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Screening for *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infection among asymptomatic men who have sex with men in Bangkok, Thailand

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Abstract

We report positivity rates of *Chlamydia trachomatis* (CT) and *Neisseria gonorrhoeae*(NG) infection at each anatomic site among asymptomatic men who have sex with men (MSM). We calculated the number needed to screen (NNS) to detect CT and NG infection at each anatomic site. From 2006 to 2010, we enrolled Thai MSM, age ≥ 18 years into the Bangkok MSM Cohort Study. Participants underwent physical examination and had rectal, urethral, and pharyngeal screening for CT and NG infection using nucleic acid amplification tests (NAATs). Of 1744 enrollees, 1696 (97.2%) had no symptoms of CT and NG infection. The positivity rates of CT and NG infection at any site were 14.3% (rectum, urethra, pharynx) and 6.4% (rectum, urethra), respectively. The NNS to detect rectal CT and rectal NG infections was 10 and 16, respectively ($p<0.05$). For urethral infection, the NNS of CT was lower than the NNS of NG (22, 121: $p<0.05$). The lowest NNS found for rectal CT infection was in HIV-infected MSM (6, 5–8). Asymptomatic CT and NG infection were common among MSM in Bangkok, Thailand and frequently detected in the rectum. In setting where screening in all specimens using NAAT is not feasible, rectal screening should be a priority.

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Disclaimer

The findings and conclusions in this paper are those of the authors and do not necessarily represent the official position of the U.S. Centers for Disease Control and Prevention.

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Keywords

Men who have sex with men; *Chlamydia trachomatis*; *Neisseria gonorrhoeae*; screening

Introduction

Asymptomatic infection with *Chlamydia trachomatis* (CT) and *Neisseria gonorrhoeae* (NG) is common among men who have sex with men (MSM) living in Asia and the Pacific.[1–4]

We recently described CT and NG infections and associated factors among MSM in Bangkok, Thailand, and found that more than 80% of the CT and NG infections occurred in asymptomatic Thai MSM.[4]

Undiagnosed and untreated CT and NG may increase the risk of HIV transmission and other STI.[5,6] The U.S. Centers for Disease Control and Prevention (CDC) recommends that all sexually active MSM have (1) a test for urethral infection with NG and CT if there is a history of insertive intercourse in the preceding year and (2) a test for rectal infection with NG and CT if there is a history of receptive anal intercourse during the preceding year. In both sites, nucleic acid amplification test (NAAT) is the preferred approach.[7] Thai national guidelines recommend that high risk (i.e. sexually active) MSM undergo testing for NG infection at the urethra, and at the rectum if they report any receptive anal sex in the past six months, and at the pharynx if they report any receptive oral sex in past six months (Gram stain and/or culture).[8] Thai national guidelines contain no recommendation on screening for CT infection.

NAATs have been demonstrated to have improved sensitivity and specificity compared with culture for the detection of CT and NG infection.[9,10] The cost of NAAT testing for CT and NG infections is relatively high and these tests are not routinely available in most settings in Thailand.[2] An analysis including the number of infections missed when testing only one anatomic site, and NNS, the number needed to screen to detect one infection, is helpful to evaluate screening strategies and to support screening recommendations.[2,11]

In this study, we assess the value of screening for CT and NG infection at the rectum, urethra, and pharynx (for CT only) using NAAT by addressing (1) the overall positivity rates of CT and NG infection; (2) factors associated with these infections at each site; (3) the NNS to detect one infection at each anatomic site (overall, and stratified by risk associated with CT and NG infection); and (4) the proportion of cases that would be missed if screening was not performed by each anatomic site.

Methods

We enrolled MSM into the Bangkok MSM Cohort Study (BMCS) at the Silom Community Clinic, located in central Bangkok, Thailand. BMCS was a 60-month longitudinal cohort study with four-monthly follow-up interval that aims to assess the prevalence and incidence of HIV infection, prevalence of STI, and risk factors for HIV infection. We conducted enrollment from April 2006 to January 2008 (Period 1) and September 2009 to November

2010 (Period 2). Inclusion criteria were as follows: Thai nationality, male sex at birth, age at least 18 years, residence in Bangkok or neighboring provinces, self-reported history of oral or anal sex with another man in the six months preceding study entry, ability and willingness to follow-up at four-month intervals for at least 36 months, and ability to provide written informed consent. The methods of this study have been previously described.[4,12,13]

At enrollment, participants answered an audio computer-assisted self-interview (ACASI) to report their behaviors during the previous four months and underwent physical examination. Nurse collected rectal swabs and first-void urine specimens for CT and NG testing. Rectal swabs (Amplicor® STD Swab Specimen Collection and Transport set, Roche Diagnostics, Branchburg, NJ, USA) and urine were tested for CT and NG by NAAT (Roche Amplicor®, Roche Diagnostics, Branchburg, NJ, USA). Pharyngeal swabs were tested for CT by NAAT (Roche Amplicor®, Roche Diagnostics, Branchburg, NJ, USA). Initially, pharyngeal swabs were tested for NG by NAAT (Roche Amplicor®, Roche Diagnostics, Branchburg, NJ, USA) and also cultured for NG infection. Of the 623 specimens tested for NG at the pharynx by NAAT, 205/623 (32.9%) were positive and one (0.2%) was positive by culture. Subsequently, testing for NG at the pharynx was discontinued; however, culture for NG was continued.

