

Mini-Review

Chlamydia and Gonorrhea Screening in Asymptomatic Young Women

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Abstract. *Background:* Adolescent and young adult minority women are at high risk for chlamydia (CT) and gonorrhea (NGC) cervical infections, which are significant causes of pelvic inflammatory disease, impaired fertility, ectopic pregnancy and chronic pain. The purpose of this article is to review among young women in the United States: (1) the epidemiology of CT and NGC cervical infection and their medical complications; (2) current public health recommendations to promote asymptomatic CT and NGC screening; (3) current screening practices and challenges of implementing public health recommendations; (4) testing and cost issues; and (5) future directions in promoting asymptomatic CT and NGC screening.

Methods: We conducted a MEDLINE search for articles published over the last two decades relating to CT and NGC screening in young women and then systematically reviewed all relevant articles.

Results: The data indicate that CT and NGC infection are geographically widespread in the U.S. and asymptomatic infection is highly prevalent among economically disadvantaged young females. Public health recommendations promoting CT and NGC screening in asymptomatic young women are directed to both health care providers and clients. However, strategies to promote screening efforts have been primarily directed toward health care providers; there are no published studies on client-initiated screening strategies. Challenges of implementing public health recommendations and future directions for CT and NGC screening are discussed.

Conclusions: Young sexually active women continue to be at high risk for CT and NGC infection. The data indicate that implementation of health provider-based and client-initiated screening in private and public health care settings is a challenge. However, there is a great need to develop

strategies to understand and promote client-initiated screening.

Key Words. Chlamydia screening women—Gonorrhea screening women—STI screening women

Introduction

Among young women living in the United States, delay in the diagnosis and treatment of chlamydia (CT) and gonorrhea (NGC) cervical infections is a significant cause of asymptomatic and symptomatic pelvic inflammatory disease (PID), resulting in impaired fertility, ectopic pregnancy, and chronic pain.¹ Thus, early detection through screening and treatment of both symptomatic and asymptomatic infections is important to decrease the incidence of PID and minimize tubal damage.^{1–3}

This article reviews the literature on CT and NGC screening and related areas in adolescent (15–19 years) and young adult (20–24 years) women. The topic areas reviewed include: (1) the epidemiology and medical complications of CT and NGC cervical infection; (2) current public health recommendations to promote asymptomatic CT and NGC screening in response to the sexually transmitted infections (STI) epidemic in young women; (3) current screening practices and challenges of implementing public health recommendations; (4) testing and cost issues; and (5) future directions in promoting asymptomatic CT and NGC screening.

A MEDLINE search for articles on CT and NGC and STI screening and STI health seeking was conducted. The search was limited to studies on adolescent and young adult women conducted in the U.S. and published in domestic or international journals over

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Synopsis: Efforts to promote chlamydia and gonorrhea screening in young women have been directed at health care providers. Strategies to promote client-initiated screening are needed as well.

the last two decades. The main source of epidemiologic data is the Centers for Disease Control and Prevention (CDC), U.S. Department of Health and Human Services.⁴

Epidemiology and Medical Complications of CT and NGC Cervical Infection

Prevalence of CT and NGC Cervical Infection

Prevalence data on CT and NGC infection reported in this review are drawn from a variety of settings as reported by the CDC. These settings represent areas of the country where expansion of CT screening activities have occurred (Table 1).⁴ In 2002, national CT rates in women were higher than NGC rates and the highest age-specific reported CT rates occurred among 15 to 19-year-olds (2,619 per 100,000) followed by 20 to 24-year-olds (2,570 per 100,000).⁴ Since 1998, NGC rates among young women in these age groups have decreased; however, the prevalence of NGC remains highest in women aged 15 to 19 years than women in any other age group.⁴

Overall CT and NGC infections in the U.S. predominate in the south, in medium to large major metropolitan areas and in lower socio economic populations.⁴ However, with few exceptions, the prevalence of CT is equal to or greater than 5% regardless of region, rural or urban location of the provider, or race/ethnicity of clients.^{4,5} Thus, as demonstrated by these data, CT and NGC infection continue to be a public health problem particularly in young women.

Race Disparities in Rates of CT and NGC Cervical Infection

In 2002, in contrast to white females aged 15 to 24 years, CT and NGC rates were eight times higher

for African-Americans in the same age group.⁴ The reported rates of CT (approximately 8,000 cases per 100,000 population) and NGC (approximately 3,300 cases per 100,000 population) were highest for African-American females aged 15 to 24 years. Relative to non-Hispanic Whites (1,300 cases per 100,000 population), Hispanic adolescent and young adult women have three times higher rates of CT (2,900 per 100,000 population). In contrast, NGC rates for Hispanic and non Hispanic white females aged 15 to 24 years in 2002 were similar (300 cases and 200 cases per 100,000 population, respectively).⁴ Of note, higher rates of CT are reported in Hispanic females from Arizona and Texas than California, and in U.S.-born Hispanics than foreign-born Hispanic females.⁶⁻¹² Of all CT cases reported in Texas and Houston in 2002, a higher number of CT cases were reported in Hispanic (40%) than African American (25%) young women.^{13,14} Thus, while the African-American population continues to be disproportionately affected by NGC, Hispanic young women are disproportionately affected by CT infection in this state.¹³

Prevalence of Pelvic Inflammatory Disease and Ectopic Pregnancy

Ectopic pregnancy and PID are potential complications associated with CT and NGC cervical infection. However, age-specific data for PID and ectopic pregnancy are not available, and accurate estimates of these conditions as they result from CT and NGC are difficult to obtain due to the fact that confirmation of PID by laparoscopy is not standard care and many women today receive treatment for ectopic pregnancy as outpatients.⁴ Similarly, prevalence rates for other complications including infertility and chronic pain are difficult to obtain.

