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Estimating the incidence of antimicrobial resistant *Neisseria gonorrhoeae* in the United States among men and women aged 15–39 years, 2008–2019

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Abstract

Background: The Gonococcal Isolate Surveillance Project (GISP) was established to monitor antimicrobial resistance (AR) in *N. gonorrhoeae* in the United States. Isolates collected in GISP undergo antimicrobial susceptibility testing allowing for estimates of resistance, based on exceeding minimum inhibitory concentrations (MICs), to be calculated.

Methods: We estimated the annual number and proportion of gonococcal infections with antibiotic resistance or elevated MICs (AR/eMICs) against six antibiotics for men and women aged 15 to 39 years in the US using male urethral specimens collected in GISP during 2008–2019. Although GISP only measured MICs for male gonococcal infections, this study estimated AR/eMICs in women using data from men with female sex partners. GISP data were weighted against national gonorrhea case report data based on four variables (age group, year of report, US Census region, and race/Hispanic ethnicity) to estimate annual, national proportions of gonococcal infections with AR/eMICs. These weighted proportions were then multiplied by national estimates of incident gonococcal infections to calculate the number of incident gonococcal infections with AR/eMICs nationally.

Results: Women had a higher estimated number of cases with AR/eMICs compared with men (440,900 vs. 387,200 in 2019) although the estimated percentage of gonococcal infections with

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AR/eMICs was lower in women (50.7% vs. 54.4% in 2019). Elevated MICs to ceftriaxone remained below 1% throughout the study period.

Conclusions: Our analysis indicates that there are more women with AR/eMICs gonorrhea than men. Although the proportion of cases that are resistant to any one antimicrobial is increasing, eMICs to ceftriaxone remains low.

Short Summary:

As a follow-up to previous estimates in men only, we estimate the proportion of gonococcal infections with antimicrobial resistance in men and women in the US.

Keywords

gonorrhea; antimicrobial resistance; raking; disease surveillance

INTRODUCTION

Gonorrhea is the second most common notifiable sexually transmitted infection (STI) in the United States¹. Between 2009 and 2019, rates of reported gonorrhea cases in the US increased from 98.1 to 187.8 cases per 100,000 population¹. At the same time, *N. gonorrhoeae* has developed resistance to nearly all antibiotics used to treat it¹. As of 2019, more than half of all gonococcal infections were estimated to be resistant to at least one antibiotic¹. Currently, ceftriaxone is the recommended treatment for gonorrhea. In 2020, treatment guidelines for uncomplicated urogenital, anorectal, and pharyngeal gonorrhea were changed from dual therapy with ceftriaxone and azithromycin to monotherapy with ceftriaxone partially due to the increased incidence of azithromycin resistance^{2,3}. As *N. gonorrhoeae* quickly develops resistance to antibiotics, monitoring antimicrobial resistance (AR) is necessary to inform ongoing updates to treatment recommendations.

The Gonococcal Isolate Surveillance Project (GISP) was established in 1986 to monitor AR in *N. gonorrhoeae* in the US by collecting urethral isolates from men with symptomatic gonococcal urethritis presenting to participating STI clinics. Isolates collected in GISP undergo antimicrobial susceptibility testing (AST), allowing for estimates of either AR or elevated minimum inhibitory concentrations (eMICs), based on criteria set by the Clinical Laboratory and Standards Institute (CLSI), to be calculated⁴. However, two major challenges arise in interpreting data from GISP: the data are limited to only infections in men, and they may not be nationally representative of all gonococcal infections in men in the US. A recent study addressed the national representativeness of GISP by employing a rigorous weighting strategy using data from GISP and case notification data provided to the US Centers for Disease Control and Prevention (CDC) through the National Notifiable Diseases Surveillance System (NNDSS) to produce nationally representative estimates of gonococcal infections with antimicrobial resistance or elevated MICs (AR/eMICs) in men⁵.

Because we don't have direct estimates of AR/eMICs gonorrhea in women, we assume the proportion of AR/eMICs in men who have sex with women reflects the proportion of AR/eMICs in women. This assumes that women acquire AR/eMICs gonorrhea from men, and men who have sex with women represent the partner pool from which they can

acquire gonorrhea. In this work, we build from previous analyses by estimating AR/eMICs in women, using GISP data among men who report sex with women as indicators of AR/eMICs in women.