Participants were tested for HIV infection using oral fluid by OraQuick® (OraSure Technologies Inc., Bethlehem, PA USA). If reactive, three other HIV rapid tests were performed on blood: (1) Determine™ HIV 1&2, Abbott, Japan; (2) DoubleCheck™ II HIV 1&2 Organics Ltd, Israel; and (3) Capillus™ HIV-1/HIV-2, Trinity Biotech, Jamestown, NY, USA, replaced after November 2008 by Core™ HIV-1/2, UK. HIV infection was confirmed if all three tests were reactive,[4] and the result was provided to the participant during posttest counseling. If rapid tests were inconclusive, anti-HIV testing (both rapid tests and enzyme immunoassay) was performed on a second sample taken after 14 days from the initial blood draw. *Treponema pallidum* (TP) screening was performed using the rapid plasma reagin (RPR) assay (Macro-Vue™ RPR 18mm Circle Card Test, Becton Dickinson Microbiology Systems, Sparks, MD, USA). Specimens that were reactive at any titer were tested using a TP-specific antibody test (Determine™ Syphilis TP, Abbott Laboratories, Tokyo, Japan) to confirm a positive result. Prevalence of TP seropositivity in this cohort has been previously described.[14] After the enrollment visit, participants returned for a follow-up visit every four months to assess HIV acquisition, during which they completed an ACASI, and underwent HIV counseling and testing. We referred all participants who tested positive for HIV for care and treatment, and treated all those diagnosed with a CT, NG, or syphilis infection on site, according to Thai national guidelines (NG: ceftriaxone 250 mg IM single dose and azithromycin 250 mg four capsules orally single dose, CT: azithromycin 250 mg four capsules orally single dose dual, syphilis: benzathine penicillin G 2.4 MU IM). At each visit, participants received 500 Thai baht (about US $16) as compensation for time and transportation costs.

Statistical analysis

In this analysis, we excluded participants who reported any symptoms of CT and NG infection (i.e. penile or anogenital pain, urethral discharge). We described asymptomatic CT

and NG infection by site at the baseline visit. We used frequencies and proportions to describe baseline sociodemographic characteristics and CT and NG infections at each anatomic site using the exact binomial distribution to calculate 95% confidence intervals (CI). Because of the uncertainty regarding test specificity due to the presence of oropharyngeal commensal organisms including *Neisseria subflava* and *Neisseria cinerae* that may cross react with NG on NAAT,[15,16] we did not include pharyngeal NG test results obtained by NAAT in our results. Factors associated with site-specific CT and NG infection were separately evaluated using logistic regression, and those with a $p \leq 0.10$ in bivariate analysis were included in a multivariable analysis. Likelihood ratio tests were used to determine factors to include in the final model (two-sided $p<0.05$). To determine the NNS to detect infection at relevant anatomic sites, we calculated the inverse of the proportion of asymptomatic MSM with unrecognized infection at the given site detected by NAAT, stratified by age, sexual role, and HIV status. We classified age into two groups using the standard WHO definition of youth.[17] CIs for NNS were determined using the exact binomial method. We calculated the proportions of CT and NG infection that would have been missed by the following screening practices: urethral only, rectal only, and pharyngeal only (for CT only) for men who had all tests performed. We performed all analyses using STATA® (Version 12, 2011; Stata Corp., College Station, TX, USA).

Ethical review

The Ethical Review Committee for Research in Human Subjects of the Thailand Ministry of Public Health and the Institutional Review Board of the CDC reviewed and approved the study protocol. All participants were informed about the voluntary nature of participation. Written informed consent was obtained from all participants.

Results

Participant characteristics at baseline visit

From 2006 to 2010, we enrolled 1744 MSM into the BMCS. At enrollment, 48 (2.8%) had signs or symptoms of CT or NG (i.e. penile or anogenital pain, urethral discharge). Among the 1696 participants, one participant declined all sampling due to feeling unwell. Of the remaining 1695, 1552 (91.6%) provided rectal and urethral specimens, and 1551 (91.6%) provided rectal, urethral, and pharyngeal specimens (Figure 1).

Of 143 participants who had a urethral but no rectal specimen collected, 90 (62.9%) reported any receptive anal intercourse, 49 (34.3%) reported insertive-only anal intercourse, and four (2.8%) had oral sex only. Participants who did not provide a rectal specimen were more likely to report insertive-only anal intercourse compared with those who did provide rectal swab specimens (34.3% versus 17.5%, $p<0.001$). Of the 1552 participants, 929 (59.9%) were older than 24 years, 1221 (78.7%) self-reported identity as homosexual/gay, and 980 (63.1%) reported having both insertive and receptive anal intercourse (Table 1).

