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Prevalence of Neisseria gonorrhoeae *Among Men Screened for* Chlamydia trachomatis *in Four United States Cities, 1999–2003*

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Objectives: **Neisseria gonorrhoeae infections are the second most commonly reported disease in the United States and cause significant morbidity. We describe the prevalence of gonorrhea in a large sample of men tested for gonorrhea and *Chlamydia trachomatis* in Baltimore, Denver, San Francisco, and Seattle.**

Methods: **Gonorrhea prevalence was measured among 17,712 men tested in a variety of non–sexually transmitted disease (STD) clinic venues using urine-based nucleic acid amplification tests.**

Results: **Among 16,850 asymptomatic men, prevalence ranged from 0% to 1.5% by city ($P = 0.20$): Baltimore 1.3%, Denver 1.5%, San Francisco 1.5%, and Seattle 0%. Among 862 symptomatic men, the gonorrhea prevalence varied from 0.0% to 28.3% by city ($P < 0.01$).**

Conclusions: **The high prevalence of gonorrhea in symptomatic men supports the importance of testing for symptomatic men. The prevalence of gonorrhea among asymptomatic men is low, and routine screening cannot be recommended when screening is performed for chlamydia, unless a substantial local prevalence of gonorrhea can be documented in specific targeted venues or population groups.**

ALTHOUGH NATIONAL GONORRHEA RATES have declined steadily over most of the last half century, disease rates leveled off during the late 1990s and dramatic racial disparities persist. Currently, infections resulting from gonorrhea are the second most commonly reported notifiable disease in the United States, with 335,104 cases reported in 2003 (116.2 cases per 100,000 population),[1] and national rates remain well above the Healthy People 2010 objective of 19 per 100,000 population. Increases in gonorrhea case rates are being observed in certain population subgroups, including American Indian/Alaska Natives, Hispanics, and non-Hispanic whites, particularly white men aged 30 to 44 years,[1] yet there is a lack of updated evidence-based data for asymptomatic males. Data from a variety of sources suggest that gonorrhea rates are increasing among men who have sex with men (MSM).[1,2] *Neisseria gonorrhoeae*, along with *Chlamydia trachomatis*, is a leading cause of pelvic inflammatory disease (PID), which can result in sequelae such as tubal factor infertility, chronic pelvic pain, and ectopic pregnancy female partners of infected men.[3] Epidemiologic data also indicate that gonococcal infections can lead to a threefold to fivefold increase in risk for human immunodeficiency virus transmission or acquisition.[4,5] This report provides current data for gonorrhea prevalence in asymptomatic men.

Because male gonococcal infections are largely symptomatic,[3] diagnostic testing, rather than routine screening, has been the recommended disease control strategy, and national disease rates in men reflect mainly symptomatic infection. Although there is evidence that asymptomatic gonococcal infections in heterosexual men may contribute disproportionately to disease transmission to women,[6] relatively few studies have measured the prevalence of *N. gonorrhoeae* infection among asymptomatic men,[7–9] and in June 2005, the United States Preventive Services Task Force concluded that there was insufficient evidence to recommend for or against routine screening in men, even those men who are at increased risk for infection.[10] We tested men for gonococcal infection as part of a large project aimed at measuring the prevalence of *C. trachomatis* infection among asymptomatic heterosexual men attending clinical and nonclinical venues other than STD clinics in 4 metropolitan areas in the United States.[11] We describe the prevalence of *N. gonorrhoeae* infection and *N. gonorrhoeae* and *C. trachomatis* coinfection among both asymptomatic and symptomatic men tested for chlamydia in 4 geographically diverse cities in non-STD clinic venues with substantial variation from nationally reported disease rates of both gonorrhea and chlamydia.

