REVIEW

Gonorrhea infection in women: prevalence, effects, screening, and management

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Abstract: Gonorrhea is a set of clinical conditions resulting from infection with the sexually-acquired bacterial pathogen *Neisseria gonorrhoeae*. Acquisition may involve multiple mucosal sites in the lower female genital tract, including the urethra, cervix, Bartholin's and Skene's glands, as well as the anorectal canal, pharynx, and conjunctivae. It may spread to the upper genital tract, uterine tubes, abdominal cavity, and other systemic sites. Gonorrhea is the second most commonly reported sexually-transmitted infection in the US and rates are higher among women than men. Women and infants are affected disproportionately by gonorrhea, because early infection may be asymptomatic and also because extension of infection is often associated with serious sequelae. Screening is critical for infection identification and the prevention or limitation of upper genital tract spread, and horizontal and vertical transmission. Routine genital screening is recommended annually for all sexually active women at risk for infection, including women aged < 25 years and older women with one or more of the following risks: a previous gonorrhea infection, the presence of other sexually transmitted diseases, new or multiple sex partners, inconsistent condom use, commercial sex work, drug use, or human immunodeficiency virus infection with sexual activity or pregnancy. Pharyngeal gonococcal infections are common in adolescents, and direct culture screening is necessary to identify affected individuals. Nucleic acid amplification tests (NAATs) are considered the standard for screening and diagnosis. Although urine NAAT testing is most commonly used, there is growing support for vaginal swabs collected by providers or patients themselves. Resistance to all antibiotics currently recommended for the treatment of gonorrhea has been documented and complicates therapeutic strategies. The Centers for Disease Control and Prevention recommend treatment of gonorrhea with a single class of drugs, ie, the cephalosporins.

Keywords: gonorrhea, women, infection, treatment, cephalosporins

Introduction

Gonorrhea refers to a set of clinical conditions involving infection with the sexually acquired bacterial pathogen, *Neisseria gonorrhoeae*, identified microbiologically by its Gram-negative intracellular diplococci. *N. gonorrhoeae* may be acquired at multiple mucosal sites in the lower genital tract, including the urethra, cervix, Bartholin's and Skene's glands, as well as through the anorectal canal, pharynx, and conjunctivae. It may spread to the upper genital tract, uterine tubes, and abdominal cavity, as well as other systemic sites. With references to this condition dating back over 2000 years, gonorrhea is an old disease, with humans serving as the sole natural host.

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Epidemiologic features
Prevalence

Gonorrhea is a common infection, with recent Centers for Disease Control and Prevention (CDC) figures estimating more than 700,000 new cases in the US each year, only half of which are reported.[1] In 2009, there were 301,174 cases of gonorrhea reported in the US, a rate of 99.1 cases per 100,000 people, a 10.5% decrease from the previous year. Gonorrhea follows chlamydial infections as the second most commonly reported sexually transmitted infection (STI) in the US.[1] As a treatable STI, gonorrhea rates respond to public health interventions aimed at aggressive case finding and treatment, and between 1975 and 1997, rates fell 74% in response to a national gonorrhea control program. Following the conclusion of that program, gonorrhea rates have remained relatively stable.

Overall rates and comparisons between subpopulations must be understood within the context that reported case results are greatly influenced by changes in public awareness, health care access, screening practices, resistance patterns, reporting practices, outbreaks of other STIs, and budgetary limitations that hamper the abilities of public health officials to monitor disease patterns accurately.[1,2] In particular, rates of asymptomatic infections are subject to dramatic shifts based on alterations in screening behaviors.[3–6]

Reported rates of gonorrhea and other STIs are commonly held to represent the tip of the iceberg of true infection prevalence, in large part because roughly half of all gonococcal infections in women are asymptomatic.[7] Some have cautioned that actual prevalence is likely to be roughly twice the reported rate.[8] Problems that evolve from that paradigm are that many infected individuals harbor untreated infection for protracted periods of time, greatly increasing the potential both for transmission of infection to sex partners and development of complications due to more profound extension of the infection.[1]

