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**Routine Testing for Chlamydia and Gonorrhea in an HIV Pre-
Exposure Prophylaxis Program in Hanoi, Vietnam: Implications for
Low- and Middle-Income Countries**

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36 **Short Title:** CT/NG Testing in an HIV PrEP Program in Vietnam

37 **Abstract**

38 **Objectives:** To assess the prevalence, anatomical distribution, and
39 correlates of *Neisseria gonorrhoeae* (NG) and *Chlamydia trachomatis* (CT)
40 infections within an HIV pre-exposure prophylaxis (PrEP) program in Hanoi,
41 Vietnam.

42 **Design:** Cross-sectional, observational study

43 **Methods:** Between January-December 2022, HIV PrEP program clients who
44 were male at birth, ≥ 16 years old, reported ≥ 1 male sex partner in the prior
45 12 months, were enrolled. A questionnaire collected sociodemographics,
46 sexual behaviors, and clinical data. CT/NG testing was performed on self-
47 collected urine, rectal, and pharyngeal specimens. Multivariate logistic
48 regression was used to identify factors associated with infections.

49 **Results:** Among 529 participants, the prevalence of CT or NG was 28.9%
50 (153/529). The prevalence of NG was 14.4% (76/529) and highest for
51 pharyngeal infections (11.7%; 62/528), while for CT, the prevalence was
52 20.4% (108/529) and highest for rectal infections (15.0%; 74/493).
53 Symptoms in the prior week were reported by 45.8% (70/153) of those with
54 CT or NG infections. Among asymptomatic participants, there was a low
55 prevalence of urethral CT (3.1%; 14/457) and NG (0.9%; 4/457). Condomless
56 anal sex (aOR= 1.98; 95% CI: 1.27, 3.09) and sexualized drug use in the
57 prior 6 months (aOR= 1.71; 95% CI: 1.09, 2.69) were associated with CT/NG
58 infections.

59 **Conclusions:** The study found a high prevalence of CT/NG infections,
60 particularly pharyngeal and rectal infections, within an HIV PrEP program in
61 Hanoi, Vietnam. The findings suggest testing for urethral infections among
62 asymptomatic individuals is of limited value. Further research is needed for
63 STI prevention strategies and updated guidelines for CT/NG screening in HIV
64 PrEP programs in low- and middle-income countries.

65 **Keywords:** Neisseria gonorrhoeae, Chlamydia trachomatis, HIV Pre-
66 Exposure Prophylaxis, Sexually Transmitted Infections, Low- and Middle-
67 Income Countries, Men who have sex with men

68 **Introduction**

69 Sexually transmitted infections (STIs) are a significant public health
70 challenge globally. *Neisseria gonorrhoeae* and *Chlamydia trachomatis* are
71 the two most common bacterial STIs. Men who have sex with men (MSM) are
72 disproportionately affected by STIs.[1,2] MSM on HIV pre-exposure
73 prophylaxis (PrEP) have high frequencies of bacterial STIs. [3–5] Thus, major
74 HIV PrEP guideline groups recommend routine screening for *C. trachomatis*
75 and *N. gonorrhoeae* among MSM on HIV PrEP, including testing at multiple
76 anatomic sites of infection.

77

78 In low- and middle-income countries (LMICs), HIV PrEP programs are
79 expanding, yet data on STIs among MSM in HIV PrEP programs are limited.
80 Understanding the epidemiology of STIs in these settings is important for
81 planning and implementation of HIV PrEP programs. Moreover, in many LMIC
82 settings, the availability of molecular *C. trachomatis* and *N. gonorrhoeae*
83 testing is limited and the costs associated testing remain significant barriers
84 for testing.[6,7] Identifying clinical and behavioral risk factors associated
85 with those infections can help optimize diagnosis and prevention of STIs,
86 particularly in LMIC settings where resources might be limited and there is
87 ongoing rapid scale-up of HIV PrEP services.

88

89 Vietnam is a LMIC where HIV PrEP became available in 2018. Prior to that,
90 baseline data from the Hanoi-MSM (HIM) study found a high prevalence of *C.*

trachomatis (22%) and *N. gonorrhoeae* (12%) among MSM without HIV, who subsequently were enrolled into the pilot HIV PrEP project.[8] Currently, HIV PrEP guidelines in Vietnam recommend quarterly screening for *C. trachomatis* and *N. gonorrhoeae* at all sites with potential exposure[9]; however, the clients are responsible for covering the majority of the costs of those tests, which greatly limits testing uptake and available data on infections. The aims of this study are to fill gaps in research on STIs among MSM on HIV PrEP in Vietnam, since the rollout of HIV PrEP. The study objectives were to determine the prevalence of urethral, rectal, and pharyngeal *N. gonorrhoeae* and *C. trachomatis* infections within an HIV PrEP program in Hanoi, Vietnam, as well as to determine behavioral and clinical factors associated with *N. gonorrhoeae* and *C. trachomatis* infections.