Prevalence of Asymptomatic and Recurrent Infection

Sexually active 13 to 19-year-old females are susceptible to asymptomatic STIs with up to 45% and 77% of infected young women being asymptomatic with NGC and CT infections, respectively.^{15,16} Young women are also at high risk for repeat CT cervical infections: up to 30% of repeat CT cases are reported within 6 months and up to 40% of all types of STIs are reported within 12 months of a previous infection.^{15,17-23} These data have been collected from studies of predominantly African American young women; very little is known about repeat infections among Hispanic and non-Hispanic whites.

Behavioral Risk Factors and Predictors for CT and NGC Cervical Infection

Independent risk factors for CT—the more common infection in adolescent and young women—have been

Table 1. Prevalence rates of Chlamydia (CT) and Gonorrhea (NGC) Infection in Young Women⁴

Location	Age (range in years)	Infections	Prevalence Rate(s) (%)
Family planning clinics	15–24	CT	3.0%–14.2%
		NGC	0.1%–2.8%
Prenatal clinics	15–24	CT	1.5%–14.4%
		NGC	0%–5.7%
National Job Corps	16–24	CT	4.4%–16.8%
		NGC	0%–6.8%
School-based Clinics	15–18	CT	7.9%–15.9%
		NGC	1.6%–8.5%
Street Youth	15–18	CT	5.2%–39.1%
		NGC	0%–6.4%
Juvenile detention facilities	15–18	CT	6.3%–28.3%
		NGC	0.6%–12.4%

studied primarily in urban African American populations and include: age of first sexual experience before 15 years, currently pregnant, current contraceptive use, NGC as an initial infection, mucopurulent cervicitis, cervical friability, new partner in previous 60 days, multiple sexual partners in previous 30 days, sex partner with multiple sex partners, having sex with a symptomatic partner, inconsistent condom use, and greater than five life-time partners.^{20,21,24,25} Having sex with an untreated or with an incompletely treated partner are also independent predictors for repeat CT infection,^{21,26} and higher risk sex (five or more acts of unprotected sex during the 3-month period preceding each followup period) is associated with repeat STIs (NGC, CT, *Trichomonas*, and syphilis).²⁶ While no single risk factor or combination of risk factors has been determined to effectively predict CT infection, age less than 25 years appears to be the strongest overall predictor for CT and NGC infection.^{15,20}

Patterns of sexual relationships and frequency of condoms may also influence STI acquisition. A combined effect of serial monogamy, concurrent sexual relationships, and diminishing use of condoms over the duration of a relationship may be particularly important in the eventual exposure to and ongoing transmission of organisms.²⁷ Partner acquisition tends to follow a pattern of serial monogamy, with fewer than 10% of sexually active adolescents reporting more than one partner during the previous 3 months.^{28,29} Furthermore, a recent study using Ad Health data found that teens in sequential and concurrent relationships reported lower condom use and were 2.3 and 3.9 times more likely, respectively, to report a STI than single-relationship teens.³⁰ Although condom use rates have increased, few young women report consistent condom use. In fact, inner city minority young women are most at risk for STIs and therefore most likely to benefit from condom use,⁴ however, they appear to use them the least.^{19,30,31}

Public Health Recommendations to Promote CT and NGC Screening in Asymptomatic Young Women

Centers for Disease Control recommendations for promoting CT and NGC screening have evolved over time in response to emerging epidemiological and behavioral evidence. In 1985, the CDC provided its first set of recommendations for asymptomatic CT screening.³² It was recommended that the screening of asymptomatic, high-risk women should be accorded the highest priority. Since no single individual characteristic or behavior was in itself a sufficient criterion to define which persons should be screened, the CDC recommended that individuals attending STI clinics who

were asymptomatic and who otherwise would not be offered treatment for CT (no history of exposure to CT) should be screened for CT infection. In addition, persons in urban settings who were younger, of lower socioeconomic status, who reported multiple sex partners, and who otherwise would not be offered treatment for CT infection (no history of exposure to CT), should also be screened.³²

In 1991, the CDC published recommendations for PID prevention³³ which promoted routine STI screening in preselected groups and settings. Health-care providers were encouraged to detect asymptomatic STIs through routine screening for CT and NGC infection in (a) adolescent-health and family-planning clinics serving high percentages of young persons; (b) high-prevalence groups such as commercial sex workers and illicit drug users; and (c) facilities in which high levels of STI might be expected (e.g., jails, emergency rooms).³³ In 1993 these recommendations were followed by CT prevention recommendations³⁴ which further refined the criteria for CT testing. In particular, annual screening was encouraged for women aged 20 to 25 years using specific screening criteria—inconsistent barrier contraception and a new or more than one partner in the previous 3 months. However, routine screening in all women less than 20 years of age undergoing pelvic exams was encouraged. Routine CT screening was also encouraged in all sexually active female patients of adolescent-care providers, women undergoing induced abortion, women attending STI clinics, and women in detention facilities. Screening for CT at family planning and prenatal care clinics was also considered particularly cost-effective because of the large number of sexually active young women who underwent pelvic examinations.³⁴

In 2002, the CDC further revised its screening recommendations to health care providers stating that all sexually active women under 25 years should be screened for CT and GC at least annually. Furthermore, in response to concerns about high recurrent CT infection rates, the CDC added the recommendation that instead of a test-of-cure visit 3 to 4 weeks after treatment for CT infection, health care providers screen women 3 months after such treatment.³⁵

The CDC has also provided strategies for PID and CT prevention that were directed to young women. The strategies included screening guidelines that encouraged young women to seek screening by paying attention to their own sexual behavior, STI risk, and the presence of genital symptoms. They were encouraged to (1) seek a medical evaluation promptly after having unprotected sex with someone who is suspected of having an STI; (2) seek routine STI checkups if in a non-mutually monogamous relationship, even if symptoms are not present; and (3) seek care immediately when genital symptoms appear.^{33,34}