Factors associated with site-specific CT infection

Among the 1695 men with at least one specimen from the urethra, rectum, or oropharynx, the overall positivity rate of CT infections at any site was 14.3% (95% CI: 12.7–16.1%,

n=243/1695) (Table 2). Among HIV-infected MSM, the overall positivity rate of CT infection was 22.6% (95% CI: 18.3–27.3%, n=79/350). More than half (59.2%) of CT infections were detected in the rectum (n=144/243). Factors independently associated with rectal CT infection in multivariable analysis were HIV-1 infection (aOR 1.8, 95% CI: 1.2–2.6), age 18–24 years (aOR 1.7, 95% CI: 1.1–2.5), living alone or living with a roommate (aOR 1.6, 95% CI: 1.05–2.4), secondary/vocational education (aOR 1.7, 95% CI: 1.1–2.6), and self-reported receipt of money/goods for sex in the past four months (aOR 1.9, 95% CI: 1.3–2.8). MSM who reported insertive-only anal intercourse without a condom in the past four months were significantly less likely to have rectal CT infection (aOR 0.3, 95% CI: 0.1–0.9), compared to those who consistently used condoms or who reported only oral sex (Table 3). Urethral CT infection was independently associated with STI diagnosis in the past four months (aOR 2.4, 95% CI: 1.5–3.9) and insertive-only anal intercourse without a condom in the past four months (aOR 2.6, 95% CI: 1.4–5.1) (Table 3). HIV-1 infection was the only factor independently associated with pharyngeal CT infection (aOR 2.7, 95% CI: 1.6–4.6) (Table 3).

Factors associated with site-specific NG infection

Of the 1689 specimens cultured for NG, seven (0.4%) were positive by culture (Table 2).

Among the 1695 men with at least one specimen from urethral and/or rectal sites, the overall positivity rate of NG infections detected by NAAT at either site (urethral and/or rectal) was 6.4% (95% CI: 5.3–7.7%, n=109/1695). Among HIV-infected MSM, the overall positivity rate of NG infection was 3.4% (95% CI: 1.8–5.9%, n=42/350). Factors independently associated with rectal NG infection were HIV infection (aOR 2.6, 95% CI: 1.7–4.1), young age (18–24 years) (aOR 2.0, 95% CI: 1.3–3.0), and living alone or living with a roommate (aOR 2.1, 95% CI: 1.3–3.5). Young age (18–24 years) was the only factor significantly associated with urethral NG infection (aOR 5.4, 95% CI: 1.5–19.6) (Table 4).

NNS for CT infection and NG infection

Overall, NNS values ranged from 6 to 335 depending on the pathogen, site, and participant demographics (Tables 5 and 6). The NNS values to detect one asymptomatic, sexually active MSM infected with rectal CT and rectal NG were 10 and 16, respectively ($p<0.05$), while NNS values for urethral CT and NG infection were 22 and 121, respectively ($p<0.05$, Tables 5 and 6). The lowest NNS value obtained occurred for the detection of rectal CT infection in HIV-positive participant (6, 95% CI: 5–8).

We evaluated the number of infections that would be missed by screening at a single site. Overall, 1407 men had no rectal CT infection detected by NAAT. Of these, 53/1407 (3.8%) had urethral CT infection, and 34/1407 (2.4%) had pharyngeal CT infection that would have been missed with a strategy of rectal screening alone (Figure 2). Screening only at the urethral site would have resulted in 129 missed rectal and 53 missed pharyngeal CT infections among 1484 persons with negative urethral samples (8.7% and 3.6%, respectively, $p<0.001$). If only pharyngeal specimens had been performed, 122 missed rectal and 67 missed urethral CT infections would have been expected among 1495 with negative pharyngeal testing (8.2% and 4.5%, respectively, $p<0.001$). Overall, rectal sampling would

have resulted in a lower proportion of missed infections compared with urethral sampling (87/1408 versus 182/1483, $p<0.001$) and pharyngeal sampling (87/1408 versus 189/1495, $p<0.001$).

For NG infection, 11/1458 (0.8%) would have had a missed urethral NG infection if only rectal specimens had been performed, and 90/1539 (5.8%) would have had a missed rectal NG infection if only urethral specimens had been performed (Figure 3). Rectal sampling alone would also have resulted in a lower proportion of missed NG infections compared with urethral sampling (11/1458 versus 90/1539, $p<0.001$).

Discussion

In this study, among MSM in Bangkok, Thailand, more than one in ten had asymptomatic CT infection, and about one in 20 had asymptomatic NG infection; asymptomatic infection was most commonly detected at the rectum. Risk factors associated with CT and NG infection were young age (18–24 years), HIV-1 infection, and insertive-only anal intercourse without a condom (for urethral CT infection only). With rectal and urethral specimens, the NNS to detect CT infection was significantly lower than the NNS to detect NG infection.

The overall positivity rate of CT infection among HIV-infected MSM reported in our study was higher than a previous study conducted in HIV-infected MSM in Bangkok that failed to include rectal sampling for the detection of CT infection[2] (this study: 22.6%, 95% CI: 18.3–27.3; and Sirivongrangson et al.: 10%, 95% CI: 5.9–16.4%). The NG positivity rates among HIV-infected MSM were comparable with the study by Sirivongrangson et al., because rectal screening was also included for the detection of NG infection (Sirivongrangson et al.: 13.0%, 95% CI: 8.2–19.6%; and this study: 12.4%, 95% CI: 9.0–16.5).[2] We found that the urethral CT positivity rate in our study was similar to the report from MSM attending a men's sexual health clinic in Australia (this study 4.4%, 95% CI: 3.5–5.5; and Cornelisse et al.: 2.2%, 95% CI: 1.3–3.5).[18]However, the rectal CT positivity rate reported here was higher than the report from Cornelisse et al. (this study: 9.2%, 95% CI: 7.9–10.8; and Cornelisse et al.: 4.3%, 95% CI: 3.0–5.9).[18] Australian MSM reported a higher rate of condom use for receptive anal intercourse with casual sexual partners than has been reported by Thai MSM (Cornelisse et al.: 82%, 95% CI: 78.8–83.1; and this study 52%, 95% CI: 49.5–54.6). The prevalence of rectal CT infection and pharyngeal CT infection reported in this study was similar to the literature review from Chan et al.[19]