Given the biased and incomplete nature of passive case reporting, active surveillance efforts are used to assess disease burden in selected higher risk populations. In 2009, the median state-specific gonorrhea test positivity among women aged 15–24 years in a subset of states, the District of Columbia, Puerto Rico, and the Virgin Islands, was ascertained through screening efforts in various settings: family planning clinics 1.0% (range 0.0%–3.4%); prenatal clinics 1.2% (range 0.0%–5.5%); women entering the National Job Training Program 1.6% (0.0%–5%); and women entering juvenile corrections facilities 2.9% (0.0%–13.4%).[1]

Geographic distribution

Prevalence in the US varies by geography and demographics, with the highest risk profile in adolescent black women residing in urban locales in the South. The South has traditionally had the highest rates in the US, followed closely by the Midwest. State-reported gonorrhea rates fell in 84% of states between 2008 and 2009.[1] In 2009, gonorrhea rates per 100,000 population by state ranged from 7.2 in Utah to 246.4 in Mississippi. The majority of people with gonorrhea reside in urban locations, with 60% of gonorrhea cases reported by the 50 most populous metropolitan areas that report to the CDC in 2009.

Gender

Traditionally, men were more likely to have gonorrhea, but rates equilibrated by 1996 and have remained similar since then.[1] In 2009, the gonorrhea rate among women was higher than the rate among men, and the most common reporting source for women was private physicians/health maintenance organizations (30.9%), followed by STI clinics (16.7%), family planning clinics (9.1%), other health department clinics (8.1%), and emergency rooms (5.8%).

Race and age

Gonorrhea rates are highest among blacks, and in 2009 the rate in black women was 17 times greater than the rate among white women.[1] Adolescents and young adults bear the greatest burden of infection. Among females in 2009, black women aged 15–19 years and 20–24 years had the highest rates of gonorrhea (2614 and 2549 per 100,000, respectively).

Education

Education has been inversely correlated to behavioral risk-taking associated with the acquisition of STIs in adolescents.[9–13] A recent study of self-reported STIs, including gonorrhea, chlamydia, and trichomoniasis, among young adult women confirmed that education is associated with decreased engagement in sexual risk behaviors and lower rates of STI diagnosis, but that those associations varied across racial strata, with college-educated black women reporting higher rates of STI compared with white women who had not completed high school.[8]

Clinical manifestations

Women and infants are affected disproportionately by gonorrhea, because early infection may be asymptomatic or subclinical and also because extension of infection is often

associated with serious sequelae. The simplest gonococcal infections in women involve mucosal surfaces of the endocervix, urethra, anus, or pharynx. Most such infections are either silent or generate only mild symptoms, including discharge and mild irritation, that may or may not be appreciated until the infection spreads to the upper genital tract. Pharyngeal infections are nearly always asymptomatic. When an etiologic organism is isolated in the presence of cervicitis, it is typically *Chlamydia trachomatis* or *N. gonorrhoeae*.

Because cervicitis might be a sign of upper genital tract infection, women who seek medical treatment for a new episode of cervicitis should be assessed for pelvic inflammatory disease. An estimated 10%–20% of women with gonorrrhea or chlamydia may develop pelvic inflammatory disease if their infection is not identified and they do not receive adequate treatment.[14] Among women with pelvic inflammatory disease, uterine tubal scarring can cause involuntary infertility in 20% of women, ectopic pregnancy in 9%, and chronic pelvic pain in 18%.[15] Some cases of pelvic inflammatory disease have a severe presentation with abdominal pain and fever, and may result in tubo-ovarian abscesses and systemic infection. As with uncomplicated gonococcal infection, many women with pelvic inflammatory disease are asymptomatic or have subtle signs and symptoms of ongoing damage to uterine tubes, resulting in treatment delays in approximately 85% of women with pelvic inflammatory disease and enhancing the chance for long-term sequelae.[15,16]

Gonorrhea can become disseminated, with bacteremia leading on occasion to chronic joint infections and sepsis. Disseminated gonorrhea frequently results in petechial or pustular acral skin lesions, asymmetrical arthralgia, tenosynovitis, or septic arthritis. The infection is complicated occasionally by perihepatitis and rarely by endocarditis or meningitis.

