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Tetracycline Resistance among *Neisseria gonorrhoeae* Isolates — United States, 1987–2022

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Abstract

Background: Doxycycline use in sexually transmitted infection (STI) care is changing.

Concerns about antimicrobial resistance (AR) have accompanied recent recommendations for doxycycline as bacterial STI post-exposure prophylaxis (doxy PEP). We describe trends in tetracycline resistance (TetR) among *Neisseria gonorrhoeae* (GC) isolates collected through United States (US) national surveillance in anticipation of expanded use of doxy PEP.

Methods: GC isolates were collected from men with symptomatic urethritis attending Gonococcal Isolate Surveillance Project (GISP) clinics during 1987–2022 or from patients diagnosed with gonorrhea attending GISP, enhanced GISP and/or Strengthening the US Response to Resistant Gonorrhea clinics during 2018–2022. Antimicrobial susceptibility testing was performed using agar dilution. We describe TetR (tetracycline minimum inhibitory concentration (MIC) ≥ 2 $\mu\text{g/mL}$) and high-level tetracycline resistance (TetHLR) (MIC ≥ 16 $\mu\text{g/mL}$) patterns among collected GC isolates, including by sex and sex of sex partner(s).

Results: A total of 183,668 urethral GC isolates were collected from men with symptomatic urethritis during 1987–2022. The proportion of isolates demonstrating TetR was stable during 1987 (19.7%) to 2022 (19.7%) though isolates demonstrating TetHLR increased from 2.8% to 14.6%. A total of 38,383 GC isolates were collected from patients with gonorrhea during 2018–

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Author Contributions

S.W., E.L., M.S., A.H., K.M., L.Q., and S.S. contributed towards conceptualization and design of the study. AR GC Workgroup participated in data acquisition and transmission to CDC. S.W. conducted data analysis and wrote the original draft of the manuscript. S.S. provided supervision for the project. S.W., E.L., M.S., A.H., K.M., J.P., L.Q., and S.S. contributed to interpretation of data and further revisions of the manuscript. All authors reviewed and approved the manuscript.

Disclaimer:

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

This study used data that are routinely collected as a part of public health surveillance for the purpose of guiding public health disease control efforts and was therefore not subject to institutional review board approval for human subjects' protection.

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2022; TetHLR increased across all sex/sex of sex partner(s) groups and was highest among men reporting male sex partner(s).

Conclusions: An increasing proportion of GC isolates collected through US national surveillance are demonstrating TetHLR. As doxycycline use expands in STI care, enhanced surveillance will be needed to monitor downstream impacts of its use on antimicrobial-resistant GC.

Summary:

The proportion of tetracycline-resistant *Neisseria gonorrhoeae* isolates collected through national surveillance in the United States has remained stable during 1987–2022; however, an increasing proportion are demonstrating high-level tetracycline resistance.

Keywords

Neisseria gonorrhoeae ; gonorrhea; tetracycline resistance; antimicrobial resistance; surveillance

Introduction:

Use of tetracyclines in sexually transmitted infection (STI) prevention and treatment has evolved since the 1940s.^{1,2,3} Most recently, doxycycline—a broad-spectrum tetracycline antimicrobial—has been recommended for use by the United States (US) Centers for Disease Control and Prevention (CDC) as post-exposure prophylaxis (doxy PEP) to prevent bacterial STIs.³ With the anticipation of expanded use of doxycycline in STI care, there is concern for the potential development of antimicrobial resistance (AR) among bacterial STIs and other bacterial pathogens.

Ceftriaxone (a third-generation cephalosporin) is the sole recommended and last remaining antibiotic for empiric treatment of gonorrhea.² Fortunately, there have been no resistance-related ceftriaxone treatment failures identified in the US to date.¹ It is possible that the introduction of doxy PEP may facilitate development of resistance to tetracyclines and other antimicrobial agents among circulating *Neisseria gonorrhoeae* (GC). GC genomic sequencing data from Europe have shown associations between the presence of tetracycline-resistance mutations and other resistance-associated mutations.⁴ Another global study found that GC strains with decreased susceptibility or resistance to ceftriaxone typically exhibit dual resistance to tetracyclines.⁵ Limited data from clinical trials show a higher proportion of GC isolates with tetracycline resistance among doxy PEP groups.^{6,7} Monitoring for the development of antimicrobial-resistant GC is imperative so as to ensure efficacy of recommended treatment regimens.