Current Screening Practices and Challenges of Implementing Public Health Recommendations

Health Provider-based Screening Practices

In response to CDC recommendations, CT, and NGC screening programs for young women have been implemented in a variety of publicly-funded settings serving populations at high risk for CT infection, including family planning clinics, urban adolescent clinics, high schools, the military, Job Corps, and detention centers; see Table 1.^{4,5,20,22,35-44} Reports published from these screening programs further supported the importance of screening all sexually active female populations less than 20 years of age. For example, over a 5-year period, Mosure et al assessed whether use of specific screening criteria as compared to universal screening would allow better targeting of screening efforts in multiethnic adolescent females attending 160 family planning clinics in four states.²⁰ When using criteria that included presence of mucopurulent cervicitis, cervical friability, use of oral contraceptive methods, having a new sexual partner, having multiple partners, a symptomatic partner or a partner with multiple partners, 79% of CT infections were detected while testing 77% of women attending these clinics. Within this study, even a “low risk” sexually active group of non pregnant teenagers, with no clinical findings or sexual behavior history risks, and who used condoms, were found to have a 6% prevalence rate, representing 21% of teenagers seen and accounting for 17% of all infections. The authors concluded that the only selection criteria that should be used to screen for CT infection in females is age.²⁰ Similar findings were reported by Miller et al, who found that testing women ≤ 22 years would detect 77% of CT infections while testing 51% of the women in a family planning clinic and detect 74% of CT infections while testing 48% of the women in a STD clinic.⁴²

The effectiveness of health provider-based screening programs has been difficult to assess due to the large size of programs, variations in prevalence rates in populations targeted, diverse laboratory tests used over time, and the criteria used to determine effectiveness. An annual urine-based NGC and CT screening program at a high school found CT rates declined only slightly over a 3-year period among females who sought annual screening.⁴¹ Observed results may be explained by re infection in females from untreated partners rather than program ineffectiveness per se. A large scale, region-wide screening program at family planning clinics found that during a 1-year period, observed changes in CT prevalence in women varied between regions.⁴ From 2000 to 2001, after adjusting for changes in laboratory methods from culture to enzyme immunoassays to amplification tests, and corresponding increases in test sensitivity in CT

test positivity, regional screening programs demonstrated a decrease in CT positivity in five of 10 regions, an increase in four regions, and no change in one region.⁴ The decrease in prevalence was demonstrated in screening programs that had been in place for several years. The expansion of screening programs to populations with higher prevalence of disease may have contributed to the observed increases in CT positivity.^{4,5,20,38,39}

Decreased incidence of PID as a result of screening has also been demonstrated.⁴⁵ A randomized controlled trial of one-time CT screening among women seeking care at a health maintenance organization (HMO) at high risk for CT infection found a significantly lower incidence of PID in the intervention group as compared to the usual care group.⁴⁵

Challenges of Implementing Health-provider Screening Practices

Screening programs developed in response to the 1993 CDC recommendations have been implemented more successfully in the public sector than in private practice settings.⁴ Many women at risk for CT were not being tested in settings outside of the public health sector, partly due to lack of awareness of risk for CT infection among some health care providers, as well as limited resources available to support screening.^{4,46} Surveys of primary care practices have documented low rates of routine CT screening: fewer than one third of physicians routinely screened men or women for STIs.⁴⁶⁻⁴⁸ This was well below practice guidelines for women and strongly suggested that efforts to improve STI care by private physicians were required.⁴⁶⁻⁴⁸ In contrast, the prevalence of CT and NGC in females in some private practice settings may have been too low (2%) to justify routine screening of all sexually active young women.⁴⁹ Thus, in response to the low rate of screening by health care providers in the private sector, the Health Plan Employer Data and Information Set (HEDIS) measure was established in the year 2000 for CT screening of sexually active women 15 to 25 years of age who were provided medical care through managed care organizations.⁵⁰

Shafer et al observed multiple barriers to implementing a urine-based CT screening program in primary care clinics within a HMO.⁵¹ Using a randomized cluster design of 10 clinics to assess a system-level, clinical practice improvement intervention, Shafer's group found that barriers existed despite providers recognizing the benefits of screening for CT infection in sexually active adolescent girls seeking “well adolescent care.”⁵¹ Barriers included absence of site-specific clinical protocols for obtaining urine specimens confidentially; primary care physicians having difficulty obtaining sexual histories from their adolescent patients; lack of awareness by primary care physicians that

CT infection was a significant problem in their practice; a low level of knowledge of urine-based tests; and reluctance by clinic staff to be involved in screening adolescents for STIs.⁵¹ Boekeloo et al found that an independent predictor of primary care provider willingness to screen adolescents was a belief that routine screening is cost effective.⁵² Cook et al learned that only a third of primary care physicians said they would screen asymptomatic sexually active adolescent women.⁵³ Female physicians were more likely to screen than were male physicians and those who worked in a clinic were more likely to screen than those in solo practice. Screening was likely to be done in a metropolitan area that had a population with greater than 20% African Americans.⁵³ Thus, interventions to train health care providers to screen young women for CT and NGC in primary care and urgent care settings are critically needed.

The 2002 CDC recommendation to screen women for CT 3 months after treatment for a CT infection may help to identify repeat infection.³⁵ However, this approach will not identify cases of new infection from a change in partner. If a young woman were to remain asymptomatic until the next annual checkup, she would be placed at risk for silent tubal infection.^{2,3} Burstein et al observed a mean of 6.3 months to repeat infection within an adolescent sample and therefore suggests that routine screening be conducted every 6 months for sexually active urban adolescents.¹⁵ The enormous financial cost of routinely screening young women every 6 months has been voiced by Orr⁵⁴ and the CDC thus far has not recommended this approach. Additional studies are needed to determine the optimal frequency with which young women should be screened for STIs.

