Incident Chlamydia trachomatis Infections Among Inner-city Adolescent Females

Gale R. Burstein, MD, MPH; Charlotte A. Gaydos, DrPH; Marie Diener-West, PhD; M. Rene Howell, MA; Jonathan M. Zenilman, MD; Thomas C. Quinn, MD

Context.—Adolescents are at highest risk for infection with Chlamydia trachomatis, an important preventable cause of pelvic inflammatory disease and subsequent tubal factor infertility in US women. Current guidelines for delivery of adolescent primary care services recommend yearly chlamydia screening for those adolescent females considered to be at risk.

Objectives.—To describe the epidemiology of prevalent and incident chlamydia infection among adolescent females to assess the appropriate interval for chlamydia screening and to define risk factors that would identify adolescent females to target for screening.

Design.—Prospective longitudinal study.

Patients.—A consecutive sample of 3202 sexually active females 12 through 19 years old making 5360 patient visits over a 33-month period, January 1994 through September 1996.

Setting.—Baltimore, Md, family planning, sexually transmitted disease, and school-based clinics.

Intervention.—Testing for C trachomatis by polymerase chain reaction.

Main Outcome Measures.—Prevalence and incidence of C trachomatis infections; predictors of positive test result for C trachomatis.

Results.—Chlamydia infection was found in 771 first visits (24.1%) and 299 repeat visits (13.9%); 933 adolescent females (29.1%) had at least 1 positive test result. Females who were 14 years old had the highest age-specific chlamydia prevalence rate (63 [27.5%] of 229 cases; P<.01). The chlamydia incidence rate was 28.0 cases per 1000 person-months (95% confidence interval, 24.9-31.5 cases). The median time was 7.2 months to a first positive chlamydia test result and 6.3 months to a repeat positive test result among those with repeat visits. Independent predictors of chlamydia infection—reason for clinic visit, clinic type, prior sexually transmitted diseases, multiple or new partners, or inconsistent condom use—failed to identify a subset of adolescent females with the majority of infections.

Conclusions.—A high prevalence and incidence of C trachomatis infection were found among adolescent females. We, therefore, recommend screening all sexually active adolescent females for chlamydia infection every 6 months, regardless of symptoms, prior infections, condom use, or multiple partner risks.

JAMA. 1998;280:521-526

CHLAMYDIA TRACHOMATIS infection is the most important preventable cause of pelvic inflammatory disease and subsequent tubal factor infertility in women in the United States.1,4 Most cervical infections are identified by screening both symptomatic and asymptomatic women, although most infections are asymptomatic.5-16 Chlamydial pelvic inflammatory disease is often minimally symptomatic or asymptomatic. Therefore, chlamydia screening programs play a crucial role in preventing infertility.2 Sexually active adolescent females are at highest risk for chlamydia infection and for repeated infections, which further increase their risk of sequelae.11,18 Current guidelines for delivery of adolescent primary care services recommend yearly chlamydia screening for those adolescent females considered to be at risk.19-21 Since 1993, the Centers for Disease Control and Prevention (CDC), Atlanta, Ga, has recommended screening all sexually active female adolescents (younger than 20 years) for C trachomatis whenever they undergo a pelvic examination.2,3 Nucleic acid amplification tests have recently been developed that are more sensitive and specific than previously available chlamydia tests.22-25 In addition, these tests can be performed using either a cervical, self-administered vaginal swab or a urine sample.22,23,35 Furthermore, nucleic acid amplification chlamydia tests are cost-effective if prevalence is greater than 3%.22

In this study, we evaluated longitudinal data collected on sexually active adolescent females screened for chlamydia by nucleic acid amplification testing. Our objectives were to describe the epidemiology of chlamydia, including calculation of chlamydia incidence (ie, new and repeat cases) in this population of sexually active adolescent females. These data provide a basis for recommending for chlamydial screening frequency and criteria for adolescent females.

METHODS

Study Sample

Chlamydia screening in family planning (FP), sexually transmitted disease (STD), and school-based clinics in Baltimore, Md, is a component of the CDC Region III Chlamydia Project.27 This study included data collected from these
participating sites from January 1994 through September 1996. The 2 FP, 2 STD, and 6 school-based clinics participating in the Region II project are used predominantly by an urban African American community with limited financial resources. Maryland advocates universal STD screening of sexually active females, regardless of age. Informed consent was obtained from all patients attending Baltimore City Health Department FP, STD, and school-based clinics to receive standard care. The study was approved by the institutional review boards of the Johns Hopkins University, Baltimore, and the Baltimore City Health Department.

