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# Sexually Transmitted Infections in Adolescent Women

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**Abstract:** Adolescent women possess physiologic and, frequently, behavioral characteristics that place them at an increased risk for contracting sexually transmitted infections. Diagnosis and prompt treatment of sexually transmitted infections is of paramount importance for an adolescent's future fertility and prevention of transmission to future partners. Diagnosis and treatment is often hindered by lack of symptoms, concern for screening and treatment confidentiality, and lack of knowledge about community medical resources.

**Key words:** *Neisseria gonorrhoea*, *Chlamydia trachomatis*, adolescents, teens, pelvic inflammatory disease

fourth of the 15 million new cases of STIs occur within the adolescent population.<sup>3</sup> Recent ligase chain reaction assay data on urine specimens from the National Health and Nutrition Examination Survey (NHANES 1999 to 2002)—a large, cross-sectional, population-based study of asymptomatic persons aged 14 to 39 years—showed the highest prevalence for both gonorrhea [0.61%, confidence interval (CI): 0.37-0.98] and chlamydia (3.4%, CI: 2.7-4.2) in the adolescent population aged 14 to 19 years.<sup>2</sup>

## Introduction

Adolescent women are at particularly high risk for contracting and transmitting sexually transmitted infections (STIs). *Neisseria gonorrhoea* (gonorrhea) and *Chlamydia trachomatis* (chlamydia) infection rates are highest among females aged 15 to 19 years compared with other sex or age group.<sup>1,2</sup> Adolescents are disproportionately affected by STIs. Each year, one

There are several factors that place sexually active adolescent females at particular risk for STIs. Sexual behaviors such as multiple sexual partners, serial monogamy, having older male sex partners, and inconsistent condom use contribute to risk for STIs.<sup>4-6</sup> Anal intercourse, used by some teens to preserve virginity, also increases the risk.<sup>7</sup> Physiologically, adolescents are more susceptible to gonorrhea and chlamydia infections owing to the prominent cervical ectropion in adolescent cervix. Cervical columnar epithelial cells are thought to be more

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easily colonized by pathogens.<sup>6,8</sup> Pregnancy and hormonal contraceptives are also thought to increase persistence of cervical ectropion and, consequently, prolong a woman's physiologic susceptibility to STIs.<sup>4,7</sup> When adolescents are infected by chlamydia or gonorrhea, compared with adult women, they are at an increased risk of contracting an upper genital tract infection.<sup>6</sup> In addition, adolescent women may not have been previously exposed to pathogens and, consequently, lack immunity to encounter sexually transmitted microorganisms.<sup>4,7</sup>

Adolescents also have to surmount many real and perceived barriers to healthcare and healthy sexuality.<sup>4,8</sup> Although The Centers for Disease Control (CDC) guidelines state that medical care for all STIs can be provided to adolescents without parental consent or parental knowledge in all 50 states, many adolescents are dependent on their parents' health insurance programs or lack the finances to pay even small clinic fees.<sup>4,8</sup> Adolescents often express concerns about confidentiality with their family physician and may be afraid of being stigmatized once they have been diagnosed with an STI.<sup>9</sup> Similarly, adolescence is a time of rapid psychosocial development. The transition to adulthood can be accompanied by increased risk-taking behavior and a decreased concern about the consequences.<sup>4</sup> Sexual education is addressed inconsistently in schools and households, forcing adolescents to gain information about sexuality and STIs from peers, the media, and personal experiences.<sup>4</sup> When alcohol and drug use accompany sexual activity, good judgment is further clouded and condoms may be less likely to be used.

STIs and healthy sexuality are important topics for the female adolescent population. STIs often have an indolent course. Delayed diagnosis and treatment of STIs, however, can have serious long-term consequences for the reproductive

health of both adolescent and adult women. In this chapter, we will discuss the epidemiology, screening, diagnosis, treatment, and follow-up for gonorrhea and chlamydia infections and pelvic inflammatory disease (PID).

## Gonorrhea

### EPIDEMIOLOGY

*N. gonorrhea* is the second most commonly reported bacterial STI.<sup>3</sup> Women under the age of 25 years are at highest risk for contracting gonorrhea, and women aged 15 to 19 years had the highest rate of gonorrhea (624.7/100,000 population).<sup>3,8</sup> The presence of asymptomatic gonorrhea infection in adolescent women ranges from 0% to 13%, depending on the population screened.<sup>7</sup> Incidence of gonorrhea is higher among young, single women of lower socioeconomic status; inner city residents; women of African American, Latino, or Native American ethnicity; incarcerated women; and women who exchange intercourse for drugs, shelter, food, or money.<sup>2,7</sup> According to CDC data from the year 2003, the Southeastern United States has the highest rates of gonorrhea infection.<sup>9</sup>

Seventy-five percent to ninety percent of gonorrhea infections in women are asymptomatic; whereas 10% to 40% are asymptomatic in men.<sup>7</sup> In addition, women are more susceptible to contracting STIs than their male counterparts. The difference in transmission is thought to be because of the greater receptivity of the mucosal surface in the female genital tract and the propensity for infective secretions to remain in the female genital tract.<sup>7</sup> The vagina also provides a greater surface area.