MATERIALS AND METHODS

Data Sources

For our analysis, we used data from two main sources -- GISP and NNDSS. GISP is an enhanced sentinel surveillance program established to monitor AR in *N. gonorrhoeae* in the US by collecting isolates from men with symptomatic gonococcal urethritis presenting to participating STI clinics whereas NNDSS is the case notification system for any case of gonorrhea that is diagnosed in the US. We will describe basic characteristics of both data sets and how we used them for our analysis.

We used data from GISP during 2008 to 2019 to estimate gonococcal infections with AR/eMICs in men and women aged 15–39 years. During these years, STI clinics affiliated with 24 to 33 state or city health departments participated in GISP⁶. Epidemiologic and laboratory data are collected along with specimens from the first 25 males presenting to participating STI clinics with symptomatic gonococcal urethritis each month. If *N. gonorrhoeae* is isolated from the specimens, the isolates are sent to a regional laboratory for AST⁷. GISP isolates are tested to determine the MICs of ciprofloxacin, penicillin, tetracycline, azithromycin, ceftriaxone, cefixime, and gentamicin. MIC values correlated with susceptibility have not been established for gentamicin. This study uses the AR/eMIC criteria outlined in the protocols for the CDC *Neisseria gonorrhoeae* Regional Antimicrobial Resistance Laboratory Network for the remaining six antimicrobials^{6,7}. The following MIC breakpoints for AR were defined by CLSI⁴: ciprofloxacin MIC ≥ 1.0 $\mu\text{g/ml}$, penicillin MIC ≥ 2.0 $\mu\text{g/ml}$ or positive β -lactamase test, and tetracycline MIC ≥ 2.0 $\mu\text{g/ml}$. There are no defined CLSI resistance criteria for azithromycin, ceftriaxone, and cefixime. For these three antimicrobials, eMICs were defined as: azithromycin MIC ≥ 2.0 $\mu\text{g/ml}$, ceftriaxone MIC ≥ 0.125 $\mu\text{g/ml}$, and cefixime MIC ≥ 0.25 $\mu\text{g/ml}$ ^{2,6,7}. For the sake of brevity, “AR/eMICs” will hereafter be defined as meeting CLSI resistance criteria for ciprofloxacin, penicillin, and tetracycline or meeting eMICs criteria for azithromycin, ceftriaxone, and cefixime.

Variables recorded in the GISP data include the STI clinic where the case was diagnosed, age, race/Hispanic ethnicity, year of diagnosis, and sex of sex partners (within the past three months). Sex of sex partners is classified as: men who have sex with men only (MSM), men who have sex with women only (MSW), and men who have sex with men and women (MSMW)⁷.

In the US, gonorrhea is a notifiable STI meaning that state and local STI programs report cases to the CDC’s NNDSS⁸. People with gonorrhea, reported to NNDSS, are classified by the year of diagnosis, the reporting jurisdiction, sex, age, and race/Hispanic ethnicity. In GISP, throughout the study period, 98% of reports had race/Hispanic ethnicity data compared to only 80% in NNDSS data. Sex of sex partner data are available for 99% of GISP participants and less than 10% of NNDSS gonorrhea case reports. AR data are not

collected through NNDSS. Anatomical site of specimen collection is not systematically collected in NNDSS.

NNDSS case reports represent only a portion of gonococcal infections occurring in the US population due to undiagnosed and/or unreported gonococcal infections. Recently, Pollock et al performed mathematical modeling to estimate the annual incidence of gonorrhea among men and women aged 15–39 years in the US between 2006 and 2019, accounting for undiagnosed and/or unreported infections⁹. Multiple model parameters, including the percentage of cases that are asymptomatic and the duration of untreated infections, were estimated by sex. Throughout the study period, women had a higher estimated number of gonococcal infections compared with men. The simulated distribution of the annual incident cases of gonorrhea in the US from these mathematical models was applied in this study to estimate the distribution of annual incident cases of AR/eMICs gonorrhea.

Statistical Analysis

Factors associated with AR/eMICs gonorrhea in men include age, geography, and race/Hispanic ethnicity. To estimate the national proportion of gonococcal infections with AR/eMICs in men, the GISP data are weighted to match the distributions of age, geography, and race/Hispanic ethnicity found in the NNDSS data. Assuming age, geography, and race/Hispanic ethnicity are also predictive of AR/eMICs gonorrhea in women, the rates of AR/eMICs gonorrhea in men with female sex partners are weighted to match the demographic distributions of all women aged 15–39 years in the US with reported gonococcal infections.

