. Extragenital Infections Caused by Chlamydia trachomatis and Neisseria gonorrhoeae: A Review of the Literature. Infect. Dis. Obstet. Gynecol. 2016;2016:5758387. [PubMed: 27366021]
6. Dewart CM, Bernstein KT, Degroote NP, et al. Prevalence of Rectal Chlamydial and Gonococcal Infections. Sex. Transm. Dis. 2018;45(5):287–93. [PubMed: 29465688]
7. Bernstein KT, Marcus JL, Nieri G, et al. Rectal gonorrhea and chlamydia reinfection is associated with increased risk of HIV seroconversion. J. Acquir. Immune Defic. Syndr. 2010;53(4):537–43. [PubMed: 19935075]
8. Unemo M, Shafer WM. Antimicrobial Resistance in Neisseria gonorrhoeae in the 21st Century: Past, Evolution, and Future. Clin. Microbiol. Rev. 2014;27(3):587–613. [PubMed: 24982323]
9. Workowski KA BL, Chan PA,. Sexually Transmitted Infections Treatment Guidelines, 2021. MMWR Recomm. Rep 2021(70 (No. RR-4)):1–87.
10. World Health Organization. Prevention and treatment of HIV and other sexually transmitted infections among men who have sex with men and transgender people. Recommendations for a public health approach.; 2011.
11. Ong JJ, Baggaley RC, Wi TE, et al. Global Epidemiologic Characteristics of Sexually Transmitted Infections Among Individuals Using Preexposure Prophylaxis for the Prevention of HIV Infection: A Systematic Review and Meta-analysis. JAMA Netw Open. 2019;2(12):e1917134. [PubMed: 31825501]
12. Wi TE, Ndowa FJ, Ferreyra C, et al. Diagnosing sexually transmitted infections in resource-constrained settings: challenges and ways forward. J. Int. AIDS Soc. 2019;22(S6).
13. World Health Organization. Prevention and control of sexually transmitted infections (STIs) in the era of oral pre-exposure prophylaxis (PrEP) for HIV. Geneva, Switzerland; 2019.
14. Ministry of Health & National Institute of Hygiene & Epidemiology. HIV/STI Integrated Biologcial and Behavioral Surveillance (IBBS) in Vietnam - Results from Round III and Trends Across Three Rounds (2005 – 2009 - 2013) of Surveys; 2014.
15. Pham QD, Nguyen TV, Hoang CQ, et al. Prevalence of HIV/STIs and associated factors among men who have sex with men in An Giang, Vietnam. Sex. Transm. Dis. 2012;39(10):799–806. [PubMed: 23001268]
16. Clatts MC, Goldsamt LA, Giang le M, et al. Sexual practices, partner concurrency and high rates of sexually transmissible infections among male sex workers in three cities in Vietnam. Sex Health. 2015;12(1):39–47. [PubMed: 25622225]
17. Goldsamt LA, Clatts MC, Giang LM, et al. HIV and other STIs in male sex workers: Findings from a sexual health promotion intervention in Vietnam. Int. J. STD AIDS. 2018;29(6):540–6. [PubMed: 29130407]
18. Hiransuthikul A, Sungsing T, Jantarapakde J, et al. Correlations of chlamydia and gonorrhoea among pharyngeal, rectal and urethral sites among Thai men who have sex with men: multicentre community-led test and treat cohort in Thailand. BMJ Open. 2019;9(6):e028162.
19. Tongtoyai J, Todd CS, Chonwattana W, et al. Prevalence and Correlates of Chlamydia trachomatis and Neisseria gonorrhoeae by Anatomic Site Among Urban Thai Men Who Have Sex With Men. Sex. Transm. Dis 2015;42(8):440–9. [PubMed: 26165436]
20. Yang L-G, Zhang X-H, Zhao P-Z, et al. Gonorrhea and chlamydia prevalence in different anatomical sites among men who have sex with men: a cross-sectional study in Guangzhou, China. BMC Infect. Dis 2018;18(1).
21. Zhang X, Jia M, Chen M, et al. Prevalence and the associated risk factors of HIV, STIs and HBV among men who have sex with men in Kunming, China. Int. J. STD AIDS. 2017;28(11):1115–23. [PubMed: 28120646]
22. Adamson PC, Klausner JD. The Staying Power of Pharyngeal Gonorrhea: Implications for Public Health and Antimicrobial Resistance. Clin. Infect. Dis. 2021;73(4):583–5. [PubMed: 33508084]
23. Unemo M, Bradshaw CS, Hocking JS, et al. Sexually transmitted infections: challenges ahead. Lancet Infect. Dis. 2017;17(8):e235–e79. [PubMed: 28701272]