Methods

Study Design

Urine-based nucleic acid amplification testing for *N. gonorrhoeae* and *C. trachomatis* was offered to men attending adult and adolescent primary care clinics, high school–based health clinics and health fairs, college clinics, street-based outreach venues, community-based organizations, drug treatment centers, and juvenile and adult detention centers in Baltimore, Denver, San Francisco, and Seattle between October 1999 and April 2003 (39 months). At all detention facilities except those in Baltimore, men

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were systematically tested within 2 weeks of incarceration. Screening in the detention facility in Baltimore was offered to men who may have been incarcerated for a much longer period than 2 weeks and occurred after men volunteered for testing after an announcement was made over a public address system. At the time of screening, all men in the multicenter study were asked to complete a brief, standard questionnaire including demographic data and questions related to sexual health, including symptoms of discharge and dysuria. Those accepting screening provided a urine specimen. We defined as asymptomatic those men who reported neither "discharge from the penis" nor "burning when urinating." After laboratory results became available, gonorrhea or chlamydia-infected men were notified and treated in accordance with Centers for Disease Control and Prevention (CDC) treatment guidelines.[12] Project staff sought to locate and notify all sex partners of infected men in order to provide testing and treatment. Determination of "research-exempt status" or human subjects review and approval was obtained from all participating institutions. Where required, informed consent was obtained; patient confidentiality was maintained as required by law.

Specimen Collection Procedures

Patients provided 20 ml of first catch urine for testing for *N. gonorrhoeae* and *C. trachomatis* by US Food and Drug Administration–approved nucleic acid amplification assays (NAATs), all of which are comparable in sensitivity and specificity.[13] Initially, Baltimore used the ligase chain reaction test (LCR; Abbott, Abbott Park, IL). Beginning in June 2002, Baltimore switched to testing samples using strand displacement amplification (SDA; ProbeTec, Becton Dickinson, Sparks, MD). Denver originally used polymerase chain reaction (PCR; Roche Molecular Diagnostics, Indianapolis, IN) and then switched to ProbeTec in July 2002. San Francisco initially used the LCR test and switched to the SDA test in June of 2002. Seattle used the LCR assay until October 2002, after which transcription-mediated amplification (Aptima Combo 2, Gen-Probe, San Diego, CA) was used. Urine collection, storage, transport, and processing of urine were conducted in accordance with manufacturer's directions. Specimens were excluded if the patient had urinated within 1 hour before providing the specimen, had taken antibiotics within the previous 21 days; or if collection, storage, or transport requirements were not met. In each city, testing was performed by a single Clinical Laboratory Improvement Act (CLIA)–approved and certified laboratory.

Analysis

Because some men were screened more than once during the project period as part of a separate reinfection longitudinal study, the first testing episode at the baseline visit with a test result for each individual was selected to determine the prevalence of gonorrhea for men tested during the 39-month interval. The analysis was limited to men tested in venues where at least 50 men where tested. Adolescent and adult primary care and college and school clinics were defined as clinical settings. Prevalence was estimated separately for asymptomatic and symptomatic men using the number of infections detected among men at their first testing visit as the numerator and the number of men with a first visit as the denominator. Coinfection was defined as the detection of both *N. gonorrhoeae* and *C. trachomatis* in a single urine specimen. Univariate and bivariate analyses are presented with gonococcal infection or coinfection with gonorrhea and chlamydia as the main outcomes of interest. Because of the marked variation in the prevalence by city, analyses are presented stratified by metropolitan area. *P* values less than 0.05 were considered statistically significant. All analyses were done using SAS (Statistical Analysis Software version 8; SAS Institute, Inc., Cary, NC).[14]

Results

A total of 17,712 men were tested for *N. gonorrhoeae* and *C. trachomatis*, and 16,850 (95.1%) were asymptomatic. San Francisco tested the most men (11,054, 64.6%), followed by Denver (3098, 17.5%), Baltimore (2872, 16.2%), and Seattle (308, 1.7%) (Table 1). The demographic characteristics by age group and race/ethnicity were as follows: 40.9% were younger than 19 years, 22.9% were 20 to 24 years, 15.5% were 25 to 29 years, and 20.7% were 30 years or older; 43.3% were black, 23.6% were Hispanic, 18.2% were white, and 14.8% were of other race/ethnicities. Among the men tested in the 4 cities, 413 gonococcal infections were identified (overall, 2.3% prevalence). The prevalence of gonococcal infection varied significantly by city ($P < 0.0001$), with Baltimore having the highest prevalence and Seattle the lowest prevalence (Table 1), and followed a similar rank order to

TABLE 1. Prevalence of *Neisseria gonorrhoeae* and *Chlamydia trachomatis* Infection Among Men Tested as Part of the Four-City Demonstration Project, Proportion of Men in Each City Reporting Symptoms, and Reported Rates of Male and Female *N. gonorrhoeae* Infection as Reported to the Centers for Disease Control and Prevention by City (Baltimore, Denver, San Francisco, and Seattle)

