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Strengthening the US Response to Resistant Gonorrhea: An Overview of a Multisite Program to Enhance Local Response Capacity for Antibiotic-Resistant *Neisseria gonorrhoeae*

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Abstract

Background: In 2016, Centers for Disease Control and Prevention initiated Strengthening the US Response to Resistant Gonorrhea (SURRG) in multiple jurisdictions to enhance antibiotic resistant gonorrhea rapid detection and response infrastructure and evaluate the impact of key strategies.

Methods: Eight jurisdictions were funded to establish or enhance local gonococcal culture specimen collection in sexually transmitted disease and community clinics, conduct rapid antimicrobial susceptibility testing AST) in local laboratories, modify systems for enhanced data collection and rapid communication of results, and initiate enhanced partner services among

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patients with gonorrhea demonstrating elevated minimum inhibitory concentrations (MICs) to ceftriaxone, cefixime or azithromycin.

Results: Grantees incorporated genital, pharyngeal, and rectal gonococcal culture collection from all genders at participating clinics. During 2018 to 2019, grantees collected 58,441 culture specimens from 46,822 patients and performed AST on 10,814 isolates (representing 6.8% [3412] and 8.9% [4883] of local reported cases in 2018 and 2019, respectively). Of isolates that underwent AST, 11% demonstrated elevated azithromycin MICs; fewer than 0.5% demonstrated elevated ceftriaxone or cefixime MICs. Among patients whose infections demonstrated elevated MICs, 81.7% were interviewed for partner elicitation; however, limited new cases were identified among partners and contacts.

Conclusions: As a public health model to build capacity to slow the spread of emerging resistance, SURRG successfully expanded culture collection, implemented rapid AST, and implemented an enhanced partner services investigation approach in participating jurisdictions. Findings from SURRG may enhance preparedness efforts and inform a longer-term, comprehensive, and evidence-based public health response to emerging gonococcal resistance. Continued development of innovative approaches to address emerging resistance is needed.

Before the COVID-19 pandemic, gonorrhea had consistently been the second most commonly reported nationally notifiable disease in the United States; 616,392 cases were reported in 2019.[1] Gonorrhea classically presents as urethritis among cisgender men but is often asymptomatic when infections occur in women and at other anatomic sites in men. If left untreated, gonorrhea may cause pelvic inflammatory disease and severe reproductive health complications in women, such as ectopic pregnancy and tubal infertility. Gonorrhea may also increase the risk of sexual transmission of human immunodeficiency virus (HIV).[2]

Prevention and control of gonorrhea depends on timely and effective treatment, yet treatment has been challenged by the ability of *Neisseria gonorrhoeae* to acquire resistance to each class of antibiotics used for treatment.[3] During January 2010 to December 2020, the Centers for Disease Control and Prevention (CDC) recommended azithromycin as part of gonorrhea treatment.[4] However, amidst concern for declining gonococcal azithromycin susceptibility, the potential impact of azithromycin use on susceptibility among commensal organisms and concurrent pathogens, and prioritization of antimicrobial stewardship, current CDC treatment guidelines no longer recommend azithromycin as part of first-line therapy. Ceftriaxone is the only remaining treatment option.[5] Although ceftriaxone resistance remains rare, an increasing number of ceftriaxone-resistant *N. gonorrhoeae* infections have been reported across the world, including some unsuccessfully treated with ceftriaxone.[6–8] In the United States, there have been no treatment failures due to ceftriaxone-resistant infections; however, an isolate with a ceftriaxone minimum inhibitory concentration (MIC) of 1.0 μg/mL was detected in 2019 and was likely imported from China.[9] Emergence and spread of *N. gonorrhoeae* resistance will substantially hinder treatment, prevention, and control efforts.

