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Estimates of Chlamydia trachomatis *Infections Among Men: United States*

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Objective: **To describe the epidemiology of genital *Chlamydia trachomatis* infections among men in the United States.**

Study Design: **Data from the notifiable disease case surveillance system, the National Health and Nutrition Examination Survey (NHANES), the National Longitudinal Study of Adolescent Health (AddHealth), the National Job Training Program, the Men Having Sex with Men (MSM) Prevalence Monitoring Project, and adult and juvenile corrections facilities were used to summarize national chlamydia case and prevalence rates. Data were stratified by age and race/ethnicity.**

Results: **In 2005, 232,781 chlamydia cases among men were reported, corresponding to a rate of 161.1 cases per 100,000 men, an increase of 43.5% compared with the case rate in 2001 (112.3). Population-based chlamydia prevalence rates from NHANES (1999–2002) were highest among men aged 20 to 29 years (3.2%); men aged 18 to 26 years participating in AddHealth (2001–2002) had a 3.7% prevalence rate. Rates were highest among black men in both NHANES (5.3%) and AddHealth (11.1%). The prevalence rate among men (aged 16–24 years) participating in the National Job Training Program was 8.1%. Among MSM, the 2005 median urethral chlamydia prevalence rate was 6%. Overall, chlamydia rates were highest in adult corrections facilities; the 2005 positivity rate among men aged 21 to 25 years was 7.8%. In juvenile corrections facilities, the 2005 positivity rate among men aged 15 to 17 years was 6.7%.**

Conclusions: **Rates of genital *C. trachomatis* infections among men are persistently high, particularly among men entering the National Job Training Program and men in corrections facilities. The burden of disease is generally highest among young men and black men.**

CHLAMYDIA IS THE MOST COMMONLY reported notifiable disease in the United States among both women and men.[1] Prevention efforts have focused primarily on prompt identification of *Chlamydia trachomatis* infections among women and subsequent timely, appropriate treatment. Given the high disease burden among young women, national recommendations encouraging annual screening of all sexually active young women under the age of 26 years have been in place since 1993.[1,2–4] These screening guidelines have led to a wealth of data on the epidemiology of chlamydia among women; the general population chlamydia prevalence among young women aged 14 to 19 years is 4.9%, whereas rates in excess of 19% are found among young women (aged <20 years) in adult correctional facilities.[1,5] However, the epidemiology of chlamydia among men in the United States has not been characterized thoroughly.

Increasingly, the importance of understanding and addressing chlamydia infections among men is being recognized.[6] The role of identifying and treating male infections in preventing adverse outcomes among women, such as pelvic inflammatory disease, ectopic pregnancy, and infertility, has prompted some researchers to call for chlamydia screening guidelines directed at detecting male infections.[6] Untreated chlamydia infections may rarely have direct adverse outcomes among men, including epididymitis and proctitis.[7] Currently, males are opportunistically tested for chlamydia; no recommendations for screening males for chlamydia exist.

Although several existing studies have examined chlamydia infections in men, these studies are typically geographically limited (restricted to one or several urban locales), targeted to a certain portion of the population, such as military recruits, or were conducted a number of years ago.[8–13] Using data from existing sources, we sought to characterize and summarize genital *C. trachomatis* infections among men in the United States, both in the general population and in specific subpopulations.

Materials and Methods

We reviewed published data from national sources on chlamydia infection among men in the United States, including data from national surveys and programs. We also conducted a PubMed search using the terms "United States," "chlamydia," "epidemiology," and "men" to identify articles published from 2002 to 2007. To be included in this summary, data provided on male chlamydia infections must have included multiple regions of the United States (not limited to a single geographic area or select metropolitan areas) and have been stratified at least by age.

Data identified for use in this summary include national chlamydia morbidity data and prevalence data from the National Health and Nutrition Examination Survey (NHANES), the National Longitudinal Study of Adolescent Health (AddHealth), the National Job Training Program, the Men Having Sex with Men (MSM) Prevalence Monitoring Project, and juvenile and adult corrections facilities. Data and literature sources are briefly described as follows.

Case Reporting

Chlamydia morbidity data are reported weekly by state health departments to the Centers for Disease Control and Prevention

From the Division of STD Prevention, CDC, Atlanta, Georgia

The findings and conclusions in this report have not been formally disseminated by the Centers for Disease Control and Prevention and should not be construed to represent any agency determination or policy.

