Gonorrhea and Chlamydia Infection Among Women Visiting Family Planning Clinics: Racial Variation in Prevalence and Predictors

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CONTEXT: *Black women are disproportionately infected with gonorrhea and chlamydia. Because of the potential impact of these infections on women's reproductive health, it is important to determine whether different factors are predictive of infection in women of different races.*

METHODS: *Data from 31,762 women aged 15–24 who were tested for gonorrhea and chlamydia at Missouri family planning clinics in 2001 were used to calculate the prevalence of each infection by selected variables. Logistic regression analysis was used to assess factors associated with the risk of infection.*

RESULTS: *Overall, 0.7% of women had gonorrhea, and 4% had chlamydia. The gonorrhea rate was 4% for blacks and 0.4% for whites; the chlamydia rate, 9% and 4%, respectively. Independent predictors of gonorrhea in both races were symptoms, recent sexual contact with a partner who had STD symptoms, and chlamydia infection. Predictors specific to whites were visiting the clinic for STD care and having a new partner or multiple partners in the past year. Being aged 15–21 was associated with an elevated risk of gonorrhea for blacks only. In both racial groups, chlamydia infection was associated with younger age, contact with a symptomatic partner, cervicitis, cervical friability and gonorrhea positivity. Additional predictors among whites were having a new partner, having multiple partners and having pelvic inflammatory disease; no other factors were significant for blacks.*

CONCLUSIONS: *The prevalence and predictors of gonorrhea and chlamydia infection differ significantly between blacks and whites. Until these disparities are better understood, it will be difficult to establish screening criteria for gonorrhea.*

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Neisseria gonorrhoeae and *Chlamydia trachomatis* are the nation's most prevalent bacterial sexually transmitted infections, and females aged 15–19 are at higher risk than those of other ages.[1] Infections among these women are especially problematic because of the severe reproductive sequelae that may develop, including pelvic inflammatory disease (PID), ectopic pregnancy and tubal scarring. Furthermore, infants born to women with gonorrhea or chlamydia may suffer from ocular infections that cause blindness if left untreated.[2]

Some 30–60% of gonorrhea-infected women and up to 70% of chlamydia-infected women have been reported to be asymptomatic.[3] As a result of the high rate of undetected cases, screening strategies to identify high-risk individuals have become increasingly important.[4] An early study of the efficacy of screening for chlamydia in asymptomatic women found that high-risk women who were identified by screening and then were treated had a significantly lower incidence of PID than those who received usual care without selective testing.[5]

National chlamydia screening criteria have been vital for improved disease detection and favorable reproductive health outcomes among sexually active women younger than 25. Implementation of similar population-based gonorrhea screening criteria, however, has proven difficult; a major challenge has been a lack of evidence-based criteria addressing the variation in prevalence across populations.[6]

Previous studies have focused mainly on high-prevalence populations in STD clinics; it is important also to understand high-risk populations in other clinical settings. Gershman and Barrow[7] compared predictors of gonorrhea and chlamydia in young women attending family planning clinics in Colorado. Exposure to a partner with gonorrhea was the only significant risk factor found for gonorrhea infection, and black race was a significant predictor of both infections. However, the study did not compare the predictors of infection for the two races directly. More recently, an analysis of data from the National Longitudinal Study of Adolescent Health (Add Health) found significant racial disparities in both chlamydia and gonorrhea infection rates.[8] The reasons for the differences are not fully understood. Moreover, the Add Health study was descriptive and did not divide the genders by race.

A comparison of predictors of gonorrhea and chlamydia infection in black and white females in a broad-based population would lead to better understanding of the racial disparity in risk of disease. In the study described in this article, we sought to determine the frequency of *Neisseria gonorrhoeae* and *Chlamydia trachomatis* infection in a sample of white and black teenage and young adult family plan-

TABLE 1. Percentage of women aged 15–24 visiting family planning clinics who tested positive for gonorrhea, by selected characteristics, according to race, Missouri, 2001