We categorized age into two groups: 15–24 years and 25–39 years. The four US Census regions are Northeast, Midwest, South, and West. Race/Hispanic ethnicity categories were: American Indian/Alaska Native, Asian/Pacific Islander, Black/African American, Hispanic/Latino, Multiracial, and White.

Weights were computed separately for men and women. For men, the marginal proportions of male NNDSS case reports by age group, Census region, race/Hispanic ethnicity category, and year of diagnosis were used to assign a weight to each GISP case. This raking procedure was performed using the “rake” function in the R software “survey” package¹⁰. We used default settings, allowing the function to iterate up to 10 times to estimate weights such that the joint distributions of the specified variables matched across the GISP and NNDSS data sets. The function stops before the tenth iteration if the maximum change between the estimated weights is less than one. Annual proportions of cases with AR/eMICs were calculated from the weighted GISP cases using a logistic regression model. A separate model was run for each antimicrobial. The “svyglm” function in the R software “survey” package provided estimates of the log odds of AR/eMICs gonorrhea for each year with standard errors¹⁰. The function returns Horvitz-Thompson-type standard errors which are a generalization of the model-robust “sandwich” estimators. These estimates were later used to generate a distribution of 10,000 weighted proportions to calculate the simulated national AR/eMICs gonorrhea incidence.

To estimate the national proportion of gonorrhea cases with AR/eMICs among women, we assigned weights to the subset of male GISP participants that reported having female sexual

partners (ie, MSW and MSMW). Weights were estimated from the marginal proportions of female NNDSS case reports by age group, Census region, race/Hispanic ethnicity category, and year using the same procedure that was used for estimating weights for men. If there was no information about the sex of sex partners in the GISP data, then the record was excluded from the estimation of the national proportion of gonorrhea cases with AR/eMICs among women. The isolates from three GISP participants with transgender sex partners were not included in the analysis estimating the AR/eMICs gonorrhea in women. Infections in individuals that couldn't be classified into any of the six defined race/Hispanic ethnicity categories were also excluded from the weighting procedure to estimate AR/eMICs proportions in men and women.

To estimate AR/eMICs gonorrhea incidence for men and women separately, we drew 10,000 random samples from a normal distribution with mean set to the log odds of AR/eMICs and standard errors from the respective logistic regression models. The sampled log odds were transformed to proportions and multiplied by the 10,000 Monte Carlo annual incidence estimates of gonorrhea in the US among men and women aged 15–39 years from the study by Pollock et al⁹. We report the median and interquartile ranges (IQRs) of the estimated national incidence of AR/eMICs gonorrhea, rounded to the nearest hundred cases.

RESULTS

There were 51,744 GISP isolates included in the analysis and a subset of 37,511 GISP isolates from MSW (34,990) and MSMW (2,521) were used to estimate the national proportion of gonorrhea cases with AR/eMICs among women. The weights to estimate the national proportion of gonorrhea cases with AR/eMICs among men were calculated from 1,758,672 NNDSS case reports with known race/Hispanic ethnicity. The weights for women were estimated from 1,701,530 NNDSS case reports with known race/Hispanic ethnicity.

The geographic, race/Hispanic ethnicity, and age distribution of the GISP participants and NNDSS case reports aggregated over all studied years are described in Table 1. Compared to GISP MSW and MSMW participants, a higher percentage of NNDSS gonorrhea cases among women were of White race (26.3% vs. 8.1%). Also, a higher percentage of GISP isolates were collected from Black MSM and MSMW compared to the percentage of women with gonorrhea that were reported as Black in NNDSS (79.1% vs 58.5%). The subset of male GISP participants that reported having female sexual partners was older than women with gonorrhea reported to NNDSS: 51.6% aged 25–39 years in GISP vs. 32.8% age 25–39 years in NNDSS. Among the women with gonorrhea reported to NNDSS that were included in our analysis, 50.0% resided in the southern Census region compared to the 34.8% of MSW/MSMW contributing isolates to GISP that lived in the southern Census region. Because GISP oversamples STI clinics from the western Census region, we see a higher percentage of MSW and MSMW participants from that region compared with the percentage of women with gonorrhea reported to NNDSS from the west (25.6% vs. 14.5%). Supplementary Tables 1–4 show annual changes in these demographic characteristics.