### CLINICAL PRESENTATION OF GONOCOCCAL CERVICITIS AND URETHRITIS

The incubation period for gonorrhea is typically 1 week but can extend to

1 month.<sup>7</sup> Symptoms, if they occur, usually appear within 10 days of exposure, are often mild, and can be mistaken for cystitis or vaginitis.<sup>1,7</sup> Other symptoms include fever, malaise, anorexia, vaginal discharge, vaginal bleeding, dysuria, painful bowel movements, and lower abdominal or suprapubic pain.<sup>7</sup>

### SCREENING/DIAGNOSIS

The CDC recommends annual screening of high risk women defined as women < 25 years of age, women with inconsistent condom use, women with a history of other STIs, women with new or multiple partners, sex workers, and women who use illicit drugs.<sup>3,10</sup> The CDC recommends that all patients diagnosed with gonorrhea be retested 3 to 4 months after initial treatment, as the rates of reinfection are high.<sup>3</sup>

Genitourinary gonorrhea can be detected by nucleic acid hybridization tests, culture, and nucleic acid amplification tests (NAATs).<sup>7,10,11</sup> The use of Gram stain for diagnosis of gonorrhea from rectal, pharyngeal, and endocervical specimens is not recommended by the CDC; Gram stain is only 30% to 65% sensitive with these specimens.<sup>3</sup> Gram stain showing intracellular Gram negative diplococci and polymorphonuclear leukocytes, however, is considered diagnostic for gonorrhea urethritis in symptomatic men, as it has high sensitivity (> 99%) and high specificity (> 99%).<sup>3</sup>

Culture on Thayer Martin or Martin Lewis medium or nucleic acid hybridization testing requires an endocervical, rectal, or pharyngeal swab sample. Culture, the current gold standard, is more specific (100%) than other screening tests and allows for the discernment of antimicrobial sensitivities, which is useful in recurrent gonorrhea infections, pediatric patients, or to obtain specimens for legal purposes.<sup>7,10,12</sup> The sensitivity of culture for gonorrhea ranges from 69.8% to 92.6%.<sup>12</sup>

Nucleic acid hybridization assays for gonorrhea have sensitivities ranging from 94.2% to 99.2% and specificities ranging from 98.7% to 99.5% for cervical samples.<sup>1,11,12</sup> NAATs are also versatile, as specimens can be obtained from endocervical or vaginal swabs and urine samples. Urine-based NAAT assays for gonorrhea have sensitivity and specificity ranging from 55.6% to 91.3% and 98.7% to 99.4%, respectively.<sup>11</sup> Yet, there are also disadvantages to these tests. Inhibitors that interfere with the NAAT assay can exist, yielding a false positive result<sup>11</sup> that can have profound psychosocial consequences. Although the sensitivity and specificity of many NAATs are high, some CDC guidelines suggest that in a population where disease prevalence is low, a positive NAAT be confirmed by a second Food and Drug Administration (FDA)-approved NAAT using an alternative primer or other screening test.<sup>10-12</sup> Furthermore, antimicrobial sensitivities cannot be performed on noncultured specimens. DNA and RNA from chlamydia may persist for 1 to 3 weeks after treatment, and blood and other substances in the urine can make urine-based tests less sensitive.<sup>1,12</sup> Culture must be used for rectal and pharyngeal samples.<sup>3</sup>

When testing for gonorrhea, testing for coinfection with chlamydia is always recommended. Recent data from the NHANES 1999-2002 population-based study showed a 45.7% prevalence of coinfection with chlamydia in those subjects with positive urine ligase chain reaction assays for gonorrhea.<sup>2</sup>

### TREATMENT

Unless the patient has tested negative for coinfection of chlamydia with an FDA-approved NAAT, the patient should be treated empirically for chlamydia at the time of treatment for gonorrhea.<sup>3</sup> There are 2 CDC recommended regimens for uncomplicated gonococcal infections of the cervix, urethra, and rectum as listed

in Table 1. Both of these regimens are safe in pregnancy.<sup>3,13</sup> The CDC also recommends 2 alternative regimens as listed in Table 2. Spectinomycin can also be given to pregnant adolescents.<sup>13</sup>