Data Collection

Demographic and behavioral data were routinely collected using a standardized form on all females tested for chlamydia at each visit. Race or ethnicity and date of birth were recorded according to patients' self-description. Reasons for chlamydia test/examination were coded as mutually exclusive categories and included the following: (1) STD contact regardless of symptoms, (2) evaluation of any STD-related symptoms, such as vaginal discharge or lower abdominal pain, (3) STD screening without symptoms, such as for a routine physical examination or for STD concerns without symptoms (ie, "I just want to get checked out"), and (4) “other” reason, such as injury, viral illness complaints, or refill of contraception method. Prior STD history was by self-report and included a prior syphilis infection and a prior gonorrhea and/or chlamydia infection. Sexual risk behaviors in the 90 days prior to testing included whether the adolescent had a new partner or multiple partners or was inconsistent with using a condom. These behaviors were not mutually exclusive.

Patients with clinical signs of infection who were diagnosed as having gonorrhea cervicitis, or who had sexual contact with a partner with symptoms, or a diagnosis of urethritis were treated with either doxycycline, 100 mg twice daily for 7 days, or with a single 1.0-g dose of azithromycin before leaving the clinic. All patients with a positive chlamydia test result at the STD and FP clinics were notified by telephone or mail and requested to return for treatment (if not already provided). Patients at the school-based clinics were usually available on site to receive test results and treatment. All infected patients were advised to refer their partners to treatment.

Laboratory Methods

Cervical specimens were routinely obtained by clinicians using a standard procedure when a pelvic examination was performed. Urine specimens were obtained when no pelvic examination was performed. Cervical specimens were tested for chlamydia DNA by polymerase chain reaction (PCR) (Amplicor at Roche Diagnostics System, Branchberg, NJ) according to the manufacturer's directions. For the urine-based PCR, 7 to 8 mL of urine was processed according to the manufacturer's instructions given for urine specimens for male subjects.24

Subjects

From January 1994 through September 1996, there were 21,269 clinic visits in which patients were tested for chlamydia. Two hundred eight (1.0%) were male and were excluded. Sixty-three observations (0.5%) were included where either nonnucleic acid chlamydia testing was done or test results were not available. One thousand twenty observations (4.8%) with unknown or unavailable demographic and/or behavioral information were excluded. We defined incident infection as infection at visits more than 30 days apart in order to remove the possibility of including in the analysis more than 1 positive test result per unique infection, thus excluding 1,304 observations.6 Finally, 13,314 observations of girls younger than 12 years or women older than 19 years were excluded from the sample, leaving a total of 5,360 patient visits, in which the repeat visits were made more than 30 days apart, among 3,202 females 12 to 19 years of age.

Data Analysis

Data were entered into a computer database (D-Base III Plus, Ashton Tate, Borland International, Inc, Scotts Valley, Calif). All statistical analyses were performed using Intercooled Stata 5.0 (Stata Corporation, College Station, Tex).

Chlamydia prevalence and incidence rates among the sexually active adolescent females in the sample were calculated for January 1994 through September 1996. The prevalence rate was calculated as the proportion of chlamydia-positive test results among all chlamydia tests.7 Patients with at least 2 clinic visits more than 30 days apart included in the analysis of incident infection. Incidence was calculated as the rate of incident cases per person-month of exposure among females with more than 1 clinic visit. An individual was classified as having an incident infection if either a positive test result with a prior positive or prior negative test results had been documented at least 30 days earlier.10,28 Thus, if 2 successive test results for a given individual were positive and separated by more than 30 days, the second positive test result was considered an incident case.10,28 A positive result at a first visit was not considered an incident case. In this situation, where the duration of infection was unknown, the calculation of person-months was based on time from the first to the second visit. A 95% confidence interval (CI) for the incidence rate was calculated under the assumption of an exponential distribution for time to disease using a maximum likelihood estimate of variance.29

The chlamydia PCR test result obtained with a cervical and/or urine specimen was the dependent variable. Independent variables analyzed as possible predictors were reason for clinic visit, clinic type, prior STDs, condom use, and new or multiple sex partners. Association between these clinical and behavioral variables with incident and prevalent chlamydia infection were evaluated by univariate analysis using the Pearson χ² test of independence or the Fisher exact test. All independent variables found significant in the univariate analysis were entered into the logistic regression model. Intervisit correlations were taken into account by using the generalized estimating equation method in multiple logistic regression.24 A P value of less than .05 was the significance level specified for variables to remain in the model.