	Baltimore		Denver		San Francisco		Seattle		Total	
Characteristic	%	(n/N)	%	(n/N)	%	(n/N)	%	(n/N)	%	(n/N)
Gonorrhea prevalence	3.9	(112/2872)	1.8	(56/3098)	2.1	(245/11,434)	0.0	(0/308)	2.3	(413/17,712)
Asymptomatic	1.2	(33/2593)	1.4	(40/2942)	1.5	(164/11,054)	0.0	(0/261)	1.4	(237/16,850)
Symptomatic	28.3	(79/279)	10.3	(16/156)	21.3	(81/380)	0.0	(0/47)	20.4	(176/862)
Chlamydia prevalence	12.5	(349/2872)	9.7	(302/3098)	5.4	(616/11,434)	2.3	(7/308)	7.2	(1274/17,712)
Asymptomatic	10.3	(266/2593)	8.9	(262/2942)	4.9	(545/11,054)	2.3	(6/261)	6.4	(1079/16,850)
Symptomatic	29.7	(83/279)	25.6	(40/156)	18.7	(71/380)	2.1	(1/47)	22.6	(195/862)
Proportion symptomatic men	9.7	(279/2872)	5.0	(156/3098)	3.3	(380/11,434)	15.3	(47/308)	4.9	(862/17,712)
*Rates of reported gonorrhea per 10^5 population										
Males	630.9		243.5		400.2		109.8		NA	
Females	612.2		223.1		65.2		44.5		NA	

*Rates reported to the Centers for Disease Control and Prevention.[1]

TABLE 2. Prevalence of Asymptomatic *Neisseria gonorrhoeae* (GC) Infections Among Men Screened in Various Venues in Baltimore, Denver, San Francisco, and Seattle

	Baltimore		Denver		San Francisco		Seattle		Total	
Venue	% +	(n/N)	% +	(n/N)	% +	(n/N)	% +	(n/N)	%+	(n/N)
Adult primary care	NA	(0)	NA	(0)	1.5	(9/594)	NA	(0)	1.5	(9/594)
Adolescent primary care	3.6	(11/307)	1.3	(2/149)	2.8	(11/397)	NA	(0)	2.8	(24/853)
School clinic	1.0	(12/1216)	1.1	(4/351)	1.3	(1/77)	NA	(0)	1.0	(17/1644)
School health fair	NA	(0)	NA	(0)	0.0	(0/106)	NA	(0)	0.0	(0/106)
College clinic	NA	(0)	NA	(0)	1.5	(3/202)	NA	(0)	1.5	(3/202)
Street-based outreach	NA	(0)	1.2	(3/244)	1.0	(15/1442)	NA	(0)	1.1	(18/1686)
Community-based organization	NA	(0)	1.4	(4/292)	NA	(0)	NA	(0)	1.4	(4/292)
Drug treatment	NA	(0)	1.3	(1/77)	NA	(0)	NA	(0)	1.3	(1/77)
Juvenile detention	NA	(0)	1.2	(18/1437)	0.6	(7/1129)	0.0	(0/261)	0.9	(25/2827)
Adult detention	0.9	(10/1070)	2.0	(8/392)	1.7	(118/7107)	NA	(0)	1.6	(136/8569)
Overall	1.3	(33/2593)	1.4	(40/2942)	1.5	(164/11,054)	0.0	(0/261)	1.4	(237/16,850)

the gonorrhea rates reported to the CDC for each metropolitan area[4] (Table 1). The overall prevalence of *C. trachomatis* was 7.2% (1274/17,712) and followed the same rank order, by city, as the gonorrhea prevalence ($P < 0.0001$) (Table 1). The prevalence of chlamydia in asymptomatic men was 6%.[11] The proportion of men reporting symptoms at the time of testing also varied significantly by city ($P < 0.001$) (Table 1). The single venue testing the most men was the adult detention facility in San Francisco, where 7261 men were screened, of whom 7107 were asymptomatic (Table 2).