The rate of quinolone-resistant gonorrhea is rising across the world. In the United States, resistance has emerged in Hawaii and California. Consequently, fluoroquinolone treatment of gonorrhea was discontinued in the years 2000 and 2002 in Hawaii and California, respectively.<sup>14</sup> Recently, the Gonococcal Isolate Surveillance Project summarized the results of data collected from heterosexual men and men who have sex with men in the US.<sup>14</sup> Quinolone-resistant *N. gonorrhoea* has greatly increased from < 1% during the years 1990 to 2001 to 13.3% of 3005 isolates in the year 2006.<sup>14</sup> As a result of these findings, fluoroquinolone use for treatment of *N. gonorrhoea* and PID is no longer recommended by the CDC.<sup>13,14</sup> *N. gonorrhoea* culture and antimicrobial susceptibility testing should be performed on any patient suspected of having a persistent infection after undergoing a CDC recommended treatment.<sup>3</sup>

Patients allergic to penicillin or cephalosporin should be treated with spectinomycin, if available, or should be desensitized to penicillin.<sup>13</sup> Treatment with a macrolide is also an option, as indicated in Table 3, if desensitization is not an option for the patient.<sup>13</sup> There is

**TABLE 1. CDC Recommended Regimens for Treatment of Uncomplicated Gonococcal Infections of the Cervix, Urethra, and Rectum<sup>3,13</sup>**

Ceftriaxone 125 mg intramuscularly in a single dose*
Or
Cefixime 400 mg orally in a single dose*
And
Treatment for chlamydial infection if not ruled out

\* Both regimens safe in pregnancy.

Table adapted from CDC.

CDC indicates The Centers for Disease Control.

**TABLE 2. CDC Alternative Regimens for Treatment of Uncomplicated Gonococcal Infections of the Cervix, Urethra, and Rectum<sup>3,13</sup>**

Spectinomycin 2 g in a single intramuscular dose*
Or
Single-dose cephalosporin regimen (one of the following):
Ceftiozoxime 500 mg intramuscularly
Cefoxitin 2 g intramuscularly with probenecid 1 g orally
Cefotaxime 500 mg intramuscularly
May be oral alternatives
Cefpodoxime 400 mg orally
Cefuroxime axetil 1 g orally
And
Treatment for chlamydial infection if not ruled out

\* Spectinomycin is currently not available in the United States.

Table adapted from CDC.

CDC indicates The Centers for Disease Control.

over emerging antimicrobial resistance to macrolides.

#### FOLLOW-UP

Women should abstain from sexual activities until they and their partner(s) have been treated appropriately and remain symptom free.<sup>3</sup> No test-of-cure or test for therapeutic failure is needed after completion of treatment with a CDC recommended antibiotic regimen. If symptoms persist after treatment, the teen should undergo culture with antimicrobial sensitivities and testing for chlamydia and other organisms.<sup>3</sup> Adolescents

**TABLE 3. CDC Regimens for Treatment of Uncomplicated Gonococcal Infections of the Cervix, Urethra, and Rectum in Patients Allergic to Penicillin or Cephalosporin<sup>3,13</sup>**

Spectinomycin 2 g in a single intramuscular dose
Or
Patient should be desensitized to penicillin
Or
Azithromycin 2 g orally in a single dose (if patient cannot be desensitized to penicillin)

Table adapted from CDC.

CDC indicates The Centers for Disease Control.

should, however, be rescreened for gonorrhea and chlamydia 3 months after treatment, given the high rate of reinfection.<sup>3,7</sup> If she is not retested within 3 months, then she should be retested whenever she seeks care within the next 12 months.<sup>3</sup>

The CDC recommends testing all pregnant women at risk for gonorrhea or living in an area of high gonorrhea prevalence at their initial prenatal visit; retesting these women for gonorrhea in the third trimester is also recommended.<sup>3</sup>

## Chlamydia

### EPIDEMIOLOGY

*C. trachomatis* is the most common sexually transmitted infection in women, with a rate of 496.5 cases/100,000 females in the year 2005.<sup>8</sup> It is most prevalent in women <25 years of age; sexually active adolescents have infection rates that are 2 to 3-fold higher than those of adult women.<sup>7,8</sup> Depending on the population tested, prevalence of chlamydia infection ranges from 2.7% of sexually active adolescents seen in suburban private pediatric practices to 12.7% of low income adolescents and 13% to 15% adolescents in juvenile detention facilities.<sup>7,8,12</sup> One school-based urine screening study of ninth to 12th graders in New Orleans showed that almost 12% of female students tested positive for chlamydia.<sup>15</sup> The prevalence of chlamydia in adolescent (ages 15 to 19 y) males and females varies among racial and ethnic groups; a prevalence of 12% exists for African Americans, 6% for Mexican Americans, and almost 4% for white Americans.<sup>15</sup> In addition, the incidence of chlamydia infections is inversely proportional to age. Rates of chlamydia infections in women <20 years old range from 5% to 14% compared with rates of 3% to 12% in women 20 to 24 years of age.<sup>9</sup> In 1 study, the rate of chlamydia infection was 8-fold greater in women

<15 years of age and 5-fold greater in women aged 15 to 19 years compared with older women.<sup>7</sup>

### CLINICAL PRESENTATION

Most women with chlamydia infection of the cervix have no symptoms.<sup>4</sup> Chlamydial infections can also present as subclinical upper respiratory tract infection or PID.<sup>3</sup> Other presenting symptoms include vaginitis, cervicitis, urethritis, proctitis, Bartholins gland infection, salpingitis, Reiter syndrome, postabortal endometritis, and lymphogranuloma venereum.