Three separate models to estimate predictors of infection were analyzed. The first model, the prevalence model, was used to determine predictors of any positive chlamydia test result. All of the 5,360 clinic visits more than 30 days apart by 3,202 sexually active females 12 through 19 years old who underwent testing for chlamydia were included in this model. The second model, the first incident infection model, was used to determine predictors of the first positive chlamydia test result at a repeat visit, ie, the first incident infection. This model included all 1,474 repeat visits more than 30 days apart made by 887 adolescent females for whom all prior test results (≥ 1) were negative during the study period. The third model, the repeat infection model, evaluated predictors of a repeat positive test for chlamydia and included all 684 repeat visits more than 30 days apart made by 277 adolescent females who had had at least 1 prior positive test result during the study period. An individual with multiple visits could be included in both the first incident and repeat infection models for estimating predictors at repeat visits if she had a positive test result with prior negative results. The first repeat visits with positive test results were included in the first incident infection model and all visits subsequent to the positive test result were included in the repeat infection model.
Table 1—Characteristics of 3202 Sexually Active Adolescent Females With Chlamydia trachomatis Testing by Polymerase Chain Reaction in Baltimore, Md

<table>
<thead>
<tr>
<th>Variables</th>
<th>Clinic Visits, %</th>
<th>N = 5360</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12-14</td>
<td>7.2</td>
<td></td>
</tr>
<tr>
<td>15-17</td>
<td>56.3</td>
<td></td>
</tr>
<tr>
<td>18-19</td>
<td>36.5</td>
<td></td>
</tr>
<tr>
<td>Reason for test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STD contact</td>
<td>11.9</td>
<td></td>
</tr>
<tr>
<td>STD symptoms</td>
<td>20.3</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>8.0</td>
<td></td>
</tr>
<tr>
<td>Screening</td>
<td>59.8</td>
<td></td>
</tr>
<tr>
<td>Clinic type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family planning</td>
<td>34.5</td>
<td></td>
</tr>
<tr>
<td>STD</td>
<td>44.1</td>
<td></td>
</tr>
<tr>
<td>School</td>
<td>21.4</td>
<td></td>
</tr>
<tr>
<td>Risk factors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inconsistent condom use</td>
<td>74.7</td>
<td></td>
</tr>
<tr>
<td>&gt;1 Sex partner</td>
<td>14.0</td>
<td></td>
</tr>
<tr>
<td>New sex partner</td>
<td>17.7</td>
<td></td>
</tr>
<tr>
<td>Self-reported STD history</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prior syphilis infection</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>Prior Neisseria gonorrhoeae or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C trachomatis infection</td>
<td>35.4</td>
<td></td>
</tr>
</tbody>
</table>

*The 5360 clinic visits more than 30 days apart included those made to family planning, sexually transmitted disease, and school-based clinics, conducted in January 1994 through September 1996. STD indicates sexually transmitted disease.

RESULTS

Study Sample

The 5360 patient visits more than 30 days apart were made by 3202 adolescent females over the 33-month period. The mean (±SD) age of females at clinic visits was 16.9 years (±1.5 years) and 98% were African American. The median number of clinic visits per individual was 2, with 75% of the sample making 1 to 3 visits. A high proportion of females practiced sexual risk behaviors, defined as multiple partners, new partners, or inconsistent condom use during the 90 days before the time of clinic visit (Table 1).

There were a total of 3332 visits made by 1174 adolescent females, followed up prospectively, who made repeat visits (at least 2 visits) to the clinics. The total number of repeat visits per individual ranged from 1 to 9, with a mean (±SD) of 2.4 (±1.6) repeat visits per person (median of 2 repeat visits per person, with 75% making 1-3 repeat visits). The median time to repeat visit was 4.0 months, with 25% of repeat visits occurring by 2.5 months.