Client-initiated Screening Practices

STI health care seeking behaviors by young women is a central issue in understanding client-initiated STI screening practices. Studies specifically evaluating STI health seeking in adolescent, young adult and adult women are reviewed.⁵⁵⁻⁶⁰ Many women appear to interpret their STI symptoms as normal and thus delay seeking health care,⁵⁶ yet symptoms from a suspected STI seem to be the most important reason to seek STI care among young women with a past history of STIs as compared to those without a past history of STIs.^{55,56} However, of those women who seek treatment, the majority does so after a period of waiting.⁵⁶ Other studies report reasons given by asymptomatic women to seek STI screening following a risky sexual encounter include recognition that they are at risk; being told by their partners to seek treatment; and being told their partner has a STI.^{55,56,58}

Applying the Health Belief Model (perceptions of susceptibility and seriousness of STIs, and barriers and

benefits to seeking STI testing and treatment) specifically to STI health seeking behavior, Simon and Das found the likelihood of action for prevention and control of asymptomatic and symptomatic STIs in college female students did not correlate with perceived seriousness of an STI but did correlate with perceived susceptibility, barriers, and benefits.⁵⁷ They found a direct relationship between perceived susceptibility to STI and asymptomatic checkups such that young women who thought they could get a STI were more likely to seek testing when asymptomatic. In addition, these investigators found that among asymptomatic females of African descent, 14% had gone for STI checkups every 3 to 6 months and 24% every 9 to 12 months.⁵⁷ Perceived barriers to screening when asymptomatic included fear of pain associated with checkups and privacy issues for self and partner. Early diagnosis, having partners examined, and being able to more easily refrain from casual sex if a partner refused condom use were cited as perceived benefits.⁵⁷

The type of partner appears to influence perceived STI risk and thus screening behaviors. Approximately 60% of young, predominantly minority, women in a recent study reported that they were only "slightly" to "not at all likely" to acquire a STI from unprotected sex with their main partner.⁵⁹ These young women were significantly more likely to seek STI screening with a change in partner than with their main partner: 47% had already sought screening after unprotected sex and when asymptomatic with a change in partner as compared to 26% with a main partner.⁵⁹

Fear of or discomfort with pelvic exams may be a barrier to seeking STI screening. With the newer amplification tests, young women have the option of obtaining their own vaginal specimens. Studies have found that young women appear very comfortable obtaining their own specimens and the majority report it is easy to perform, preferable to a gynecological examination, and that they would undergo testing at frequent intervals if self-testing were available.⁶¹⁻⁶⁴ Home testing is an additional option that may be available in near the future.⁶⁵

Screening behavior can be influenced by lack of privacy at a testing site, and the testing experience being too embarrassing.⁶⁰ Almost 70% of adolescents indicate that they have health concerns (including STIs) they wish to keep confidential and they would choose not to seek health services because of the perceived inability to obtain confidential services.⁶⁶ Fear of finding out that one has a STI or fear of surreptitious drug testing maybe additional barriers to seeking testing.⁶⁰ Fortenberry et al found that rates of shame and stigma were higher among young adults without a NGC test than among those who had sought a NGC test in the past year.⁶⁷ Making a decision to adopt a behavior such as STI screening may involve

weighing of factors for (pro) and against (con) STI screening. In a recent study which applied the transtheoretical model of change to seeking STI screening when asymptomatic, young women ranked the pro item for screening—"I would not have to worry about having a STI"—highest in importance. They also ranked con items against screening—"it takes a lot of time" and "clinic workers may tell my business to others"—highest in importance.⁵⁹ While pro item scores for screening increased in importance from precontemplation to action along the stages of change, con item scores remained important across all stages.⁵⁹ Thus, discussion of both pros and cons to screening with a young woman are important in order to reduce perceived barriers and bring about change in behavior.

Additional barriers such as transportation problems and low health literacy may be important factors influencing STI health seeking behavior among adolescent females. Adolescent females report receiving transportation services to a large STI clinic from friends (28%), sex partner (28%), and from parents (20%).⁶⁸ A low level of health literacy may also pose as a barrier to STI health-seeking behavior. Fortenberry et al reported that despite a self-estimation of high risk for STIs, low health literacy individuals (ability to read medical information at 8th grade or lower level) seek health care less than respondents of higher health literacy (ability to read medical information at 9th grade or higher level).⁶⁹ Seeking STI screening when asymptomatic can be a complex concept as it involves abstract thinking. Thus, level of health literacy is a potentially significant factor influencing health-seeking behavior. Conveying health information at lower literacy levels may be an important strategy to promote STI screening.

In summary, studies on STI health seeking indicate that young women seek STI screening under a variety of circumstances. Important factors that appear to influence a young woman's STI screening behavior include her ability to interpret genital symptoms, being prompted by a partner to seek testing, her perceived level of risk for STI, her relationship with her partner, her comfort level with pelvic examinations, her ability to receive confidential and non-judgmental care, transportation, other forms of social support, and her level of health literacy.