In recognition of this threat, the 2015 US National Action Plan for Combating Antibiotic-Resistant Bacteria included a goal of slowing emergence of resistance and preventing spread of resistant infections and specifically addressed preventing spread of resistant *N.*

gonorrhoeae through advanced local capacity for rapid response to detect, diagnose, and investigate suspected drug-resistant gonorrhea cases.[10] However, capacity for rapid response faced multiple challenges. With the widespread adoption of nucleic acid amplification tests (NAATs) for the detection of gonorrhea and limited capacity for gonorrhea culture and rapid antimicrobial susceptibility testing (AST) (which has required an isolate from culture), rapid detection of resistance—a starting point for response activities—was generally not feasible in the United States. In health department jurisdictions (ie, defined geographic area for which a health department is responsible for conducting disease surveillance and providing public health services) participating in CDC's Gonococcal Isolate Surveillance Project (GISP) (a longstanding sentinel surveillance program that monitors long-term antimicrobial susceptibility trends to inform treatment guidelines), culture is routinely performed, but typically only among the first 25 male patients at sexually transmitted disease (STD) clinics who present with urethritis each month.[11] For GISP, AST is performed at regional laboratories up to 3 months after specimen collection, and thus is not intended for rapid public health action. Response activities were also hampered by drastic reductions in or elimination of partner services investigations for patients diagnosed with gonorrhea because of declining health department STD program resources, competing priorities, and questions about their effectiveness.[12–14] Compounding these challenges, data on effective public health approaches for slowing the spread of resistant *N. gonorrhoeae* are extremely limited.

To address these challenges, support the goals of the Action Plan, better understand the epidemiology of gonococcal antimicrobial resistance, and expand the evidence base of effective public health approaches, CDC implemented the Strengthening the US Response to Resistant Gonorrhea (SURRG) program in 2016. Strengthening the US Response to Resistant Gonorrhea program provided resources to participating jurisdictions to enhance local and state capacity to rapidly detect (through expanded culture and establishment of local AST), investigate (with expanded partner services), and ensure adequate treatment of infections demonstrating elevated MICs to ceftriaxone or cefixime or nonsusceptibility to azithromycin as defined below (with tests of cure). In this article, we describe the SURRG project and provide an overview of project findings, focusing on data from 2018 to 2019.

METHODS

Initially, 9 grantees (state health departments or city health departments directly funded by CDC) were funded through a competitive application process, with resources to be focused in a county or city. Strengthening the US Response to Resistant Gonorrhea program was designed to complement and build upon CDC-supported GISP surveillance activities.[11] Eight grantees participated during the entire 5-year cycle: California (San Francisco County/San Francisco), Colorado (Denver County/Denver), Indiana (Marion County/Indianapolis), Hawaii (Honolulu County/Honolulu), New York City (NYC), North Carolina (Guilford County/Greensboro), Washington (King County/Seattle);, and Wisconsin (Milwaukee City). This article presents findings from these 8 continuously participating jurisdictions. Georgia (Fulton County/Atlanta) participated from 2016 to 2018; data from Georgia are not included. Specimen collection began in 2017 for all grantees. Data collection plans and management systems were not fully in place for all grantees until 2018.