We sought to describe the relative value of screening different anatomic sites using a NNS calculation. NNS can be used as a metric to use in models to assess potential or existing screening programs.[12] In our study, NNS values varied dramatically depending on the subpopulations examined (Tables 5 and 6), and these observations may be helpful in supporting STI screening programs in settings comparable to the one studied here. In particular, our data suggest that at least annual screening of rectal sites by NAAT, especially in asymptomatic HIV-infected MSM, may result in higher positivity rates of both CT and NG infection than screening solely at the urethral site. The overall NNS to detect CT and NG infections reported in this study was much lower than the NNS reported from the HIV-infected women attending hospitals in Thailand.[12] However, the NNS to detect CT infection

among HIV-infected pregnant women was comparable to the NNS from the rectal site among HIV-infected MSM (HIV-infected women: 3, 95% CI: 4–24; HIV-infected MSM: 6, 95% CI: 5–8). HIV-infected pregnant women and HIV-infected MSM may be the subgroups that benefit most from CT screening using NAAT.

In Thailand, MSM with HIV or STI symptoms typically access STI clinics, anonymous Voluntary Counseling and Testing clinics, or general outpatient clinics for STI treatment, and HIV counseling and testing. Unpublished data from a survey at Silom Community Clinic Thailand, showed that 24% (46/191) of MSM visited the clinic because they had symptoms of an STI, and only 15% (29/191) of MSM visited the clinic for asymptomatic STI screening (p=0.03).[20] Based on our study, education about asymptomatic CT and NG infections and routine CT and NG screening regardless of symptoms are necessary for MSM in this setting, as well as potential other settings serving MSM.

Screening for CT and NG infections could be used as an entry point for inclusion in prevention interventions such as HIV pre-exposure prophylaxis (PrEP). Detection of CT and NG infection at the rectum could also be used as an opportunity to initiate sensitive discussions about HIV risk reduction, as many providers may not otherwise discuss sexual risk at each visit,[21,22] and self-reported sexual behavior, even when discussed, is often an inaccurate measure of true behaviors.[21]

Several limitations should be considered when interpreting these results. First, behaviors were self-reported and might not accurately reflect true behavioral risk. The definition of symptomatic infection used in the analysis included urethral pain but not specifically dysuria and may have failed to capture some cases of urethral infection. Because of uncertainty regarding test specificity, the analyses presented here did not include NAAT for pharyngeal NG infection.[15,16,23] We did not perform tissue culture for CT. In addition, the results presented here reflect the population of MSM participating in our cohort study and may not represent all MSM in Bangkok, Thailand or elsewhere. Lastly, the usefulness of the results presented here depends on the underlying prevalence of infection with each pathogen, which may vary over time.

Based on our findings, in settings serving MSM where screening for all specimens for CT and NG infection using NAAT is not feasible, rectal screening is important as including this specimen for testing may mean fewer cases of missed CT or NG infection. This study demonstrates the value of routine screening and especially the importance of rectal screening in any CT and NG screening program for sexually active MSM in Bangkok, Thailand.

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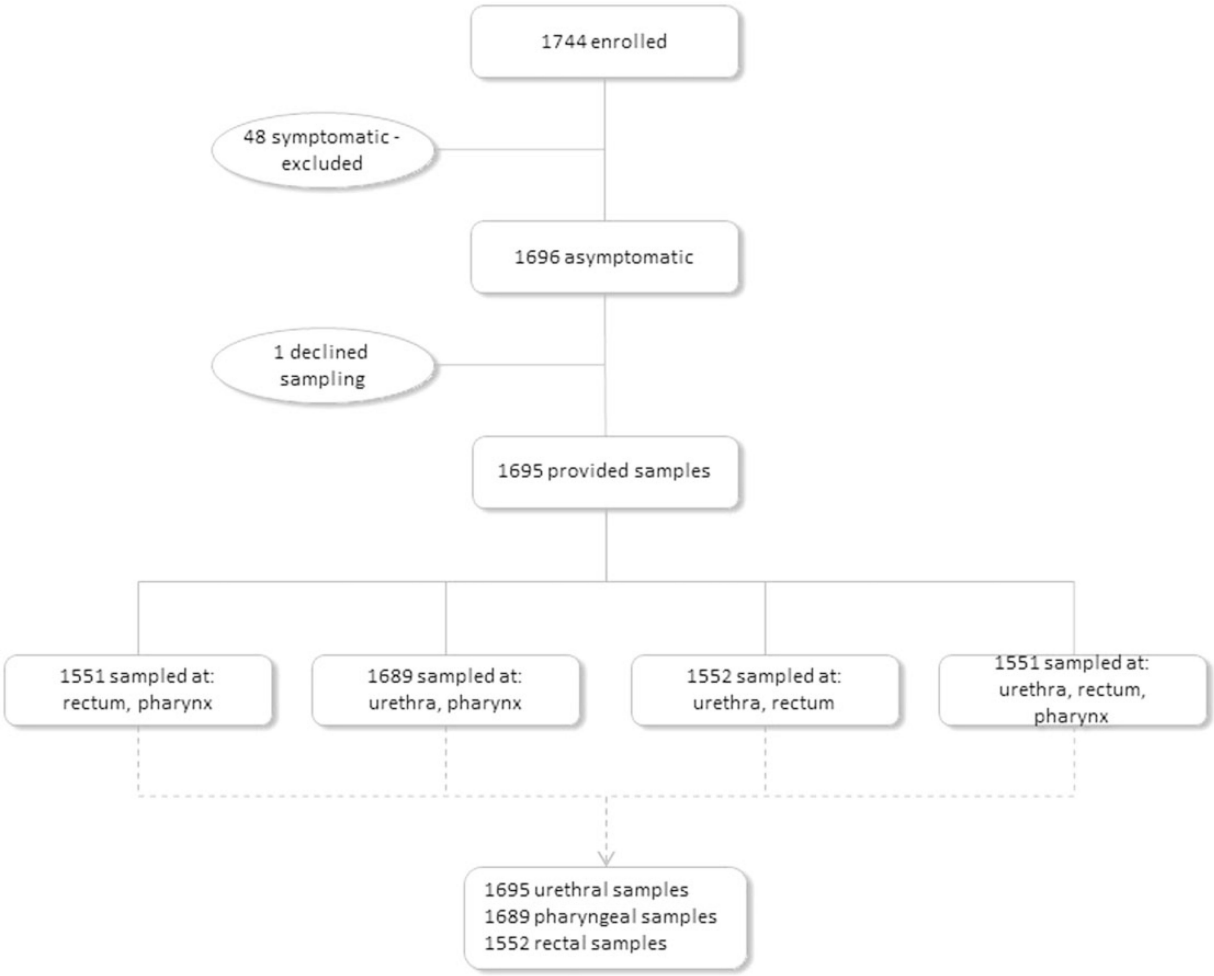