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(CDC) through the National Electronic Telecommunications System for Surveillance. Chlamydia was added to the nationally notifiable disease list in 1995; since 2000, all 50 states have reported chlamydia cases to CDC. Cases are diagnosed based on the current chlamydia case definition,[14] but test technologies used vary across reporting areas. Data are not deduplicated; therefore, a single individual may contribute more than 1 case per year, if multiple diagnoses are made. Morbidity data are reported in an annual summary produced by CDC using both absolute case counts and case rates per 100,000 population, stratified on demographic factors such as sex, age, and race/ethnicity.[1,15–18] Age groups, in years, are standardized as follows: 10 to 14, 15 to 19, 20 to 24, 25 to 29, 30 to 34, 35 to 39, 40 to 44, 45 to 54, 55 to 64, and greater than 64. Race/ethnicity groups included in the annual summary are non-Hispanic white, non-Hispanic black, Hispanic, Asian/Pacific Islander, and American Indian/Alaska Native.

Prevalence

General Population. NHANES is a cross-sectional survey that provided data on demographics, sexual behavior, and chlamydia prevalence of the general US household population through interviews and the collection of urine specimens. From 1999 to 2002, specimens were tested for chlamydia using a ligase chain reaction assay (LCx, Abbott Laboratories, Abbott Park, IL). The NHANES sampling plan is a stratified, multistage, probability cluster design that selected a sample representative of the US civilian noninstitutionalized population. Eighty-three percent of persons aged 14 to 39 years who were invited to participate in NHANES in 1999–2002 completed the interview; 92% of those interviewed had chlamydia results. The resulting1999–2002 sample included 6632 participants aged 14 to 39 years.[5]

A prospective cohort study, AddHealth tracked a school-based probability sample of 18,924 adolescents to adulthood (Wave I). Wave III follow-up data were collected from April 2001 to May 2002. Sixty-six percent of the original Wave I cohort provided urine specimens, approximately half of them were men. Men ranged from 18 to 26 years.[19] Urine specimens were tested by ligase chain reaction assay to identify the presence of *C. trachomatis*. Prevalence rates were calculated while taking into account the AddHealth sampling methodology.

Specific Populations. Male chlamydia positivity data are collected from participating juvenile corrections facilities and adult corrections facilities and reported annually.[1,15–18] Data are obtained through CDC's Corrections Prevalence Monitoring Project and the national Infertility Prevention Program. Chlamydia is diagnosed based on the detection of *C. trachomatis* using locally selected laboratory tests, including both nucleic acid amplification tests (NAATs) and non-NAATs. Males were voluntarily screened upon entry into the correctional facility. Data consist of test results that are not linked to individuals; a single individual could have multiple tests during the course of a year. Therefore, positivity rates (not prevalence rates) are calculated using the total number of positive chlamydia tests as the numerator and the total number of positive and negative chlamydia tests as the denominator. Positivity rates have been found to accurately approximate prevalence rates in monitoring chlamydia rates in these populations.[20] In addition to annual reports, a more detailed analysis was recently conducted using 2005 data.[21]

Men entering into the National Job Training Program, a program for socioeconomically disadvantaged youth aged 16 to 24 years, were routinely screened for chlamydia from July 2003 to December 2004; data were subsequently analyzed.[22] Chlamydia cases were identified via the use of a strand displacement assay (BDProbeTec ET, Becton-Dickinson, Sparks, MD) performed using a urine specimen collected during the entrance examination. Chlamydia screening has continued since December 2004, and limited National Job Training Program data from 2005 are also available.[1]

The final data included in our review are from the MSM Prevalence Monitoring Project, a surveillance project consisting of data collected from MSM of all ages attending STD clinics located in 9 US cities. Based on either a urethral swab or urine specimen, chlamydia diagnoses are made according to local case definitions and locally available test technologies,[1] which vary by site. Positivity rates are reported, calculated using the same methodology as data from corrections facilities, described earlier.

Data are reported as presented in the original publication; if available, supporting statistics, confidence intervals (CI), ranges, and odds ratios (OR) are included.