Rapid Detection: Specimen Collection

To enhance rapid detection, build preparedness capacity outside of STD clinics, and enhance knowledge of the epidemiology of gonococcal resistance beyond that of urethral isolates from male STD clinic attendees, SURRG grantees implemented collection of urogenital, rectal and pharyngeal specimens for culture and AST from patients of all genders, from attendees of STD clinics and other community healthcare settings (hereafter referred to as "non-STD clinics"). To develop local criteria for culture specimen collection in participating clinics, SURRG grantees worked closely with local STD clinics and established new or enhanced partnerships with other high-gonorrhea morbidity non-STD clinics, such as emergency departments, HIV care providers, LGBTQ-focused and Planned Parenthood health centers. With a goal of performing ASTon isolates from at least 15% of locally reported gonorrhea cases (or at least 1000 isolates per year in very high gonorrhea morbidity jurisdictions), grantees were afforded flexibility to pilot innovative approaches to specimen collection and to tailor local criteria to maximize specimen collection while efficiently using resources, and tailoring specimen collection to local epidemiology and priorities. Therefore, culture specimen collection criteria varied across jurisdictions, but generally included specimens from all potentially exposed anatomic sites (genital, rectum, and pharynx) of (1) symptomatic patients presumptively treated for gonorrhea, (2) patients returning to the clinic for treatment of NAAT-diagnosed gonococcal infection, or (3) sex partners of previously identified persons with infections. As an example of more restrictive criteria, the NYC SURRG program collected culture specimens from patients being presumptively treated for gonorrhea only at anatomic sites at which the patients were symptomatic in addition to criteria 2 and 3 above. As an example of more expansive criteria, the North Carolina SURRG program collected culture specimens from all potentially exposed anatomic sites of all patients screened or tested for gonorrhea. Swab specimens for culture were predominately collected by medical providers, but some health centers offered patients the option to self-collect vaginal, rectal, and/or pharyngeal swabs.[15] The Washington SURRG project piloted urine specimen collection for culture in non-STD clinic sites beginning in 2019. Swab type and transport media differed across jurisdictions, though most jurisdictions used fiber-wrapped swabs and a nutritive transport system or media developed for *N. gonorrhoeae* isolation, such as InTray (Biomed Diagnostics, Oregon) or MTM-JEMBEC (BD, New Jersey). Persons found to have gonorrhea were treated per local treatment protocols.

Laboratory Services

Local public health or other healthcare organization laboratories processed specimens and performed NAAT and culture, and AST of gonococcal isolates for susceptibility to azithromycin, ceftriaxone, and cefixime by Etest (bioMérieux, France). Gradient strip AST using Etest is a relatively easy and rapid quantitative test for measuring antimicrobial susceptibility and well-suited for settings in which a rapid result is required.[16] Capacity to perform ASTon *N. gonorrhoeae* isolates via Etest was newly implemented or rapidly scaled up in all jurisdictions by hiring and training laboratory staff, purchasing equipment, establishing ongoing quality control and quality assurance protocols, obtaining any required validation certification to allow reporting of Etest results, and participating in biannual Etest

proficiency testing. Laboratories established new workflows to reduce culture and AST turnaround times.

Isolates exhibiting azithromycin MICs of 2.0 μg/mL or greater were considered "alert" values since the inception of SURRG and, in 2019, were designated as nonsusceptible by the Clinical and Laboratory Standards Institute (CLSI) criteria.[17] In this article, we use nonsusceptible to refer to azithromycin MICs of 2.0 μg/mL or greater. Isolates exhibiting ceftriaxone MICs of 0.125 μg/mL or greater or cefixime MICs of 0.25 μg/mL or greater were categorized as having elevated MICs. The ceftriaxone and cefixime breakpoints used in SURRG are lower than the CLSI breakpoints for nonsusceptibility (MICs ≥0.50 μg/mL) to allow detection of emerging resistance, and with different MIC breakpoints used because historically in GISP, MICs for cefixime have been 1 dilution higher than ceftriaxone MICs. Laboratories communicated AST results within 1 business day to submitting medical providers and local SURRG project staff. The AST results demonstrating ceftriaxone or cefixime elevated MICs or azithromycin nonsusceptibility were reported to CDC within 24 hours. Copies of all isolates were transported to the designated Antibiotic Resistance Laboratory Network (AR Lab Network) regional laboratory for agar dilution AST on an expanded antibiotic panel (including confirming azithromycin, ceftriaxone, and cefixime MICs) and whole genome sequencing on a subset of isolates.[18] AR Lab Network AST data on the first 25 male urethral isolates collected per month through participating SURRG STD clinics were integrated into CDC's GISP data.