Figure 1.
Participant flow diagram.

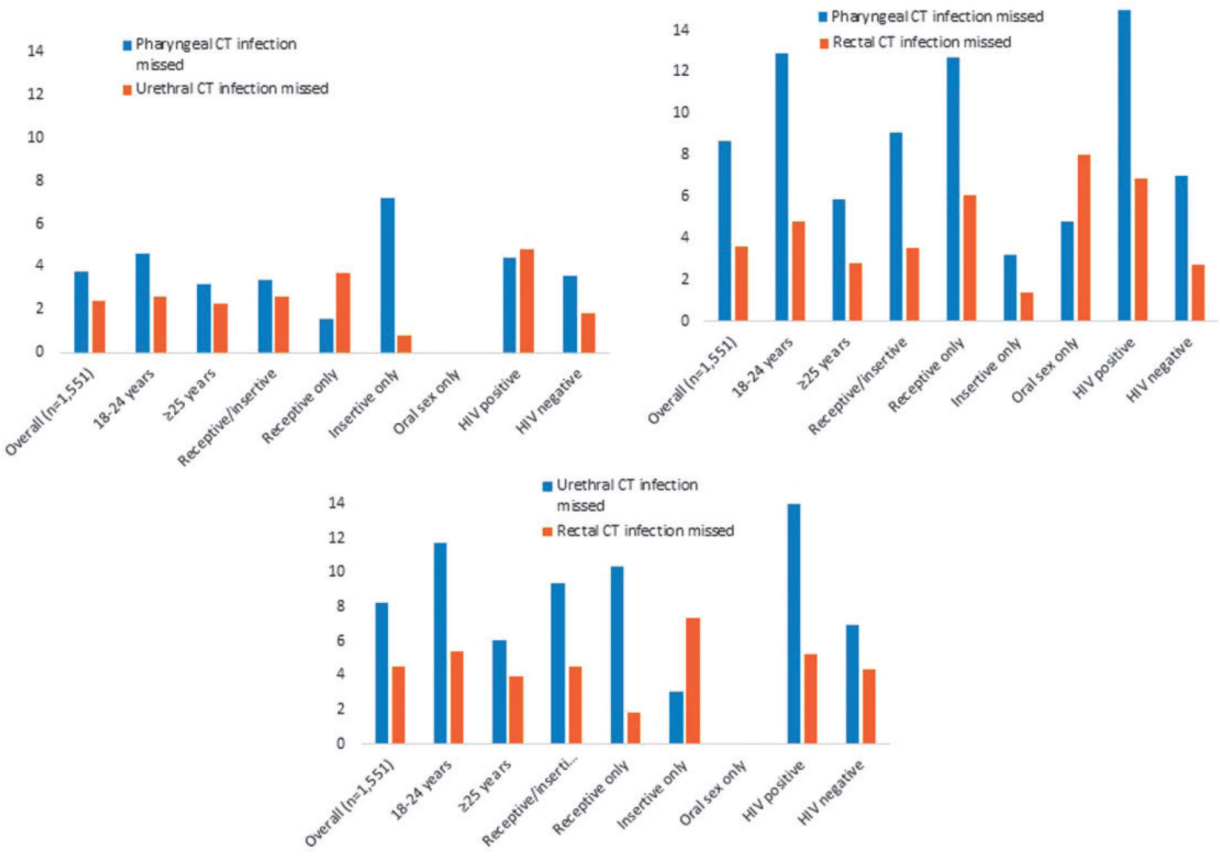

Figure 2.

Proportions of CT infections that would be missed by screening only for: rectal infection (left), urethral infection (right), and pharyngeal infection (bottom).

CT: *Chlamydia trachomatis*.