Interventions to Promote Client-initiated Screening Practices

To date, behavioral intervention programs funded by the CDC have focused on primary prevention measures to reduce the risk of STIs among adolescent and young adult women. These programs have involved client-focused, theory-based risk-reduction programs with the common objective of promoting condom use.^{26,70-73} Although consistent use of condoms may double

in response to clinic-based risk-reduction counseling,^{26,70,71,73} consistent condom use seldom exceeds 50% of coital exposures. Moreover, extensive and personalized risk-reduction counseling interventions have been observed to reduce incident STIs by only 5 to 10%.^{26,70,71,73} Thus, STI screening should be an important adjunct to risk-reduction efforts.⁷⁴

There has been a marked absence of programs and no publications describing interventions to improve client-initiated screening behaviors. This is despite the CDC's recommendations that encourage young women to (1) seek a medical evaluation promptly after having unprotected sex with someone who is suspected of having an STI; (2) seek routine STI checkups if in a non-mutually monogamous relationship, even if symptoms are not present; and (3) seek care immediately when genital symptoms appear.^{33,34} The more recent movement toward empowering youth to take an active role in maintaining health supports a client-initiated approach to STI screening. Development of client-initiated screening programs may also enhance the current efforts to promote health care provider screening practices. Blake et al recently reported potential ways to motivate young people to get tested for CT including: putting a positive focus on testing; providing incentives for testing; providing more information about CT infection testing and treatment; providing emotional support for people who are getting tested; providing more privacy at testing sites; making test results available faster; providing low cost or free testing; and offering CT testing when patients come in for other reasons.⁶⁰

Testing and Cost Issues

Screening tests for Chlamydia and Gonorrhea Infection

An important component of screening is the selection of a highly sensitive test for CT and NGC. In large volume, community-based clinics, the DNA Probe (Gen-Probe) at present is currently the most popular test used to screen for CT and NGC infection. This test is simple to perform and can be a "mail-out" specimen.⁷⁴ The test performs best in clinic populations with high prevalence rates of CT and NGC infection. The sensitivity and specificity in detection of CT infection is approximately 80% and 100%, respectively. The sensitivity and specificity in detection of NGC infection by DNA Probe is 90 to 97% and 99%, respectively.^{75,76}

The most significant advance in the field of STIs is the development of automated methods to detect amplified CT DNA or RNA.⁷⁷ These tests are capable of detecting even small amounts of CT DNA in voided urine or self-collected vaginal swabs and are highly sensitive and specific, thus making these tests excellent

screening and diagnostic tools and a good alternative to cell culture.⁷⁷ The amplification tests overall are considered the most sensitive and specific tests available today, with testing of urine specimens expected to revolutionize STI screening and diagnosis. The reliability of the polymerase chain reaction (PCR), ligase chain reaction (LCR), strand displacement amplification (SDA), and transcription mediated amplification (TMA) to detect CT and NGC appears to be equivalent for cervical, vaginal and urine specimens as long as a first-catch specimen is obtained for the latter. The sensitivity of PCR, LCR, SDA, and TMA for CT ranges from 87 to 99% and specificity from 97 to 100%.⁷⁵⁻⁷⁷ The amplification tests for NGC from cervical and first-catch urine specimens have a sensitivity of 95 to 97% and specificity of 99 to 100%.^{62,75,76} At present, these tests are predominantly being used for research purposes due to their high cost; however, it is anticipated that as these tests become more affordable they will be available for widespread use in clinical and non-clinical settings.

Mention must be made of the appropriate STI screening tests to use following sexual assault of a young woman. A highly specific test is needed to acquire evidence for potential use in a legal investigation. As a result, if an examination is conducted, culture specimens for CT and NGC are recommended from all sites of penetration or attempted penetration.³⁵ Non-culture tests such as Gen Probe, EIA, and direct fluorescent antibody tests are not acceptable alternatives for culture because false-negative and false-positive test results occur more often with these non-culture tests.³⁵ To date, research data, clinical experience and court cases provide insufficient evidence of the utility of nucleic acid amplification tests in investigating sexual assault. Thus, if a nucleic acid amplification test is used as an alternative to culture method, the CDC recommends that a positive test result should be confirmed by a second FDA-licensed nucleic acid amplification test that targets a different sequence from the initial test.^{4,35,76}

Economics of Screening

A few recent studies conducted in the USA have assessed cost-effectiveness of CT screening.⁷⁸⁻⁸¹ Wang et al used standard cost-effectiveness analytic methods to estimate incremental cost-effectiveness of a school-based CT screening program by comparing such a program with a screening program at a primary care practice.⁷⁹ The school-based screening program was found to be cost-effective and cost-saving at a CT prevalence estimate ranging from 6.2% to 18.6% in females. In addition, the school-based screening program, in contrast to the private practice program, resulted in a net savings of \$1524 per case of PID

prevented.⁷⁹ For adolescent females in a juvenile detention center, the most cost effective approach to prevent short and long term complications of CT infection was treatment of CT infection based on clinical suspicion and treatment based on urine LCR test results.⁸⁰ In contrast, in terms of short-term cost benefits based on cure rates, Tao et al determined that the most cost effective approach when operating on a fixed budget at publicly-funded family planning clinics was to screen all women under 31 years with DNA Probe, as opposed to the urine LCR, and to treat all positive CT cases with single-dose azithromycin, as opposed to 7 days of doxycycline.⁸¹ It appears that when clinic age distribution and age specific prevalence of CT and NGC are known, a cost effective screening strategy that involves careful test and treatment selection can be developed for young women. Additional studies are needed to evaluate the efficacy of various approaches to detection and treatment within specific target populations.

Future Directions

Taken together, the epidemiologic data indicate that CT and NGC infection are geographically widespread and are highly prevalent among economically disadvantaged young minority females. Although public health recommendations for CT and GC screening have evolved over the years, they continue to emphasize health care provider initiated opportunistic screening of sexually active young women. In the absence of efforts to increase young women's awareness of the public health guidelines on when to seek STI screening, young women are likely to seek screening only if they experience symptoms or are told to do so by health authorities or an infected partner. Asymptomatic infections will continue to be largely untreated, thereby increasing PID risk and potentially prolonging duration of infectiousness.