Rapid Response: Enhanced Investigations and Partner Services

Upon being notified of an isolate with elevated MICs to ceftriaxone or cefixime, or azithromycin nonsusceptibility, health department STD program disease intervention specialists (DIS) attempted to interview the patient to collect additional standardized clinical and epidemiological data, elicit recent sex partners, and social contacts (persons who are not sex partners but who might benefit from STD testing), and provide risk reduction counseling and service referrals (eg, HIV biomedical interventions, substance use treatment). If sufficient contact information was available, DIS attempted to contact partners and social contacts and refer them to a participating SURRG clinic for testing (including culture) and management. From partners of index cases (and regardless of whether they were diagnosed with gonorrhea), DIS also elicited names of and attempted to contact and refer their sex partners (partners of partners) for testing. Strengthening the US Response to Resistant Gonorrhea program employed this "expanded" partner services approach (inclusion of social contacts and partners of partners) to assess feasibility and possible effectiveness of these field investigations that leveraged sexual/social networks to identify and halt the spread of resistance, and to improve our understanding of gonorrhea transmission networks. Disease intervention specialist attempted to continue expanded partner services for any partner or social contact newly diagnosed with gonorrhea, regardless of whether a culture was collected, or any *N. gonorrhoeae* isolate was identified as having elevated MICs. Testing, partner elicitation, and interviewing would continue until all social contacts and 2 generations of sex partners tested negative for gonorrhea.

Ensure Adequate Treatment

Persons whose isolates demonstrated elevated ceftriaxone or cefixime MICs or azithromycin nonsusceptibility were asked to return to the clinic (by a DIS during partner services follow-up, or by a nurse) for a test of cure (TOC) by NAAT and culture 8 to 10 days after treatment to ensure adequately treatment. Patients with positive TOC test results were managed per CDC treatment guidelines and local protocols. Strengthening the US Response to Resistant Gonorrhea program TOC data are presented elsewhere.[19]

Data Use Capacity Building and Information Technology

To support the objectives of SURRG, improve local surveillance capacity and data use, and enable rapid communication and data transmissions, grantees invested in local data management and analysis capacity-building, including information technology and data management infrastructure upgrades. Sites updated investigation databases and electronic medical record and laboratory information systems, and modified workflows to collect and rapidly communicate necessary information. Sites submitted aggregated performance measures and de-identified line-listed data to CDC for program monitoring and multisite analyses. Sites also conducted routine (typically quarterly) program monitoring activities and regularly shared key program outcomes with local stakeholders (eg, staff at participating health centers and local health department leadership).

Human Subjects Protection

Centers for Disease Control and Prevention's institutional review board reviewed the SURRG protocol and determined the project to be a public health activity and not human subject research.

Analysis

In this report, we analyzed 2018 to 2019 data from performance measures (laboratory AST turnaround time), line-listed data from participating clinics, laboratories, and field investigations, and case report data to calculate frequencies and percentages of patient and specimen characteristics. Patient-level analyses were not restricted to unique individuals, as patients may have had multiple separate gonorrhea diagnoses during the study period. Per jurisdictions discretion, specimens collected and/or gonorrhea diagnoses from the same patient that occurred more than 30 days apart were classified as separate patient-infection episode events.

RESULTS

During 2018 to 2019 and across 8 SURRG grantees, 58,441 specimens were collected from 46,822 patients attending 16 STD clinics and 31 non-STD clinics. The number of patients from whom specimens were collected ranged by jurisdiction from 1319 in Hawaii to 21,941 in North Carolina. Nearly 73% of patients attended STD clinics and just over half self-identified as male; fewer than 1% self-identified as transgender persons (Table 1). Among male patients (cismale or transgender male), 46.0% reported only male sex partners during the past 2 to 3 months, 37.5% reported only female sex partners, 3.5% reported both male and female sex partners, and 13.1% had missing data on recent sex partners. The

median age of patients with specimens collected was 29 years (interquartile range, 23–34) and a majority (53.7%) were non-Hispanic Black. Approximately 40% of patients were symptomatic at an anatomic site from which a culture specimen was collected.

Among 10,121 patients from whom culture specimens were positive for *N. gonorrhoeae*, 340 were from Hawaii and nearly 3000 were from NYC. The proportion of patients by jurisdiction with at least 1 positive culture ranged from 4.7% (North Carolina) to 59.3% (Indiana) (Table 1, noting row percent not calculated in Table 1). Relative to patients from whom specimens were collected, STD clinic attendees, self-identified males, Whites, and symptomatic patients were overrepresented among those with at least 1 positive culture (Table 1). Notably, self-identified females were markedly underrepresented among those with at least 1 positive culture.