AR/eMICs Results

Among men aged 15–39 years, gonococcal infections demonstrated more resistance to ciprofloxacin and tetracycline compared to the other four antimicrobials (Figure 1). The percentage of isolates demonstrating resistance to ciprofloxacin and tetracycline generally increased over time and reached 34.1% (IQR: 33.5 – 34.7) and 27.9% (IQR: 27.3 – 28.5), respectively by 2019. Less than 1% of gonococcal infections annually were estimated with elevated MICs to ceftriaxone, the current standard of care. The percentage of isolates with elevated MICs to cefixime also remained low throughout the study period and has been below 1% since 2012. Penicillin resistance fluctuated over the years with an estimated low of 10.1% (IQR: 9.7 – 10.4) in 2008 and a high of 18.3% (IQR: 17.9 – 18.8) in 2016. The percentage of isolates with elevated MICs to azithromycin was relatively low throughout the study period; however, estimates quadrupled from 0.7% (IQR: 0.6 – 0.8) to 3.1% (IQR: 2.9 – 3.4) between 2013 and 2014. During the first six years of the study period, the percentage of isolates with elevated MICs to azithromycin was below 1% but increased to above 3% for the last six years of the study period. The estimated percentage of men in the US with resistance or elevated MICs to any one of the six antibiotics ranged from 23.5% (IQR: 23.0 – 24.0) in 2008 to 54.4% (IQR: 53.8 – 55.1) in 2019 (Figure 2a). This equates to an estimated 387,200 (IQR: 344,000 – 444,700) cases of gonorrhea in men aged 15–39 years in 2019 with AR/eMICs to at least one of the six antimicrobials studied (Figure 2b).

Among women aged 15–39 years, the estimated percentage of gonococcal infections with resistance or elevated MICs to any one of the six antibiotics studied exhibited a similar increase over time, albeit with lower percentages each year than estimated for men: 20.9% (IQR: 20.2 – 21.7) in 2008 to 50.7% (IQR: 49.5 – 51.8) in 2019 (Figure 2a). This equates to an estimated 440,900 cases (IQR: 390,800 – 502,500) of gonorrhea in women aged 15–39 years in 2019 with resistance or elevated MICs to at least one of the six antimicrobials studied (Figure 2b). Gonococcal infections in women were estimated to more frequently show resistance to ciprofloxacin and tetracycline compared to the other four antimicrobials (Figure 1). The percentage of isolates demonstrating resistance to ciprofloxacin and tetracycline generally increased over time and reached 30.3% (IQR: 29.2 – 31.3) and 25.7% (IQR: 24.7 – 26.7) respectively by 2019. Less than 1% of gonorrhea cases were estimated with elevated MICs to ceftriaxone annually (Figure 1). The percentage of isolates with elevated MICs to cefixime also remained below 1% throughout the study period (Figure 1). Penicillin resistance fluctuated over the years with a low of 8.3% (IQR: 7.7 – 8.9) in 2008 and a high of 16.3% (IQR: 15.4 – 17.2) in 2016 (Figure 1). The percentage of isolates with elevated MICs to azithromycin was relatively low throughout the study period but rose sharply between 2013 and 2014 and was at its highest in 2019 at 3.5% (IQR: 3.2 – 3.8; Figure 1).

DISCUSSION

The estimated percentage of gonococcal infections in the US with resistance or elevated MICs to at least one of six antibiotics in 2019 was above 50% for both men and women aged 15–39 years, marking an increase in both men and women since 2008. Fortunately, elevated

MICs to ceftriaxone, the current recommended treatment for gonorrhea, remained below 1% throughout the study period.

Perhaps the most surprising finding of our analysis is that women had a higher number of estimated incident gonococcal infections with AR/eMICs despite having a lower estimated proportion with AR/eMICs compared to men. This is the result of the incidence estimates published by Pollock et al including two parameters that led to higher rates of disease in women⁹. They assumed that men have a rate of natural clearance that is twice as fast as the rate for women (46 vs. 91 days). The Pollock et al study also assumed that the percentage of cases that are asymptomatic are higher in women compared with men (68.4 vs. 41.3%).