Prevalence of N. gonorrhoeae Among Asymptomatic Men

Among men classified as asymptomatic, the overall prevalence of gonococcal infection was 1.4% (237/16,850), ranging from 0.0% (0/261) in Seattle to 1.5% (164/11,054) in San Francisco ($P = 0.20$) (Table 2). Overall, men aged 20 to 24 had the highest prevalence of infection; however, in Baltimore the prevalence of infection was highest among men 19 years and younger (Table 3). In asymptomatic men, the prevalence was not much varied by age, whereas in symptomatic men, the 2 younger age groups had the highest prevalence (23–24%) (Table 3).

In San Francisco and Baltimore, the prevalence of infection varied significantly across different venues, with asymptomatic men screened in clinical venues having a higher prevalence of infection than those in nonclinical venues. The overall prevalence of asymptomatic gonorrhea varied significantly by race/ethnicity ($P < 0.0001$) (Table 3); across all cities, black men had a significantly higher prevalence of infection than white men [prevalence rate ratio = 2.1 (95% confidence interval 1.4–3.1)].

Prevalence of N. gonorrhoeae Among Symptomatic Men

In men reporting discharge and/or dysuria, the overall prevalence of gonorrhea was 20.4% (176/862), ranging from 0% (0/47) in Seattle to 28.3% (79/279) in Baltimore ($P < 0.001$) (Table 1). The prevalence of symptomatic infection varied significantly by age and was highest in men 19 years and younger ($P < 0.01$) (Table 3).

The prevalence of infection among symptomatic men varied significantly by venue type within each of the 3 cities where *N. gonorrhoeae* was detected (all $P < 0.05$) (data not shown). The largest numbers of symptomatic infections were detected among men attending an adolescent primary care clinic in Baltimore. After controlling for city, blacks were twice as likely to report symptoms as whites (prevalence rate ratio = 2.1; 95% confidence interval, 1.3–3.4). In addition, the prevalence of symptomatic infection was significantly higher among blacks ($P < 0.0001$), a pattern seen in all 3 cities where gonococcal infections were detected (Table 3).

TABLE 3. Prevalence of *Neisseria gonorrhoeae* by Symptom Status, Age Group, and Race/Ethnicity by City

	Asymptomatic								Symptomatic							
	Baltimore		Denver		San Francisco		Total		Baltimore		Denver		San Francisco		Total	
	% +	(n/N)	% +	(n/N)	% +	(n/N)	% +	(n/N)	% +	(n/N)	% +	(n/N)	% +	(n/N)	% +	(n/N)
Age group (years)																
≤19	1.6	(23/1483)	1.2	(28/2376)	1.3	(35/2727)	1.3	(86/6586)	36.9	(48/130)	8.4	(10/119)	27.3	(21/77)	24.2	(79/326)
20–24	1.2	(5/402)	2.4	(9/367)	1.8	(56/3053)	1.8	(70/3822)	27.8	(25/90)	14.8	(4/27)	22.3	(23/103)	23.6	(52/220)
25–29	1.6	(2/122)	1.2	(2/170)	0.9	(22/2349)	1.0	(26/2641)	5.6	(1/18)	22.2	(2/9)	11.9	(8/67)	11.7	(11/94)
≥30	0.5	(3/575)	3.8	(1/26)	1.7	(50/2887)	1.5	(54/3488)	10.0	(4/40)	0.0	(0/1)	21.2	(28/132)	18.5	(32/173)
Race/ethnicity																
Black	1.3	(31/2340)	2.3	(18/798)	2.4	(94/3948)	2.0	(143/7086)	29.5	(79/268)	20.5	(8/39)	24.6	(59/240)	26.7	(146/547)
Hispanic	0.0	(0/30)	1.1	(13/1189)	0.9	(25/2817)	0.9	(38/4036)	0.0	(0/1)	6.6	(5/76)	7.6	(4/53)	6.9	(9/130)
Other	1.3	(1/78)	1.5	(5/343)	1.0	(21/2016)	1.1	(27/2437)	0.0	(0/2)	10.5	(2/19)	20.0	(8/40)	16.4	(10/61)
White	0.7	(1/145)	0.6	(4/612)	1.1	(24/2273)	1.0	(29/3030)	0.0	(0/8)	4.6	(1/22)	21.3	(10/47)	14.3	(11/77)