Characteristic	White		Black	
	N	%	N	%
All	**28,710**	**0.4**	**3,052**	**4.0*** **
Age				
15–17	6,492	0.5	587	5.3
18–21	14,828	0.4	1,513	4.2
22–24	7,390	0.3	952	2.4
Reason for visit				
Family planning	24,751	0.3	2,342	3.5
STD	3,959	1.0	710	4.8
Risk history†				
No	23,313	0.3	2,393	2.7
Yes	5,304	1.0	628	8.3
Partner with STD symptoms				
No	23,313	0.3	2,393	2.7
Yes	546	4.0	139	18.0
New partner				
No	23,313	0.3	2,393	2.7
Yes	4,005	0.8	430	6.1
Multiple partners				
No	23,313	0.3	2,393	2.7
Yes	1,329	1.5	124	8.1
Clinical signs‡				
No	26,199	0.3	2,653	2.9
Yes	2,198	1.6	347	9.8
Cervicitis				
No	26,199	0.3	2,653	2.9
Yes	1,351	1.8	195	12.3
PID				
No	26,199	0.3	2,653	2.9
Yes	242	2.1	39	12.8
Cervical friability				
No	26,199	0.3	2,653	2.9
Yes	721	1.5	120	8.3
Urethritis				
No	26,199	0.3	2,653	2.9
Yes	221	1.4	37	8.1
Symptoms				
No	25,760	0.3	2,273	2.7
Yes	2,786	1.6	743	7.4
Chlamydia infection				
No	27,643	0.2	2,775	2.6
Yes	1,032	4.4	273	16.5

***Significantly different from the percentage for whites at p<.001. †A woman was classified as having a risk history if she reported having any of the following during the previous year: a partner with STD symptoms, a new partner or multiple partners. ‡A woman was classified as having clinical signs if she had any of the following: cervicitis, PID, cervical friability or urethritis.

ning clinic clients in Missouri, and to identify significant predictors associated with these diseases.

METHODS

The sample consisted of all 31,762 women aged 15–24 who visited family planning clinics in Missouri between January 1, 2001, and December 31, 2001, as part of the Centers for Disease Control and Prevention's (CDC's) Region VII Infertility Prevention Project. Administration of the study was approved by the University of Iowa Institutional Review Board.

All women were tested for both gonorrhea and chlamydia during an annual family planning visit or a visit for treatment of an STD. Cervical swab specimens were collected and were sent to the Missouri State Public Health Laboratory in Jefferson City, where they were processed using the Gen-Probe PACE 2.[9] A standardized form was used at the visit to collect behavioral and demographic data on study participants, including age, race, reason for clinic visit, risk history, and clinical signs and symptoms of STD. Reason for visit was defined as either family planning care (i.e., to obtain birth control) or STD treatment. A woman was classified as having a risk history if, within the past year, she had had contact with a symptomatic male, had had multiple sexual partners or had acquired a new sexual partner. If she had cervical friability, cervicitis, PID or urethritis, she was classified as having clinical signs of infection.* Symptoms (e.g., vaginal discharge, dysuria, pelvic pain) were determined by patient self-report.

The chi-square test was used to compare the overall infection rates between the races. Multiple logistic regression was used to estimate adjusted odds ratios. Ninety-five percent confidence intervals for odds ratios were based on normal approximations. Backward stepwise modeling with significance set to $p<.10$ was used to determine independent predictors of infection. Two-way interactions were evaluated by the Wald statistic. Multivariate models for gonorrhea infection among all women adjusted for age, risk history, symptoms and clinical signs. Factors controlled for in the multivariate analyses for chlamydia infection were age, risk history and clinical signs. In the race-specific analyses, adjustments were made for identical sets of factors, to allow direct comparisons between races. The reference group for each component of risk history (i.e., contact with a symptomatic partner, a new partner and multiple partners) consisted of individuals with no risk history components. As a result, estimation of the odds ratios for an individual component of risk history did not adjust for any of the other components, because of problems of collinearity within the model. Similarly, a common reference group, consisting of women with no clinical signs of infection, was used for the individual components for clinical signs.

To determine if the associations between the various factors and the risk of gonorrhea or chlamydia differed, subgroup analyses among symptomatic and asymptomatic women by race also were performed. Adjustment in logis-

*Cervical friability was defined by the presence of easily induced bleeding with initial swabbing of tissue during testing. Mucopurulent cervicitis was defined by the presence of yellow or green mucopurulent discharge from the cervix. Cervicitis included any of the following: edema, erythema or a follicle-like lesion in an area of ectopy (the extension of columnar epithelium onto the ectocervix), or cervical mucus with 10 or more polymorphonuclear leukocytes per high-powered field (per 1,000 microscopic level). PID was defined by the presence of lower abdominal tenderness, adnexal tenderness and cervical motion tenderness in a patient with complaint of pelvic pain. Urethritis was defined by the presence of dysuria or urethral discharge.

tic regression models for these analyses included the same factors accounted for in the overall analyses. All statistical analyses were performed using SAS version 8.2.