Our study yielded consistent results with several others. A study to identify risk factors for reduced susceptibility to ceftriaxone in England and Wales found that women were less likely than heterosexual men to have ceftriaxone MICs ≥ 0.015 mg/L¹¹. These findings are similar to ours based on comparing the percentage of isolates with eMICs in MSW and MSMW to those in all men. Our results are also consistent with historical findings from GISP. A prior study using GISP data concluded that isolates from MSM were more likely than isolates from MSW to exhibit elevated MICs to the six antimicrobials included in our analysis¹². By incorporating the national surveillance data for women and MIC results for GISP isolates from MSW and MSMW, we found that, compared with men, women with gonorrhea in the US have lower MICs to the antimicrobials included in our analysis.

In the Strengthening the US Response to Resistant Gonorrhea (SURRG) project, urogenital specimens are collected from men and women. Three of the eight SURRG project sites focused efforts on collecting urogenital specimens in women for antimicrobial susceptibility testing. Antibiotic susceptibility testing results from these sites were published for isolates collected in 2018 and 2019¹³. They observed that the proportion of gonococcal isolates with AR/eMICs from women seemed to align more closely to those seen in MSW than MSM/MSMW. They also report less than 0.5% of men and women had elevated MICs against ceftriaxone.

This analysis has several limitations. We assume the proportion of AR/eMICs in MSW and MSMW reflects the proportion of AR/eMICs in women. If some men are more likely to transmit gonorrhea to women, the true proportion of isolates with AR/eMICs in women could be higher or lower based on the AR/eMICs status of those men. Though it may be possible for women to acquire gonorrhea and AR/eMICs gonorrhea from other women, our estimates do not adjust for the possibility that women who have sex with women may have a differing proportion of AR/eMICs gonorrhea compared with women who have sex with men¹⁴.

Although GISP data included an average of 4,421 isolates annually across the 12 years of this study, annual gonorrhea case reports for men aged 15–39 years are over 40 times greater. We may not observe any AR/eMICs in strata that have a relatively small number of isolates. Even if those demographic groups are given very large weights to account for under sampling, the weighted proportion of isolates with AR/eMICs will be zero – potentially underrepresenting the true instances of AR/eMICs in that group and leading to

biased or unreliable aggregate estimates. Stratifying the GISP participants by age, Census region, year, and race/Hispanic ethnicity categories led to some sparse or empty cells. For example, American Indian/Alaska Native is one of the smallest race/Hispanic ethnicity categories. Only 1.0% of men with gonorrhea reported to NNDSS are American Indian/Alaska Native. In GISP, American Indian/Alaska Native participants are under sampled with only 0.3% of isolates coming from American Indian/Alaska Native men. For the raking procedure to better adjust for AR/eMICs in American Indian/Alaska Native people with gonorrhea, the GISP data would require more isolates from American Indian/Alaska Native men. Alternative approaches to survey weighting, such as model-based estimation or imputation, can produce AR/eMICs estimates for strata with no resistant isolates. Therefore, such methods may estimate slightly higher adjusted case counts than raking when some strata have no data. AR/eMICs case counts among men based on raking were compared to counts from multilevel regression with poststratification in the analysis by Nielsen et al⁵. They found similar results with the two approaches and supported use of either method.

By using age matched MSW and MSMW GISP data as the source of AR/eMICs data for women, our analysis implicitly assumes that women aged 15–39 years have male sex partners aged 15–39 years. Because women are more likely than men to have older sex partners, our estimates may reflect a slightly younger female population than intended¹⁵. To adjust for this, GISP data for slightly older men who report having sex with women could be used as indicators of AR/eMICs in women aged 15–39 years.

All GISP isolates were collected in STI clinics. The population seeking care in these settings may be different from patients who seek care in other settings, such as primary care or emergency departments. If gonorrhea isolates collected in STI clinics are more likely to have AR/eMICs compared with isolates collected in other clinical settings, our results would be an overestimate.

This analysis was also limited by the completeness of certain variables collected in the NNDSS case report data for gonorrhea. Over 20% of NNDSS case reports were excluded from the weighting due to missing race/Hispanic ethnicity data. We assume that weights would be unchanged if race/Hispanic ethnicity data had been collected for all individuals with gonorrhea reported to NNDSS. If this assumption is false, for example, if most of the individuals with unknown race were Black, our estimated percentage of infections with AR/eMICs would be an overestimate, as GISP cases identifying as Black had the lowest percentage of isolates with AR/eMICs.