TABLE 4. Distribution of *Neisseria gonorrhoeae* (GC) and *Chlamydia trachomatis* (CT) Infections Among Men With Symptoms, and Prevalence of Coinfection in Men by City

	Baltimore		Denver		San Francisco		Seattle		Total	
Characteristic	%	(n/N)	%	(n/N)	%	(n/N)	%	(n/N)	%	(n/N)
GC and CT infection among men with symptoms										
GC only	17.6	(49/279)	7.7	(12/156)	16.6	(63/380)	0.0	(0/47)	14.4	(124/862)
GC and CT	10.8	(30/279)	2.6	(4/156)	4.7	(18/380)	0.0	(0/47)	6.0	(52/862)
CT only	19.0	(53/279)	23.1	(36/156)	14.0	(53/380)	2.1	(1/47)	16.6	(143/862)
Neither GC nor CT	52.7	(147/279)	66.7	(104/156)	64.7	(246/380)	97.9	(46/47)	63.0	(543/862)
Proportion of GC infection that is symptomatic	70.5	(79/112)	28.6	(16/56)	33.1	(81/245)	NA	NA	42.6	(176/413)
Proportion of dual infection with CT among men with GC										
Asymptomatic	42.4	(14/33)	37.5	(15/40)	17.7	(29/164)	NA	NA	24.5	(58/237)
Symptomatic	38.0	(30/79)	25.0	(4/16)	22.2	(18/81)	NA	NA	29.6	(52/176)
Proportion of dual infection with GC among men with CT*										
Asymptomatic	5.3	(14/266)	5.7	(15/262)	5.3	(29/545)	0.0	(0/6)	5.4	(58/1079)
Symptomatic	36.1	(30/83)	10.0	(4/40)	25.4	(18/71)	0.0	(0/1)	26.7	(52/195)

*$P < 0.001$.

Symptomatic Infection

Overall, less than half (41%) of men with *N. gonorrhoeae* reported discharge or dysuria, and the proportion of symptomatic men varied substantially by city (Baltimore 70.5%, Denver 28.6%, and San Francisco 33.1%; $P < 0.001$; Table 4). Sixty-three percent of men with symptoms had neither *C. trachomatis* nor *N. gonorrhoeae*; this also varied significantly by city ($P < 0.001$), with Seattle having the highest proportion (97.9%) and Baltimore the lowest (52.7%) (Table 4), and was inversely related to the prevalence of gonorrhea detected in each city (Table 1).

C. trachomatis and *N. gonorrhoeae* Coinfection Among Both Asymptomatic and Symptomatic Men

Overall, 26.6% (110/413) of men with *N. gonorrhoeae* (both asymptomatic and symptomatic) also had chlamydial infection (range, 19.2% in San Francisco to 39.3% Baltimore). Chlamydial coinfection rates did not vary significantly by symptom status ($P = 0.61$) (Table 4). The proportion of men with chlamydial infection who also had gonorrhea infection was 8.6% (110/1274) (range, 0% in Seattle to 12.6% in Baltimore); men with chlamydial infection were significantly more likely to be coinfected with gonorrhea if they had symptoms ($P < 0.0001$) (Table 4).

Discussion

We detected a low prevalence of gonococcal infection using highly sensitive NAAT testing in a large population of men attending clinical (non-STD) and nonclinical venues in 4 US cities as part of a demonstration project designed to measure the prevalence of *C. trachomatis* among asymptomatic heterosexual men. Although more than 40% of gonococcal infections detected were in asymptomatic men, the prevalence of gonorrhea infection among asymptomatic men was ≤1.5% in all 4 cities. This is in contrast to the 6% prevalence of chlamydia measured in the same population.[11] It does not appear that the high case rates reported to the CDC for some locations[1] should be a basis for screening asymptomatic men because the prevalence in asymptomatic men appeared to be low no matter what the rate was in symptomatic men. A small proportion of men was found to have symptoms at enrollment, and when such symptomatic men were included in prevalence estimates, the overall prevalence of gonococcal infection increased but remained less than 4% in every city, venue, age group, and race/ethnicity group examined. Not surprisingly, gonococcal infection rates were much higher in symptomatic men and accompanied by high rates of chlamydial coinfection.