Among all 58,441 specimens collected for culture, 37.7% were pharyngeal, 25.3% were urethral or urine, 21.9% were cervical or vaginal, and 15.1% were rectal (Table 2). And, among the 10,814 specimens positive for N. gonorrhoeae, most were urethral (62.5%), nearly 30% were pharyngeal or rectal, and only 8% were cervical or vaginal. Among specimens collected for culture, 60.1% (35,128) were from self-identified males or transgender males and 39.6% (23,166) were from self-identified females or transgender females, whereas among positive cultures, 88.8% (9600) were from males and 10.7% (1160) from females (data not shown). Culture success by anatomic site among NAAT-positive patients in SURRG is reported elsewhere.[20] Of isolates that underwent AST (99.3% of positive cultures), 11% demonstrated azithromycin nonsusceptibility; fewer than 0.5% demonstrated elevated ceftriaxone or cefixime MICs (Table 2).

Across all sites, median turnaround time between specimen collection and reporting of AST results from the laboratory to the submitting clinic and jurisdiction's SURRG staff was 5 days. Most results (61.2%) were reported within 5 business days; an additional 9% were reported within 7 days.

Of the 50,303 cases of gonorrhea reported across all 8 participating jurisdictions in 2018, SURRG sites performed AST on isolates from 6.8% (3412) of all local reported cases (range by jurisdiction, 4.2%–13.7%) (Table 3). In 2019, of 54,583 reported cases of gonorrhea across the 8 SURRG jurisdictions, SURRG programs performed ASTon isolates from 8.9% (4883) of all local reported cases (range by jurisdiction, 5.7%–20.4%). In both years, NYC performed ASTon less than 6%, but more than 1000 isolates from in-jurisdiction cases. In addition, SURRG programs performed AST on isolates from 534 and 716 patients who resided outside of the funded jurisdiction in 2018 and 2019, respectively.

Disease intervention specialists were able to contact and interview 81.7% (894/1094) of patients from whom *N. gonorrhoeae* isolates were determined to be nonsusceptible to azithromycin and/or exhibit elevated MICs to ceftriaxone or cefixime. Through partner services activities with sexual and social partners of index cases and with subsequently contacted partners of partners, SURRG sites identified 83 individuals with gonorrhea whose infections had not been previously diagnosed.[21]

DISCUSSION

Emerging gonococcal antimicrobial resistance threatens to undermine effectiveness of gonorrhea therapy and prevention and control interventions. With only a single remaining recommended treatment option and novel treatment options still undergoing clinical investigation, public health approaches to slow the spread of resistant *N. gonorrhoeae* strains may be an especially important component of a multi-pronged response. As an investment to build capacity for rapid detection and response to emerging resistance and establish operational lessons learned, SURRG successfully expanded the reach of specimen collection for culture to a sizable proportion of gonorrhea cases, implemented or expanded local rapid AST, and implemented and evaluated a model for public health response to emerging resistance. Strengthening the US Response to Resistant Gonorrhea program was able to expand the use of AST from surveillance of susceptibility trends to inform treatment guidelines (as with GISP) to the application of AST results for public health action, which has the potential to reduce onward transmission.

To lay a foundation for rapid detection, we expanded specimen collection for culture and AST to include specimens from varied clinical settings, multiple anatomic sites, and from patients from multiple gender categories. Participating jurisdictions conducted AST on specimens from approximately 6% to 20% of patients with local in-jurisdiction gonorrhea cases. The wide variability in the proportion of patients with specimens collected that were positive for *N. gonorrhoeae by* jurisdiction (5–59%) is likely due to a combination of varying culture collection criteria across jurisdictions, differing morbidity within local populations, and differences in culture sensitivity by anatomic site.