The prevention of negative sequelae from STIs is contingent on the successful prevention of STIs and the early detection of existing infection. Just as efforts are being made to promote primary STI prevention programs, secondary prevention programs, such as health provider-based and client-initiated screening programs across a variety of settings, are sorely needed. The decision to seek STI screening and the behaviors required to carry forth the decision are complex. There is a pressing need to better understand the multifaceted issues associated with perceived risk, sexual decision making, and recognition of cues to high-risk sexual behaviors, especially among adolescent and young adult women from a variety of race and ethnic groups. Development and implementation of client-based education programs to promote

screening is an under addressed area. As home-based amplification test kits become available, studies to assess their role in promoting client-initiated screening will be needed.⁶⁵ Studies that utilize theoretically-based behavioral models to promote screening by health care providers and to promote screening initiated by young women should be encouraged. In addition, data that support the need for screening programs are largely derived from research with African American populations. To address emerging health disparities in STIs and promote STI screening in Hispanic young women, further studies are needed to assess rates of recurrent infection and to understand sociocultural risk factors and STI health seeking in this cultural group.

Finally, Blum et al suggest two important demographic shifts which will tax the current public health system and its funding for STI prevention and treatment.⁸² Over the next 25 years, the number of young people (10 to 24 years of age) is anticipated to increase from 35 million in 1990 to an estimated 43 million in year 2022. In addition, there will be more than a proportional increase in minority youth. If the projections for adolescent demographic trends continue, even those young women who are highly motivated to seek STI screening in publicly funded clinics will not be able to receive timely care due to inadequate funding. Thus, in order to provide CT and NGC screening to meet rising needs, there must be a concomitant increase in the availability of funds to both screen and effectively treat infected cases. In a survey of national Maternal and Child Health state and regional staff, the issue of STI/HIV prevalence was ranked fourth among priorities in adolescent health care.⁸² Although these infections have a larger prevalence in the population than teenage pregnancy and substance abuse, they ranked lower in importance.⁸² To aggressively address the consequences of CT and NGC, the disease must have a higher priority among those public health officials who set national and state health promotion disease prevention agendas that subsequently impact funding opportunities.

References

- Westrom L, Eschenbach D: Pelvic inflammatory disease. In: Sexually Transmitted Diseases, (3rd ed.). Edited by KK Holmes, PF Sparling, P-A Marsh, et al. New York, McGraw Hill Health Professions Division, 1999, pp 783-809
- Osser S, Persson K, Liedholm P: Tubal infertility and silent salpingitis. *Hum Reprod* 1989; 4:280
- Pavletic AJ, Wolner-Hanssen P, Paavonen J, et al: Infertility following pelvic inflammatory disease. *Infect Dis Obstet Gynecol* 1999; 7:145
- Centers for Disease Control and Prevention: Sexually Transmitted Disease Surveillance, 2002. Atlanta, GA, U.S. Department of Health and Human Services, 2003
- Mertz KJ, Levine WC, Mosure DJ, et al: Trends in the prevalence of chlamydial infections: The impact of community-wide Testing. *Sex Transm Dis* 1997; 24:169
- Mertz KJ, McQuillan GM, Levine WC, et al: A pilot study of the prevalence of chlamydial infection in a national household survey. *Sex Transm Dis* 1998; 25:225
- Gunn RA, Hillis SD, Shirey P, et al: *Chlamydia trachomatis* infection among Hispanic women in the California-Mexico border area, 1993: Establishing screening criteria in a primary care setting. *Sex Transm Dis* 1995; 22:329
- Glennay KF, Glassman DM, Cox SW, et al: The prevalence of positive tests results for *Chlamydia trachomatis* by direct smear for fluorescent antibodies in a south Texas family planning population. *J Reprod Med* 1988; 33:457
- Neu NM, Grumet S, Saiman L, et al: Genital chlamydial disease in an urban, primarily Hispanic, family planning clinic. *Sex Transm Dis* 1998; 25:317
- Campos-Outcalt D, Ryan K: Prevalence of sexually transmitted diseases in Mexican-American pregnant women by country of birth and length of time in the United States. *Sex Transm Dis* 1995; 22:78
- Minnis AM, Padian NS: Reproductive health differences among Latin American- and US-born young women. *J Urban Health* 2001; 78:627
- Klausner JD, McFarland W, Bolan G, et al: Knock-knock: a population-based survey of risk behavior, health care access, and Chlamydia trachomatis infection among low-income women in the San Francisco Bay area. *J Infect Dis* 2001; 183:1087
- Texas Department of Health: Epidemiologic Profile of Sexually transmitted Diseases, 2001. <http://www.tdh.state.tx.org>; March 2003. Accessed June 2003.
- Houston Department of Health and Human Services: AIDS/HIV Prevention and Sexually Transmitted Diseases. <http://www.ci.houston.tx.us:2002>. Accessed June 2003.
- Burstein GR, Gaydos CA, Diener-West M, et al: Incident *Chlamydia trachomatis* infections among inner-city adolescent females. *JAMA* 1998; 280:521
- Farley TA, Cohen DA, Elkins W: Asymptomatic sexually transmitted diseases: The case for screening. *Prev Med* 2003; 36:502
- Chacko MR, Smith PB, McGill L: Recurrent Chlamydia cervicitis in young women at a family planning clinic. *J Ped Adolesc Gynecol* 1989; 2:149
- Blythe MJ, Katz BP, Batteiger BE, et al: Recurrent genitourinary chlamydial infections in sexually active female adolescents. *J Pediatr* 1992; 121:487
- Oh MK, Cloud GA, Fleenor M, et al: Risk for gonococcal and chlamydial cervicitis in adolescent females: Incidence and recurrence in a prospective cohort study. *J Adolesc Health* 1996; 18:270
- Mosure DJ, Berman S, Fine D, et al: Genital chlamydia infections in sexually active female adolescents: Do we really need to screen everyone? *J Adolesc Health* 1997; 20:6
- Fortenberry JD, Brizendine EJ, Katz BP, et al: Subsequent sexually transmitted infections among adolescent women with genital infection due to *Chlamydia trachomatis*, *Neisseria gonorrhoeae* or *Trichomonas vaginalis* infection. *Sex Transm Dis* 1999; 26:26