We find that MSM and MSMW have higher proportions of gonococcal infections with antibiotic resistance or elevated MICs compared to men who have sex with women only. However, our AR/eMICs gonorrhea estimates for men were not adjusted for the distribution of MSM among nationally reported cases of gonorrhea. This is because sex of sex partner data are available for less than 10% of NNDSS case reports. Therefore, we must assume the percentages of MSM and MSMW are the same among GISP participants and gonorrhea cases reported to NNDSS. Sensitivity analyses performed by Nielsen et al. concluded that if this assumption is inaccurate the estimated national AR/eMICs gonorrhea estimates for

men would be biased – highlighting the need for additional data collection to further refine estimates.

We assume that the MIC values from GISP isolates collected from symptomatic men with female sex partners are representative of the MIC values in women after adjusting for age, region, race/Hispanic ethnicity, and year regardless of symptomatic status and clinical site of infection. However, GISP data only includes symptomatic urethral gonococcal infections in men and NNDSS data do not systematically collect symptom status or clinical site of infection. Given that AR/eMICs may vary by either of these factors our results should be interpreted cautiously. There may be a need for future research to focus on symptomatology and clinical site of infections as they relate to AR/emics in gonorrhea.

These estimates address an important knowledge gap, as there are limited data on AR/eMICs gonorrhea among women in the US. Compared with urethral specimen collection in men, endocervical swab collection in women is more difficult, requiring speculum examination. Because women have more asymptomatic disease compared with men, cases are less likely to be identified. Surveillance of AR/eMICs gonorrhea in women must increase to better monitor AR/eMICs across both genders. By incorporating data from national and sentinel surveillance along with annual gonorrhea incidence estimates from mathematical models, this study estimates that the burden of AR/eMICs gonorrhea is higher in women than in men.

The 2019 Antibiotic Resistance Threats Report classified AR bacteria and fungi into three threat categories: urgent, serious, and concerning¹⁶. Gonorrhea is among five urgent threats identified. While that report states that there are 550,000 estimated AR gonococcal infections per year, our analysis suggests that the number could be much higher at over 800,000 estimated infections for men and women combined in 2019. Although the proportion of gonorrhea cases that are resistant to any one antimicrobial is increasing, it is reassuring to see that eMICs to ceftriaxone, the current recommended treatment, remain low. Continued monitoring for increases in AR/eMICs gonorrhea is critical for addressing this urgent global public health threat.

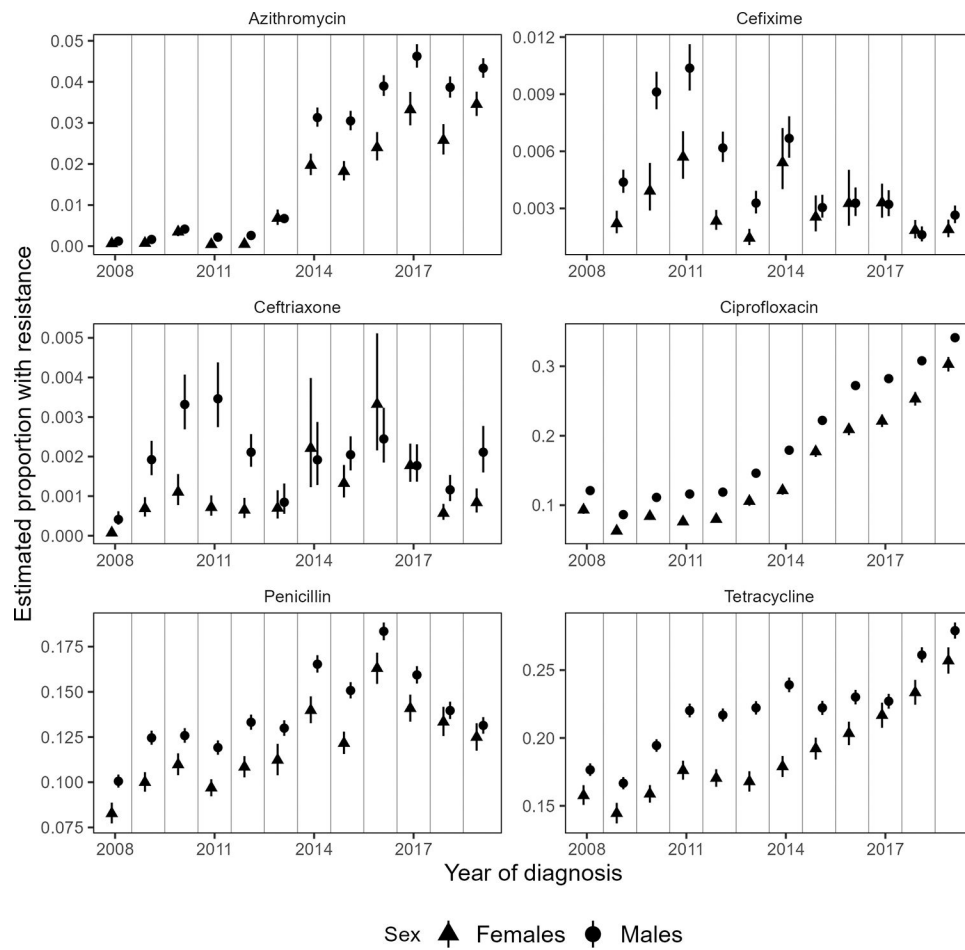
Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figures 1:
Estimated proportions and interquartile ranges of people aged 15–44 years whose gonococcal infection exhibited resistance to antimicrobials, United States