National sentinel surveillance projects have provided valuable insight into AR trends among GC isolates in the US. CDC's Gonococcal Isolate Surveillance Project (GISP) has monitored trends in antimicrobial-resistant GC among male gonococcal urethral isolates collected at STI clinics in the US since 1986. Enhanced GISP (eGISP) and Strengthening the US Response to Resistant Gonorrhea (SURRG) expanded antimicrobial-resistant GC surveillance within the last decade by monitoring trends among genital and extragenital

isolates collected from patients attending STI clinics (eGISP and SURRG) and high-gonorrhea morbidity non-STI clinic sites (SURRG).^{8,9}

In anticipation of expanded use of doxy PEP, we describe the epidemiology of tetracycline resistance among GC isolates in the US. Specifically, we used available data from three sentinel surveillance programs in the US (GISP, eGISP and SURRG) to examine:

1. historical trends in tetracycline resistance among male urethral GC isolates during 1987–2022 and,
2. recent trends in tetracycline resistance among urogenital, pharyngeal and rectal GC isolates by sex/sex of sex partner(s) during 2018–2022.

Materials and Methods:

Study Population

We examined isolates collected from patients who attended participating GISP clinic sites during 1987–2022 or attended participating GISP, eGISP, or SURRG clinic sites during 2018–2022 and: 1) provided at least one isolate from any anatomic site with a positive GC culture, 2) had available tetracycline antimicrobial susceptibility testing data from these isolates and, 3) had related clinical and epidemiologic data submitted to CDC. Programs had different patient sampling criteria. Per GISP protocol, isolates were collected at STI clinics from male patients with symptomatic urethritis and a positive urethral GC culture, employing a standardized sampling frame.⁸ As part of eGISP and SURRG, isolates were additionally collected from female patients with positive urogenital (vaginal or endocervical) GC culture and, male or female patients with positive pharyngeal and/or rectal GC cultures. Similar to GISP, eGISP isolates were collected from STI clinics only; SURRG isolates were collected from STI clinics and non-STI clinic sites. GISP and eGISP sites collected up to 300 male urethral gonococcal isolates annually, and up to 300 female genital and 300 male and female extragenital isolates annually.¹⁰ SURRG sites collected isolates from at least 15% of annually reported cases (or, in high morbidity jurisdictions, at least 1,000 isolates). Isolates were excluded if known to be collected at a test of cure (TOC) visit (applicable to SURRG isolates).

Interpretation of Antimicrobial Susceptibility Test Results

Antimicrobial susceptibility testing (AST) by agar dilution on a panel of antimicrobials was performed at participating GISP Regional Laboratories for all GISP isolates collected between 1987–2016 and Antimicrobial Resistance Laboratory Network (AR Lab Network) regional laboratories on all gonococcal isolates collected at GISP, eGISP and SURRG sites between 2017–2022. AST results were reported as a minimum inhibitory concentration (MIC). For our analysis, we used tetracycline AST results to define tetracycline resistance (TetR) as a tetracycline MIC of ≥ 2 $\mu\text{g/mL}$ and high-level tetracycline resistance (TetHLR) as a tetracycline MIC of ≥ 16 $\mu\text{g/mL}$.^{11,12}

Data Analysis

To examine historical trends in TetR and TetHLR among male urethral GC isolates collected at GISP clinics during 1987–2022, we first characterized patients from whom isolates were collected by age group, race/Hispanic ethnicity, sex of sex partner(s), and US Census Region of STI clinic site. We then calculated the annual proportion of isolates with TetR and TetHLR during 1987–2022 by reported sex of sex partner(s) and US Census Region.