Interestingly, the universally low prevalence of gonorrhea in asymptomatic men in this study deserves comment. It may be that the asymptomatic infections represent largely prevalent infections, whereas the symptomatic infections are more likely incident infections. As opposed to chlamydial infection, reported gonorrhea rates are largely based on incident infections in men. Perhaps asymptomatic prevalent gonorrhea infections persist for long periods of time in some men such that over time the population rates of asymptomatic infections equilibrate to approximately the same level in high- and low-incidence populations.

The few other large studies conducted to test asymptomatic men for gonorrhea in the United States[7–9] have also observed low prevalence. In approximately 6000 male military recruits from across the United States, the prevalence of gonorrhea was 0.6% and 0.4% in 2 studies,[7,9] findings consistent with the 0.43% prevalence reported by Miller et al.[8] in adolescents across the United States. At 1.5%, the prevalence among asymptomatic men reported in our study is higher, likely because a substantial proportion (67%) of the testing was performed in detention settings, where STD prevalence is known to exceed that in the general population.[15,16] The recommendation to target gonorrhea screening particularly in corrections can be easily justified by our data,[15] as well as by other detention studies targeting women, which yield even higher prevalence.[17] Thus, asymptomatic men should probably not be screened ahead of women in detention. In addition, about 20% of testing in this study was performed in clinical settings where higher prevalence of infection has been found even when men report no symptoms.[18] Although gonococcal infection is usually considered to be symptomatic in men, data collectively indicate that some proportions of gonococcal infections are asymptomatic. This study and others document that a low-level reservoir of infection exists among asymptomatic men; however, it is difficult to quantify the extent to which transmission from asymptomatic men contributes to overall prevalence.

In 2003, the number of male gonorrhea cases at each of the 4 participating cities reported to CDC resulted in disease rates that varied as much as fivefold from one city to another, with Baltimore having the highest rates (630.9/100,000 men) and Seattle the lowest (109.8/100,000). Given that most diagnosed and reported gonorrhea among men is likely symptomatic, it was not surprising to find that the prevalence of *N. gonorrhoeae* in symptomatic men in each city followed the same rank order and varied almost threefold. There was a similarly ordered variation in the prevalence of infection among asymptomatic men attending venues common to the cities where *N. gonorrhoeae* was detected (e.g., adult detention); however, the prevalence was consistently less than 4%. Note that the lower prevalence of asymptomatic infection detected in adult detention in Baltimore than in San Francisco and Denver may have been the result of the longer duration of incarceration among men tested; providing a greater opportunity for treatment or natural clearance of gonococcal infections. The consistently low prevalence of gonorrhea among asymptomatic men in all 4 cities suggested that the size of the reservoir of asymptomatic *N. gonorrhoeae* may be due more to the characteristics of the pathogen, rather than the local disease burden, and that regardless of the prevalence of infection in symptomatic men, the burden of disease will be low among asymptomatic men.

The question arises that because San Francisco screened many more men than did Seattle whether the potential for bias exists for the findings of this study. Although San Francisco screened more men, the low prevalence in asymptomatic men was approximately the same as in Seattle and the other cities. However, the overall rank order of gonorrhea prevalence rates in our study reflected what had been reported to the CDC in 2003, with the Seattle rates being among the lowest at 59th of 63 selected cities, with San Francisco being at 31st, Denver being at 33rd, whereas Baltimore was number 4, so we believe the potential for bias in the results was small.

CDC STD Treatment Guidelines recommend empirical treatment for *C. trachomatis* when treating a diagnosed gonococcal infection because chlamydial coinfection is frequent among persons diagnosed with gonorrhea. However coinfection data are largely derived from STD clinic settings where patients are likely to present with symptoms of, or suspected exposure to, an STD.[19] In our study, which did not include an STD clinic population, almost a third of gonorrhea-infected men had concurrent chlamydial infection, and symptom status made little difference in the rate of coinfection (25% of asymptomatic men versus 30% of symptomatic men). Gonococcal coinfection was far less common among men with chlamydia overall; however, among men with symptoms, the gonococcal coinfection rates approached 30%. Among asymptomatic men with chlamydia, only 5% had gonorrhea coinfection. Reasons for this are not entirely clear, but speculation may be based on the fact that gonorrhea is more likely to be symptomatic and less prevalent and chlamydia is more likely to be asymptomatic and more prevalent. It may be that the men with gonorrhea infections represent a smaller universe of men (less prevalent disease) and are producing the major symptomatology, with chlamydia being the silent, more prevalent coinfection present regardless of symptoms. Conversely, the larger-numbered population (more prevalent disease) of men who have chlamydia are probably less likely to have symptoms, thus less likely to also have gonorrhea. Regardless of the reasons, in summary, these data support the CDC recommendations for cotreatment for chlamydia for gonorrhea cases,[19] but not necessarily the reverse.