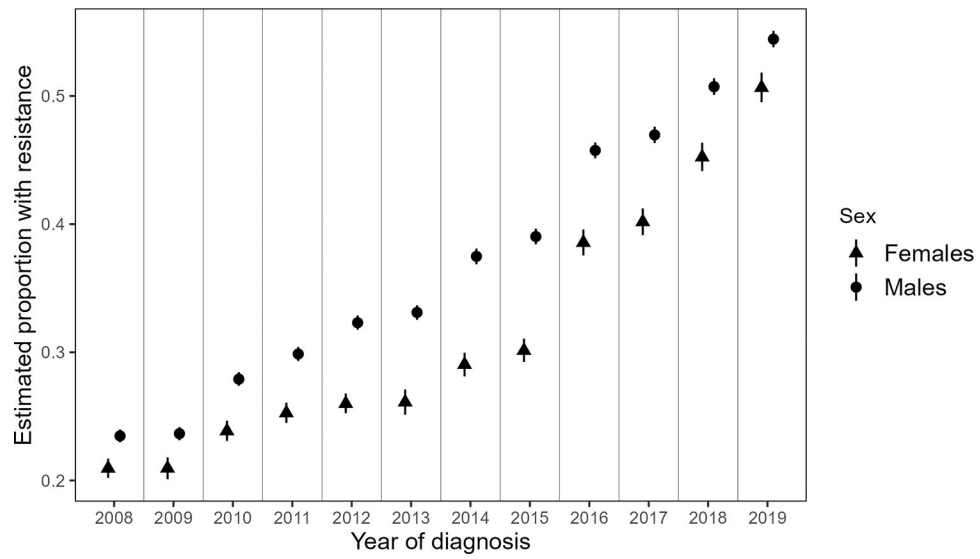


Figure 2a:
Estimated proportions and interquartile ranges of people aged 15–44 years whose gonococcal infection exhibited resistance to any of six antimicrobials, United States

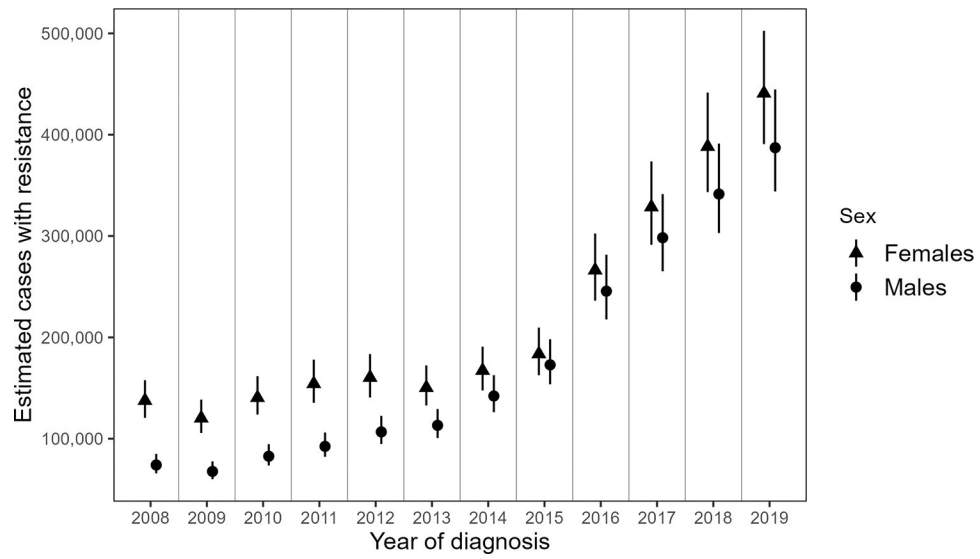


Figure 2b:
Estimated number and interquartile ranges of people aged 15–44 years whose gonococcal infection exhibited resistance to any of six antimicrobials, United States

Table 1.