To examine trends in TetR and TetHLR among urogenital (urethral, vaginal or endocervical), pharyngeal and rectal GC isolates collected from patients attending GISP, eGISP and SURRG clinic sites during 2018–2022, we first characterized patients from whom GC isolates were collected by age group, race/Hispanic ethnicity, sex, sex of sex partner(s) (among male participants), US census region of clinic site, facility type (STI or non-STI clinic), and anatomic site of infection. Stratification by reported sex of sex partner(s) among male participants included men who reported male or male and female sex partner(s) (MSM), men who reported female sex partner(s) only (MSW), and men where sex of sex partner was unknown (MSU). We then described overall and annual proportion of TetR and TetHLR isolates by sex/sex of sex partner(s) during 2018–2022. All analyses were conducted using RStudio.

Preliminary analyses related to this project were presented as conference abstracts at the STI & HIV 2023 World Congress and 2023 IDWeek.^{13,14}

Results:

Historical trends in TetR and TetHLR among male urethral GC isolates during 1987–2022:

A total of 183,668 GC urethral isolates were collected from men with symptomatic urethritis attending GISP STI clinics during 1987–2022. The annual number of participating clinics ranged from 21 to 34 during this period. A plurality of isolates was collected from STI clinics in the West (40.5%) and a majority of isolates were collected from MSW (76.1%), men identifying as non-Hispanic Black/African American (68.0%) and men aged 15–34 (74.7%) (Table 1). Among all isolates collected during 1987–2022, 21.0% demonstrated TetR and 8.2% TetHLR.

The annual proportion of urethral GC isolates with TetR remained stable during 1987–2022, at 19.7% (median: 20.8%, IQR: 19.7%–23.1%) (Figure 1). In contrast, annual TetHLR was 2.8% in 1987 and 14.6% in 2022 (during 1987–2022, median: 7.9%, IQR: 6.0%–10.2%). Thus, a higher proportion of TetR isolates were demonstrating TetHLR in 2022 than 1987; in 2022, 74.4% of TetR isolates demonstrated TetHLR, compared to 14.2% of TetR isolates in 1987 (Figure 1).

Regional differences in TetR trends were present (Figure 2). The proportion of TetR isolates was higher in 2022 than 1987 in the Midwest (19.0% compared to 16.9%) and West (20.8% compared to 14.1%) and lower in the Northeast (19.1% compared to 34.5%) and South (18.8% compared to 21.6%). All regions demonstrated higher TetHLR in 2022 than in 1987 (Northeast: 13.2% compared to 9.1%; Midwest: 14.8% compared to 0.0%, South: 13.6% compared to 3.4%; West: 15.5% compared to 0.8%) (Figure 2).

Trends by sex of sex partner(s) showed that the proportion of urethral GC isolates with TetR has remained relatively stable among MSM, MSW, and MSU during 1987–2022 (Figure 3). In 2022, TetR among urethral GC isolates was highest among MSM (25.9%), followed by MSU (21.6%), and MSW (16.5%). In the same year, TetHLR was highest among MSM (18.8%), followed by MSU (15.3%), and MSW (12.6%). The proportion of isolates demonstrating TetHLR was higher in 2022 than in 1987 across all sex of sex partner(s) groups.

Trends in TetR and TetHLR among all (urogenital, pharyngeal and rectal) GC isolates by sex/sex of sex partner(s) during 2018–2022:

A total of 38,383 isolates (29,388 [76.6%] genital, 4,293 [11.2%] rectal, and 4,702 [12.2%] pharyngeal) were collected from patients attending GISP, eGISP, or SURRG clinic sites during 2018–2022 (Table 1). The annual number of participating clinics ranged from 31 to 35 during this period. Most isolates were collected from patients aged 15–34 (69.8%) and from males (91.8%). A plurality of isolates were collected from non-Hispanic Black/African American patients (47.9%) and from the clinics in the West (42.3%) (Table 1). Most isolates were collected at STI clinics (92.2%). Among all isolates collected from any anatomic site during 2018–2022, 24.8% demonstrated TetR and 11.6% TetHLR (Table 1).