In this study, we used diagnostic laboratory tests designed to detect both *N. gonorrhoeae* and *C. trachomatis* in a single assay applied to a single urine specimen. Combining multiple target organisms in a single multiplex assay has diagnostic advantages for the clinician and operational advantages for the testing laboratory and may appear cost saving when compared to running diagnostic assays for each pathogen separately. However, when such multiplex tests are used for screening (rather than diagnostic testing) the disadvantages of dual testing may outweigh any benefits. At low gonorrhea prevalence, the incremental increase in cost posed by dual testing may not be justifiable, and there is a substantial risk for false-positive test results.[20] Given the low prevalence of gonorrhea we observed among asymptomatic men, the positive predictive value of a positive *N. gonorrhoeae* test result could be as low as 60%, even using a test with specificity greater than 99%. To save costs, and to avoid false positives, some laboratories use the multiplex test to screen only for chlamydia by turning off the software that reads gonorrhea results and then performing the gonorrhea test only if the chlamydia test is positive. In our population, 25% of all asymptomatic *N gonorrhoeae* infections could have been detected by this 2-stage testing strategy.

This study has a number of limitations. Given the low prevalence of gonorrhea among asymptomatic screened men and the resulting positive predictive value of a NAAT test,[20] it is possible that a number of the asymptomatic infections detected were false positives and the measured prevalence may have been artificially elevated. Balanced against this possibility is another laboratory factor from a manufacturer that may have led to an underestimate of some infections. Quality control problems with decreased sensitivity with the LCR test kit were recognized by the manufacturer during the study period,[21] leading 2 investigators from 3 cities using this assay to switch to another assay partway through the study period. Although the project aimed to enroll heterosexual men, not all the screening venues ascertained the gender of men's sex partners, so it is likely that screened men included MSM in each city, a group that has been observed to have increasing rates of gonococcal infection. However, it is unlikely that the proportion of MSM participating exceeds that expected in the general population. In addition, confounding by venue type may explain differences in city- or age-specific prevalence, at least among symptomatic men. Finally, the symptom status of study participants was measured by self-report, and the large proportion of men with symptoms who had neither *N. gonorrhoeae* nor *C. trachomatis* suggests that these questions may not have been specific enough to accurately identify persons with symptoms suggestive of urethral infection. Alternatively, reported symptoms may have been due to other pathogens causing urethral infection, such as *Trichomonas vaginalis*, *Mycoplasma genitalium*, or *Ureaplasm urealyticum* that we did not test for. Despite these limitations, this study of more than 17,000 men provides one of the largest non-STD clinic venue studies of *N. gonorrhoeae* prevalence.

Currently, neither the United States CDC nor any other organizations recommend screening men for gonorrhea, and the results of this study do not support a recommendation to routinely screen asymptomatic men for gonorrhea. Testing symptomatic men for gonorrhea still appears to be the most practical strategy for detection of gonorrhea infection. Even in areas with high gonorrhea prevalence among symptomatic men, the prevalence was low ($\sim$1%) among asymptomatic men. However, even after the probability of false positives in a low-prevalence population has been taken into account, this study, as well as several other recently published population-based studies in asymptomatic men, provides data on the prevalence of asymptomatic gonorrhea infections in men who may serve as reservoirs for the transmission and sustain infection in the community.[7–9] Because the prevalence of gonorrhea among asymptomatic men is low, routine screening cannot be recommended when screening is performed for chlamydia, unless a substantial local prevalence of gonorrhea can be documented. Rather than screening asymptomatic men, it may be more practical to allocate resources to targeted strategies; some of these might include partner notification, repeat testing of infected men and women, reflex *N. gonorrhoeae* screening of *C. trachomatis*–positive specimens, testing symptomatic men in non-STD clinic venues such as in detention centers, or innovative approaches to case finding, including sexual network-based screening or core-based screening.

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