Culture collection was successfully implemented in non-STD clinics, such as emergency departments and reproductive health centers, although patients who attended these healthcare settings contributed relatively few isolates. Partnering with non-STD clinics may have expanded the reach to patient populations which are difficult to access through STD clinics, such as cisgender women, or those who may have gonorrhea infections with different strains and antimicrobial susceptibility profiles than STD clinic patients.[22] The inclusion of women is notable, as the proportion of gonorrhea cases among women that are diagnosed in STD clinics continues to decline.[1] Importantly, however, specimens collected from non-STD clinics did not yield a substantial number of isolates and implementation of collaborations between health departments and non-STD clinics for culture collection often required sustained partnership building efforts. Despite these challenges, such partnerships with non-STD clinics might be useful investments for future outbreaks of resistant strains, potentially allowing for rapid scale-up of culture and AST or, if or when available in the future, molecular assays for resistance determinants.

Although jurisdictions were able to collect specimens from a relatively large number of females and from multiple anatomic sites among patients of all genders, roughly two thirds of isolates were urethral. Although not surprising given the lower sensitivity of culture of cervical and extragenital specimens[20] and asymptomatic nature of most nonurethral gonococcal infections, these findings highlight that collection of cervical, pharyngeal, or rectal *N. gonorrhoeae* isolates likely requires a large number of specimens and clinical and

laboratory resources to handle a large specimen volume. Despite these challenges, SURRG demonstrated feasibility of collecting and isolating *N. gonorrhoeae* from such specimens, as over 4000 nonurethral isolates were included. Inclusion of nonurethral isolates in SURRG expanded the reach of surveillance for rapid detection and response and facilitated important explorations of possible differences in antimicrobial susceptibility trends by gender or anatomic site of infection.[22,23]

Presently, detection of resistance requires culture-based AST. Whereas susceptibility data from existing surveillance of long-term susceptibility trends (ie, GISP) has often been available 1 to 3 months after specimen collection, SURRG grantees rapidly processed culture specimens and performed and reported AST by Etest locally within a median of 5 days from specimen collection. Local laboratories developed proficiency and workflows to allow for rapid testing. Participating jurisdictions were therefore able to initiate investigations and ensure infections that may represent emerging resistance were cured, thus reducing risks of adverse complications and potentially containing the continued transmission of such strains in a community.

Armed with timely AST results, local SURRG program staff were able to contact and interview most persons (82%) with isolates demonstrating elevated MICs. These partner services investigations facilitated the diagnosis of over 80 previously undetected cases of gonorrhea. While this case detection potentially reduced onward transmission of these infections, the yield was quite modest despite labor intensive efforts. Detailed findings from the field investigations are available at Learner et al.[21] Data from the investigations provide a useful baseline of anticipated yield from partner services in the setting of an outbreak of resistant gonorrhea and given the modest success documented, will hopefully spur innovation to improve the yield of these investigations and/or develop new models of public health control. Future work can investigate whether even more rapid AST results would further improve investigation outcomes. More rapid results would likely require development and use of molecular assays (that detect known genetic markers of antibiotic resistance) and point-of-care testing, however. Use of molecular assays from NAAT specimens and point-of-care testing, for which specimen collection is easier and more convenient than culture, might also have the additional benefit of expanding the number of partners tested.[24,25] Particularly with novel diagnostics, rapid detection and response holds promise for containment of newly identified resistant strains, but given our experience with partner services, may not be impactful enough to slow infection transmission once a resistant strain becomes widespread in a community.

Strengthening the US Response to Resistant Gonorrhea program fits within a larger landscape of activities to address the threat of gonococcal resistance. This larger landscape includes the development and investigation of new therapeutics and diagnostics, vaccine development, surveillance, identification of treatment failures, rapid response, and periodic updating of evidence-based treatment guidelines. Particularly as new therapeutics, diagnostics, and vaccines are still being developed, slowing the spread of resistant strains through public health rapid detection and response activities might avert significant morbidity. Bridging between clinical, laboratory, and public health domains, SURRG has begun to fill critical gaps in knowledge of how best to conduct public health detection

and response activities with the aim of slowing the spread of resistant strains. The local flexibility and varying programmatic approaches across jurisdictions that SURRG has allowed will hopefully facilitate translation of programmatic lessons learned to capacity building and response activities in other states and counties. Strengthening the US Response to Resistant Gonorrhea program can also serve as a platform for piloting innovative approaches to public health detection and response.