24. Centers for Disease Control and Prevention 2018;Pages. Accessed at https://www.cdc.gov/std/stats18/msm.htm.
25. Giang le M, Viet VD, Hao BT. Sexual health and men who have sex with men in Vietnam: an integrated approach to preventive health care. Adv. Prev. Med. 2012;2012:796192. [PubMed: 23119171]
26. Philbin MM, Hirsch JS, Wilson PA, et al. Structural barriers to HIV prevention among men who have sex with men (MSM) in Vietnam: Diversity, stigma, and healthcare access. PLoS One. 2018;13(4):e0195000. [PubMed: 29614104]
27. Bui HTM, Le GM, Mai AQ, et al. Barriers to access and uptake of antiretroviral therapy among HIV-positive men who have sex with men in Hanoi, Vietnam: from HIV testing to treatment. Culture, Health & Sexuality. 2017;19(8):859–72.
28. Clatts MC, Goldsamt LA, Giang LM, et al. Sexually transmissible infection and HIV prevention and treatment for young male sex workers in Vietnam: findings from the SHEATH intervention. Sex Health. 2016;13(6):575–81. [PubMed: 27607764]
29. Cristillo AD, Bristow CC, Peeling R, et al. Point-of-Care Sexually Transmitted Infection Diagnostics: Proceedings of the STAR Sexually Transmitted Infection-Clinical Trial Group Programmatic Meeting. Sex. Transm. Dis. 2017;44(4):211–8. [PubMed: 28282646]
30. World Health Organization. WHO Implementation tool for pre-exposure prophylaxis (PrEP) of HIV infection. Module 10: Testing. Geneva, Switzerland; 2017.
31. Cristillo AD, Bristow CC, Peeling R, et al. Point-of-Care Sexually Transmitted Infection Diagnostics: Proceedings of the STAR Sexually Transmitted Infection-Clinical Trial Group Programmatic Meeting. Sex. Transm. Dis. 2017;44(4):211–8. [PubMed: 28282646]
32. World Health Organization. WHO Implementation tool for pre-exposure prophylaxis (PrEP) of HIV infection. Module 10: Testing. Geneva, Switzerland; 2017.
33. Bhatia R, Le Minh G, An LT, et al. Substantial Need for Preexposure Prophylaxis Among Men Who Have Sex With Men in Hanoi, Vietnam. Sex. Transm. Dis 2021;48(5):e56–e8. [PubMed: 32890336]
34. Beymer MR, Weiss RE, Bolan RK, et al. Sex on demand: geosocial networking phone apps and risk of sexually transmitted infections among a cross-sectional sample of men who have sex with men in Los Angeles county. Sex. Transm. Infect. 2014;90(7):567–72. [PubMed: 24926041]
35. Choi EPH, Wong JYH, Fong DYT. The use of social networking applications of smartphone and associated sexual risks in lesbian, gay, bisexual, and transgender populations: a systematic review. AIDS Care. 2017;29(2):145–55. [PubMed: 27454158]
36. Chan PA, Crowley C, Rose JS, et al. A Network Analysis of Sexually Transmitted Diseases and Online Hookup Sites Among Men Who Have Sex With Men. Sex. Transm. Dis. 2018;45(7):462–8. [PubMed: 29465663]
37. Paz-Bailey G, Hoots BE, Xia M, et al. Trends in Internet Use Among Men Who Have Sex With Men in the United States. J. Acquir. Immune Defic. Syndr. 2017;75 Suppl 3(Suppl 3):S288–S95. [PubMed: 28604430]
38. Nguyen MX, Krishnan A, Le GM, et al. The use of technology to find sexual health information online among men who have sex with men in Hanoi, Vietnam, 2016. Int. J. STD AIDS. 2018;29(5):505–10. [PubMed: 29059034]
39. Krishnan A, Nguyen M, Giang LM, et al. Finding Sex Partners Through Social Media Among Men Who Have Sex with Men in Hanoi, Vietnam. J. Community Health 2018;43(1):146–56. [PubMed: 28677027]
40. Nguyen LH, Tran BX, Rocha LEC, et al. A Systematic Review of eHealth Interventions Addressing HIV/STI Prevention Among Men Who Have Sex With Men. AIDS Behav. 2019;23(9):2253–72. [PubMed: 31401741]
41. Shannon CL, Koussa M, Lee S-J, et al. Community-Based, Point-of-Care Sexually Transmitted Infection Screening Among High-Risk Adolescents in Los Angeles and New Orleans: Protocol for a Mixed-Methods Study. JMIR Res Protoc. 2019;8(3):e10795. [PubMed: 30900994]