Chlamydia Prevalence and Incidence

During the study period, 20% of all chlamydia tests performed on adolescent females were positive. Chlamydia infection was found in 771 (24.1%) of first visits and 299 (33.9%) of repeat visits. Of the 3202 females in the sample, 933 (29.1%) had at least 1 positive test result. Females who were 14 years old had the highest proportion of positive chlamydia test results (63 [27.5%] of 229 cases; P = .01) (Figure 1) in the sample. Among the females with repeat clinic visits, the chlamydia incidence rate was 28.0 cases per 1000 person-months (95% CI, 24.9-31.5 cases per 1000 person-months) based on 273 chlamydia infections detected during 9760 person-months of observation. Following a negative chlamydia test result, the median time to a first positive chlamydia test result was 7.2 months (first incident infection model), with 25% incident cases diagnosed within 5.0 months (Figure 2). The median time to a repeat positive chlamydia test result was 6.3 months (repeat infection model), with 25% incident cases diagnosed within 4.1 months (Figure 2).

Predictors of Infection

Three separate models estimating predictors of infection were analyzed. The prevalence model included all 5360 clinic visits among adolescent females. Variables in this model identified by logistic regression to be independently associated with a positive chlamydia test result included being seen at an FP or STD clinic, a clinic visit for STD contact and “other” reason for visit, multiple or new partners, and inconsistent condom use (Table 2). In this model containing all clinic visits, a clinic visit for STD symptoms and reported STD history were not found to be independently associated with infection.

The first incident infection model included visits by adolescent females who had their first positive test result (after at least 1 negative test result) for chlamydia during the study period. Variables that were identified by logistic regression to be independently associated with diagnosis of a first incident chlamydia infection include being seen at an FP or STD clinic and having multiple or new sex partners (Table 3). Reasons for clinic visit, reported STD history, and condom use were not found to be independently associated with infection in this model.

The repeat infection model included visits by adolescent females with repeat positive test results for chlamydia during the study period. Only being seen at an STD clinic was identified by logistic regression to be independently associated with diagnosis of a repeat chlamydia infection (Table 4). Reasons for clinic visit, reported STD history, new or multiple sex partners, and condom use were not independently associated with chlamydia infection in this model.

Independent behavioral and clinical predictors of chlamydia defined at each clinic visit failed to identify a high-risk subset of adolescent females with the majority of infections. The independently predictive chlamydia risk factors were present in only a small proportion of the clinic visits with a positive test result or were present at nearly all clinic visits, regardless of chlamydia test results, among this sample of adolescent females (Tables 1-4). For example, if a chlamydia screening program targeted all the adolescent females with any STD symptom, chlamydia screening would have been performed at only 20% of the clinic visits made by adolescent females (Table 1), resulting in lower total screening costs incurred, but only 23% of all chlamydia infections in this sample would have been detected (Table 2). If chlamydia screening was performed at all visits where inconsistent condom use was identified as a risk of infection, 81% of infections would have been identified (Table 2), but screening would have been indicated at 75% of all clinic visits (Table 1), offering no advantage to selective screening.

Figure 1.—Chlamydia trachomatis prevalence in sexually active adolescent females according to age tested by polymerase chain reaction in Baltimore, Md, January 1994 through September 1996. Sample sizes by each year of age are listed below graph.

Figure 2.—Box plots depicting distribution of time to first and repeat Chlamydia trachomatis infection tested by polymerase chain reaction in sexually active females 12 through 19 years old in Baltimore, Md, January 1994 through September 1996. The box describes the interquartile distance between the 75th and 25th percentiles. Upper boundary of box represents the 75th percentile (12.3 months for time to first infection; 11.1 months for time to repeat infection), lower boundary of box represents the 25th percentile (5.0 months for time to first infection; 4.1 months for time to repeat infection), and bold line represents the median (7.2 months for time to first infection; 6.3 months for time to repeat infection). The circles that fall outside a distance of 1.5 times the interquartile distance above the 75th percentile may be considered outliers.
If both variables were used as chlamydia screening criteria, then chlamydia screening would have been performed at 18% of the clinic visits where both STD symptoms and inconsistent condom use were acknowledged, but only 21% of the infections would have been identified (data not shown). If chlamydia screening would have been performed at 77% of visits where either STD symptoms or inconsistent condom use were acknowledged, 83% of infections would have been identified (data not shown). The same weakness was apparent in the functional utility of predictors to distinguish a subset of adolescent females in which selective screening would have identified most of first incident infections (first incident infection model) and repeat infections (repeat infection model).