Finally, gonorrhea is highly transmissible, both to sexual contacts and at birth. Infections in the neonate include conjunctivitis, blindness, sepsis, and joint infections.

Screening

Because gonorrhea is often asymptomatic in women, screening is critical for the identification of infection and the prevention or limitation of upper genital tract spread, and horizontal and vertical transmission. Data from a randomized controlled trial of chlamydia screening in a managed care setting suggest that such screening programs can reduce the incidence of pelvic inflammatory disease by as much as 60%.[17]

Because the prevalence of gonorrhea varies widely among communities and populations, targeted rather than widespread screening is recommended by the US Preventive Services Task Force and the CDC. Routine genital screening for *N. gonorrhoeae* is recommended annually for all sexually active women at risk for infection, including women aged < 25 years and older women with one or more of the following risks: a previous gonorrhea infection, the presence of other STIs, new or multiple sex partners, inconsistent condom use, commercial sex work, drug use, or human immunodeficiency virus infection with sexual activity.[18] Pharyngeal gonococcal infections are common in some segments of the population, especially adolescents, and pharyngeal culture screening is responsible for identification of up to one-quarter of infected adolescent women who would likely be missed with traditional genital tract screening.[19–23]

All pregnant women at risk for gonorrhea or living in an area in which the prevalence of *N. gonorrhoeae* is high should be screened at the first prenatal visit for *N. gonorrhoeae*.[18] Pregnant women who test positive should be retested within approximately 3–6 months, and those who remain at high risk for gonococcal infection, including adolescents, should be retested also during the third trimester.[24]

Specific testing for *N. gonorrhoeae* is recommended because of the subtle and nonspecific nature of presentation in most women as well as the availability of highly sensitive and specific testing modalities. Although there are three ways to diagnose gonorrhea, ie, traditional culture, nucleic acid hybridization, and nucleic acid amplification tests (NAATs), NAATs are considered the standard for screening and diagnostic purposes currently. Culture requires collection of actual cells from infected mucosal surfaces, and is the only methodology approved for detection of *N. gonorrhoeae* from both genital (endocervical, urethral) and nongenital (anorectal, pharyngeal, and conjunctival) mucosal surfaces. Cultures can provide antimicrobial susceptibility results, and should be the test of choice in cases of suspected or documented treatment failure. Nucleic acid hybridization tests detect gonococcal DNA and some brands also test for chlamydial DNA; they are recommended for use on specimens collected from genital tract surfaces, including genital tract, vagina, and urine. The principal types of NAATs, ie, transcription-mediated amplification, polymerase chain reactions, and strand displacement amplification, detect and copy gonococcal DNA to enhance detection. NAATs are approved by the US Food and Drug Administration for use with urine, urethral, and endocervical samples, and some are cleared for use on vaginal swabs, but none are approved for use in specimens from the

rectum, oropharynx, or conjunctivae due to concerns that specificity could be compromised by cross-reaction with nongonococcal *Neisseria* species. NAATs have demonstrated improved sensitivity and specificity compared with culture for the detection of *N. gonorrhoeae* at rectal and oropharyngeal sites among men.[21,22,25,26] Numerous public and private laboratories have established performance specifications for using NAAT with vaginal, rectal, and pharyngeal swab specimens, thereby allowing results to be used for clinical management. Under these circumstances, NAATs are preferred for rectal, oropharyngeal, and conjunctival specimens. Liquid-based cervical cytology specimens appear to hold promise for NAAT testing, although test sensitivity using these specimens might be lower than those resulting from the use of cervical swab specimens.[27]