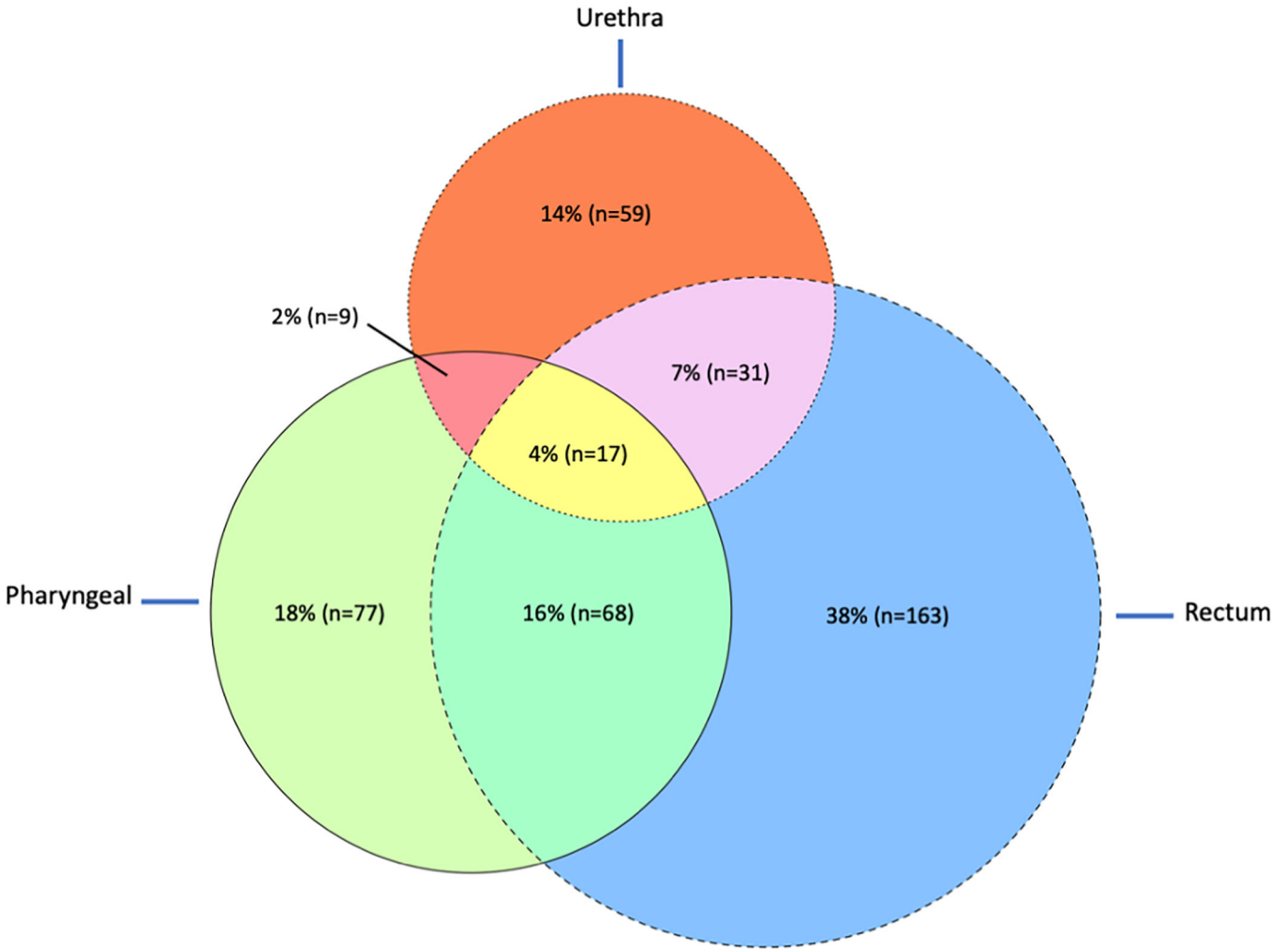

Figure 1.