Methods:

Study design and population

This was an observational, cross-sectional study from January 2022 to December 2022. The study was conducted within the HIV PrEP program at the Sexual Health and Promotion (SHP) Clinic at Hanoi Medical University. Study participants were eligible if they were male sex at birth, aged 16 years or older, reported having sex with men or transgender women in prior 12 months, and were enrolled in, or presenting for enrollment into, the HIV PrEP program; exclusion criteria were if they had *C. trachomatis* or *N. gonorrhoeae* testing done in the prior 3 months, unless they reported acute STI symptoms on the day of enrollment. The exclusion criteria were included to align closely with the HIV PrEP program recommendations. Participants were allowed to participate in the study more than once. Eligible participants were approached in the clinic and the study's objectives and procedures were explained by study research staff.

115

116 ***Data collection***

117 Demographic, behavioral, and clinical characteristics were collected using a tablet self-
118 administered survey. Sexual behaviors were self-reported and included: number of sex partners
119 in the prior month as the combined number of male, female, and transgender sex partners, anal
120 sex position(s), condomless anal intercourse in the prior month, group sex (defined as having
121 more than one sex partner at the same encounter), or having sex with partners met via mobile
122 apps in the prior 6 months. Sexualized drug use was considered if the participant reported using
123 a substance (heroin, ketamine, ecstasy, methamphetamine, gamma hydroxybutyrate or
124 gamma butyrolactone, poppers, or prostaglandin E medications) in the prior 6 months to
125 enhance sexual pleasure. Poppers are commonly included in the definition of sexualized drug
126 use in the Asia Pacific region.[10] History of STIs in the prior three months was obtained by self-
127 report.

128

129 Participants were asked about any genitourinary, rectal, or pharyngeal symptoms in the prior
130 one week. Genitourinary symptoms were classified as any of the following: pain with urination,
131 discharge, bleeding, pruritis, testicular pain, lymphadenopathy, or ulcers. Rectal symptoms were
132 classified as any of the following: tenesmus, dyschezia, pruritis, bleeding, discharge, ulcers, or
133 diarrhea. Pharyngeal symptoms included pain or itching in the throat.

134

135 ***Sample collection, testing, and treatment***

136 Study participants received instructions on providing rectal, pharyngeal, and urine specimens for
137 testing by study staff and with visual aids. Clinician-collected samples were obtained if
138 participants preferred or were unable to perform self-collection. Study specimens were

collected using either the Alinity m multi-Collect Specimen Collection Kits (Abbott Molecular, USA) or cobas PCR Urine or Swab Sample Kits (Roche Diagnostics, Branchburg, NJ, USA). Specimens were stored in the clinic and transported daily to the laboratory. Testing was performed using either the Alinity m STI Assay (Abbott Molecular, USA) or the cobas 4800 CT/NG assay (Roche Diagnostics, Branchburg, NJ, USA) according to manufacturer's instructions. Test results for *C. trachomatis* and *N. gonorrhoeae* were either positive, negative, or inconclusive, in the event of failed internal controls or the presence of inhibitors. Participants were informed of their test results. For those found to have infections, free treatment was offered. For *C. trachomatis* infections, doxycycline 100mg by mouth twice daily for 7 days was provided. For *N. gonorrhoeae* infections, ceftriaxone 500mg intramuscular injection once was the preferred treatment offered; cefixime 800mg by mouth once was provided as an alternative treatment.

Data analysis

The primary outcome was the prevalence of *C. trachomatis* or *N. gonorrhoeae* infections at different anatomic sites. The study sample size was determined based on available resources, staffing, and a defined study duration (2022). Rather than relying on formal sample size calculations, recruitment was intentionally inclusive of all eligible study participants, that could be enrolled based on research timing and staffing. A sample size of 500 would have a reasonable estimate of infection prevalence with a margin of error <5%. Descriptive statistics were performed for demographic, behavioral and clinical data; percentages for categorical variables, or median and interquartile range for continuous variables, were reported. Categorical variables between those with and without *C. trachomatis* or *N. gonorrhoeae* infections were

compared using Pearson's Chi-squared test and Fisher's exact test, when frequencies were low, and nonparametric continuous variables were compared using Wilcoxon rank-sum tests.