Although the standard female genital screening tool at most public health clinics is urine NAAT testing, there is growing support for vaginal swabs collected by providers and patients in clinical and nonclinical settings. Vaginal swab specimens perform at least as well as with other approved specimens using NAATs, and women find this screening strategy highly acceptable.[31,32] In a study of women using long-acting contraception who remain at risk of STI acquisition, those randomized to self-collected vaginal swabs were more likely to complete screening than the women in the traditional clinical screening group.[33] Another study showed that women recruited by the Internet demonstrated higher positivity of chlamydia than those attending a family planning clinic, providing an important at-risk market for self-collected vaginal swabs.[34] Finally, as a practical matter, swabs reduce biological waste associated with urine testing.

In symptomatic women, the finding of >10 white blood cells per high powered field in vaginal fluid in the absence of trichomoniasis, may reflect endocervical inflammation caused by *C. trachomatis* or *N. gonorrhoeae*,[28,29] and should increase motivation for empiric treatment.

Due to high prevalence of gonorrhea in juvenile detention and jail facilities, the CDC recommends universal screening at intake of adolescent and adult women up to 35 years of age or on the basis of local institutional prevalence data.[1]

Routine testing of inmates has the potential to diagnose a large portion of STIs in the community. When the Cook County Jail in Chicago stopped offering routine chlamydia and gonorrhea testing to all male inmates, approximately 90% fewer detainees were diagnosed with either disease and citywide diagnosis in males and females decreased by 9.3% for chlamydia and 12.9% for gonorrhea.[5] Failure

to perform universal screening in high-risk populations represents a missed opportunity to uncover substantial numbers of infections. When New York City began routine testing for chlamydia and gonorrhea among incarcerated men less than 35 years of age, the citywide diagnosis of chlamydia and gonorrhea increased by 59% and 4%, respectively.[6] Kahn examined the link between incarceration and sexually transmitted infections from a social network perspective in Brooklyn, NY (n = 343) and found that acquisition of an STI was highly associated with a history of incarceration.[30]

Persons with gonorrhea should be tested for other STIs. Outside of the neonatal period, evidence of gonococcal infection at any site is considered virtually 100% indicative of sexual contact.[35]

Management
Antimicrobial-resistant *N. gonorrhoeae*

Gonorrhea treatment is complicated by the ability of *N. gonorrhoeae* to develop resistance to antimicrobial therapies.[36] In 1986, the CDC developed a national surveillance program called the Gonococcal Isolate Surveillance Project to monitor gonococcal isolate resistance patterns in the US among selected STI clinics in approximately 25–30 Gonococcal Isolate Surveillance Project sentinel sites and 4–5 regional laboratories.

Penicillin was the original treatment choice for gonococcal infections until the discovery in 1976 of resistance mediated by plasmid production of β-lactamase.[37] Rates of penicillinase-producing *N. gonorrhoeae* have risen steadily since then, and chromosomal-mediated resistant *N. gonorrhoeae* has emerged to tetracycline, cephosporins, spectinomycin, and aminoglycosides.[38] Newer findings include plasmid-mediated tetracycline resistance resulting from acquisition of a *tet*-M gene[38–40] and fluoroquinolone resistance.[1,41]

Treatment with quinolones used to be the mainstay of *N. gonorrhoeae* treatment in the US, but resistant strains spread throughout the US and the world,[42] leading to removal of that class of drugs from recommendations for the treatment of gonorrhea and pelvic inflammatory disease in April 2007.[43] Provider compliance has been excellent, with the proportion of Gonococcal Isolate Surveillance Project patients treated with fluoroquinolones (ciprofloxacin, ofloxacin, or levofloxacin) at 0.5% and the proportion treated with cephalosporins at 96.2% in 2009. By 2009, 23.5% of isolates collected from Gonococcal Isolate Surveillance Project sites were resistant to penicillin, tetracycline, or ciprofloxacin.[1]