There are several limitations to this analysis of SURRG programmatic data. Because multiple specimens were often collected from the same individual from different anatomic sites at the clinic visit, and because SURRG did not use a standardized sampling frame, the percentage of isolates with elevated MICs should not be interpreted as prevalence. The characteristics of persons from whom specimens were collected were influenced by the patient population of participating clinics and local culture criteria. Patient characteristics are not expected to be representative of all persons with gonorrhea in the participating jurisdictions.

As a public health model to build capacity to slow the spread of emerging resistance, SURRG expanded culture collection and implemented rapid AST and an expanded field investigation approach in participating jurisdictions. While effectively building local capacity, piloting approaches, demonstrating feasibility, and identifying challenges in a relatively small number of jurisdictions in the short-term, findings and operational decisions for SURRG implementation may inform preparedness efforts and a longer-term, comprehensive, and evidence-based public health response to emerging gonococcal resistance. Continued public health efforts and the further development and implementation of innovative approaches are needed to meet the challenge.

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TABLE 1.

Characteristics of Patients With at Least 1 Specimen Collected for *Neisseria gonorrhoeae* Culture and Those With at Least 1 Positive Culture, SURRG, 2018–2019

Characteristics	Patients With Specimen(s) Collected for Culture* n = 46,822 (%)	Patients With *N. gonorrhoeae*-Positive Culture(s)*† n = 10,121 (%)
Jurisdiction		
Denver County, CO	3211 (6.9%)	1272 (12.6%)
Guilford County, NC	21,941 (46.9%)	1022(10.1%)
Honolulu County, HI	1319(2.8%)	340 (3.4%)
Marion County, IN	2142(4.6%)	1271 (12.6%)
Milwaukee City, WI	4602 (9.9%)	1095 (10.8%)
New York City, NY	8040 (17.2%)	2975 (29.4%)
San Francisco County, CA	2763 (6.0%)	953 (9.4%)
Seattle-King County, WA	2804 (6.0%)	1193 (11.8%)
Clinic type		
STD clinic	34,073 (72.8%)	8874 (87.7%)
Non-STD health center‡	12,749 (27.2%)	1247 (12.3%)
Gender§		
Male	25,463 (54.4%)	9021 (89.1%)
Female	21,079 (45.0%)	1018(10.1%)
Transgender male	31 (0.1%)	10(0.1%)
Transgender female	148 (0.3%)	25 (0.3%)
Other gender identity	93 (0.2%)	43 (0.4%)
Unknown	8 (0.0%)	4 (0.0%)
Sex partners among men¶		
MSM	11,732 (46.0%)	4238 (46.9%)
MSMW	881 (3.5%)	357 (4.0%)
MSW	9551 (37.5%)	3605 (39.9%)
Unknown	3329(13.1%)	831 (9.2%)
Age, y		
12–19	3773 (8.1%)	677 (6.7%)
20–29	19,373 (42.2%)	4797 (47.4%)
30–39	12,177 (26.0%)	2843 (28.1%)
40+	7061 (15.1%)	1802(17.8%)
Unknown	82 (0.2%)	2 (0.0%)
Race/Hispanic ethnicity#		
Black/African-American	25,128 (53.7%)	4652 (46.0%)
White	9513 (20.3%)	2541 (25.1%)
Hispanic/Latino	7033 (15.0%)	1751(17.3%)
Asian	1388 (3.0%)	415 (4.1%)
Multirace/other	1680 (3.6%)	480 (4.7%)

Characteristics	Patients With Specimen(s) Collected for Culture* n = 46,822 (%)	Patients With *N. gonorrhoeae*-Positive Culture(s)*† n = 10,121 (%)
Unknown	2080 (4.4%)	282 (2.8%)
Symptomatic//	18,842 (40.2%)	6859 (67.8%)

*One or more specimen(s) collected per patient.