Logistic regression modeling was used to evaluate factors associated with *N. gonorrhoeae* and *C. trachomatis* infections separately as well as the outcome of having either infection. Variables with p-values < 0.20 in univariate comparisons were included in the multivariable logistic regression models; except for age, which was included in the final models. The number of sex partners in the prior month was dichotomized to above or below the median (0-1 and ≥ 2) to improve interpretation and model fit. For participants with multiple study visits, data analysis was restricted to their first participation. A variance inflation factor was used to measure for multicollinearity between variables in the multivariate logistic regression. Variables with missing data were excluded from the logistic regression models. P-values ≤ 0.05 was defined as statistical significance. All data analyses were performed using STATA version 18 (StataCorp LLC, College Station, TX, USA).

Ethics

The study was approved by the Institutional Review Boards of Hanoi Medical University (HMUIRB580), the University of California, Los Angeles, and the University of Southern California. All study participants provided written informed consent. People aged 16 years or older are eligible for the HIV PrEP program, thus study eligibility included these individuals, who could participate in the study with assent and parental consent. Participants were compensated 200,000 VND (~9 USD) for their time and effort of study participation.

Results

186 *Participant Characteristics*

187 From January to December 2022, there were 529 participants enrolled into
 188 the study among 775 approached and 538 screened. The primary reasons
 189 for refusal of those who were approached, but who did not undergo
 190 screening, was “too busy/not enough time” or “will consider next time.”
 191 Multiple visits occurred for 134 participants: 116 with two, 16 with three, and
 192 two with four visits. Among the study participants, 81.6% (432/529)
 193 identified as men, 1.7% (9/529) identified as transgender women, and 16.6%
 194 (88/529) identified as gender non-conforming. (Table 1). The median age
 195 among all participants was 25.1 years (IQR: 21.7-29.5). There were 29.1%
 196 (154/529) currently undergoing university or post-secondary training, while 61.1%
 197 (323/529) had completed university or post-secondary training.

198

199 In the prior six months, 95.8% (507/529) reported only male sex partners; the median number of
 200 sex partners in the prior month was 1 (IQR: 1-2). (Table 1). Anal sex in the prior 6 months was
 201 reported by 88.4% (396/529), of which 51.2% reported condomless anal sex in the prior month.
 202 In the prior 6 months, group sex was reported by 12.3% (65/529) and sexualized substance use
 203 was reported by 45.4% (240/529). A history of a STI in the prior 3 months was reported by 5.5%
 204 (29/529), with 69.0% (20/29) of those being syphilis. Additional sexual behavior data are shown
 205 in Table 1.

206

207 *C. trachomatis and N. gonorrhoeae infections*

208 All participants submitted a urine sample for testing, a pharyngeal specimen
 209 was not collected for one (0.2%) participant, while 11 (2.1%) participants

210 refused rectal specimen collection. In total, 28.9 % (153/529) participants
 211 had *C. trachomatis* or *N. gonorrhoeae* infections at any anatomical site. The
 212 prevalence of *C. trachomatis* was 20.4% (108/529) and 14.3% (76/529) for *N.*
 213 *gonorrhoeae*; 5.9% (31/529) of participants had *C. trachomatis* and *N.*
 214 *gonorrhoeae* co-infections (Table 1). Among the 153 participants with either
 215 *C. trachomatis* or *N. gonorrhoeae* infections, the median age was 25.1 years
 216 (IQR: 21.5 – 28.3). The median number of sex partners in the prior month
 217 was 2 (IQR: 1-3), 14.2% (22/155) reported group sex in the prior month, and
 218 60.1% (94/155) reported sexualized substance use. Of the 153 with *C.*
 219 *trachomatis* or *N. gonorrhoeae* infections, 45.8% (70/153) reported any
 220 symptoms in the prior week; 33 (21.6%) reported pharyngeal symptoms, 29
 221 (19.0%) reported rectal symptoms, and 26 (17.0%) reported urethral
 222 symptoms. More participants with *C. trachomatis* or *N. gonorrhoeae*
 223 infections reported having symptoms on the day of enrollment, compared to
 224 those without infections (9.2% vs. 3.0%, $p=0.001$).