Venn diagram of the distribution of 424 *Neisseria gonorrhoeae* or *Chlamydia trachomatis* infections by anatomic sit

Table 1.

Baseline demographic, behavioral, and clinical characteristics of 1489 HIV-negative men who have sex with men enrolled in the Health in Men (HIM)-Hanoi Study, an observational cohort study in Hanoi, Vietnam from July 2017 to April 2019.

	Overall (N = 1489)*	***C. trachomatis* or *N. gonorrhoeae* infection (n = 424)**		***C. trachomatis* infection (n = 322)**		***N. gonorrhoeae* infection (n = 173)**	
		n	**%†**	**n**	**%†**	**n**	**%†**
Median Age (IQR)	22 (20–26)	22 (20 – 25)		22 (20 – 25)		23 (20 – 26)	
Age, years							
16–24	1004	303	30.2%	241	24.0%	116	11.6%
25–34	378	93	24.6%	64	16.9%	43	11.4%
≥ 35	107	28	26.2%	17	15.9%	14	13.1%
Education							
High school or less	312	106	34.0%	88	28.2%	40	12.8%
Some higher education	718	198	27.6%	156	21.7%	70	9.7%
Completed university	459	120	26.1%	78	17.0%	63	13.7%
Income (N = 1437)							
<5 mil VND	582	164	28.2%	139	23.9%	52	8.9%
≥ 5 mil VND	855	245	28.7%	173	20.2%	114	13.3%
Any illicit substance in the prior 3 months (cannabis, cocaine, amphetamine type substance, opioids, hallucinogens) (N = 1455)							
No	1334	371	27.8%	285	21.4%	150	11.2%
Yes	121	42	34.7%	29	24.0%	18	14.9%
Use of amphetamine-type stimulants (ATS) in the prior 3 months (N = 1450)							
No	1394	386	27.7%	297	21.3%	154	11.0%
Yes	56	24	42.9%	14	25.0%	14	25.0%
Number of anal sex partners in the last month (N = 1438)							
None	340	73	21.5%	53	15.6%	23	6.8%
One	563	136	24.2%	104	18.5%	55	9.8%
Two or more	472	184	39.0%	139	29.4%	81	17.2%
Don’t remember	63	24	38.1%	21	33.3%	11	17.5%

	Overall (N = 1489)*	*C. trachomatis* or *N. gonorrhoeae* infection (n = 424)		*C. trachomatis* infection (n = 322)		*N. gonorrhoeae* infection (n = 173)	
		n	%†	n	%†	n	%†
Anal sex position in the last 6 months, among those reporting anal sex partners (N = 1485)							
Insertive	477	133	27.9%	94	19.7%	59	12.4%
Receptive	446	124	27.8%	100	22.4%	36	8.1%
Both	438	147	33.6%	114	26.0%	71	16.2%
Any condomless anal sex in the prior 6 months (N = 1438)							
No	609	141	23.2%	111	18.2%	55	9.0%
Yes	829	276	33.3%	206	24.8%	115	13.9%
Reported commercial sex with a male partner in the prior 6 months (N = 1488)							
No	1369	390	28.5%	296	21.6%	159	11.6%
Yes	120	34	28.3%	26	21.7%	14	11.7%
Use ATS to enhance sexual performance in the prior 6 months (N = 1482)							
No	1386	385	27.8%	298	21.5%	152	11.0%
Yes	96	37	38.5%	22	22.9%	19	19.8%
Group sex in the prior 6 months (N = 1484)							
No	1114	302	27.1%	230	20.6%	121	10.9%
Yes	370	121	32.7%	91	24.6%	51	13.8%
Met sexual partners via Internet or mobile apps in prior 6 months (N = 1479)							
No	679	156	23.0%	122	18.0%	55	8.1%
Yes	800	264	33.0%	196	24.5%	116	14.5%
Genitourinary or rectal symptoms in prior 6 months							
Asymptomatic	841	210	25.0%	162	19.3%	78	9.3%
Genitourinary symptoms only	213	75	35.2%	55	25.8%	36	16.9%
Rectal symptoms only	215	70	32.6%	51	23.7%	29	13.5%
Both	220	69	31.4%	54	24.5%	30	13.6%
Any genitourinary or rectal symptoms in prior 6 months							
No symptom	841	210	25.0%	162	19.3%	78	9.3%