When stratifying by sex/sex of sex partner(s), during 2018–2022, TetR was highest among GC isolates collected from MSM (30.0%), followed by MSU (24.3%), females (21.3%) and MSW (20.9%) (Table 2). Similarly, TetHLR was highest among isolates collected from MSM (13.7%), followed by MSU (12.8%), females (10.9%), and MSW (9.8%). Regarding annual trends, the proportion of GC isolates demonstrating TetHLR was higher in 2022 compared to 2018 among MSM (19.0% compared to 12.4%), MSW (12.9% compared to 9.2%), MSU (18.4% compared to 11.5%) and females (15.6% compared to 8.7%) (Table 2).

TetR and TetHLR trends by anatomic site of infection are provided in Supplemental Table 1 (see Supplemental Digital Content 1). The overall proportion of TetR was higher among pharyngeal (28.1%) and rectal (27.7%) isolates compared to genital (23.9%) isolates though the sex/sex of sex partner(s) patterns differed among patients from which genital, rectal and pharyngeal isolates were collected. Most genital isolates were collected from MSW (56.6%) and MSM (31.6%). Most rectal isolates were collected from MSM (77.8%) and MSU (17.6%). Most pharyngeal isolates were collected from MSM (55.6%) and female patients (17.7%). Genital, rectal and pharyngeal isolates all demonstrated higher TetHLR during 2022 compared to 2018 (genital: 14.9% compared to 10.3%; rectal: 18.0% compared to 10.8%; pharyngeal: 20.1% compared to 12.8%).

Discussion

Our analysis using national sentinel surveillance data shows that TetR among GC isolates has remained stable since 1987, currently at about 20% of sampled GC isolates. Interestingly, the proportion of isolates demonstrating TetHLR has increased over time, now representing a majority of identified TetR. TetHLR increased across US census regions and anatomic sites of infection. Further, though TetR varied by sex/sex of sex partner(s), as

consistent with published data,^{10,15} TetHLR increased among all sex/sex of sex partner(s) groups.

TetHLR among GC isolates was first described during the mid-1980s in the US, with the emergence of the conjugative plasmid-encoded *TetM* determinant.¹² High and increasing proportions of TetHLR have been described in other countries, with selection pressure from doxycycline use and introduction of gonococcal lineages from other regions considered potential contributing factors.^{16,17,18} A recently published analysis of publicly-available US GC genomic sequence data from 2018 through 2024 has similarly shown an increasing proportion of isolates carrying the *TetM* gene as well as expansion of *tetM*-carrying lineages.¹⁹

Mechanisms of TetR (chromosomally encoded vs plasmid encoded resistance) may be associated with differences in co-resistance or reduced susceptibility to other antimicrobial agents. In one study, ceftriaxone—our last remaining empiric GC treatment—was noted to have higher MICs among GC isolates with chromosomally encoded TetR.²⁰ Though the proportion of GC isolates exhibiting decreased susceptibility to ceftriaxone remains low in the US,^{9,10} ongoing antimicrobial-resistant GC surveillance remains crucial. Alongside phenotypic AR surveillance, expanding molecular surveillance, including whole genome sequencing (WGS) capacity, will be important. Paired phenotypic and genetic data can improve our understanding of genetic determinants of AR, including the identification of novel mutations. Further, through WGS, GC strain diversity can be tracked across sexual networks, geographical regions and time. These data can help to identify outbreaks, provide insight into changing AR patterns and inform the development of molecular assays for improved antimicrobial-resistant GC detection. Development and implementation of robust PCR-based tests for plasmid-mediated TetR would allow for improved estimates of TetHLR prevalence through the testing of remnant clinical specimens. As doxycycline use expands, a robust surveillance system that includes both phenotypic and molecular surveillance will be critical to understand TetR/TetHLR and other AR patterns and inform our collective public health response to antimicrobial-resistant GC.

There is concern that GC infections at extragenital sites, particularly oropharyngeal infections, are harder to eradicate compared to genital infections and may facilitate the development of antimicrobial-resistant GC.^{21,22} Our data suggest potential differences in TetR and TetHLR by anatomic site; however, interpretation is limited as the contribution of isolates by sex/sex of sex partner(s) groups varied by anatomic site of infection. Differences in gonorrhea screening recommendations by population and potential differences in screening protocols/practices across participating jurisdictions may have contributed to selection bias.² Further investigation is needed to better understand the role of extragenital GC infections in the development of antimicrobial-resistant GC, including in the context of increased doxycycline use for STI prevention.