**COMMENT**

Adolescents are at highest risk for chlamydia infection, which can result in sequelae such as pelvic inflammatory disease and infertility. In this study, 29.1% of the adolescent females tested positive at least once, with the highest age-specific prevalence rates being among 14-year-olds (27.5%). This is consistent with other studies using nucleic acid amplification testing of sexually active adolescent females. We also found a high chlamydia incidence rate of 28.0 cases per 1000 person-months (95% CI, 24.9-31.5 cases per 1000 person-months). More than 50% of adolescent females with an infection incident in this sample tested positive for chlamydia within a 6-7-month period, which is approximately twice that of the current recommendations for annual primary care chlamydia screening of adolescent females considered to be at risk. Since the frequency of testing and identification of those “at risk” are based on data using chlamydia tests less accurate than PCR tests with cross-sectional data. Our study used highly sensitive and specific tests and was able to approximate the pattern of care observed in the primary care setting by following adolescents longitudinally over multiple consecutive visits, thereby providing a more robust database. Since the responsibility of STD prevention and treatment is increasingly being placed on primary care providers, identification of adolescent females at risk and the frequency of repeat chlamydia infection is important information that should influence clinical practice.

The results of our study elucidate the need for universal chlamydia screening of all sexually active adolescent females, regardless of symptoms. Most of the infections identified were asymptomatic (Table 2). Complaint of STD symptoms was not an independent predictor of chlamydia infection (odds ratio [OR], 1.0; 95% CI, 0.9-1.3) and only identified 23% of infections (Table 2). However, “other” reason for visit was found to be a strong predictor of infection (OR, 2.0; 95% CI, 1.6-2.6). Adolescent females may feel uncomfortable disclosing their STD symptoms or may not perceive their symptoms as being associated with an infection.

Studies evaluating the effects of aggressive chlamydia-screening programs have demonstrated a decrease in prevalence among adolescent females in both the FP and primary managed care settings. Recent surveys of primary health care providers have confirmed that STD screening of asymptomatic sexually active adolescent females has not ubiquitously been incorporated into the routine physical examination. The ease of testing with a self-administered vaginal swab or urine sample may make it comfortable disclosing their STD symptoms or not perceive their symptoms as being associated with an infection.
One fifth of the visits made by chlamydia-negative adolescent females were for evaluation of STD symptoms (Table 2). Health care providers must remember to consider other causes of STD symptoms in this adolescent age group, such as gonorrhea and trichomoniasis, which may cause STD symptoms and sequelae if left untreated.43-46

Although several behavioral risk factors for chlamydia infection that are consistent with previous studies were identified for this population,13,17,47,48 none of these variables could be used to identify a large proportion of the chlamydia infections among the adolescent females in this study without performing chlamydia screening at almost every clinic visit. Prior infection status did not contribute to chlamydia risk. This study, like others, confirms that risk factors, including behavioral factors, fail to identify a high-risk subgroup of adolescent females to target for chlamydia screening. Chlamydia control programs have succeeded by screening all sexually active adolescent females, regardless of sexual practices or demographics.13,17 Public health researchers should concentrate future efforts on prevention and partner notification rather than on continuing to categorize adolescent females at risk.

Our study had several limitations. First, the ethnicity and socioeconomic status of our sample population were homogeneous. Some of our findings may not apply to populations with more diverse racial, ethnic, and socioeconomic backgrounds. Black race and low socioeconomic status are demographic factors that have been identified as independent predictors of infection in earlier studies using less sensitive chlamydia tests.37,47,48

However, other studies using predominately white suburban and predominately white rural adolescent samples have detected chlamydia rates greater than 10%.41,48 In addition, Marrazzo et al38 found that race was not a predictor for chlamydia infection among adolescent females screened with nucleic acid amplification tests in the Pacific Northwest. Also, our rates of chlamydia infection were very high and conclusions drawn may not be generalizable to areas where lower rates of chlamydia exist, such as sites where prevention programs have been in place for longer periods.

A second limitation is the small numbers of behavioral risk factors included in the study. Although we presented information regarding number of sex partners, other pertinent information such as age and sex of partner was not included. In addition, the relationships between contraception methods, STD and human immunodeficiency virus coinfection, or sexual abuse and chlamydia infection need further definition in this population.

Adolescent males were not included in this sample, which is a current limitation of the CDC chlamydia-screening program. The epidemiology of chlamydia infection in adolescent males is different from that of adolescent females, but data on this subject are limited.13,31

A number of observations were not included in the data analysis due to incomplete information on demographic and behavioral characteristics. These exclusions represented only 4.8% of the total number of observations. We therefore do not feel that these data would have altered our findings significantly. Finally, history of infection status of these sexually active women whose conditions were diagnosed in other clinics outside the study sites is unknown. Adolescent females in this sample may have had their conditions diagnosed and have been treated for chlamydia infection at other clinical sites before or during the study period. Thus, determination of true chlamydia history and prevalence is limited to data available to us and may have resulted in an underestimation of the absolute rate of chlamydia infection and warrant more aggressive chlamydia screening.