Decreased susceptibility has been documented to azithromycin in US isolates of *N. gonorrhoeae*,[1] and resistant strains have been documented internationally.[44–47] Most of the treatment failures resulting from use of oral cephalosporins have been reported from Asian and European countries,[48–51] although one possible case was reported in Hawaii in 2001.[52] To ensure appropriate antibiotic therapy, clinicians should ask patients testing positive for gonorrhea about recent travel to and sexual activity in these countries. Two cases of suspected treatment failure with ceftriaxone have been reported.[53] Decreased susceptibility of *N. gonorrhoeae* to cephalosporins and other antimicrobials is expected to continue to spread; therefore, state and local surveillance for antimicrobial resistance is crucial for guiding local therapy recommendations.[36] The CDC website (http://www.cdc.gov/std/gisp) and state health departments can provide the most current information.

Antimicrobial regimens

While gonorrhea is a bacterial infection that responds to a number of antibiotics, resistance to all antibiotic treatments currently recommended for the treatment of gonorrhea has been documented and complicate therapeutic strategies. The CDC released new STI treatment guidelines in 2010, with evidence-based antibiotic regimens designed to treat gonorrhea by anatomic site of infection (Table 1).[35] The recommended treatment of gonorrhea has been limited to a single class of drugs, the cephalosporins. The regimens listed in Table 1 are recommended for treatment of uncomplicated lower genital tract and anorectal gonococcal infection in women. Treatment should be administered or dispensed at the time of diagnosis to maximize patient adherence. Patients should be instructed to abstain from sexual intercourse until therapy is completed and until they and their sex partners no longer have symptoms.

Uncomplicated gonococcal infections

Ceftriaxone has been shown to cure 99.2% of uncomplicated urogenital and anorectal and 98.9% of pharyngeal infections in published clinical trials.[49,50] While a dose of 125 mg was recommended until recently for lower genital and anorectal infection, a doubling of the dose is recommended to reduce development of resistance and to cover unrecognized oropharyngeal infection. Other injectable cephalosporins recommended for gonococcal treatment include ceftizoxime, cefoxitin, and cefotaxime. None of these offers any advantage over ceftriaxone for urogenital infection, and efficacy for pharyngeal infection is less certain.[54,55] The only recommended oral choice for gonorrhea is cefixime, which has a lower cure rate at 97.5% for uncomplicated urogenital and anorectal and 92.3% of pharyngeal gonococcal infections. Published sources estimate that approximately 50 patients are thought to have failed oral cephalosporin treatment.[49,56–59]

The 2 g dose of azithromycin should be used only in limited circumstances because of concerns about resistance development to macrolides. The 1 g dose is not recommended because of documented treatment failures, and concerns about rapid emergence of antimicrobial resistance are even greater than with the 2 g dose.[45,59,60]

All alternative regimens for gonorrhea are considered inferior to ceftriaxone, because of lower efficacy in urogenital and rectal infection and unacceptably low cure rates for oropharyngeal infection. Cure of gonococcal infection may become increasingly elusive, given growing clinical and in vitro resistance patterns.[61]

Gonococcal infections of the pharynx are more difficult to eradicate than infections at urogenital and anorectal sites, leaving ceftriaxone 250 mg intramuscularly as the single drug of choice.[62] Two treatment failures have been reported and sensitivity of gonococcal isolates to ceftriaxone has been steadily declining.[53,61] This trend is expected to continue.