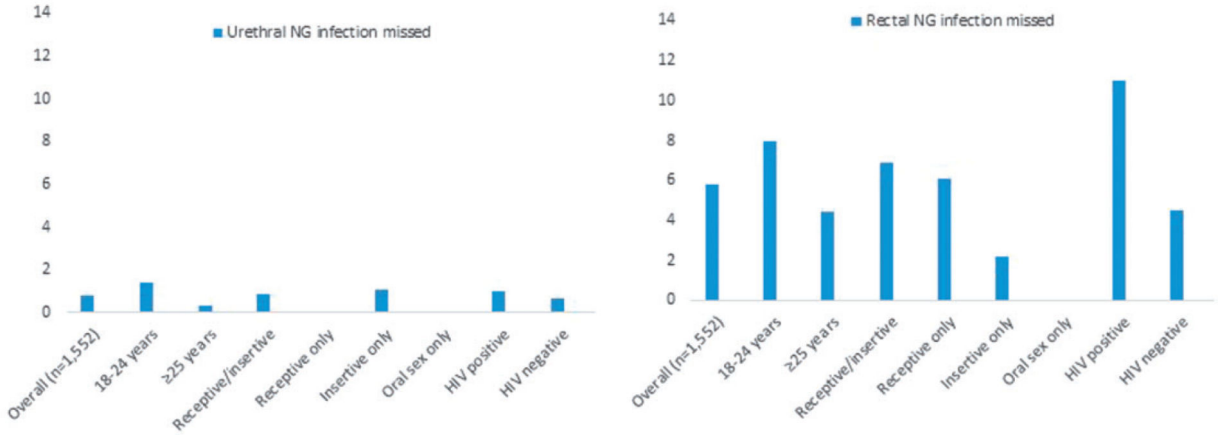

Figure 3.

Proportions of NG infections that would be missed by screening only for: rectal infection (left) and urethral infection (right).

NG: *Neisseria gonorrhoeae*.

Table 1.

Baseline characteristics among asymptomatic sexually active Thai men who have sex with men enrolled in Bangkok MSM Cohort Study, Thailand 2006–2010.

	CT infection analysis n/N, %	NG infection analysis n/N, %
Overall positivity rate[a]	243/1551, 15.7	104/1552, 6.7
Period 1	173/1121, 15.4	76/1122, 6.8
Period 2	70/430, 16.3	28/430, 6.5
Age at entry		
18–24 years	623/1551, 40.2	623/1552, 40.1
≥25 years	928/1551, 59.8	929/1552, 59.9
Education		
<Secondary	54/1551, 3.5	54/1552, 3.5
Secondary/vocational	805/1551, 51.9	806/1552, 51.9
≥University	692/1551, 44.6	692/1552, 44.6
Employment		
Unemployed	68/1551, 4.4	68/1552, 4.4
Student	549/1551, 35.4	549/1552, 35.4
Employed	934/1551, 60.2	935/1552, 60.2
Living with		
Steady partner	235/1551, 15.1	235/1552, 15.1
Roommate/alone	714/1551, 46.0	715/1552, 46.1
Family	602/1551, 38.8	602/1552, 38.8
Sexual identity		
Bisexual	265/1551, 17.1	265/1552, 17.1
Transgender woman(TGW)	54/1551, 3.5	55/1552, 3.5
Homosexual/gay	1221/1551, 78.7	1221/1552, 78.7
Heterosexual	11/1551, 0.7	11/1552, 0.7
Role in anal sex in the past four months		
Insertive and receptive	979/1551, 63.1	980/1552, 63.1
Insertive only	271/1551, 17.5	271/1552, 17.5
Receptive only	280/1551, 18.0	280/1552, 18.0
None, oral sex only	21/1551, 1.3	21/1552, 1.3

CT: *Chlamydia trachomatis*; MSM: men who have sex with men; NG: *Neisseria gonorrhoeae*.

[a]Positivity rate detected by NAAT only.

Table 2.

Positivity rates of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infection among asymptomatic sexually active Thai men who have sex with men enrolled in Bangkok MSM Cohort Study, Thailand 2006–2010.

	CT positivity (NAAT) (n/N, %)	NG positivity (NAAT) (n/N, %)	NG positivity (culture) (n/N, %)	NG positivity (NAAT or culture) (n/N, %)
Overall	243/1695 (14.3)	109/1695 (6.4)	7/1689 (0.4)	109/1695 (6.4)
Urethral only	53/1695 (3.1)	12/1695 (0.7)	N/A[a]	12/1695 (0.7)
Rectal only	110/1552 (8.0)	90/1552 (5.8)	N/A[a]	90/1552 (5.8)
Pharyngeal only	34/1689 (2.0)	N/A[b]	7/1689 (0.4)	7/1689 (0.4)
Multisite infections				
Urethral and rectal	14/1551 (0.9)	2/1552 (0.1)	N/A[a]	2/1552 (0.1)
Urethral and pharyngeal	0/1551 (0.0)	N/A[b]	N/A[a]	0/1552 (0.0)
Rectal and pharyngeal	19/1551 (1.2)	N/A[b]	N/A[a]	3/1552 (0.2)
Urethral, rectal and pharyngeal	1/1551 (0.1)	N/A[b]	N/A[a]	0/1552 (0.0)

CT: *Chlamydia trachomatis*; MSM: men who have sex with men; NAAT: nucleic acid amplification test; NG: *Neisseria gonorrhoeae*.