Characteristics of people aged 15–39 years whose gonococcal infections were recorded in the National Notifiable Diseases Surveillance System (NNDSS) and the Gonococcal Isolate Surveillance Project (GISP), 2008–2019, United States

	Male Estimates		Female Estimates	
	NNDSS (N=1758672)	GISP* (N=51744)	NNDSS (N=1701530)	GISP† (N=37511)
Year of diagnosis				
2008	106,692 (6.1%)	4,699 (9.1%)	135,217 (7.9%)	3,884 (10.4%)
2009	97,576 (5.5%)	4,656 (9.0%)	120,611 (7.1%)	3,709 (9.9%)
2010	101,411 (5.8%)	4,717 (9.1%)	124,432 (7.3%)	3,646 (9.7%)
2011	104,965 (6.0%)	4,493 (8.7%)	127,264 (7.5%)	3,419 (9.1%)
2012	113,558 (6.5%)	4,466 (8.6%)	130,696 (7.7%)	3,240 (8.6%)
2013	116,278 (6.6%)	4,789 (9.3%)	124,105 (7.3%)	3,374 (9.0%)
2014	127,853 (7.3%)	4,025 (7.8%)	124,327 (7.3%)	2,751 (7.3%)
2015	148,492 (8.4%)	4,007 (7.7%)	130,885 (7.7%)	2,710 (7.2%)
2016	179,907 (10.2%)	4,066 (7.9%)	149,279 (8.8%)	2,755 (7.3%)
2017	210,178 (12.0%)	3,865 (7.5%)	173,784 (10.2%)	2,582 (6.9%)
2018	219,568 (12.5%)	3,858 (7.5%)	176,878 (10.4%)	2,628 (7.0%)
2019	232,194 (13.2%)	4,103 (7.9%)	184,052 (10.8%)	2,813 (7.5%)
Race/Ethnicity‡				
AIAN	18,023 (1.0%)	171 (0.3%)	31,489 (1.9%)	103 (0.3%)
Asian/PI	27,838 (1.6%)	1,167 (2.3%)	15,634 (0.9%)	527 (1.4%)
Black	1,040,686 (59.2%)	34,296 (66.3%)	995,266 (58.5%)	29,664 (79.1%)
Hispanic	255,872 (14.5%)	7,122 (13.8%)	196,819 (11.6%)	3,833 (10.2%)
Multiracial	16,958 (1.0%)	614 (1.2%)	15,514 (0.9%)	348 (0.9%)
White	399,295 (22.7%)	8,374 (16.2%)	446,808 (26.3%)	3,036 (8.1%)
Region				
Midwest	376,513 (21.4%)	13,485 (26.1%)	432,700 (25.4%)	11,274 (30.1%)
Northeast	231,805 (13.2%)	5,062 (9.8%)	171,661 (10.1%)	3,582 (9.5%)
South	793,281 (45.1%)	15,247 (29.5%)	850,893 (50.0%)	13,043 (34.8%)
West	357,073 (20.3%)	17,950 (34.7%)	246,276 (14.5%)	9,612 (25.6%)
Age, in years				
15–24	852,081 (48.5%)	22,794 (44.1%)	1,144,000 (67.2%)	18,167 (48.4%)
25–39	906,591 (51.5%)	28,950 (55.9%)	557,530 (32.8%)	19,344 (51.6%)

* All isolates from men regardless of sex of sex partners

† Isolates from men with female sex partners (ie, MSW and MSMW)

‡ AIAN indicates non-Hispanic American Indian/Alaska Native; Asian/PI, non-Hispanic Asian/Pacific Islander; Black, non-Hispanic Black/African American; Hispanic, Hispanic/Latino; Multiracial, non-Hispanic ≥2 races; White, non-Hispanic White

See supplemental tables for annual counts and percentages of people with reported gonococcal infections by race/ethnicity, region, and age