Efficacy of doxycycline in preventing gonorrhea has varied among doxy PEP clinical trials, in part due to geographic differences in prevalence of pre-existing gonococcal TetR.^{6,7,23} Modeling has demonstrated that a higher prevalence of TetHLR prior to introduction of doxy PEP attenuates the benefit of doxy PEP in reducing the burden of gonococcal infections in a

population.²⁴ Our analysis shows that tetracycline-resistant GC is circulating in the US and that most identified resistant isolates are now demonstrating high-level resistance, including among populations for which doxy PEP is recommended.³ As doxy PEP implementation expands, ongoing evaluations of real-world effectiveness of doxy PEP in preventing GC and continued surveillance of TetHLR prevalence will be important to understand the potential impact of TetHLR prevalence on doxy PEP. It is important that doxy PEP complement other established preventative measures and STI screening continues as recommended.^{3,25}

Though our analysis is strengthened by use of a large, population-based sample identified through national sentinel surveillance, there are limitations to consider. Sampling methods for eGISP and SURRG did not allow for interpretation of percentage of TetR or TetHLR as prevalence.^{8,9} Urethral GC isolates collected from men through GISP and eGISP were limited to men with symptomatic urethritis, which may have introduced bias if gonococcal strain types differentially cause symptomatic or asymptomatic infections. Known challenges in isolating GC through culture, particularly at extragenital sites, may limit our sample from representing all circulating strains of GC infections in the US;^{26,27,28} this may have affected our findings if sensitivity of GC culture varies among gonococcal strains. Our sample is largely limited to public STI clinics and biased towards areas with high GC morbidity; findings may not all be generalizable to populations outside of these settings. Estimates of antimicrobial-resistant GC through GISP have been shown to be nationally representative of men in the US who are reported with urogenital gonorrhea;²⁹ similar evaluations of antimicrobial-resistant GC estimates through eGISP and SURRG are needed. As discussed, our interpretation of differences in TetR and TetHLR patterns by anatomic site is limited due to differential contribution of isolates by sex/sex of sex partner(s) groups across anatomic sites of infection, and future analyses examining patterns of TetR and TetHLR by additional stratifications will be important. Data collection practices for sex and sex of sex partner(s) variables differed by project and project site and may affect observed differences across sex/sex of sex partner(s) groups. Future national and regional estimates may be enhanced by additional data on sex of sex of partner(s). Finally, our estimates are based on GC isolates collected through US national surveillance and thus, do not represent global TetR patterns, as demonstrated through a recent systematic review of global estimates of tetracycline-resistant GC.³⁰

In sum, our analysis showed that while the overall level of TetR has remained stable over time, a growing proportion of GC isolates collected through national surveillance are demonstrating TetHLR. This increase in TetHLR was observed across US census regions and across sex/sex of sex partner(s) groups. As doxycycline use in STI care expands, enhanced surveillance methods will be imperative to both monitor and better understand the downstream impact on antimicrobial-resistant GC.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Data Statement:

Data are not publicly available.

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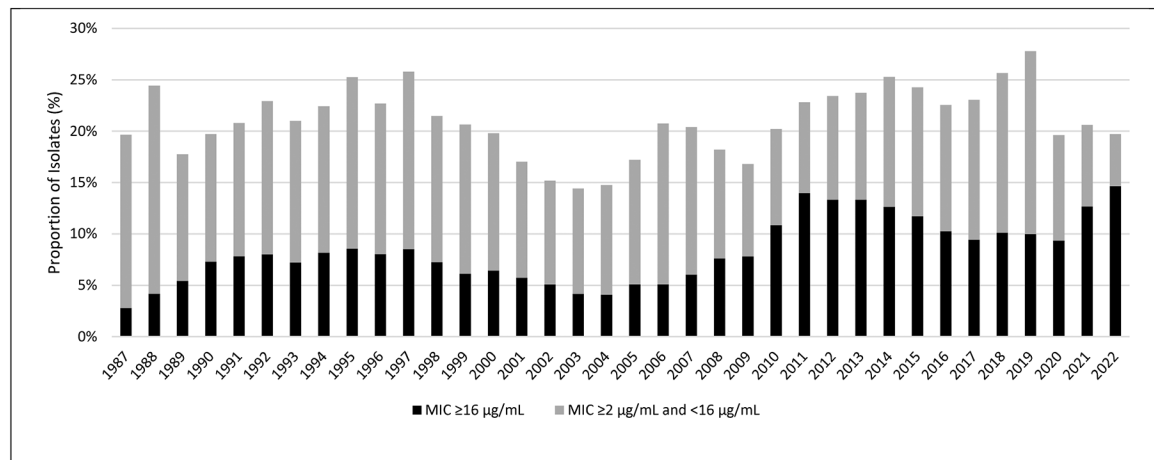