[a]NG culture not performed at urethral and rectal sites.

[b]NG NAATs in pharyngeal specimen were excluded due to the possibility of false-positive results for *N. gonorrhoeae*.

Table 3.

Multivariate models of characteristics associated with *Chlamydia trachomatis* infection by rectal, urethral, and pharyngeal sites among asymptomatic sexually active men who have sex with men in Bangkok, Thailand 2006–2010.

	Rectal infection[a] (n = 1552)		Urethral infection[b] (n = 1695)		Pharyngeal infection[c] (n = 1689)	
Characteristics	**n, % (n = 144)**	**aOR, 95% CI**	**n, % (n = 75)**	**aOR, 95% CI**	**n, % (n = 60)**	**aOR, 95% CI**
HIV-1 infection						
Positive	51, 15.8	1.8, 1.2–2.6	18, 5.1	NS	24, 2.7	2.7, 1.6–4.6
Negative	93, 7.6	1.0	57, 4.2	1.0	36, 6.9	1.0
Age						
18–24 years	83, 13.3	1.7, 1.1–2.5	36, 5.2	NS	32, 4.7	1.7, 1.02–2.9
≥ 25 years	61, 6.6	1.0	39, 3.9	1.0	28, 2.8	1.0
STI diagnosis in the past four months[d]						
Yes	46, 11.7	N/S	34, 8.0	2.4, 1.5–3.9	11, 2.6	N/S
No	98, 8.5	1.0	41, 3.2	1.0	49, 3.9	1.0
Living with						
Steady partner	25, 10.6	1.7, 0.9–3.0	15, 6.0	NS	10, 4.0	N/S
Rommate/alone	79, 11.0	1.6, 1.05–2.4	30, 3.8	NS	34, 4.3	N/S
Family	40, 6.6	1.0	30, 4.6	1.0	16, 2.4	1.0
Receiving money/goods for sex in the past four months						
Yes	53, 17.6	1.9, 1.3–2.8	20, 6.2	N/S	15, 4.7	N/S
No	91, 7.3	1.0	55, 4.0	1.0	45, 3.3	1.0
Anal intercourse with any partner in the past four months						
Receptive and insertive without a condom	86, 11.9	1.2, 0.8–1.8	32, 4.2	1.1, 0.7–1.9	32, 4.2	N/S
Insertive only without a condom	4, 3.0	0.3, 0.1–0.9	16, 9.9	2.6, 1.4–5.1	2, 1.2	N/S
Consistent condom use/oral sex only	54, 7.8	1.0	27, 3.5	1.0	26, 3.4	1.0
Education						
<Secondary	6, 11.1	1.2, 0.4–3.2	5, 8.9	N/S	3, 5.4	N/S
Secondary/vocational	102, 12.7	1.7, 1.1–2.6	46, 5.2	N/S	36, 4.1	N/S
≥ University	36, 5.2	1.0	24, 3.2	1.0	21, 2.8	1.0

aOR: adjusted odds ratio; CI: confidence interval; STI: sexually transmitted infection.

NS: Variables shown in the table but not included in multivariate model ($p > 0.10$ in bivariate model).

N/S: Variables shown in the table but not retained in the final multivariate model based on Likelihood ratio test ($p \geq 0.05$).

[a]Variables not shown in table because they were not included in multivariate model ($p > 0.10$ in bivariate model): employment (student/unemployed/ employed), HIV test (ever/never), club drug use in the past four months (yes/no)[e].

[b]Variables not included in multivariate model ($p > 0.10$ in bivariate model) and therefore not shown: syphilis (TP reactive) (yes/no), HIV test (ever/ never), club drug use in the past four months (yes/no)[e] and erectile dysfunction drug use in the past four months (yes/no), employment (student/ unemployed/employed), and group sex in the past four months (ever/never).

[c]Variables not included in multivariate model ($p > 0.10$ in bivariate model) and therefore not shown: employment (student/unemployed/employed), HIV test (ever/never), club drug use in the past four months (yes/no)[e], syphilis (TP reactive) (yes/no), erectile dysfunction drug use in the past four months (yes/no), and group sex in the past four months (ever/never).

[d]During the past four months, told by a health professional that participant had a sexually transmitted infection.

[e]Use of one or more of the following drugs: cannabis, ecstasy, methamphetamine, ketamine, cocaine, gamma-hydroxybutyrate (GHB), amylnitrite (poppers), and benzodiazepine (sedative).

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Table 4.

Multivariate models of characteristics associated with *Neisseria gonorrhoeae* infection by rectal and urethral sites among asymptomatic sexually active men who have sex with men in Bangkok, Thailand 2006–2010