225

226 *C. trachomatis* and *N. gonorrhoeae* infections by anatomic site are shown in
 227 Table 2. The prevalence of *C. trachomatis* was highest in the rectum (15.0%;
 228 74/493) and 3.4% (18/529) had infections in multiple anatomic sites. For *N.*
 229 *gonorrhoeae*, pharyngeal site infections were most prevalent (11.7%;
 230 62/528) and 6.0% (32/529) had infections at multiple anatomic sites. Among
 231 participants with either *C. trachomatis* or *N. gonorrhoeae*, the prevalence of
 232 rectal infections was 19.1% (94/493) and 9.3% (49/529) had infections at

233 multiple anatomic sites. For rectal specimens, 24 (4.5%) were inconclusive
234 for both infections and one additional result was inconclusive for *C.*
235 *trachomatis*.

236

237 The prevalence of *C. trachomatis* or *N. gonorrhoeae* infections by anatomic
238 site, stratified by reported symptoms in the prior week are shown in Figure 1.
239 Among those reporting rectal symptoms in the prior week, the prevalence of
240 having a rectal infection with *C. trachomatis* or *N. gonorrhoeae* was 27.2%
241 (22/81), followed by 25.0% (18/72) for urethral symptoms and urethral
242 infections, and 18.3% (23/126) for pharyngeal symptoms and pharyngeal
243 infections. Among those who did not report symptoms in the prior week, the
244 prevalence of urethral *C. trachomatis* was 3.1% (14/457) and 0.9% (4/457)
245 for *N. gonorrhoeae*. For both infections, the prevalence of both rectal and
246 urethral infections were higher among those reporting symptoms in the prior
247 week; there were no differences in the prevalence of pharyngeal infections
248 by symptom status for either infection.

249

250 *Factors associated with C. trachomatis and N. gonorrhoeae infections*

251 In the multivariate logistic regression models, having either *C. trachomatis* or
252 *N. gonorrhoeae* infection was associated with condomless anal intercourse in
253 the prior month (aOR: 1.98; 95% CI: 1.27-3.09) and sexualized drug use in
254 the prior 6 months (aOR: 1.71; 95% CI: 1.09, 2.69). (Table 3) Rectal and
255 urethral symptoms in the prior week were associated with infections in

univariate analyses, but not in the multivariate model (aOR: 1.19; 95% CI: 0.73, 1.94). When examining each infection separately, meeting sex partners in mobile apps in the prior 6 months was an independent risk factor for *N. gonorrhoeae* infections (aOR: 2.32; 95% CI: 1.19, 4.53), but not *C. trachomatis* (aOR: 0.83; 95% CI: 0.49, 1.43). Both condomless anal sex in the prior month (aOR: 2.10; 95% CI: 1.27-3.45) and sexualized drug use in the prior 6 months (aOR: 2.20; 95% CI: 1.32-3.68) were associated with *C. trachomatis*, but not *N. gonorrhoeae*. There was no evidence of multicollinearity among variables in the multivariate logistic regression.

Discussion

In this study including 529 primarily MSM in an HIV PrEP program in Hanoi, Vietnam, testing for *C. trachomatis* and *N. gonorrhoeae* at multiple anatomic sites identified a high prevalence (29%) of infections. Rectal infections were most common for *C. trachomatis* (14%), while pharyngeal infections were most common for *N. gonorrhoeae* (11%), demonstrating the utility of testing at multiple anatomic sites for the detection of infections outside of the genital tract. While the prevalence of urethral and rectal *C. trachomatis* and *N. gonorrhoeae* infections were higher among those who reported symptoms at those sites in the prior week, a majority of overall infections (54%) were detected among those without symptoms, underscoring the limitations of relying on syndromic management as an infection control strategy in this

278 setting. These findings highlight the opportunity to enhance STI diagnosis
279 and treatment within HIV PrEP programs in LMICs.

280

281 Our study provides important data on routine testing for *C. trachomatis* and
282 *N. gonorrhoeae* within a large HIV PrEP program in a LMIC setting, where
283 prevalence data are limited. A recent meta-analysis of STIs among people in
284 HIV PrEP programs estimated a pooled prevalence of *C. trachomatis* or *N.*
285 *gonorrhoeae* was 24%, suggesting a slightly higher burden among
286 participants in our study population.[5] However, that study highlighted the
287 scarcity of data from LMICs, which makes comparisons difficult, but the study
288 did not find a significant difference in prevalence of chlamydia or gonorrhea
289 by country income level. There is a paucity of published prevalence
290 estimates of *C. trachomatis* and *N. gonorrhoeae* among MSM on HIV PrEP
291 from other nearby countries in Asia, which could provide further context. One
292 study done among adolescent MSM and transgender women in Thailand
293 found a *C. trachomatis* prevalence of 15% and *N. gonorrhoeae* prevalence of
294 4.5%, estimates that are much lower than our study, although pharyngeal
295 testing was not performed in that study which would likely account for some
296 of that difference.[11] The prevalence of infections observed in our study
297 align with existing evidence from other, largely high-income, settings
298 indicating a high burden of STIs among MSM on HIV PrEP.[6,12]