Figure 1.

Annual tetracycline resistance among *Neisseria gonorrhoeae* urethral isolates collected from men attending STI clinics, by minimum inhibitory concentration (MIC) — Gonococcal Isolate Surveillance Project, 1987–2022

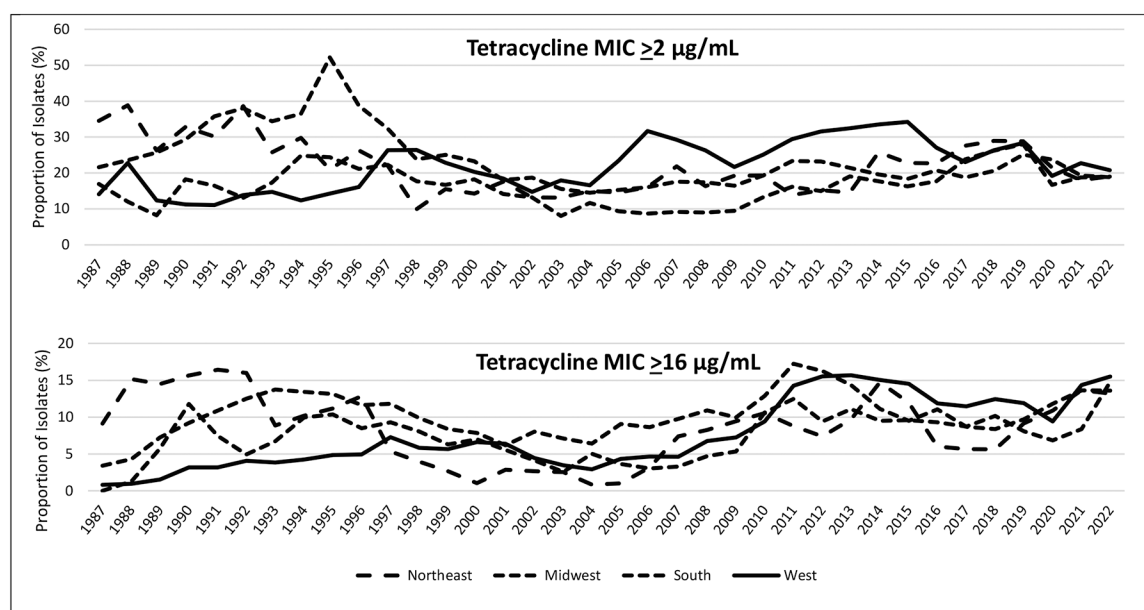


Figure 2.

Annual tetracycline resistance among *Neisseria gonorrhoeae* urethral isolates collected from men attending STI clinics, by US Census region — Gonococcal Isolate Surveillance Project, 1987–2022