	Overall (N = 1489)*	*C. trachomatis* or *N. gonorrhoeae* infection (n = 424)		*C. trachomatis* infection (n = 322)		*N. gonorrhoeae* infection (n = 173)	
		n	%†	n	%†	n	%†
Some symptoms	648	214	33.0%	160	24.7%	95	14.7%
Ever reported prior diagnosis of syphilis, chlamydia, or gonorrhea							
No	1254	350	27.9%	271	21.6%	134	10.7%
Yes	235	74	31.5%	51	21.7%	39	16.6%
Ever had an HIV test (N = 1486)							
Never	579	164	28.3%	129	22.3%	61	10.5%
Within 6 months	533	150	28.1%	116	21.8%	67	12.6%
More than 6 months ago	374	109	29.1%	76	20.3%	45	12.0%
Syphilis RPR and TPHA positive							
No	1217	323	26.5%	242	19.9%	130	10.7%
Yes	272	101	37.1%	80	29.4%	43	15.8%

IQR – interquartile range; RPR – rapid plasma reagin; TPHA - *Treponema pallidum* hemagglutination; ATS – amphetamine-type stimulants.

Note:

*N varies for some variables due to missing data

†Percentages are presented by row

Table 2.

Prevalence of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infections by anatomic site among 1489 HIV-negative men who have sex with men enrolled in an observational cohort study in Hanoi, Vietnam.

Anatomic Site(s)	*C. trachomatis* (n/N*, %)	*N. gonorrhoeae* (n/N*, %)	*C. trachomatis* or *N. gonorrhoeae* (n/N*, %)
Single Site Infections			
Urethral only	61/1480 (4.1)	5/1480 (0.3)	59/1480 (4.0)
Rectal only	163/1419 (11.5)	42/1419 (3.0)	163/1419 (11.5)
Pharyngeal only	21/1486 (1.4)	80/1486 (5.4)	77/1488 (5.2)
Multisite Infections			
Urethral and rectal	38/1412 (2.7)	4/1412 (0.3)	31/1412 (2.2)
Urethral and pharyngeal	2/1477 (0.1)	5/1477 (0.3)	9/1479 (0.6)
Rectal and pharyngeal	33/1417 (2.3)	32/1416 (2.3)	68/1418 (4.8)
Urethral, rectal and pharyngeal	4/1410 (0.3)	5/1409 (0.4)	17/1411 (1.2)
Total Infections (Any Site)	**322/1489 (21.6)**	**173/1489 (11.6)**	**424/1489 (28.5)**

*N varies due to missing testing data (specimen not available for testing or test with inconclusive results)

Note: Data should be viewed by infection status according to column and not across columns, as the anatomic distribution is reported separately for each infection and in combination in the last column. For example, in the “Urethral, rectal and pharyngeal” row, there are 4 CT infections, 5 NG infections, but 17 for either CT or NG. This is because the 17 infections includes those with: a) CT at all three sites (n=4), b) NG at all three sites (n=5), and c) CT at rectal and urethral sites and NG at the pharyngeal site (n=8).

Sex Transm Dis. Author manuscript; available in PMC 2023 July 01.

Table 3.

Bivariable and multivariable logistic regression models showing baseline demographic, behavioral, and clinical characteristics associated with *Neisseria gonorrhoeae* or *Chlamydia trachomatis* infections among 1378 HIV-negative men who have sex with men in Hanoi, Vietnam.