299

300 Among participants in our study, we observed those reporting condomless
301 anal sex were about twice as likely to have *C. trachomatis* or *N. gonorrhoeae*
302 infection and those having sexualized drug use in the prior 6 months were
303 70% more likely to have *C. trachomatis* or *N. gonorrhoeae* infection.
304 Identifying factors associated with infections could help to focus testing
305 among those at highest risk for infections. For example, of the total 153 *C.*
306 *trachomatis* or *N. gonorrhoeae* infections in our study, testing those
307 reporting either condomless anal sex or sexualized drug use in the prior 6
308 months would have detected 75% of those infections. Meeting sex partners
309 on mobile apps is increasingly common globally and this behavior was
310 associated with twice the odds of *N. gonorrhoeae*, but not *C. trachomatis*,
311 infections in our study, a finding that was also observed in our previous work
312 in a similar study population.[8] Possible explanations for this observation
313 might be there is a higher prevalence of *N. gonorrhoeae* among certain
314 sexual networks of online mobile app users or there is more oral sex within
315 that network, since the majority of these infections were pharyngeal. These
316 findings indicate that focused testing for *N. gonorrhoeae* among those
317 meeting sex partners on apps could be a strategy to improve gonorrhea
318 control.

319

320 We found that reporting rectal or urethral symptoms in the prior week was
321 not associated with infections in multivariate analysis, highlighting the
322 difficulty of using symptoms to identify infections, given a high proportion of

323 these types of infections are asymptomatic.[13] Despite this, the prevalence
324 of rectal and urethral *C. trachomatis* and *N. gonorrhoeae* was significantly
325 higher among those who reported symptoms in the prior week, suggesting
326 symptoms are still correlated with a higher frequency of infections at those
327 sites. Our findings suggest that testing for urethral infections among
328 asymptomatic individuals is of limited value, as the prevalence in this group
329 was very low, 0.9% for *N. gonorrhoeae* and 3.1% for *C. trachomatis*;
330 furthermore, testing only at urethral sites would have missed more than
331 three-quarters (77.8%) of these infections. The low positivity coupled with
332 the high costs of testing, approximately 25-32 USD for one site *C.*
333 *trachomatis/N. gonorrhoeae* testing in Vietnam, are important
334 considerations, especially as the costs are typically managed by the patient,
335 outside of research settings. Pooled testing, where samples from one
336 individual from multiple anatomic sites are combined into one sample for
337 testing, is an approach that might be cost-saving but is associated with some
338 compromise in test sensitivity.[14,15] However, anatomic sites of infection
339 are important for treatment and follow-up, particularly with regard to
340 antimicrobial resistance in *N. gonorrhoeae*, which would limit the cost
341 savings of this approach in a high prevalence setting such as ours. Further
342 research on the implementation and cost-effectiveness of pooled testing
343 within HIV PrEP programs in LMICs would help to provide further guidance.
344

345 Our study further highlights the high prevalence of *C. trachomatis* and *N.*
346 *gonorrhoeae* infections among people in HIV PrEP programs and the need to
347 improve evidence-based guidelines for testing, particularly in LMICs. Given
348 the high prevalence and incidence of STIs in HIV PrEP programs, many
349 guidelines recommend quarterly screening for *C. trachomatis* and *N.*
350 *gonorrhoeae* among MSM on HIV PrEP.[16,17] Yet while some modeling
351 studies support quarterly screening to reduce the population prevalence, the
352 clinical and public health evidence supporting the frequency of testing is
353 lacking and the coverage needed to achieve a population-benefit of
354 decreased prevalence is much higher than observed in practice.[18–22] The
355 recent Gonoscreen Study, a randomized-controlled trial evaluating quarterly
356 screening for *C. trachomatis* and *N. gonorrhoeae* compared to no screening
357 among MSM in Belgium found quarterly screening was associated with fewer
358 *C. trachomatis* infections and complications, but observed no difference
359 among *N. gonorrhoeae* infections.[23] Additional research on alternative
360 screening frequencies, e.g. – every 6 months or annually, and in different
361 settings could provide further evidence on the public health benefits of
362 different screening approaches. Beyond the frequency of screening, there is
363 also a larger debate about the utility of screening for asymptomatic STIs in
364 populations of MSM, particularly those on HIV PrEP.[24,25] While *C.*
365 *trachomatis* and *N. gonorrhoeae* infections increase the risk for HIV
366 transmission and provide a strong rationale for using these as an entry point
367 for HIV PrEP,[26] the increased risk for HIV acquisition caused by bacterial