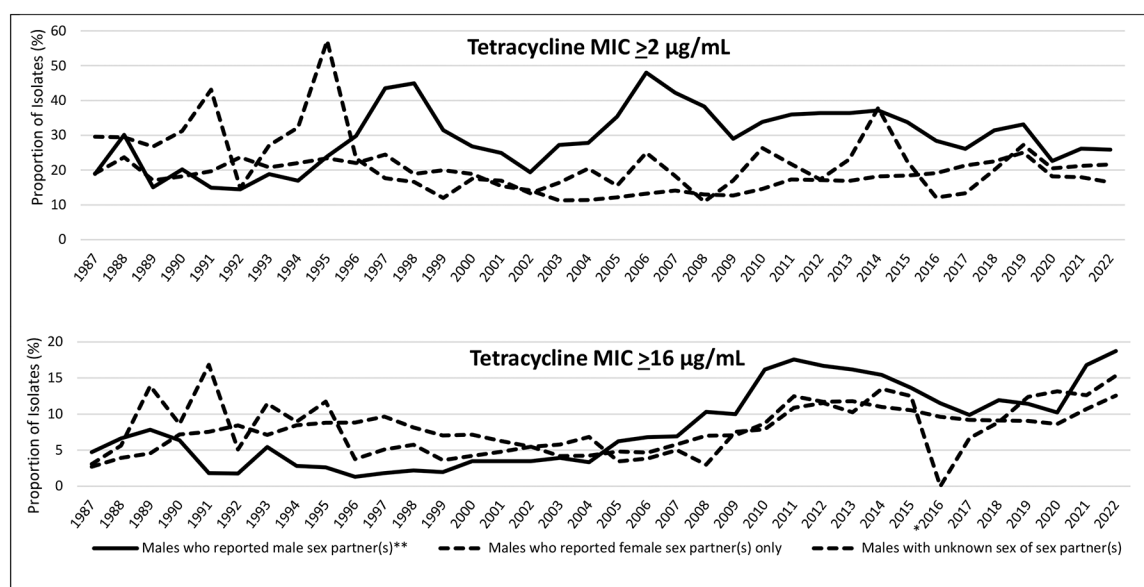


Figure 3.

Annual tetracycline resistance among *Neisseria gonorrhoeae* urethral isolates collected from men attending STI clinics, by sex of sex partner(s) — Gonococcal Isolate Surveillance Project, 1987–2022.

*No isolates collected from men with unknown sex of sex partner(s) in 2016 demonstrated a tetracycline MIC ≥ 16 µg/mL.

**Males who reported male sex partner(s) includes males who reported male or male and female partner(s).

Table 1.

Descriptive Characteristics of Patients from Whom *Neisseria gonorrhoeae* Isolates Were Collected, by Anatomic Site of Infection — GISP, eGISP and SURRG, 1987–2022

	GISP Only (1987–2022)		GISP, eGISP and SURRG (2018–2022)	
	n	%	n	%
Total Isolates	183,668	100%	38,383	100%
Age, years				
10–14	305	0.2%	18	0.05%
15–24	72,304	39.4%	10,193	26.6%
25–34	64,816	35.3%	16,564	43.2%
35–44	29,305	16.0%	6,552	17.1%
45–54	12,262	6.7%	3,086	8.0%
55+	4,430	2.4%	1,757	4.6%
Unknown	246	0.1%	213	0.6%
Race/Hispanic Ethnicity*				
American Indian/Alaska Native	577	0.3%	174	0.5%
Asian	2,714	1.5%	1,302	3.4%
Black/African American	124,801	68.0%	18,384	47.9%
Hispanic/Latino	21,868	11.9%	7,474	19.5%
Multi-racial	1,322	0.7%	785	2.0%
Native Hawaiian/Other Pacific Islander	577	0.3%	159	0.4%
White	28,552	15.5%	8,391	21.9%
Other race	1,586	0.9%	587	1.5%
Unknown	1,671	0.9%	1,127	2.9%
Sex				
Male	183,668	100%	35,256	91.8%
Female	-	-	3,042	7.9%
Unknown			85	0.2%
Sex Partner(s) Among Males				
Male or Male and Female	37,201	20.3%	15,327	43.5%
Female only	139,684	76.1%	17,257	48.9%
Unknown	6,783	3.7%	2,672	7.6%
Region of STI Clinic				
Northeast	22,951	12.5%	7,006	18.3%
Midwest	42,493	23.1%	10,035	26.1%
South	43,895	23.9%	5,089	13.3%
West	74,329	40.5%	16,253	42.3%
Facility Type				
STI Clinic	183,668	100%	35,402	92.2%
Non-STI Clinic	-	-	2,981	7.8%
Tetracycline Resistance (TetR)	38,481	21.0%	9,521	24.8%