### SCREENING/DIAGNOSIS

CDC guidelines recommend yearly screening of all sexually active women <25 years of age and women older than 25 with risk factors.<sup>5</sup> Twice-yearly screening may also be warranted in women who live in areas of high prevalence of *C. trachomatis* infection.<sup>7</sup> Routine screening for chlamydia in populations of high prevalence may eventually reduce cases of PID, as illustrated by the findings of a randomized, controlled trial of 2607 women who were part of a Washington State health maintenance organization (HMO) from the years 1990 to 1992.<sup>16</sup> In this study, female respondents were identified as being at high risk for acquisition of chlamydia by means of a questionnaire mailed to all female HMO members aged 18 to 34 years. These women were randomly assigned to undergo screening for *C. trachomatis* with subsequent treatment if indicated or to receive usual care. These women were followed for 1 year, and cases of PID were identified through a database and confirmed by the women's medical record. Within 1 year, 7% of the women in the screening group tested positive for chlamydia and were treated. At the end of 1 year, 9 cases of PID were found in the screening group and 33 cases were found in the group of women undergoing usual case (relative risk: 0.44, 95% CI: 0.20-0.90). Screening

for chlamydia could reduce rates of PID by as much as 60%.<sup>16</sup>

Endocervical and male urethral swab samples can be screened for chlamydia with the use of culture, direct immunofluorescence, enzyme immunoassays, nucleic acid hybridization tests, and NAATs.<sup>3,10</sup> Culture, although only 50% to 90% sensitive, is 100% specific and considered the “gold standard” for diagnosis of chlamydia.<sup>7,12</sup> Culture does not detect dead organisms and requires the inoculation of McCoy cells followed by detection of intracytoplasmic inclusions with fluorescent antibody stain after 2 to 3 days of cell growth.<sup>7</sup> Because culture is limited by its sensitivity and its lengthy detection process, it is most commonly used for legal investigations. Nucleic acid hybridization assays on cervical specimens have sensitivities that range from 55% to 96.7% and specificities that range from 97.9% to 99.6% for chlamydia.<sup>1,7,11,12</sup> Some NAATs are cleared by the FDA for the use with vaginal swab specimens.<sup>3</sup>

Urine can be screened with NAATs. Screening of first void urine specimens has greatly expanded the ability to detect asymptomatic women; sensitivity ranging from 79.9% to 92.5% and specificity of 98.6% to 99.5% has been noted.<sup>1,11</sup> NAATs are the most sensitive tests with urethral swab specimens and have been noted to have sensitivities ranging from 79% to 92.5% in women.<sup>12</sup> NAAT rectal swabs are currently being evaluated by the FDA for their effectiveness in detecting chlamydia.<sup>3</sup>

## TREATMENT

There are currently 2 CDC recommended treatment regimens as listed in Table 4. The single dose regimen is advised in patients for whom compliance with the multiple day regimen may be difficult. Consequently, the single dose regimen is ideal for adolescents.<sup>3</sup> In addition, 4 alternative treatment regimens exist, as listed

**TABLE 4. CDC Recommended Regimens for Treatment of Urogenital Chlamydial Infections<sup>3,13</sup>**

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Azithromycin 1 g orally in a single dose
Or
Doxycycline 100 mg orally twice a day for 7 d

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Table adapted from CDC.

CDC indicates The Centers for Disease Control.

in Table 5. The lower dose erythromycin should be used in cases of nausea, as the gastrointestinal side effects of erythromycin may affect compliance.<sup>3</sup> The 2 recommended treatment regimens in pregnancy are illustrated in Table 6. The 4 alternative regimens for pregnant women are listed in Table 7.

Adolescents should be instructed to abstain from intercourse for 7 days after therapy and until all sexual partners are adequately treated. All sexual partners within the past 60 days should undergo screening for STIs and treated if positive. If the teen's most recent sexual contact was > 60 days before the onset of symptoms, this contact also needs to be informed of the positive results and screened for STIs.<sup>3</sup>

## FOLLOW-UP

According to the CDC guidelines, a test-of-cure within 3 to 4 weeks after treatment is not recommended unless she is pregnant, compliance with treatment is

**TABLE 5. CDC Alternative Regimens for Treatment of Urogenital Chlamydial Infections<sup>3,13</sup>**

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Erythromycin base 500 mg orally 4 times a day for 7 d
Or
Erythromycin ethylsuccinate 800 mg orally 4 times a day for 7 d
Or
Ofloxacin 300 mg orally twice a day for 7 d
Or
Levofloxacin 500 mg orally once daily for 7 d

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Table adapted from CDC.