RESULTS

The majority of women in the sample were white, and about half were 18–21 years old. Most visited the clinic for family planning care and did not have an STD risk history, clinical signs of infection or symptoms.

Prevalence of Infection

Overall 0.7% of the women had gonorrhea. The infection rate varied by race: 0.4% among whites and 4% among blacks (Table 1). In multivariate analyses (not shown), the odds of gonorrhea infection for blacks were 7.9 times the odds for whites (95% confidence interval, 6.0–10.4).

Among white women, the prevalence of gonorrhea was less than 1% for all age-groups, and it declined with increasing age; prevalence also was below 1% for women making a family planning visit, those with no risk history, those with no clinical signs or symptoms of infection, and those not infected with chlamydia. However, it was 1–2% in most other subgroups and reached 4% among women who reported recent sexual contact with someone who had symptoms of an STD and those with chlamydia.

Similar patterns of prevalence were observed among black women, although levels of infection were higher than those among whites. Notably, 5% of 15–17-year-olds, 8% of women reporting a risk history and 10% of those with clinical signs of infection had gonorrhea; prevalence was particularly high among women reporting recent exposure to a sexual partner who had STD symptoms (18%) and those who were infected with chlamydia (17%).

The overall prevalence of chlamydia infection was 4%. The rate was higher in blacks than in whites (9% vs. 4%—Table 2). In multivariate analyses (not shown), the risk of chlamydia also was higher among blacks than among whites (odds ratio, 2.5; 95% confidence interval, 2.2–2.9). Among white women, 18–21-year-olds were the age-group most frequently infected, while among blacks, women aged 15–17 had the highest prevalence of infection; differentials by age were greater among blacks than among whites. Seven percent of white women and 14% of blacks reporting a risk history were chlamydia-positive. Some 9–13% of white women with cervicitis, PID or cervical friability were infected with chlamydia; among blacks, 5% of women with PID and 10–20% of those with other clinical signs of infection had chlamydia. Rates of chlamydia among gonorrhea-positive women were similar for the two groups.

TABLE 2. Percentage of women aged 15–24 visiting family planning clinics who tested positive for chlamydia, by selected characteristics, according to race

Characteristic	White		Black	
	N	%	N	%
All	**28,675**	**4.0**	**3,048**	**9.0*** **
Age				
15–17	6,489	3.7	587	13.1
18–21	14,808	4.1	1,510	9.9
22–24	7,378	2.4	951	4.9
Reason for visit				
Family planning	24,726	3.3	2,338	8.5
STD	3,949	5.3	710	10.4
Risk history†				
No	23,291	2.8	2,391	7.8
Yes	5,291	7.0	626	13.6
Partner with STD symptoms				
No	23,291	2.8	2,391	7.8
Yes	542	13.5	139	20.1
New partner				
No	23,291	2.8	2,391	7.8
Yes	3,996	6.1	428	12.4
Multiple partners				
No	23,291	2.8	2,391	7.8
Yes	1,325	8.7	124	16.9
Clinical signs‡				
No	26,179	3.1	2,649	7.7
Yes	2,183	9.3	347	17.9
Cervicitis				
No	26,179	3.1	2,649	7.7
Yes	1,341	9.4	195	19.5
PID				
No	26,179	3.1	2,649	7.7
Yes	237	10.1	39	5.1
Cervical friability				
No	26,179	3.1	2,649	7.7
Yes	717	13.3	120	20.0
Urethritis				
No	26,179	3.1	2,649	7.7
Yes	220	5.9	37	10.8
Symptoms				
No	25,740	3.2	2,269	8.1
Yes	2,772	7.2	743	11.6
Gonorrhea				
Negative	28,563	3.5	2,932	7.8
Positive	112	40.2	116	38.8

***Significantly different from the percentage for whites at p<.001. †A woman was classified as having a risk history if she reported having any of the following during the previous year: a partner with STD symptoms, a new partner or multiple partners. ‡A woman was classified as having clinical signs if she had any of the following: cervicitis, PID, cervical friability or urethritis.