	Rectal infection[a] (n = 1552)		Urethral infection[b] (n = 1695)	
Characteristics	**n, % (n = 92)**	**aOR, 95% CI**	**n, % (n = 14)**	**aOR, 95% CI**
HIV-1 infection				
Positive	37, 11.5	2.6, 1.7–4.1	5, 1.4	NS
Negative	55, 4.5	1.0	9, 0.7	1.0
Age				
18 – 24 years	51, 8.2	2.0, 1.3–3.0	11, 1.6	5.4, 1.5–19.6
≥25 years	41, 4.4	1.0	3, 0.3	1.0
STI diagnosis in the past four months[c]				
Yes	21, 5.3	NS	6, 1.4	NS
No	71, 6.1	1.0	8, 0.6	1.0
Living with				
Steady partner	9, 3.8	1.0, 0.5–2.2	3, 1.2	NS
Roommate/alone	59, 8.2	2.1, 1.3–3.5	6, 0.8	NS
Family	24, 4.0	1.0	5, 0.8	1.0
Receiving money/goods for sex in the past four months				
Yes	30, 10.0	N/S	4, 1.2	NS
No	62, 5.0	1.0	10, 0.7	1.0
Anal intercourse with any partner in the past four months				
Receptive and insertive without a condom	56, 7.7	N/S	7, 0.9	NS
Insertive only without a condom	2, 1.5	N/S	2, 1.2	NS
Consistent condom use/oral sex only	34, 4.9	1.0	5, 0.6	1.0
Education				
<Secondary	4, 7.4	N/S	0, 0.0	NS
Secondary/vocational	59, 7.3	N/S	9, 1.0	NS
≥ University	29, 4.2	1.0	5, 0.7	1.0

aOR: adjusted odds ratio; CI: confidence interval; STI: sexually transmitted infection.

NS: Variables shown in the table but not included in multivariate model (p>0.10 in bivariate model).

N/S: Variables shown in the table but not retained in the final multivariate model based on Likelihood ratio test ($p \geq 0.05$).

[a] Variables not included in multivariate model (p>0.10 in bivariate model) and therefore not shown: syphilis (TP reactive) (yes/no), club drug use in the past four months (yes/no)[e] and erectile dysfunction drug use in the past four months (yes/no), and group sex in the past four months (ever/never).

[b] Variables not included in multivariate model (p>0.10 in bivariate model) and therefore not shown: syphilis (TP reactive) (yes/no), club drug use in the past four months (yes/no)[e] and erectile dysfunction drug use in the past four months (yes/no), and group sex in the past four months (ever/never).

[c] During the past four months, told by a health professional that participant had a sexually transmitted infection.

[e] Use of one or more of the following drugs: cannabis, ecstasy, methamphetamine, ketamine, cocaine, gamma-hydroxybutyrate (GHB), amylnitrite (poppers), and benzodiazepine (sedative).

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Table 5.

Number needed to screen (NNS) for *Chlamydia trachomatis* infection among asymptomatic sexually active men who have sex with men in Bangkok, Thailand (2006–2010).

Factor	Status	Specimen	n/N	%	NNS	95% CI
None	Overall	Rectal	144/1552	9.3	10	9–12
		Urethral	75/1695	4.4	22	18–29
		Pharyngeal	68/1689	4.0	24	20–32
Age	18–24 years	Rectal	83/623	13.3	7	6–9
		Urethral	36/687	5.2	19	14–27
		Pharyngeal	36/684	5.3	18	14–27
	≥25 years	Rectal	61/929	6.6	15	12–20
		Urethral	39/1008	3.9	25	19–37
		Pharyngeal	32/1005	3.2	31	23–457
Sexual role	Receptive/Insertive	Rectal	99/980	10.1	9	8–12
		Urethral	46/1045	4.4	22	17–31
		Pharyngeal	40/1042	3.8	24	19–37
	Receptive only	Rectal	36/280	12.9	7	5–11
		Urethral	5/305	1.6	61	32–466
		Pharyngeal	21/302	6.9	14	10–24
	Insertive only	Rectal	8/271	2.9	33	20–106
		Urethral	24/320	7.5	13	9–21
		Pharyngeal	5/320	1.6	64	34–490
	Oral sex only	Rectal	1/21	4.8	21	7–∞
		Urethral	0/25	0	N/A	N/A
		Pharyngeal	2/25	8.0	12	5–∞
HIV infection	Positive	Rectal	51/323	15.8	6	5–8
		Urethral	18/350	5.1	19	13–35
		Pharyngeal	25/349	7.2	13	10–22
	Negative	Rectal	93/1229	7.8	13	11–16
		Urethral	57/1345	4.2	23	18–31
		Pharyngeal	43/1340	3.2	31	24–44

CI: confidence interval; N/A: not applicable; ∞: infinity.

Table 6.

Number needed to screen (NNS) for *Neisseria gonorrhoeae* infection among asymptomatic sexually active men who have sex with men in Bangkok, Thailand (2006–2010).

Factor	Status	Specimen	n/N	%	NNS	95% CI
None	Overall	Rectal	92/1552	5.9	16	14–21
		Urethral	14/1695	0.8	121	79–253
Age	18–24 years	Rectal	51/623	8.2	12	9–16
		Urethral	11/687	1.6	62	39–150
	≥25 years	Rectal	41/929	4.4	22	17–32
		Urethral	3/1008	0.3	335	157–∞
Sexual role	Receptive/Insertive	Rectal	68/980	6.9	14	11–18
		Urethral	9/1045	0.9	116	70–332
	Receptive only	Rectal	17/280	6.1	16	11–30
		Urethral	0/305	0	N/A	N/A
	Insertive only	Rectal	7/271	2.6	38	22–144
		Urethral	5/320	1.6	64	34–490
	Oral sex only	Rectal	0/25	0	N/A	N/A
		Urethral	0/21	0	N/A	N/A
HIV infection	Positive	Rectal	37/323	11.5	8	6–12
		Urethral	5/350	1.4	70	37–539
	Negative	Rectal	55/1229	4.5	22	17–30
		Urethral	9/1345	0.7	149	90–428

CI: confidence interval; N/A: not applicable; ∞: infinity.