CDC indicates The Centers for Disease Control.

**TABLE 6. CDC Recommended Regimens for Treatment of Urogenital Chlamydial Infections in Pregnancy<sup>3,13</sup>**

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Azithromycin 1 g orally in a single dose
Or
Amoxicillin 500 mg orally 3 times a day for 7 d

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Table adapted from CDC.

CDC indicates The Centers for Disease Control.

questionable, symptoms persist, or reinfection is suspected.<sup>3</sup> The CDC recommends testing all pregnant women under the age of 25 years and those at risk for chlamydia at their initial prenatal visit; retesting these women for chlamydia in the third trimester is also recommended.<sup>3</sup> Retesting for chlamydia in < 3 weeks from the time of treatment is not recommended as dead organisms can cause false positive test results on NAAT. Recurrent infections confer an increased risk for the development of PID; consequently, retesting 3 months after treatment or whenever the patient seeks medical care in the next 3 to 12 months is recommended.<sup>3</sup>

## PID

### EPIDEMIOLOGY

Approximately 10% to 20% of women infected with *N. gonorrhoea* and 10% to 40% of women infected with *C. trachomatis* will develop PID.<sup>6,15</sup> It is estimated that 20% of cases of PID occur in women 19 years of age or younger.<sup>6</sup> The risk of PID is 10 times greater in women aged 14 to 24 years when compared with women 24 years of age and older.<sup>17</sup> Both biologic (cervical ectropion, lack of local immunity, and coexistence of bacterial vaginosis) and behavioral (exposure to multiple sex partners, sex partners of older age, inconsistent condom use, delay in seeking medical care, and fear of disclosure of sexual activity) factors place adolescents at higher risk for developing PID when compared with their adult counterparts.<sup>6,7</sup>

**TABLE 7. CDC Alternative Regimens for Treatment of Urogenital Chlamydial Infections in Pregnancy<sup>3,13</sup>**

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Erythromycin base 500 mg orally 4 times a day for 7 d
Or
Erythromycin base 250 mg orally 4 times a day for 14 d
Or
Erythromycin ethylsuccinate 800 mg orally 4 times a day for 7 d
Or
Erythromycin ethylsuccinate 400 mg orally 4 times a day for 4 d

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Table adapted from CDC.

CDC indicates The Centers for Disease Control.

### DIAGNOSIS/SCREENING/PRESENTATION

PID can manifest as salpingitis, endometritis, a tubo-ovarian abscess, and/or pelvic peritonitis. PID is a clinical diagnosis. The minimum criteria for PID include pelvic or abdominal pain in a sexually active female in conjunction with one or more of the following: cervical motion tenderness, uterine tenderness, and/or adnexal tenderness.<sup>3</sup> Additional criteria that can be used to strengthen the specificity of the minimum criteria for PID include a cervical or vaginal mucopurulent discharge, oral temperature of > 38.3°C, abundant white blood cells on saline preparation of vaginal secretions, elevated C-reactive protein or erythrocyte sedimentation rate, and laboratory confirmation of cervical infection with chlamydia or gonorrhea.<sup>3</sup> The most specific diagnostic criteria for diagnosis of PID include histopathologic evidence of endometritis on endometrial biopsy specimen, laparoscopic abnormalities consistent with PID, and transvaginal ultrasound or magnetic resonance imaging showing thickened fluid-filled tubes or findings suggestive of a tubo-ovarian complex.<sup>3</sup>

Although other causes of pelvic or abdominal pain should be explored, the clinician should maintain a low threshold

for treating PID in high-risk populations.<sup>3</sup> Unrecognized and untreated PID can have devastating effects on a woman's reproductive life. Sequelae of PID include ectopic pregnancy, infertility, persistent tubo-ovarian abscesses, chronic pelvic pain, and intra-abdominal adhesions.<sup>3,18</sup> Because of these devastating consequences, clinicians should have a low threshold for treatment and should provide treatment promptly.

### **PATHOPHYSIOLOGY**

Many organisms cause PID. Sexually transmitted organisms, such as *N. gonorrhoea* or *C. trachomatis* and vaginal flora (*Gardnerella vaginalis*, anaerobes, *Haemophilus influenzae*, enteric Gram-negative rods, *Streptococcus agalactiae*, *Bacteroides fragilis*) have all been associated with PID. Less common organisms such as *Mycoplasma genitalium*, *Mycoplasma hominis*, *Ureaplasma urealyticum*, and cytomegalovirus have also been associated with PID.<sup>3</sup> Negative cervical cultures for *N. gonorrhoea* and *C. trachomatis* do not rule out PID.