Our study excluded all 1304 visits made less than 30 days apart to remove the possibility of including in the analysis more than 1 positive test result per unique infection. We believe that the PCR-positive repeat cases more than 30 days apart represent incident infections rather than carryover from incomplete treatment. Use-effectiveness studies of doxycycline vs azithromycin have found these 2 treatment regimens to be comparable, and PCR chlamydia test results have not been found to remain positive for longer than 3 weeks following therapy.32,35

Chlamydia PCR cervical tests are commercially available to laboratories performing chlamydia tests. The urine tests for specimens from women are currently under review by the Food and Drug Administration, but are approved for use in specimens from men. However, ligase chain reaction, another DNA amplification chlamydia test, is approved for both cervical and urine testing of females. Costs involved for chlamydia PCR tests will vary depending on volume of use and whether the laboratory is public or private sector. We found the average list price for a PCR Ctrachomatis test to be approximately $315 for private sector laboratories. Additional charges for performing the assay, which include laboratory technician time, thermocycler, and transport of specimen, may also vary by site. Maryland Medicaid reimburses $26 per cervical chlamydia PCR test, but reimbursement may differ by state and insurance scheme.54

Chlamydia screening of sexually active adolescent females in both primary care and nontraditional health care settings detects a large burden of asymptomatic infection in a variety of demographically defined populations.13,17,49,50 We demonstrated that the median time to diagnosis of incident infection is approximately 6 months, regardless of prior infection status, and that selective screening criteria are unable to identify a group in which to target screening efforts among adolescent females. Nucleic acid amplification tests using self-administered vaginal swabs or urine samples are easily implemented screening tools and avoid barri-
ers associated with performance of a pelvic
examination, which can be a major dis-
benefit for young women to be tested for
STDs. Since sequelae of chla-
mphydial infections can be devastating and nu-
clear acid amplification testing can be cost-
effective in similar settings,22,55,56 we
recommend screening all sexually active
adolescent females for chlamydia infec-
tion every 6 months, regardless of symp-
toms, prior infections, condom use, or mul-
tiple sex partner risks.

This study was supported in part by a Centers
for Disease Control and Prevention—Association
of Teachers of Preventive Medicine STD Prevention
Fellowship (Dr Burstein) and by a National
Institute of Health grant NIAID-P01-AI94016 (Dr Zenilman).
We also thank Diane Bratton, Nicole Novak,
Kymberly Crotchfield, Jennifer Girder,
and numerous Region III/Baltimore City Health
Department staff and clinicians who helped make this
study possible. We also thank Sheryl Ryan, MD, for
her review of the manuscript and Judy Cathie and
Guillermo Madico, MD, for their computer support.

References
1. Centers for Disease Control and Prevention. Recommen-
dations for the prevention and manage-
ment of sexually transmitted infections. MMWR Morb Mortal
2. Scholes D, Stergachis A, Heidrich FE, Andrilla
H, Holmes KK, Stamm WE. Prevention of pelvic
inflammation for cervical chla-
9. Gaydos CA, Crotchfelt KA, Howell MR, Kralian S, Hauptman P, Quinn TC. Molecular amplification assays to detect chlamydia infections in urine spec-
imens from high school female students and to moni-
10. Schachter J, Shafer MA, Young M, Ott M. Routi-
tional Academy Press; 1997;26-67.
12. Magder LS, Harrison HR, Ehret JM, Anderson TS, Johnson FN. Factors related to genital chla-
mphydial trachomatis and its diagnosis by culture in a sexually transmitted disease clinic. Am J Epidemi-
13. Kim H, Stamm WE, Jain LM, Roberts PL, Har-
sen VW, Katholneel EI, Stamm WE. Criteria for selec-
tive screening for Chlamydia trachomatis infe-
14. Marottke CK, Wisemer E, Gelinek KJ. Screen-
ing for Chlamydia cervicitis in a sexually active popu-
15. Hills SD, Nakashima A, Marchbanks PA, Addis

526 JAMA, August 12, 1996—Vol 280, No. 6
Incident Chlamydia trachomatis Infections—Burstein et al