Results

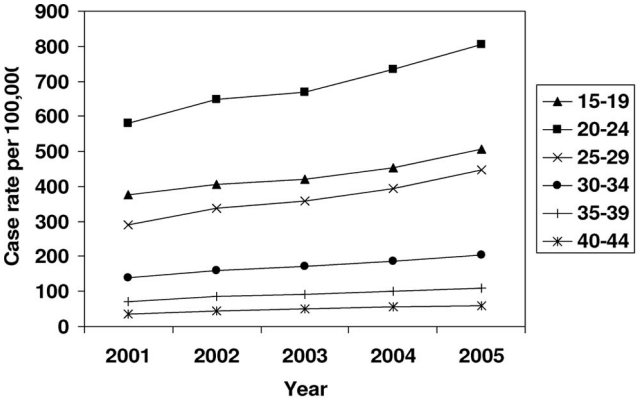
Case Reporting

In 2005, 232,781 chlamydia cases among men were reported in the United States, corresponding to a case rate of 161.1 cases per 100,000 men, an increase of 43.5% compared with the 2001 case rate of 112.3 cases per 100,000 men.[1]

Increases in reported cases among men occurred across all age and racial/ethnic groups consistently from 2001 to 2005 (Figs. 1, 2).[1,15–18] The highest age-specific case rate in 2005 was evident among men aged 20 to 24 years, at 804.7 cases per 100,000 men, representing 37% of all reported cases (86,931 of 233,553). Among racial/ethnic groups, non-Hispanic black men had the highest case rates. In 2005, the case rate per 100,000 black men (all ages) was 717.8, more than 11 times higher than that of non-Hispanic white men (63.6 per 100,000) and more than 3 times higher than the rate among Hispanic men (201.4 per 100,000). Cases among non-Hispanic black men accounted for more than 50% of all reported cases (111,513 of 217,066). In 2005, the highest case rate across race/ethnic groups and age groups was observed among non-Hispanic black men aged 20 to 24 years (2965.5 cases per 100,000 men). This was an increase of 29% since 2001 (2304.4 cases per 100,000).

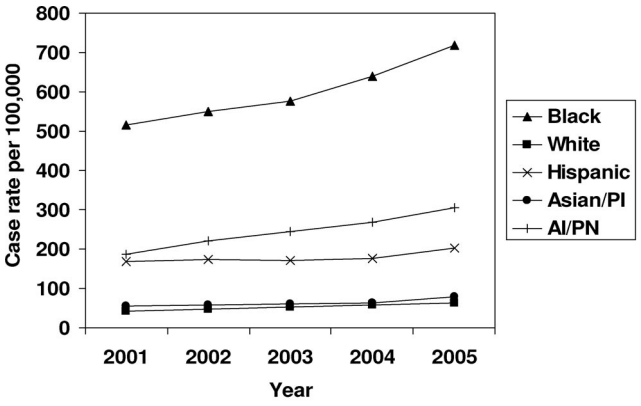
Prevalence

General Population. Data from 2 sources, NHANES and AddHealth, yielded national prevalence estimates from samples of



Source: Centers for Disease Control and Prevention. *Sexually Transmitted Disease Surveillance, 2005.*

Fig. 1. Age-specific chlamydia rates among men: United States, 2001–2005.



Source: Centers for Disease Control and Prevention. *Sexually Transmitted Disease Surveillance, 2005.*

Fig. 2. Race/ethnicity-specific chlamydia rates among men: United States, 2001–2005.

the US general population (Table 1). Based on the NHANES data collected from 1999 to 2002, the overall chlamydia prevalence rate among 3096 males aged 14 to 39 years was 2.0% (95% CI 1.6%–2.5%).[5] The prevalence rate was highest among males aged 20 to 29 years at 3.2% (CI 2.4%–4.3%), higher than both the prevalence rate among younger males aged 14 to 19 years (2.3%, CI 1.5%–3.5%) and among older males aged 30 to 39 years (0.7%, CI 0.3%–1.5%). Targeting a more restricted age group than NHANES, AddHealth showed a 3.7% chlamydia prevalence rate among young men aged 18 to 26 years (CI 2.9%–4.6%).[19]

Prevalence rates by racial/ethnic group were also available from both NHANES and AddHealth (Table 2). Prevalence rates were highest among non-Hispanic black men in both studies. In NHANES, the 5.3% (CI 3.8%–7.5%) chlamydia prevalence rate among non-Hispanic black men was higher than among non-Hispanic white men (1.5%, CI 0.9%–2.4%) and Hispanic men (3.1%, CI 1.9%–5.0%).[5] Differences among racial/ethnic groups were more pronounced in young men participating in AddHealth. The prevalence rate among non-Hispanic black men (11.1%, CI 8.5%–14.4%) was 8 times higher than the rate among non-Hispanic white men (1.4%, CI 0.9%–2.0%).[19] The rate among Hispanic men (7.2%, CI 4.9%–10.5%) was 5 times higher than that of non-Hispanic white men.