Characteristics	*C. trachomatis* or *N. gonorrhoeae* Infection		*C. trachomatis* Infection		*N. gonorrhoeae* Infection	
	OR (95% CI)	aOR[1] (95% CI)	OR (95% CI)	aOR[1] (95% CI)	OR (95% CI)	aOR[1] (95% CI)
Age group						
16–24	Ref	Ref	Ref	Ref	Ref	Ref
25–34	**0.75 (0.57–0.99)** *	**0.68 (0.49–0.93)**	**0.65 (0.47–0.87)**	**0.64 (0.45–0.92)**	0.98 (0.67–1.41)	0.75 (0.48–1.15)
35+	0.82 (0.51–1.27)	0.73 (0.44–1.20)	**0.60 (0.34–1.00)**	**0.53 (0.28–0.94)**	1.15 (0.61–2.03)	1.01 (0.51–1.88)
Income						
<5 mil VND	Ref	Ref	Ref	Ref	Ref	Ref
5+ mil VND	1.02 (0.81–1.29)	1.09 (0.82–1.44)	0.81 (0.63–1.04)	0.91 (0.67–1.23)	**1.57 (1.11–2.23)**	1.35 (0.90–2.04)
Education						
High school or less	Ref	Ref	Ref	Ref	Ref	Ref
Some higher education	**0.74 (0.56–0.99)**	0.79 (0.58–1.09)	**0.71 (0.52–0.96)**	**0.64 (0.46–0.90)**	0.73 (0.49–1.12)	0.93 (0.59–1.49)
Completed university	**0.69 (0.50–0.94)**	0.72 (0.51–1.02)	**0.52 (0.37–0.74)**	**0.53 (0.36–0.78)**	1.08 (0.71–1.67)	1.15 (0.72–1.87)
Use of ATS in the prior 3 months						
No	Ref	-	Ref	-	Ref	-
Yes	**1.96 (1.13–3.36)**	-	1.23 (0.64–2.23)	-	**2.68 (1.39–4.91)**	-
Substance use in the prior 3 months (cannabis, cocaine, ATS, opioids, hallucinogens)						
No	Ref	-	Ref	-	Ref	-
Yes	1.38 (0.92–2.03)	-	1.16 (0.74–1.78)	-	1.38 (0.79–2.29)	-
Number of anal sex partners in the prior month						
None	Ref	Ref	Ref	Ref	Ref	Ref
One	1.16 (0.85–1.61)	1.13 (0.81–1.58)	1.23 (0.86–1.77)	1.28 (0.88–1.88)	1.49 (0.91–2.52)	1.31 (0.79–2.23)
Two or more	**2.34 (1.71–3.23)**	**2.04 (1.44–2.91)**	**2.26 (1.60–3.24)**	**2.33 (1.58–3.46)**	**2.86 (1.78–4.74)**	**2.00 (1.21–3.42)**
Don’t remember	**2.25 (1.26–3.96)**	1.79 (0.90–3.49)	**2.71 (1.47–4.90)**	**2.59 (1.27–5.16)**	**2.92 (1.30–6.22)**	1.65 (0.57–4.19)
Any condomless anal sex in the prior 6 months						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	**1.66 (1.31–2.10)**	**1.44 (1.12–1.86)**	**1.48 (1.15–1.93)**	**1.34 (1.02–1.78)**	**1.62 (1.16–2.29)**	1.30 (0.91–1.88)

Characteristics	*C. trachomatis* or *N. gonorrhoeae* Infection		*C. trachomatis* Infection		*N. gonorrhoeae* Infection	
	OR (95% CI)	aOR[1] (95% CI)	OR (95% CI)	aOR[1] (95% CI)	OR (95% CI)	aOR[1] (95% CI)
Use ATS to enhance sexual performance in the prior 6 months						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	**1.63 (1.06–2.49)**	1.36 (0.84–2.18)	1.09 (0.65–1.75)	0.88 (0.51–1.49)	**2.00 (1.15–3.34)**	1.56 (0.85–2.75)
Group sex in the prior 6 months						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	**1.31 (1.01–1.68)**	0.89 (0.66–1.20)	1.25 (0.95–1.65)	0.89 (0.65–1.23)	1.31 (0.92–1.85)	0.91 (0.60–1.35)
Met sexual partners via Internet or mobile apps in prior 6 months						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	**1.65 (1.31–2.08)**	**1.35 (1.03–1.76)**	**1.48 (1.15–1.91)**	1.23 (0.92–1.65)	**1.92 (1.38–2.72)**	**1.47 (1.00–2.16)**
Any genitourinary or rectal symptoms in prior 6 months						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	**1.48 (1.18–1.86)**	1.23 (0.96–1.57)	**1.37 (1.07–1.76)**	1.18 (0.90–1.55)	**1.68 (1.22–2.32)**	1.36 (0.96–1.92)
Prior diagnosis of syphilis, chlamydia, or gonorrhea						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.19 (0.87–1.60)	1.05 (0.76–1.44)	1.01 (0.71–1.40)	0.92 (0.64–1.31)	**1.66 (1.12–2.43)**	1.42 (0.93–2.12)

OR – odds ratio in bivariable logistic regression model; aOR – adjusted OR in multivariable logistic regression model; ATS – amphetamine-type stimulants

[1]Multivariate logistic regression models were adjusted for all variables listed in the table, except for ATS and substance use in the prior 3 months, which were excluded from the multivariate models due to high collinearity with ATS use to enhance sexual performance in the prior 6 months.

*Bolded cells are those with estimates associated with *P*-values < 0.05.