Risk Factors

In the multivariate analyses, being 21 or younger was significantly associated with an elevated risk of gonorrhea infection among blacks but not whites (Table 3, page 138). Visiting the clinic for STD care was associated with an increased risk of gonorrhea infection in whites but not blacks. Whereas each component of risk history was significantly associated with an elevated risk of gonorrhea in whites, only contact with a symptomatic male was significant among blacks, and the odds ratio (5.2) was smaller than that for whites (9.1). No specific clinical signs were associated with gonorrhea in whites, and only cervicitis was associated with an increased risk among blacks. The risk of gonorrhea was significantly higher among individuals with symptoms than among those without symptoms in both populations, but

the risk was elevated to a greater extent in whites (3.5) than in blacks (1.7). Women in both racial groups who tested positive for chlamydia had increased odds of gonorrhea infection, but the risk was more elevated for whites (12.9) than for blacks (5.3).

Three factors had statistically significant interactions with race: White women visiting the clinic for family planning services were less likely to have gonorrhea than were whites visiting for STD care or blacks visiting for either reason (p=0.01); white women with no symptoms had lower odds of infection than whites with symptoms or blacks, regardless of symptom status (p=0.03); and whites who tested negative for chlamydia had a lower risk of gonorrhea infection than whites infected with chlamydia or blacks, regardless of chlamydia infection status (p=0.004). Interestingly, the subgroup analysis evaluating factors associated with gonorrhea among symptomatic versus asymptomatic women showed a difference only in the results for clinical signs. Among asymptomatic white women, the odds of gonorrhea for those with clinical signs were 3.1 times the odds for those without clinical signs (95% confidence interval, 1.2–7.7), and each clinical sign was associated with elevated odds. The same was not true for symptomatic white women.

The multivariate analysis of predictors of chlamydia showed younger age to be associated with a significantly increased risk for both races; the increase was particularly notable among black 15–17-year-olds (Table 4). Every component of risk history was associated with an elevated risk among whites, whereas only contact with a symptomatic partner was significant for blacks. Estimates of chlamydia risk associated with cervicitis and cervical friability were significantly elevated and similar for the two races. PID was significantly associated with chlamydia infection in whites, but not in blacks. Testing positive for gonorrhea was a risk factor for both races, but the odds ratio for white women was more than twice that for blacks (13.1 vs. 5.4).

Multivariate analyses of chlamydia risk revealed three significant interactions with race: White 22–24-year-olds had the lowest risk of any age-and-race group (p=0.003); white women with no risk history had lower odds of infection than other groups defined by race and risk history status (p=0.01); and white women who did not have gonorrhea were less likely to have chlamydia than white women who were gonorrhea-negative or blacks, regardless of gonorrhea status (p=0.001). Subgroup analyses evaluating the factors associated with chlamydia among symptomatic versus asymptomatic women found no differences in risk estimates between these two groups within each race.

In summary, predictors of infection generally differ for whites and blacks; furthermore, within racial groups, predictors of gonorrhea and chlamydia often differ. For both populations, contact with a symptomatic male was associated with an elevated risk of both infections, and symptoms of infection were associated with an increased risk of gonorrhea but not of chlamydia. Among whites, women

TABLE 3. Odds ratios (and 95% confidence intervals) from multivariate analysis assessing characteristics associated with gonorrhea infection among women aged 15–24 visiting family planning clinics, by race