368 STIs is largely mitigated among those on HIV PrEP.[27,28] Moreover,
369 antimicrobial resistance is one potential consequence of increased screening
370 and treatment and is a significant concern, particularly for *N. gonorrhoeae*
371 and *Mycoplasma genitalium*; increased antibiotic consumption was observed
372 among those randomized to quarterly screening in the Gonoscreen study.
373 [23] Antimicrobial resistance in *N. gonorrhoeae* is particularly concerning in
374 Vietnam, where the prevalence of ceftriaxone resistance, the first-line agent
375 for treatment, is more than 20% in some settings.[29]

376

377 Our study findings must be interpreted in light of the following limitations.
378 First, the study population might have been subject to selection bias. Efforts
379 were made to expand inclusivity by simplifying the study eligibility criteria to
380 reflect that of the HIV PrEP program. Still, it was not possible to recruit all
381 PrEP program clients and 70% of those who were recruited agreed to be
382 screened; thus, it is possible those who chose not to participate were
383 different than those who participated. Second, our study outcome was the
384 prevalence of *C. trachomatis* and *N. gonorrhoeae* infections at each visit, so
385 while participants were allowed to participate more than once, few did, and
386 we were unable to estimate the incidence of *C. trachomatis* or *N.*
387 *gonorrhoeae* infections. Third, our study population of primarily MSM were
388 largely well-educated, employed, and living in Hanoi, the second most
389 populated city in Vietnam, and might not be generalizable to other

populations or settings. Our study took place within the largest HIV PrEP program in Hanoi, which is a strength of our study.

Conclusion

Our findings provide further evidence of the high prevalence of *C. trachomatis* and *N. gonorrhoeae* infections among people on HIV PrEP, including the high proportions of rectal, pharyngeal, and asymptomatic infections. Despite the high prevalence of infections, the high cost of molecular STI testing is a major barrier to implementing routine testing in HIV PrEP programs in LMICs.[6] Testing for urethral *C. trachomatis* and *N. gonorrhoeae* infections among those without urethral symptoms is likely to be of limited value, based on our findings. Further research is needed to establish evidence-based recommendations on the role and frequency of testing for asymptomatic infections, including the cost-effectiveness of different approaches. Biomedical interventions like doxycycline prophylaxis and vaccinations are promising tools for STI prevention and further research is needed on the effectiveness and implementation in LMIC settings, where key factors such as antimicrobial resistance and differences in user preferences will influence their impact.

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414 analyses. PCA wrote the first version of the manuscript. All authors reviewed,

415 provided critical review, and approved the manuscript.

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550

551 **Table 1.** Baseline demographic, behavioral, and clinical characteristics of 529

552 participants enrolled from an HIV PrEP program clinic in Hanoi, Vietnam.

	Overall (N = 529)	Positive for <i>C. trachomatis</i> (N=108)		Positive for <i>N. gonorrhoeae</i> (N=76)		Positive for <i>C. trachomatis</i> or <i>N. gonorrhoeae</i> (N=153)	
	n (%)	n (%)	p-value	n (%)	p-value	n (%)	p-value
Median Age (IQR)	25.1 (21.7-29.5)	25.3 (21.1 – 29.7)	0.869 [†]	24.8 (22.1 – 27.2)	0.281 [†]	25.1 (21.5 – 28.3)	0.336 [†]
Age group			0.644		0.243		0.834
16- 24 years old	261 (49.3)	51 (19.5)		38 (14.6)		75 (28.7)	
25- 34 years old	221 (41.8)	45 (20.4)		35 (15.8)		66 (29.9)	
35 - 63 years old	47 (8.9)	12 (25.5)		3 (6.4)		12 (25.5)	
Gender self-identification			0.126 [‡]		0.316 [‡]		0.232 [‡]
Man	432 (81.7)	85 (19.6)		58 (13.4)		121 (28.0)	
Transgender woman	9 (1.7)	0		1 (11.1)		1 (11.1)	
Other/Unsure*	88 (16.6)	23 (26.1)		17 (19.3)		31 (35.2)	
Education			0.687		0.942		0.797
High school or below	52 (9.8)	13 (25.0)		8 (15.4)		17 (32.7)	
In post-secondary training	154 (29.1)	31 (20.1)		21 (13.6)		45 (29.2)	
Completed post-secondary training or higher	323 (61.1)	64 (19.8)		47 (14.6)		91 (28.2)	
Monthly income in million VND (median, IQR)	9.0 (5 – 15)	8.5 (5- 14)	0.813 [†]	8 (4.5 – 14.5)	0.566 [†]	8 (5 – 14.5)	0.493 [†]
Employed	419 (79.2)	84 (20.0)	0.682	63 (15.0)	0.392	123 (29.4)	0.668
Gender of sex partners prior 6 months			0.711 [‡]		0.327 [‡]		0.502 [‡]
Men only	474 (89.6)	96 (20.3)		73 (15.4)		141 (29.7)	
Women only	13(2.5)	2 (15.4)		1 (7.7)		2 (15.4)	
Men and women	33 (6.2)	9 (27.3)		2 (6.0)		9 (27.3)	
No sex partners	9 (1.7)	1 (11.1)		0		1 (11.1)	
Number of sex partners in prior 1 month (n = 520)[#]	1 (1 – 2)	2 (1 – 3)	<0.001 [†]	2 (1 – 2)	0.150 [†]	2 (1 – 3)	<0.001 [†]
Anal sex with male partners in prior 1 month (n = 447)[#]	396 (88.4)	95 (24.0)	0.043	64 (16.2)	0.219	131 (33.1)	0.043
Anal sex position with			0.633		0.109		0.385