†Among those who had at least 1 specimen collected for culture.

‡Non-STD health centers included: emergency rooms, infectious disease practices, LGBTQ-focused health centers, HIV testing sites, federally qualified health centers, Planned Parenthood health centers, and women's health practices.

§Patient self-identified gender categories.

¶Self-reported gender of sex partners in the previous 2–3 months (timeframe varied by clinic) among male patients (cismale and transgender male). Men who reported unknown, nonbinary, or other gender sex partners were classified as unknown/other.

#All classifications other than Hispanic/Latino are non-Hispanic.

//Symptomatic at the anatomic site(s) from which specimen(s) collected.

MSM, men who have sex with men; MSMW, men who have sex with men and women; MSW, men who have sex with women.

TABLE 2.

Specimens Collected for Culture, Positive for *Neisseria gonorrhoeae,* and With Elevated Azithromycin, Ceftriaxone, and/or Cefixime MICsby Anatomic Site, SURRG, 2018–2019

	Urethral/Urine*		Endocervical/Vaginal		Rectal		Pharyngeal		Total
	n	Row %	n	Row %	n	Row %	n	Row %	n
Specimens collected	14,781	25.3	12,781	21.9	8848	15.1	22,031	37.7	58,441
Specimens positive for *N. gonorrhoeae*	6735	62.3	852	7.9	1673	15.5	1554	14.4	10,814
Isolates with AST performed	6712	62.5	849	7.9	1646	15.3	1528	14.2	10,735
Azithromycin MIC ≥2.0 μg/mL †	671	56.6	47	4.0	244	20.6	223	18.8	1185
Ceftriaxone MIC ≥0.125 μg/mL †	26	59.1	1	2.3	4	9.1	13	29.6	44
Cefixime MIC ≥0.250 μg/mL †	22	53.7	2	4.9	10	24.4	7	17.1	41

*19 of 14,781 urethral/urine specimens collected for culture were urine.

†Isolates may have elevated MICs (via Etest) to >1 antibiotic; includes multiple isolates from the same individual from different anatomic sites.

TABLE 3.

Number of Reported Gonorrhea Cases and Number and Percent With AST by Jurisdiction, SURRG, 2018–2019

	Gonorrhea Cases Reported*		In-Jurisdiction Cases With AST Performed†		Percent of In-Jurisdiction Cases With AST Performed†‡	
Jurisdiction	**2018**	**2019**	**2018**	**2019**	**2018**	**2019**
Denver County, CO	2704	3234	358	343	13.2%	10.6%
Guilford County, NC	1970	2297	129	469	6.5%	20.4%
Honolulu County, HI	1048	1208	60	159	5.7%	13.2%
Marion County, IN	4013	4040	549	682	13.7%	16.9%
Milwaukee City, WI	4205	4683	434	619	10.3%	13.2%
New York City, NY	26,068	28,881	1098	1643	4.2%	5.7%
San Francisco County, CA	5887	5593	285	395	4.8%	7.1%
Seattle-King County, WA	4406	4640	499	573	11.3%	12.3%
Total	50,301	54,576	3412	4883	6.8%	8.9%

*Cases reported to CDC through the NEDSS for all jurisdictions other than Milwaukee City. Milwaukee City case reports from Wisconsin Electronic Disease Surveillance System.

†Unique cases, that is, multiple isolates from the same patient event (eg, different anatomic sites) counted once.

‡There were 534 and 716 out-of-jurisdiction cases (ie, cases from patients residing outside of the funded jurisdiction) with AST performed in 2018 and 2019, respectively, and 492 and 19 cases with AST performed of unknown jurisdiction performed in 2018 and 2019, respectively. With cases of unknown jurisdiction, the number and percent of in-jurisdiction cases with AST performed is at least the number and percent indicated on the table.

In-jurisdiction cases, patients' residence (zip code) within funded SURRG jurisdiction; NEDSS, National Electronic Disease Surveillance System.