TABLE 1. Chlamydia Prevalence Among Men, by Age, Selected Populations

Population			
Data Source	Year	Ages	Prevalence/ Positivity (%)
NHANES	1999–2002	14–19	2.3
		20–29	3.2
		30–39	0.7
AddHealth	2001–2002	18–26	3.7
Juvenile corrections facilities	2005	12–14	2.4
		15–17	6.7
		18–20	8.7
Adult corrections facilities	2005	18–20	8.8
		21–25	7.8
		26–30	3.5
		31–35	3.5
		36–40	2.9
National Job Training Program	2003–2004	16–19	8.0
		20–24	8.8
MSM Prevalence Monitoring Project	2005	15–80	6.0

TABLE 2. Chlamydia Prevalence Among Men, by Race/Ethnicity, Selected Populations

	Race/Ethnicity		
Data Source (yrs)	Black	White	Hispanic
NHANES (1999–2002; age 14–39)	5.3	1.5	3.1
AddHealth (2001–2002; age 18–26)	11.1	1.4	7.2
National Job Training Program (2003–2004; age 16–24)	13.0	3.1	5.7
MSM Prevalence Monitoring Project (2005; age 15–80)	7.0	6.0	6.0

Specific Populations. Chlamydia positivity rates among men entering corrections facilities were consistently higher than prevalence estimates for the general US population as identified in NHANES and AddHealth. Among young men (aged 12–20 years) entering juvenile corrections facilities in 2005, the median facility-specific chlamydia positivity rate was 6.0% (85 facilities).[21] The median rate was highest among men aged 18 to 20, at 8.7%, and the median rate among 15- to 17-year-old men was 6.7%. Among young men aged 18 to 20 years entering adult facilities, the median positivity rate was 8.8% (11 facilities). The median positivity decreased slightly to 7.8% among men aged 21 to 25 years and to 3.5% among men aged 26 to 30 years, continuing to decrease as age increased. Overall, among men entering adult corrections facilities (all ages), the median facility-specific chlamydia positivity rate was 4.6% (11 facilities). Over time, positivity rates in both juvenile and adult corrections facilities have consistently remained high. Median facility-specific rates were greater than 5% in both types of facilities from 2001 to 2005.[1,15–18]

Two additional sources, the National Job Training Program and the MSM Prevalence Monitoring Project, provided data on more specific groups of men than those described in the earlier data. Among socioeconomically disadvantaged young men (aged 16–24 years) entering into the National Job Training Program, the median state-specific chlamydia prevalence rates have been uniformly high over time.[1,15–18,22] In 2005, the median state-specific rate was reported as 8.1% (range 0.0%–14.8%).[1] A subset of data from the National Job Training Program, from July 2003 to December 2004, was further analyzed. When split into 2 age groups, both groups reflected high prevalence rates (ages 16–19 years: 8.0%; ages 20–24 years: 8.8%).[22] Similar to NHANES and AddHealth, prevalence rates in this subset were over 4-fold higher among black men (13.0%) compared with white men (3.1%; adjusted OR 4.1; 95% CI 3.7–4.6); the rate among Hispanic men (5.7%) was also significantly higher than that of white men (adjusted OR 2.0; 95% CI 1.7–2.3).

Data from the MSM Prevalence Monitoring Project showed a median city-specific urethral positivity rate in 2005 of 6% (9 cities, range 5%–8%).[1] Unlike the previous data sources, chlamydia positivity did not vary substantially between racial and ethnic groups. In 2005, the rate among black MSM attending STD clinics was 7.0%, whereas the positivity rate among both white and Hispanic MSM was 6.0%.

Discussion

Our summary reveals that the prevalence of chlamydial infection among men is substantial, especially in younger age groups, racial/ethnic minorities, and the incarcerated population.