	GISP Only (1987–2022)		GISP, eGISP and SURRG (2018–2022)	
	n	%	n	%
High-Level Tetracycline Resistance (TetHLR)	15,116	8.2%	4,467	11.6%
Anatomic Site of Infection				
Genital	183,668	100%	29,388	76.6%
Pharyngeal	-	-	4,293	11.2%
Rectal	-	-	4,702	12.3%
Project	-	-		
GISP Only	183,668	100%	7,441	19.4%
eGISP	-	-	9,686	25.2%
SURRG	-	-	21,256	55.4%

STI: Sexually Transmitted Infections; GISP: Gonococcal Isolate Surveillance Project; eGISP: Enhanced Gonococcal Isolate Surveillance Project; SURRG: Strengthening the U.S. Response to Resistant Gonorrhea

TetR: Tetracycline MIC ≥ 2 $\mu\text{g/mL}$

TetHLR: Tetracycline MIC ≥ 16 $\mu\text{g/mL}$

* Patients with Hispanic or Latino (Hispanic) ethnicity were categorized as Hispanic and might be of any race; patients with non-Hispanic ethnicity were categorized into single race groups or as multiracial (more than one race category selected). Patients with missing data for both race and ethnicity were categorized as unknown.

Table 2.

Tetracycline Resistance (TetR) and High-Level Tetracycline Resistance (TetHLR) * Among *Neisseria gonorrhoeae* Isolates, by Sex/Sex of Sex Partner(s) — GISP, eGISP and SURRG, 2018–2022

Year	All Isolates	TetR Isolates		TetHLR Isolates	
	N	n	%	n	%
All Populations					
2018–2022	38,383	9,521	24.8%	4,467	11.6%
2018	9,113	2,582	28.3%	964	10.6%
2019	10,204	2,978	29.2%	1,083	10.6%
2020	6,505	1,331	20.5%	607	9.3%
2021	6,353	1,311	20.6%	819	12.9%
2022	6,208	1,319	21.2%	994	16.0%
Males Who Reported Male Sex Partner(s) **					
2018–2022	15,327	4,594	30.0%	2,102	13.7%
2018	3,790	1,314	34.7%	471	12.4%
2019	4,179	1,442	34.5%	500	12.0%
2020	2,257	554	24.5%	233	10.3%
2021	2,339	574	24.5%	372	15.9%
2022	2,762	710	25.7%	526	19.0%
Males Who Reported Female Sex Partner(s) Only					
2018–2022	17,257	3,612	20.9%	1,687	9.8%
2018	4,138	970	23.4%	379	9.2%
2019	4,386	1,114	25.4%	400	9.1%
2020	3,019	540	17.9%	244	8.1%
2021	2,947	518	17.6%	306	10.4%
2022	2,767	470	17.0%	358	12.9%
Males with Unknown Sex of Sex Partner(s)					
2018–2022	2,672	648	24.3%	341	12.8%
2018	442	130	29.4%	51	11.5%
2019	837	216	25.8%	99	11.8%
2020	570	128	22.5%	75	13.2%
2021	606	126	20.8%	76	12.5%
2022	217	48	22.1%	40	18.4%
Females					
2018–2022	3,042	649	21.3%	332	10.9%
2018	705	159	22.6%	61	8.7%
2019	793	204	25.7%	84	10.6%
2020	650	106	16.3%	54	8.3%
2021	452	91	20.1%	64	14.2%
2022	442	89	20.1%	69	15.6%

GISP: Gonococcal Isolate Surveillance Project; eGISP: Enhanced Gonococcal Isolate Surveillance Project; SURRG: Strengthening the U.S. Response to Resistant Gonorrhea

* TetR and TetHLR are defined as tetracycline minimum inhibitory Concentration (MIC) ≥ 2 $\mu\text{g/mL}$ and ≥ 16 $\mu\text{g/mL}$, respectively.

** Includes males who reported sex with male or male and female partner(s)

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