It is hypothesized that a chronic inflammatory response to these organisms develops with the resultant activation of proinflammatory and anti-inflammatory cytokines furthering tissue damage.<sup>7</sup> Certain behaviors are also thought to place women at increased risk for development of PID. Cigarette smoking, vaginal douching, and intercourse during menstruation have been associated with a higher risk of developing PID.<sup>7</sup>

### **TREATMENT**

Treatment regimens for PID must treat gonorrhoea, chlamydia, and anaerobes.<sup>3</sup> According to the findings of the Pelvic Inflammatory Disease Evaluation and Clinical Health (PEACH) Randomized Trial, both outpatient and inpatient treatments are equally acceptable for treatment of mild-to-moderate first-time episodes of PID uncomplicated by

tubo-ovarian abscesses.<sup>18</sup> The PEACH trial was a large, United States multicenter trial conducted from the years 1996 to 1999 that randomized women, ages 14 to 37 years, to either inpatient parenteral or outpatient oral treatment of PID. Those randomized to outpatient treatment regimen received a single dose of intramuscular cefoxitin 2 g and 1 g of oral probenidol, followed by oral doxycycline for 14 days; those randomized to inpatient treatment regimen received intravenous cefoxitin (2 g every 6 h) and either oral or intravenous doxycycline (100 mg every 12 h) for 72 hours, followed by oral doxycycline 100 mg twice daily for 14 days.<sup>18</sup> Short-term outcomes at 30 days postrandomization (change in treatment, tubo-ovarian abscess, adverse drug reactions, abdominal tenderness on examination, *N. gonorrhoea*, *C. trachomatis*, or endometritis at 30 d) and long-term outcomes (pregnancy, spontaneous abortion, infertility, recurrent PID, ectopic pregnancy, tubal obstruction, chronic pelvic pain) at a mean of 35 months posttreatment did not differ between inpatient and outpatient groups.<sup>18</sup> Eighty-four month follow-up data from the PEACH trial showed no statistically significant differences in long-term outcomes with the exception of 1 measure: women older than 25 years of age were statistically more likely to become pregnant after the outpatient treatment regimen.<sup>19</sup> Interestingly, the frequency of ectopic pregnancy in PEACH participants was <1% at the 84-month follow-up.<sup>19</sup>

Criteria for hospitalization for PID treatment include inability to exclude a surgical emergency, pregnancy, lack of response to oral antimicrobial therapy, inability to tolerate or noncompliance with outpatient therapy, presence of a tubo-ovarian abscess or the presence of a high fever, severe illness, nausea, or vomiting. Differences of opinion regarding the need for hospitalization of teens with PID exist with some sources

advocating hospitalizing all adolescents for treatment of PID, whereas others recommending hospitalizing only teens who fulfill the aforementioned criteria for hospitalization.<sup>8,14</sup>

### PARENTERAL TREATMENT OF PID

Parenteral and oral treatment for mild-to-moderate PID have been shown to have equal efficacy.<sup>18</sup> Parenteral antimicrobial therapy should be discontinued 24 hours after the patient has shown signs of clinical improvement (defervescence, decreased abdominal or pelvic pain) with transition to oral treatment.<sup>3</sup> Twenty-four hours of direct inpatient observation for women with a tubo-ovarian abscess is advised.<sup>3</sup> The CDC recommends 2 parenteral treatments for PID: parenteral regimen A and parenteral regimen B (Tables 8 and 9). Of note, doxycycline has equal bioavailability in either the oral or IV form and causes discomfort when given IV. Women should be discharged on either doxycycline 100 mg orally twice daily or clindamycin 450 mg orally 4 times daily to complete a total of 14 days of antimicrobial therapy.<sup>3</sup>

Results from the Gonococcal Isolate Surveillance Project emphasize the increase in quinolone resistant *N. gonorrhoea* in the United States; consequently, fluoroquinolone use for treatment of *N. gonorrhoea* and PID is no longer recommended by the CDC.<sup>14</sup> An alternative parenteral

**TABLE 8. CDC Recommended Parenteral Regimen A for Treatment of Pelvic Inflammatory Disease<sup>3,13</sup>**

Cefotetan 2 g IV every 12 h
Or
Cefoxitin 2 g IV every 6 h
Plus
Doxycycline 100 mg orally every 12 h

Parenteral therapy may be discontinued 24 h after a patient improves clinically. Oral therapy with doxycycline (100 mg twice daily) should then be continued to complete 14 d of therapy.

Table adapted from CDC.

CDC indicates The Centers for Disease Control.