Characteristic	White	Black
Age		
15–17	1.51 (0.88–2.61)	2.24 (1.25–4.01)
18–21	1.32 (0.81–2.13)	1.73 (1.04–2.88)
22–24 (ref)	1.00	1.00
Reason for visit		
STD	1.73 (1.14–2.64)	0.86 (0.54–1.36)
Family planning (ref)	1.00	1.00
Risk history†		
None (ref)	1.00	1.00
Any	2.55 (1.72–3.79)	2.19 (1.44–3.32)
Partner with STD symptoms	9.05 (5.16–15.9)	5.23 (2.95–9.29)
New partner	2.18 (1.38–3.44)	1.55 (0.93–2.59)
Multiple partners	4.12 (2.39–7.11)	1.64 (0.74–3.64)
Clinical signs		
None (ref)	1.00	1.00
Any	1.50 (0.84–2.69)	2.02 (1.17–3.47)
Cervicitis	1.44 (0.77–2.70)	2.34 (1.25–4.36)
PID	1.59 (0.57–4.46)	2.55 (0.89–7.31)
Cervical friability	1.49 (0.70–3.18)	1.90 (0.89–4.04)
Urethritis	1.00 (0.29–3.48)	1.52 (0.42–5.48)
Symptoms		
No (ref)	1.00	1.00
Yes	3.51 (2.02–6.12)	1.71 (1.04–2.80)
Chlamydia infection		
No (ref)	1.00	1.00
Yes	12.92 (8.6–19.5)	5.30 (3.43–8.18)

†During the previous year. *Note:* ref=reference group.

TABLE 4. Odds ratios (and 95% confidence intervals) from multivariate analysis assessing characteristics associated with chlamydia infection among women aged 15–24 visiting family planning clinics, by race

Characteristic	White	Black
Age		
15–17	1.50 (1.23–1.83)	3.03 (2.04–4.48)
18–21	1.72 (1.45–2.04)	2.11 (1.48–2.99)
22–24 (ref)	1.00	1.00
Reason for visit		
STD	1.16 (0.98–1.37)	0.99 (0.73–1.36)
Family planning (ref)	1.00	1.00
Risk history†		
None (ref)	1.00	1.00
Any	2.23 (1.95–2.56)	1.42 (1.05–1.90)
Partner with STD symptoms	4.45 (3.39–5.84)	2.18 (1.35–3.55)
New partner	1.96 (1.68–2.30)	1.33 (0.94–1.88)
Multiple partners	2.76 (2.23–3.43)	1.67 (0.98–2.85)
Clinical signs		
None (ref)	1.00	1.00
Any	2.53 (2.14–3.00)	2.50 (1.80–3.48)
Cervicitis	2.54 (2.07–3.11)	2.76 (1.84–4.13)
PID	2.69 (1.73–4.19)	0.63 (0.15–2.65)
Cervical friability	3.90 (3.09–4.93)	2.88 (1.78–4.68)
Urethritis	1.54 (0.87–2.73)	1.44 (0.50–4.16)
Symptoms		
No (ref)	1.00	1.00
Yes	1.10 (0.87–1.40)	0.91 (0.63–1.31)
Gonorrhea infection		
No (ref)	1.00	1.00
Yes	13.10 (8.7–19.8)	5.43 (3.55–8.32)

†During the previous year. *Note:* ref=reference group.

reporting a new sexual partner or multiple sexual partners had elevated risks of both STDs; younger women and those with clinical signs of infection were at increased risk of chlamydia but not of gonorrhea. In contrast, among blacks, younger age was a predictor of both gonorrhea and chlamydia, and associations with clinical signs differed by infection.

DISCUSSION

The overall gonorrhea infection rate in this investigation, 0.7%, was similar to rates found in other studies of women in family planning and other clinical settings (0.2–1.8%); likewise, the chlamydia infection rate in this study, 4%, was comparable to those from similar studies (3–5%).[10] These studies, based in family planning clinics, as well as other research,[11] also found the highest rates of gonorrhea and chlamydia positivity among black females. In our study, infection rates were much lower in whites than in blacks (0.4% vs. 4% for gonorrhea, 4% vs. 9% for chlamydia).

Low prevalence of gonorrhea is a consistent limitation to studies of the disease. Miller et al.[12] looked at a nationwide cross-sectional cohort and analyzed gonorrhea prevalence despite an overall prevalence of 0.4%; they did not analyze racial disparities in outcomes. Our study shows how separate analyses of racial groups with significantly different prevalences of disease can help illuminate differences in risk factors between those groups.

The rates in the black women in this study may have been elevated because the sample was drawn from a family planning clinic population. According to a study of health care resource utilization, young, poor and black women are more likely to go to a family planning clinic than to other types of facilities for STD treatment, while whites are most likely to go to a private physician or an STD clinic.[13] The clinic type may also explain age differences in both racial groups. This explanation is especially applicable for chlamydia infections, because low-income women seeking prenatal care are routinely screened for the disease.[14]

A factor that was not included in the Missouri data set was whether women douche, a practice that has been associated with an increased incidence of many STDs and PID.[15] Douching is a more prevalent behavior among blacks than among whites. Thus, exclusion of douching status is a limitation of our analysis and may contribute to observed racial differences.