22. Whittington WL, Kent C, Kissinger P, et al: Determinants of persistent and recurrent *Chlamydia trachomatis* infection in young women: Results of a multi-center cohort study. *Sex Trans Dis* 2001; 28:117
23. Orr DP, Johnston K, Brizendine E, et al: Subsequent sexually transmitted infection in urban adolescents and young adults. *Arch Pediatr Adolesc Med* 2001; 155:947
24. Hillis SD, Nakashima A, Marchbanks PA, et al: Risk factors for recurrent *Chlamydia trachomatis* infections in women. *Am J Obstet Gynecol* 1994; 170:801
25. Miller HG, Cain VS, Rogers SM, et al: Correlates of sexually transmitted bacterial infections among US women in 1995. *Fam Plann Perspect* 1999; 31:4
26. Shain RN, Piper JM, Newton ER, et al: A randomized, controlled trial of a behavioral intervention to prevent sexually transmitted disease among minority women. *N Engl J Med* 1999; 340:93
27. Berman SM, Hein K: Adolescents and STDs. In: *Sexually Transmitted Diseases*, (3rd ed.). Edited by KK Holmes, PF Sparling, P-A Marsh, et al. New York, McGraw Hill Health Professions Division, 1999, pp 129-142
28. Kost K, Forrest JD: American women's sexual behavior and exposure to risk of sexually transmitted diseases. *Fam Plann Perspect* 1992; 24:244
29. Seidman SN, Mosher WD, Aral SO: Predictors of high-risk behavior in unmarried American women: Adolescent environment as risk factor. *J Adolesc Health* 1994; 15:126
30. Kelley MS, Borawski EA, Flocke SA: The role of sequential and concurrent sexual relationships in the risk of sexually transmitted diseases among adolescents. *J Adolesc Health* 2003; 32:296
31. Weisman CS, Plichta S, Nathanson CA, et al: Consistency of condom use for disease prevention among adolescent users of oral contraceptives. *Fam Plann Perspect* 1991; 23:71
32. Centers for Disease Control: *Chlamydia trachomatis* Infection. Policy guidelines for prevention and control. *MMWR* 1985; 34:34S-75S
33. Centers for Disease Control and Prevention: Pelvic Inflammatory Disease: Guidelines for Prevention and Management. *MMWR* 1991; 40(No. RR-05):1
34. Centers for Disease Control and Prevention: Recommendations for the Prevention and Management of *Chlamydia Trachomatis* Infections. *MMWR* 1993; 42(No. RR-12):1
35. Centers for Disease Control and Prevention: Sexually Transmitted Diseases Treatment Guidelines 2002. *MMWR* 2002; 51(No. RR-6):1
36. Weinstock HS, Bolan GA, Kohn R, et al: *Chlamydia trachomatis* infection in women: a need for universal screening in high prevalence populations? *Am J Epidemiol* 1992; 135:41
37. Katz B, Blythe MJ, Van Der Pol B, et al: Declining prevalence of chlamydial infection among adolescent girls. *Sex Transm Dis* 1996; 23:226
38. Marrazzo JM, Celum CL, Hillis SD, et al: Performance and cost-effectiveness of selective screening criteria for *Chlamydia trachomatis* infection in women. Implications for a National Chlamydia Control Strategy. *Sex Transm Dis* 1997; 24:131
39. Han Y, Coles FB, Hipp S: Screening criteria for Chlamydia Trachomatis in family planning clinics: Accounting for prevalence and clients' characteristics. *Fam Plann Perspect* 1997; 29:163
40. Gaydos CA, Howell MR, Pare B, et al: *Chlamydia trachomatis* infections in female military recruits. *N Engl J Med* 1998; 339:739
41. Cohen DA, Nsuami M, Martin DH, et al: Repeated school-based screening for sexually transmitted diseases: A feasible strategy for reaching adolescents. *Pediatrics* 1999; 104:1281
42. Miller WC, Hoffman IF, Owen-O'Dowd J, et al: Selective screening for chlamydial infection: Which criteria to use. *Am J Prev Med* 2000; 18:115
43. Kent CK, Branzuela A, Fischer L, et al: Chlamydia and gonorrhea screening in San Francisco high schools. *Sex Transm Dis* 2002; 29:373
44. Mertz KJ, Voigt RA, Hutchins K, et al: Jail STD Prevalence monitoring group. Findings from STD screening of adolescents and adults entering corrections facilities: Implications for STD control strategies. *Sex Transm Dis* 2002; 29:834
45. Scholes D, Stergachis A, Heidrich FE, et al: Prevention of pelvic inflammatory disease by screening for cervical chlamydial infection. *N Engl J Med* 1996; 34:1362
46. Centers for Disease Control: Chlamydia screening practices of primary-care providers—Wake County, North Carolina, 1996. *MMWR* 1997; 46(35):819
47. Burstein GR, Snyder MH, Conley D, et al: Adolescent chlamydia testing practices and diagnosed infections in a large managed care organization. *Sex Trans Dis* 2001; 28:477
48. St. Lawrence JS, Montano DE, Kasprzyk D, et al: STD screening, testing, case reporting, and clinical and partner notification practices: A national survey of U.S. physicians. *Am J Public Health* 2002; 92:1784
49. Best D, Ford CA, Miller WC: Prevalence of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infection in pediatric private settings. *Pediatrics* 2001; 108:E103
50. National Committee for Quality Assurance (NCQA): HEDIS 2000: Technical Specifications. Washington, DC, author, 1999, pp 68-70, 285-6
51. Shafer MB, Tebb KP, Pantell RH, et al: Effect of clinical practice improvement intervention on chlamydial screening among adolescent girls. *JAMA* 2002; 288:2846
52. Boekeloo BO, Snyder MH, Bobbin M, et al: Provider willingness to screen all sexually active adolescents for chlamydia. *Sex Transm Infect* 2002; 78:369
53. Cook RL, Wiesenfeld HC, Ashton MR, et al: Barriers to screening sexually active adolescent women for chlamydia: A survey of primary care physicians. *J Adolesc Health* 2001; 28:204
54. Orr DP, Fortenberry J: Screening adolescents for sexually transmitted infections. *JAMA*; 280:564
55. Neimiec MA, Chen SC: Seeking clinic care for venereal disease: A study of teenagers. *J Sch Health* 1978; 48:680
56. Harrison RM: Women's treatment decisions for genital symptoms. *J R Soc Med* 1982; 75:23
57. Simon KJ, Das AD: The application of the health belief model toward educational diagnosis for VD education. *Health Educ Q* 1984; 11:403
58. Fortenberry JD: Health care seeking behaviors related to sexually transmitted diseases among adolescents. *Am J Public Health* 1997; 87:417
59. Banikarim C, Chacko MR, Wiemann CM, et al: Gonorrhea and chlamydia screening among young women: Stage