	Overall (N = 529)	Positive for <i>C. trachomatis</i> (N=108)		Positive for <i>N. gonorrhoeae</i> (N=76)		Positive for <i>C. trachomatis</i> or <i>N. gonorrhoeae</i> (N=153)	
	n (%)	n (%)	P-value	n (%)	P-value	n (%)	P-value
male partner (n = 396)[#]							
Insertive anal sex always	137 (34.6)	29 (21.2)		22 (16.1)		44 (32.1)	
Receptive anal sex always	149 (37.6)	38 (25.5)		18 (12.1)		45 (30.2)	
Both insertive and receptive	110 (27.8)	28 (25.5)		24 (21.8)		42 (38.2)	
Condomless anal sex in prior 1 month (n = 396)[#]	203 (51.3)	63 (31.0)	0.001	39 (19.2)	0.091	83 (40.9)	0.001
Vaginal sex with female partners in prior month (n = 39)[#]	38 (7.2)	8 (21.1)	0.064	2 (5.3)	0.814	8 (21.1)	0.064
Deep kissing in prior week (n = 302)[#]	260 (86.1)	61 (23.5)	0.700	41 (15.8)	0.518	85 (32.7)	0.823
Any group sex, prior 6 months	65 (12.3)	13 (20.0)	0.929	14 (21.5)	0.078	22 (33.8)	0.350
Sexualized drug use with poppers or erectile dysfunction medications, prior 6 months	235 (44.4)	67 (28.5)	<0.001	40 (17.0)	0.120	87 (37.0)	<0.001
Any sexualized drug use, prior 6 months	239 (45.4)	68 (28.4)	<0.001	40 (16.7)	0.169	88 (36.8)	<0.001
Met sex partners via mobile apps, prior 6 months	297 (56.1)	66 (22.2)	0.244	55 (18.5)	0.002	97 (32.7)	0.032
Pharyngeal symptoms in prior week	126 (23.8)	21 (16.7)	0.232	20 (15.9)	0.581	33 (26.2)	0.438
Rectal symptoms in prior week	87 (16.5)	25 (28.7)	0.035	15 (17.2)	0.403	29 (33.3)	0.321
Genitourinary symptoms in prior week	72 (13.6)	17 (23.6)	0.469	15 (20.8)	0.092	26 (36.1)	0.148
Any genitourinary symptoms at the day of enrollment	14 (2.7)	7 (50.0)	0.012 [‡]	8 (57.1)	<0.001 [‡]	12 (85.7)	<0.001 [‡]
Any symptoms in prior week	217 (41.0)	49 (22.6)	0.303	41 (18.9)	0.013	70 (32.3)	0.158
Self-reported STI diagnosis in the prior 3 months	29 (5.5)	6 (20.7)	0.970	6 (20.7)	0.318	9 (31.0)	0.796
Used antiseptic mouthwash in the previous month	286 (54.1)	65 (22.7)	0.152	38 (13.3)	0.442	84 (29.4)	0.805

553 Note: Column percentages shown for first column. Remaining values are shown as row percentages.

554*Participants who were gender nonconforming or gender incongruent, or unsure of their gender identity.