**TABLE 9. CDC Recommended Parenteral Regimen B for Treatment of Pelvic Inflammatory Disease<sup>3,13</sup>**

Clindamycin 900 mg IV every 8 h
Plus
Gentamicin loading dose IV or IM (2 mg/kg of body weight) followed by a maintenance dose (1.5 mg/kg) every 8 h. Single daily dosing may be substituted

Parenteral therapy may be discontinued 24 h after a patient improves clinically. Oral therapy with doxycycline (100 mg twice daily) or clindamycin 450 mg orally 4 times a day should then be continued to complete 14 d of therapy.

Table adapted from CDC.

CDC indicates The Centers for Disease Control; IM, intramuscularly.

regimen for treatment of PID is given in Table 10. The CDC does acknowledge 1 additional regimen. One trial demonstrated short-term cure rates with azithromycin, 1 dose IV followed by oral therapy for 1 week, alone or with a 14-day course of metronidazole.<sup>3</sup>

### ORAL TREATMENT OF PID

Parenteral and oral treatments for acute PID have been shown to be equivalent.<sup>18,19</sup> Yet, teens who do not respond to oral therapy in 72 hours should be clinically reevaluated, hospitalized, and changed to parenteral therapy. The CDC recommends 3 oral treatment regimens as indicated in Table 11.<sup>13</sup>

### ALTERNATIVE ORAL TREATMENT REGIMENS FOR PID

According to the 2007 CDC guidelines, some fluoroquinolones can be used as an alternative regimen for treatment of PID if antimicrobial susceptibility for

**TABLE 10. CDC Alternative Parenteral Regimen for Treatment of Pelvic Inflammatory Disease<sup>3,13</sup>**

Ampicillin/sulbactam 3 g IV every 6 h
Plus
Doxycycline 100 mg orally or IV every 12 h

Table adapted from CDC.

CDC indicates The Centers for Disease Control.

**TABLE 11. CDC Recommended Oral Regimens for Treatment of Pelvic Inflammatory Disease<sup>3,13</sup>**

1	Ceftriaxone 250 mg IM in a single dose Plus Doxycycline 100 mg orally twice a day for 14 d With or without Metronidazole 500 mg orally twice a day for 14 d
2	Cefoxitin 2 g IM in a single dose and probenecid, 1 g orally administered concurrently in a single dose Plus Doxycycline 100 mg orally twice a day for 14 d With or without Metronidazole 500 mg orally twice a day for 14 d
3	Other third generation cephalosporin (ceftizoxime or cefotaxime) Plus Doxycycline 100 mg orally twice a day for 14 d With or without Metronidazole 500 mg orally twice a day for 14 d

Table adapted from CDC.

CDC indicates The Centers for Disease Control; IM, intramuscularly.

*N. gonorrhoea* can be determined. If NAAT is positive or microbial susceptibility cannot be determined for *N. gonorrhoea*, parenteral cephalosporin is recommended.<sup>14</sup> If the isolate is susceptible to fluoroquinolones, levofloxacin 500 mg orally once daily or ofloxacin 400 mg twice daily for 14 days with or without metronidazole 500 mg orally twice daily for 14 days is advised.

A recent randomized controlled trial has shown that a single intramuscular injection of 250 mg of ceftriaxone followed by 1 g of oral azithromycin weekly for 2 weeks can be equivalent to outpatient regimens using oral doxycycline in treating mild-to-moderate PID as an outpatient.<sup>20</sup> The primary outcome of this study was clinical cure, as defined by a 70% reduction in a tenderness score; long-term data from this study are not available.<sup>20</sup>

#### TREATMENT OF TUBO-OVARIAN ABSCESS

In the presence of a tubo-ovarian abscess, clinicians should use clindamycin or metronidazole with doxycycline for

additional anaerobic coverage.<sup>3</sup> These teens should be discharged on oral clindamycin 450 mg 4 times daily to complete a total of 14 days of therapy.<sup>3</sup> Oral clindamycin is thought to provide better anaerobic coverage than oral doxycycline in the presence of a tubo-ovarian abscess.<sup>3</sup>

#### PID FOLLOW-UP

Rescreening 4 to 6 weeks after the completion of therapy for PID in women who have documented gonorrhoea or chlamydia infection is advocated by some specialists.<sup>3</sup> Sexual partners within the 60 days preceding the onset of symptoms in the teen should be evaluated and treated for both gonorrhoea and chlamydia.<sup>3</sup>

### **Conclusions: Prevention, Counseling, Screening, Partner Notification, and Treatment of Adolescents**

#### PREVENTION AND COUNSELING

It should be emphasized that abstinence from any type of sexual contact is the

safest method of protecting against STIs. For adolescents who are sexually active, avoiding risky behaviors and participation in safe sexual practices should be emphasized.<sup>4</sup> Parents and school officials should discuss the dangers related to multiple sexual partners, use of illicit substances and alcohol, sexual and physical abuse, and peer pressure as they relate to adolescent sexuality. Small, intervention-focused support groups can have an impact on adolescent risk-taking behaviors and acquisition of sexually transmitted diseases, as illustrated by the Project Sexual Awareness for Everyone and Project Sexual Awareness for Everyone 2 for 15 to 45 year old at-risk women.<sup>21</sup> Adolescents should be taught to recognize forced or coerced sexual intercourse. The Commonwealth Fund's Commission on Women's Health reported that 26% of girls in ninth to 12th grade had experienced physical or sexual abuse, including rape.