Women diagnosed with gonococcal conjunctivitis should undergo saline lavage of the infected eye and be treated with high-dose ceftriaxone.[63]

Complicated gonococcal infections

Disseminated gonococcal infection is a serious infection, for which hospitalization is recommended in consultation with an infectious disease specialist, both for initiation of treatment as well as for completion of a diagnostic evaluation for endocarditis and meningitis. Parenteral therapy should be continued for 24–48 hours after improvement begins, at which time therapy can be switched to oral therapy to complete at least 1 week of antimicrobial therapy (Table 1). Prolonged duration of therapy is required for other complicated infections as well, including 10–14 days for meningitis, and at least 4 weeks for endocarditis (Table 1).

Pelvic inflammatory disease

Given the asymptomatic nature of lower genital tract gonococcal infection, nearly one in five women who do not

Table 1 Treatment recommendations for gonococcal infections in women[1]

Site		Antimicrobial regimen		
		Component 1		Component 2
Lower genital tract and ano-rectum	Recommended	Ceftriaxone 250 mg IM in a single dose OR, IF NOT AN OPTION Cefixime 400 mg orally in a single dose OR Ceftizoxime 500 mg IM in a single dose OR Cefoxitin 2 g IM + Probenecid 1 g orally, in single doses OR Cefotaxime 500 mg IM in a single dose	PLUS	Azithromycin 1 g orally in a single dose OR Doxycycline 100 mg orally twice a day for 7 days
	Alternative	Cefpodoxime 400 mg orally in a single dose OR Cefpodoxime proxetil 200 mg orally in a single dose OR Cefuroxime axetil 1 g orally in a single dose	PLUS	Azithromycin 2 g orally in a single dose
Pharynx	Recommended	Ceftriaxone 250 mg IM in a single dose	PLUS	Azithromycin 1 g orally in a single dose OR Doxycycline 100 mg orally twice a day for 7 days
Conjunctivae	Recommended	Ceftriaxone 1 g IM in a single dose		
Disseminated gonococcal infection (DIC)	Recommended	Ceftriaxone 1 g IM or IV every 24 hours[2]	PLUS	Cefixime 400 mg orally twice a day to complete a 7 day course
	Alternative	Cefotaxime 1 g IV every 8 hours[2] OR Ceftizoxime 1 g IV every 8 hours[2]		
Meningitis	Recommended	Ceftriaxone 1–2 g IV every 12 hours for 10–14 days		
Endocarditis	Recommended	Ceftriaxone 1–2 g IV every 12 hours for at least 4 weeks		

Notes: [1]Adapted from the 2010 CDC STD treatment guidelines;[35] [2]Parenteral treatment should be continued until 24 hours following the improvement of clinical symptoms.

receive treatment will develop pelvic inflammatory disease.[64] Women diagnosed with pelvic inflammatory disease may have lower and or upper genital tract evidence of a number of microbes, including *N. gonorrhoeae* and *C. trachomatis,* and a large number of Gram-negative and anaerobic bacteria. Negative lower tract screening for certain bacteria does not rule out upper reproductive tract infection, and treatment recommendations favor coverage against these various organisms (Table 2). Treatment may be administered in inpatient or outpatient settings, and there are regimens that are primarily parenteral and others that are primarily oral, choices which should be undertaken based on the severity of the infection.[35]

Cotreatment for *C. trachomatis*
Because women with gonorrhea are frequently coinfected with chlamydia, treatment for gonococcal infection at all sites and of all levels of severity should include antibiotics that eradicate both *N. gonorrhoeae* and *C. trachomatis*.[65] Because most gonococci in the US are susceptible to doxycycline and azithromycin, routine cotreatment might also hinder the development of antimicrobial-resistant *N. gonorrhoeae*. Limited data suggest that dual treatment with azithromycin might enhance treatment efficacy for pharyngeal infection when using oral cephalosporins.[66]

Special populations
Pregnant women and women who are HIV-infected and diagnosed with gonorrhea should be treated according to standard recommendations.