555†Wilcoxon rank-sum (Mann-Whitney) test was performed

556‡Fisher's exact test was performed, Chi-Squared tests were performed otherwise

557#Sample size was lower than 529 due to skip patterns (e.g., sample size for "Condomless anal sex" was among people

558who reported engaging in anal sex)

Table 2. Prevalence of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infections by anatomic site among 529 participants enrolled from an HIV PrEP program clinic in Hanoi, Vietnam.

Anatomic Site	<i>C. trachomatis</i> (n/N, %)	<i>N. gonorrhoeae</i> (n/N, %)	<i>C. trachomatis</i> or <i>N. gonorrhoeae</i> (n/N, %)	<i>C. trachomatis</i> and <i>N. gonorrhoeae</i> (n/N, %)
Total Infections (Any Site)	108 (20.4)	76 (14.4)	153 (28.9)	31 (5.9)
Single Site Infections				
Pharyngeal only	19/528 (3.6)	32/528 (6.1)	41/528 (7.7)	3/528 (0.6)
Rectal only	57/493 (11.6)	10/494 (2.0)	52/493 (10.6)	4/493 (0.8)
Urethral only	14/529 (2.7)	2/529 (0.4)	11/529 (2.1)	0/529 (0)
Multisite Infections				
Pharyngeal and rectal	9/493 (1.8)	18/494 (3.6)	26/494 (5.3)	13/493 (2.6)
Pharyngeal and urethral	1/528 (0.2)	5/528 (1.0)	7/528 (1.3)	3/528 (0.6)
Urethral and rectal	7/493 (1.4)	2/494 (0.4)	7/493 (1.4)	1/493 (0.2)
Pharyngeal, rectal, and urethral	1/493 (0.2)	7/494 (1.4)	9/494 (1.8)	7/493 (1.4)
Any pharyngeal	30/528 (5.7)	62/528 (11.7)	83/528 (15.7)	26/528 (4.9)
Any rectal	74/493 (15.0)	31/493 (6.3)	94/493 (19.1)	25/493 (5.1)
Any urethral	23/529 (4.3)	16/529 (3.0)	34/529 (6.4)	11/529 (2.1)

Table 3. Multivariable logistic regression with factors associated with *C. trachomatis* only, *N. gonorrhoeae* only, and *C. trachomatis* or *N. gonorrhoeae* infections.

Characteristics	<i>C. trachomatis</i>		<i>N. gonorrhoeae</i>		<i>C. trachomatis</i> or <i>N. gonorrhoeae</i>	
	aOR (95% CI)	p-value	aOR (95% CI)	p-value	aOR (95% CI)	p-value
Age group						
16 to < 25 years old	1.00		1.00		1.00	
25 to < 35 years old	0.75 (0.45, 1.27)	0.284	1.03 (0.58, 1.84)	0.912	0.81 (0.51, 1.30)	0.387
≥ 35 years old	1.27 (0.58, 2.80)	0.550	0.39 (0.11, 1.38)	0.144	0.76 (0.36, 1.64)	0.492
Two or more sex partners in prior 1 month	1.66 (0.97, 2.86)	0.066	1.16 (0.63, 2.14)	0.638	1.52 (0.94, 2.46)	0.086
Condomless anal sex in prior 1 month	2.10 (1.27, 3.45)	0.004	1.51 (0.86, 2.67)	0.152	1.98 (1.27, 3.09)	0.002
Sexualized drug use in prior 6 months	2.20 (1.32, 3.68)	0.003	1.09 (0.61, 1.94)	0.774	1.71 (1.09, 2.69)	0.020
Met sex partners via mobile apps	0.83 (0.49, 1.43)	0.513	2.32 (1.19, 4.53)	0.013	1.21 (0.74, 1.96)	0.445
Any anal or urethral symptoms in prior week	1.44 (0.84, 2.45)	0.185	1.30 (0.72, 2.36)	0.385	1.19 (0.73, 1.94)	0.491
Used an antiseptic mouthwash in the prior 1 month	1.15 (0.70, 1.87)	0.583	0.72 (0.41, 1.25)	0.240	0.85 (0.55, 1.32)	0.468
Model information						
Sample size included	396		396		396	
Hosmer-Lemeshow p-value	0.5244		0.5412		0.4685	
McFadden's R2	0.070		0.053		0.053	
Log likelihood	-202.98235		-165.80362		-237.93177	

566 **Figure 1. Prevalence of *C. trachomatis* (Panel A) and *N. gonorrhoeae* (Panel B) infections at pharyngeal,**
567 **rectal, and urethral sites, stratified by reported symptoms at that site in the prior week.**

568
569 Footnote: *p-value ≤ 0.05 ; **p-value ≤ 0.01