- of change, decisional balance, and self-efficacy. *J Adolesc Health* 2003; 32:288
60. Blake DR, Kearney , Oakes JM, et al: Improving participation in chlamydia screening programs. *Arch Pediatr Adolesc Med* 2003; 157:523–29
 61. Smith K, Harrington K, Wingood G, et al: Self-obtained vaginal swabs for diagnosis of treatable sexually transmitted disease in adolescent girls. *Arch Pediatr Adolesc Med* 2001; 155:676
 62. Wiesenfeld HC, Lowry DL, Heine RP, et al: Self-collection of vaginal swabs for the detection of chlamydia, gonorrhea and trichomonas: Opportunity to encourage sexually transmitted disease testing among adolescents. *Sex Transm Dis* 2001; 28:321
 63. Serlin M, Shafer MA, Tebb K, et al: What sexually transmitted disease screening method does the adolescent prefer? Adolescents' attitudes toward first-void urine, self-collected vaginal swab, and pelvic examination. *Arch Pediatr Adolesc Med* 2002; 156:588
 64. Holland-Hall CM, Wiesenfeld HC, Murray PJ: Self-collected vaginal swabs for the detection of multiple sexually transmitted infections in adolescent girls. *J Pediatr Adolesc Gynecol* 2002; 15:307
 65. Ford CA, Viadro CI, Miller WC: Testing for chlamydial and gonorrheal infections outside of clinic settings. A summary of the literature. *Sex Transm Dis* 2004; 31:38
 66. Cheng TL, Savageau JA, Sattler AL, et al: Confidentiality in health care: A survey of knowledge, perceptions and attitudes among high school students. *JAMA* 1993; 269:1404
 67. Fortenberry JD, McFarlane M, Bleakely A, et al: Relationships of stigma and shame to gonorrhea and HIV screening. *Am J Public Health* 2002; 92:378
 68. Fortenberry JD, Zimet GD: Received social support for sexually transmitted disease-related care-seeking among adolescents. *J Adolesc Health* 1999; 25:178
 69. Fortenberry JD, McFarlane MM, Hennessy M, et al: Relation of health literacy to gonorrhea related care. *Sex Transm Infect* 2001; 77:206
 70. DiClemente RJ, Wingood GM: A randomized controlled trial of an HIV risk-reduction intervention for young African-American women. *JAMA* 1995; 274:1271
 71. Boyer CB, Barrett DC, Peterman TA, et al: Sexually transmitted diseases (STD) and HIV risk in heterosexual adults attending a public STD clinic: Evaluation of a randomized controlled behavioral risk-reduction intervention trial. *AIDS* 1997; 11:359
 72. Orr DP, Langefeld CD, Katz BP, et al: Behavioral intervention to increase condom use among high-risk female adolescents. *J Pediatr* 1996; 128:288
 73. Kamb ML, Fishbein M, Douglas JM, et al: Efficacy of risk-reduction counseling to prevent human immunodeficiency virus and sexually transmitted diseases. A randomized controlled Trial. *JAMA* 1998; 280:1161
 74. Fortenberry JD: Clinic-based service programs for increasing responsible sexual behavior. *J Sex Res* 2002; 39:63
 75. Emans SJ: Sexually transmitted diseases: Gonorrhea, *Chlamydia trachomatis*, pelvic inflammatory disease and syphilis. In: *Pediatric and Adolescent Gynecology*, (4th ed.). Edited by SJH Emans, MR Laufer, DP Goldstein. Philadelphia, Lippincott-Raven, 1998, pp 457–504
 76. Johnson RE, Newshall WJ, Papp JR, et al: Screening tests to detect *Chlamydia trachomatis* and *Neisseriae gonorrhoeae* infections—2002. *MMWR Recomm Rep*; 2002; 15(RR -15):1
 77. Black CM: Current methods of laboratory diagnosis of chlamydia trachomatis infection. *Clin Microbiol Rev* 1997; 10:160
 78. Genc M, Mardh P-A: A cost-effectiveness analysis of screening and treatment for *Chlamydia trachomatis* infection in asymptomatic women. *Ann Intern Med* 1996; 124:1
 79. Wang LY, Burstein GR, Cohen DA: An economic evaluation of a school-based sexually transmitted disease screening program. *Sex Transm Dis* 2002; 29:737
 80. Mrus JM, Biro FM, Huang B, et al: Evaluating adolescents in juvenile detention facilities for urogenital chlamydial infection: costs and effectiveness of alternative interventions. *Arch Pediatr Adolesc Med* 2003; 157:696
 81. Tao G, Gift TL, Walsh CM, et al: Optimal resource allocation for curing *Chlamydia trachomatis* infection among asymptomatic women at clinics with a fixed budget. *Sex Transm Dis* 2002; 29:703
 82. Blum RW: Improving the health of youth. A community health perspective. *J Adolesc Health* 1998; 23:254