Consistent and correct condom use should be emphasized with both female and male adolescents.<sup>22</sup> Male latex condoms with water-based lubricants should be used with every act of male-female or male-male intercourse to reduce the transmission of human immunodeficiency virus (HIV), gonorrhea, chlamydia, and trichomonas. It must be acknowledged that condoms may be less effective in preventing the transmission of STIs transmitted by skin-to-skin contact (eg, syphilis, chancroid, herpes simplex virus, and human papillomavirus). Consistent use of female vaginal condoms consisting of a lubricated polyurethane sheath with a ring on each end should provide protection against STIs, although limited clinical trials have been performed.<sup>3,4</sup>

Although vaccination laws vary among states, hepatitis B and human papillomavirus vaccines should be given to all adolescents.<sup>23</sup> Adolescents can either receive the 3-dose schedule hepatitis vaccine or, adolescents 11 to 15 years of age can

receive the adult 2-dose schedule hepatitis B vaccination.<sup>23</sup> The quadrivalent human papillomavirus vaccine is a 3-dose scheduled vaccine that should be given to all children 11 to 12 years of age. Catch-up vaccine can be given to females 13 to 26 years of age.<sup>23</sup>

## SCREENING

Annual screening of sexually active adolescents for gonorrhea, chlamydia, cervical neoplasia (if 3 y after initial sexual activity), syphilis (if they have a history of prior STIs, multiple sexual partners, exchange sex for drugs or money, use illicit drugs, been in jail or detention facility, or live in an endemic area), and HIV should be performed. Both gonorrhea and chlamydia infections in women can facilitate HIV transmission (see chapter on HIV in adolescents).

Routine screening of asymptomatic male and female adolescents is important. Reported cases of gonorrhea and chlamydia only represent a partial burden of the diseases, as most cases are not reported because most people are asymptomatic.<sup>2</sup> It is estimated that 60% or fewer women at risk for STIs actually undergo STI screening.<sup>11</sup> Routine screening can be carried out in several locations, such as medical offices or schools in areas of high STI prevalence. Specimens obtained from urine, cervical, self-collected vaginal, or urethral swabs can be used in routine screening.<sup>4,11</sup> Expansion of screening in female adolescents is important, but there is evidence that routine STI screening should also target asymptomatic males, especially those aged 15 to 29 years, as shown in the NHANES asymptomatic screening study.<sup>2,15</sup>

Although CDC guidelines state that medical care for all STIs can be provided to adolescents without parental consent or parental knowledge in all 50 states, national and state legislation should be broadened to allow minors to self-enroll for reproductive health services and

STI screening without parental consent.<sup>4</sup> Confidentiality of both screening and treatment are important factors to consider when attempting to encourage asymptomatic and symptomatic adolescents to seek STI screening.

### RESCREENING

Adolescent women have a high rate of gonorrhea and chlamydia reinfection and persistent infection. Rescreening adolescents with previous gonorrhea or chlamydia infections in the past 12 months is very important, as 16.7% of adolescent women in the NHANES study had a chlamydial infection after previously being treated for either gonorrhea or chlamydia in the past 12 months.<sup>2</sup>

### ADMINISTERING TREATMENT AND PARTNER NOTIFICATION

On site, single-dose treatment of STIs is recommended for adolescents because it is often difficult to get adolescents to return for follow-up treatment. In addition, discussion of sexual partner notification, reinfection risk, condom use, abstinence from intercourse until treatment completion, and testing for other STIs should occur at the screening or treatment visit.<sup>4</sup> Improved partner notifications and expedited partner treatment may help to decrease the prevalence of chlamydia in the sexually experienced population.<sup>2</sup> Syphilis, gonorrhea, chlamydia, chancroid, HIV, and acquired immunodeficiency syndrome (AIDS) are reportable diseases in every state in the United States.<sup>3</sup> Reporting of other STIs, however, varies among states. Physicians should familiarize themselves with the local reporting requirements.<sup>3,4</sup>

### Conclusions

Various physiologic and behavioral characteristics make adolescent females especially susceptible to STIs, especially gonorrhea, chlamydia, and PID. Contracting these and other STIs can have

serious long-term consequences for the adolescent's gynecologic and obstetric health. Adolescence, therefore, is an important time for prevention, screening, and treatment of STIs.

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