Allergic reactions
Up to 10% of individuals with a history of penicillin allergy develop an adverse reaction to first-generation cephalosporins, and fewer react to third-generation cephalosporins.[67] Cephalosporin use should be avoided only

Table 2 Treatment recommendations for pelvic inflammatory disease[1]

Route of administration		Antimicrobial regimen		
		Parenteral component[2]		Oral component
Parenteral + oral	Regimen A	Cefotetan 2 g IV every 12 hours OR Cefoxitin 2 g IV every 6 hours PLUS Doxycycline 100 mg orally or IV every 12 hours	PLUS	Doxycycline 100 mg orally twice a day to complete a 14-day course PLUS, when tubo-ovarian abscess is present,
	Regimen B	Clindamycin 900 mg IV every 8 hours PLUS Gentamicin loading dose 2 mg/kg IV or IM, followed by a maintenance dose of 1.5 mg/kg every 8 hours. Single daily dosing (3–5 mg/kg) can be substituted	PLUS	Clindamycin 450 mg orally four times a day to complete a 14-day course OR
	Alternative	Ampicillin/Sulbactam 3 g IV every 6 hours PLUS Doxycycline 100 mg orally or IV every 12 hours	PLUS	Metronidazole 500 mg orally two times a day tocomplete a 14-day course
Oral	Recommended			Ceftriaxone 250 mg IM in a single dose OR Cefoxitin 2 g IM in a single dose and Probenecid, 1 g orally administered concurrently in a single dose OR Other parenteral third-generation cephalosporin (eg, ceftizoxime or cefotaxime) PLUS Doxycycline 100 mg orally twice a day for 14 days WITH or WITHOUT Metronidazole 500 mg orally twice a day for 14 days
	Alternative			Ceftriaxone 250 mg IM in a single dose PLUS Azithromycin 1 g orally once a week for two weeks WITH or WITHOUT Metronidazole 500 mg orally twice a day for 14 days

Notes: [1]Adapted from the 2010 CDC STD treatment guidelines;[35] [2]Parenteral treatment should be continued until 24 hours following the improvement of clinical symptoms.

in those with a history of a severe reaction to penicillin (eg, anaphylaxis, Stevens Johnson syndrome, and toxic epidermal necrolysis),[68] and further treatment decisions should be made in consultation with an infectious disease specialist.

Follow-up

Women treated with any of the recommended or alternative regimens for an uncomplicated episode of *N. gonorrhoeae* do not need a test-of-cure 3–4 weeks after completing therapy, but should be retested 3 months after treatment or the next time they seek medical care irrespective of partner treatment.[69] Because reinfection within a few months is common,[70–72] patient education regarding safer sexual practices and partner referral is warranted. If symptoms persist following treatment, women should be tested for other pathogens and re-evaluated by culture for *N. gonorrhoeae*; any gonococci isolated should be tested for antimicrobial susceptibility.

Sex partners of patients with *N. gonorrhoeae* infection whose last sexual contact with the patient was within

60 days of the onset of symptoms or diagnosis of infection in the patient should be evaluated and treated for *N. gonorrhoeae* and *C. trachomatis*. If a patient's last sexual intercourse was >60 days before onset of symptoms or diagnosis, the patient's most recent sex partner should be treated. For those whose partners' treatment cannot be ensured or is unlikely, delivery of antibiotic therapy for gonorrhea (as well as for chlamydia) by the patients to their partners should be considered, accompanied by efforts to educate partners about symptoms and to encourage partners to seek clinical evaluation.[73,74]

Suspected treatment failure is less common than reinfection, but has been reported, especially among persons receiving regimens other than the 250 mg dose of ceftriaxone.[49,53,56–58] Clinicians of patients with suspected treatment failure or persons found to harbor a resistant strain should consult an infectious disease specialist, conduct culture and susceptibility testing of relevant clinical specimens, re-treat with at least 250 mg of ceftriaxone intramuscularly or intravenously, ensure partner treatment, and report the situation to the CDC through state and local public health authorities.[35]

Disclosure
The authors report no conflicts of interest in this work.

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