An important advantage of this study is that it was based on a large, multisite population. Missouri, the largest state in the CDC's Region VII, has a multiracial population and both urban and rural areas. Thus, we had the opportunity to analyze predictors for a diverse population rather than focusing solely on an urban area. Predictors of gonorrhea and chlamydia have been analyzed in comparable studies based in clinics in the United States, but none has specifically analyzed the variations in predictors among racial groups.

The Colorado study[16] of family planning clinics mentioned earlier found that predictors of both gonorrhea and chlamydia included young age, black race and Hispanic ethnicity, but it did not examine differences in predictors or interactions with race. (Hispanic ethnicity could not be included in our study because of small numbers.) In the Colorado sample, predictors of chlamydia alone were cervical friability, cervicitis, contact with a partner with chlamydia and multiple sex partners; these findings are similar to the findings in our white female population. The only independent predictor of gonorrhea was contact with an infected sex partner. Black race in Colorado was five times as likely to be associated with gonorrhea as with chlamydia. Unfortunately, information on whether partners of study participants were gonorrhea- or chlamydia-positive was not available in the Missouri CDC data set. The lack of conclusive gonorrhea predictors in the Colorado study could reflect that the racial groups were combined in the analysis, and characteristics of high risk for the separate races may have been hidden in pooling of the data. Our study shows that black and white populations are clearly different in risk characteristics.

In a study of chlamydia infection in a family planning clinic sample in Iowa, age, race, risk history, symptoms, cervicitis and cervical friability were suggested as predictive of infection, but racial differences in predictors were not analyzed, because the number of minority participants was small.[17] The results are similar to ours except that symptoms were not a significant risk factor, regardless of race. Interestingly, we found both a higher rate and a higher risk of chlamydia among whites who had PID than among those without PID. These differences have not been reported previously and are not easily explained.

Testing for gonorrhea and chlamydia was performed using the GenProbe PACE 2 assay, a nucleic acid (DNA) hybridization test that detects either organism in a single specimen. The major advantage of this test is that the DNA of the specimens can remain stable for seven days without refrigeration before laboratory testing without loss of sensitivity.[18] Using a culture standard, sensitivity of an endocervical swab nucleic acid test such as that used in this study is 90–95% for gonorrhea detection in women. For chlamydia detection in women, the nonamplified hybridization assays have been reported to have a sensitivity of 71–80%; by contrast, nucleic acid amplification testing (NAAT) has 96–100% sensitivity through amplification of the target sequences to detect the specific organism.[19] Therefore, a limitation of this study may be that by using the less sensitive DNA hybridization assay, the current study slightly underestimates the prevalence of gonorrhea and chlamydia infection in the population.

However, since the potential for false negative results should not be dependent on race or other variables used in our study, there should be no systematic bias that would affect our analyses. Furthermore, the Add Health study used ligase chain reaction (LCR) assays, and the observed prevalence values (0.4% for gonorrhea in young women and 4% for chlamydia)[20] were very similar to the ones for our sample. The age-groups for the two studies were similar as well (18–26 in the Add Health study and 15–24 in ours). This suggests that our results can be generalized to this age-group

despite the use of a less sensitive test. All states in Region VII have recently begun using the NAAT for detection, and these data will be used for future studies.

This study indicates that the black and white populations attending family planning clinics have different predictors for and rates of gonorrhea and chlamydia infections. The significant interactions with race strongly support the need to evaluate predictors and the strengths of their associations by race. Future studies of more recent data from Missouri will focus on geographic locations of the clinic and socioeconomic status, to analyze other predictors of gonorrhea or chlamydia infection.

Despite low rates of gonorrhea infection, it is important to focus on high-risk populations because of the great physical and emotional costs of the disease. Identifying gonorrhea and chlamydia infections early in high-risk populations is the key to preventing costly sequelae and ensuring female reproductive health. Future studies should focus on identifying behavioral or environmental factors to address differences in predictors within racial groups. This study illustrates the difficulties of establishing screening criteria for gonorrhea until the factors leading to racial disparities for infection can be clarified and addressed.

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