Across data sources, the burden of chlamydia infection is generally greatest among young men aged approximately 20 to 24 years. This differs from the epidemiology of chlamydia among women; the greatest burden among women occurs in a younger age group, those 15 to 19 years of age.[1] The age difference may be due to partnership characteristics, suggesting that young women's sexual partners are often slightly older men, as has been noted in previous studies examining sexual mixing patterns.[23] In addition, adolescent females may have a higher biologic susceptibility to acquiring chlamydia than do adolescent males, because of cervical ectopy. Overall, the efficiency of *C. trachomatis* transmission during heterosexual vaginal sex may be greater from men to women than from women to men.[24]

With the exception of the MSM population, chlamydia infections were disproportionately found in black men compared with white and Hispanic men and in Hispanic men when compared directly with white men. These disparities were also observed in studies of other STDs, such as gonorrhea and syphilis.[1,15–18,25] Racial/ethnic disparities also exist for HIV infections; increasingly high HIV rates among black men have recently been highlighted.[26] Disparities in chlamydia prevalence among women exhibit similar patterns and are highest among black women.[1,15–18] Interestingly, there are smaller differences between positivity rates by race/ethnicity among MSM. This has also been observed in studies of other STDs.[1]

Chlamydia infection is highly prevalent in men entering corrections facilities, and among men entering the National Job Training Program. Corrections data show that the burden of infection is highest among men aged 18 to 20 years, both in juvenile and adult facilities. However, rates are substantial among men aged 15 to 25 years (range 6.7%–8.8%), suggesting that this high-risk population may be reasonable to target for screening efforts. Other local corrections data also demonstrate a high burden of disease among young men.[27]

Case report data from 2001 to 2005 show steady increases in chlamydia case rates per 100,000 men. The increases may be at least partially explained by increasing usage of NAATs,[28] which are more sensitive than prior test technologies[29] and thus may identify more cases. In addition, the increasingly widespread availability of noninvasive testing by means of collecting urine specimens has likely led to more men agreeing to chlamydia tests.[30] Finally, case report data are subject to local and state reporting practices; although all states have reported chlamydia cases to CDC since 2000, reporting practices, rates, and completeness vary. Although there are possible explanations as to the increase in chlamydia case rates among men, a true increase in infection rates cannot be ruled out.

Improvements in test technology and the availability of NAATs for use on urine specimens have led to increased opportunities to more easily test men for chlamydia. With test technology enhancements, more programs are considering creating guidelines and implementing chlamydia screening among men. Some programs have moved forward with this initiative, but locally defined screening criteria, as well as the screening practices and coverage, vary substantially (Steven Shapiro, CDC, personal communication). Another means to improve the detection and treatment of chlamydia in men is to improve partner referral practices for women with chlamydia.

The data used in our study have several limitations. First, the case report surveillance system is dependent on provider and laboratory reports, and underreporting may be significant. Although widespread reporting requirements were adopted in every state by 2000, actual reporting implementation dates and practices vary by area. Because of the asymptomatic nature of chlamydial infections, underdetection is also a likely cause of underestimation of cases. Second, the prevalence data we present are dependent on the test technology used. Increasingly sensitive tests are better able to detect any evidence of infection, resulting in fewer false negatives and more positives; changes in test technology have been associated with increases in test positivity.[31] Third, because of the lack of commercially available test technologies (beyond culture) that are Food and Drug Administration-approved to test rectal specimens, rectal chlamydia infections were not often ascertained.

Despite the limitations, the data used in our summary demonstrate consistent results across a variety of populations. Large sample sizes represent different populations, multiple regions of the country, and varying socioeconomic and risk groups. Two of our data sources, NHANES and AddHealth, are nationally representative surveys of the US population at large.

In summary, our review provides important information on the epidemiology of chlamydia among men in the United States. Although generally lower than disease rates among women, prevalence rates among men are consistently substantial. The burden of chlamydia among men is most significant in a slightly older age group[20–24] than women.[15–19] Similar to women, infection rates are higher among black men. Data presented in this analysis support routine chlamydia screening of young men in corrections settings, particularly adult corrections facilities, and continued screening of men entering the National Job Training Program. Further research on the impact and cost-effectiveness of additional strategies to detect chlamydia in men should be pursued.

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