Epidemiology of Chlamydia trachomatis

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History: Tissue Culture

- Development of tissue culture isolation procedures in the 1960s
- 1975 – 1985, thought of as cell culture era which made it possible to:
  - link *C. trachomatis* to specific clinical syndromes
    - NGU (Nongonococcal urethritis) in men
    - Cervicitis and pelvic inflammatory disease (PID) in women
- In terms of prevention, culture era focused on teaching clinicians to recognize chlamydia associated symptoms and provide empiric treatment for patients (and their partners) based on chlamydia associated syndromes without actual diagnostic testing
- Limitations of cell culture
  - Expensive and technically difficult, so never became widely available
  - Consequently, screening programs were not feasible
  - Focus of prevention efforts was largely directed at patients attending STD clinics and family planning clinics
History: Antibody Tests

- 1985 -1995, nonculture tests (i.e., antibody tests) became available for chlamydia which allowed for:
  - Widespread access to clinic based testing
  - Increased opportunities to screen for adolescent women and other high risk groups
  - Screening of pregnant women and selective screening in low prevalence populations became feasible for the first time
  - Although more people screened, most treatment remained syndromic and empiric
History: NAATS

- Mid 1990’s – present, nucleic acid amplification tests (NAATS) became available for routine clinical use
- These tests have had a major impact on our understanding of the epidemiology and approaches to prevention because of 3 unique characteristics:
  - Improved sensitivity (by as much as 20%) \( \rightarrow \) \( \uparrow \) prevalence, emphasis on asymptomatic infections
  - Urine based testing (no pelvic exams, urethral swabs, presence of physician not required \( \rightarrow \) access to new patient populations \( \rightarrow \) increase in number screened)
  - Ability to test for multiple pathogens (CT/GC)
History: NAATS

- Impact of NAATS on prevention
  - Expanded efforts to screen asymptomatic young women
  - New venues to identify asymptomatic adolescents – a group least likely to be encountered in routine clinical care (military recruits, street-based, high-school based testing)
  - Increased appreciation of the high incidence of recurrent/persistent urogenital infections, especially among adolescents
  - Rationale to screen young men (previously focused on women)
    - Noninvasive test makes it more acceptable to men
    - Substantial prevalence of asymptomatic infection in men
    - Identification and treatment in men would constitute primary prevention for women
    - Identification and treatment of asymptomatic male reservoir might help to prevent reinfection in women
Chlamydia — Number of states that require reporting of *Chlamydia trachomatis* infections: United States, 1987–2003
Most frequently reported bacterial STI in the US
Under-reporting is substantial since most cases are asymptomatic
“Silent” disease because 75% of women and 50% of men are not aware of their infection (iceberg analogy)
If symptoms (discharge, painful urination, etc.) do occur, usually 1–3 weeks after exposure
US Burden
Reported Sexually Transmitted Diseases, United States, 2007

- Chlamydia, 1,108,374, 74%
- Gonorrhea, 355,991, 24%
- Early Syphilis, 10,768, 1%
- Late & Latent Syphilis, 18,265, 1%
- Chancroid, 23, 0%
US Chlamydia Rates: Total and by sex, 1988–2007

Potential reasons for gender differential:
1. Greater number of women screened
2. Sex partners of women not diagnosed or reported

Note: As of January 2000, all 50 states and the District of Columbia had regulations requiring the reporting of chlamydia cases.

SOURCE: CDC
**US Chlamydia: Age- and sex-specific rates, 2007**

<table>
<thead>
<tr>
<th>Age</th>
<th>Men Rate (per 100,000 population)</th>
<th>Women Rate (per 100,000 population)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-14</td>
<td>11.8</td>
<td>123.0</td>
</tr>
<tr>
<td>15-19</td>
<td>615.0</td>
<td>3004.7</td>
</tr>
<tr>
<td>20-24</td>
<td>932.9</td>
<td>2948.8</td>
</tr>
<tr>
<td>25-29</td>
<td>518.6</td>
<td>1184.5</td>
</tr>
<tr>
<td>30-34</td>
<td>246.8</td>
<td>460.5</td>
</tr>
<tr>
<td>35-39</td>
<td>129.9</td>
<td>188.1</td>
</tr>
<tr>
<td>40-44</td>
<td>71.4</td>
<td>76.5</td>
</tr>
<tr>
<td>45-54</td>
<td>32.3</td>
<td>28.5</td>
</tr>
<tr>
<td>55-64</td>
<td>10.1</td>
<td>8.0</td>
</tr>
<tr>
<td>65+</td>
<td>2.7</td>
<td>1.8</td>
</tr>
<tr>
<td>Total</td>
<td>190.4</td>
<td>544.8</td>
</tr>
</tbody>
</table>

**Source:** CDC

Rate (per 100,000 population)

- American Indian/AK Native
- Asian/Pacific Islander
- Black
- Hispanic
- White

SOURCE: CDC

Rate per 100,000

<table>
<thead>
<tr>
<th>Race/Group</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Indian/Alaska Native</td>
<td>1,158</td>
<td>294</td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>209</td>
<td>66</td>
</tr>
<tr>
<td>Black</td>
<td>1,906</td>
<td>841</td>
</tr>
<tr>
<td>Hispanic</td>
<td>753</td>
<td>212</td>
</tr>
<tr>
<td>White</td>
<td>249</td>
<td>72</td>
</tr>
</tbody>
</table>
Summary: Chlamydia burden in the US

- Persistent increases in chlamydia
- Rate of reported cases was 370.2 per 100,000 in 2007 (7.5% increase from 2006)
- Over 1 million cases of chlamydia were reported in 2007 (1,108,374)
- BUT, most cases go undiagnosed:
  - Estimated annual incidence of 2.8 million new cases and annual costs exceeding $2 billion
- Rates among females are 3X those among males
- Black women have 8X the rate of white women
- American Indian/Alaskan native women have 4.5X the rate of white women
Los Angeles Burden
US Chlamydia Rates: By state, 2007

Guam 481
Virgin Is. 320
Puerto Rico 201

Note: The total rate of chlamydia for the United States and outlying areas (Guam, Puerto Rico and Virgin Islands) was 368.1 per 100,000 population.

SOURCE: CDC
US Chlamydia Rates: By county, 2007

Rate per 100,000 population

- <=300.0 (n= 2,228)
- 300.1-400.0 (n= 315)
- >400.0 (n= 597)
13 High Morbidity Jurisdictions

- Alameda
- Contra Costa
- Fresno
- Kern
- Long Beach
- Los Angeles
- Orange
- Riverside
- Sacramento
- San Bernardino
- San Diego
- San Francisco
- Santa Clara

Selected based on sum of P&S syphilis, GC, CT and population rank order for all LHJs for 2004-2006
Chlamydia, Gonorrhea, and P&S Syphilis
Ranking of County Rates, California, 2007
(with 95% Confidence Intervals*)

State Rate = 378.4

State Rate = 82.5

State Rate = 5.4

* Confidence intervals were calculated using Poisson exact method; not shown for counties with zero cases.

Note: Rates are per 100,000 population.

Source: California Department of Public Health, STD Control Branch
Chlamydia, Rates by County, California, 2007

Rate per 100,000
- 0 cases reported
- < 100
- 100 to 199
- 200 to 299
- 300 +

LA
Chlamydia Rates, 2001-2007*

* 2007 Rate is based on 2006 population estimate and is provisional
LA Chlamydia: Age- and sex-specific rates, 2007

*62% of chlamydia cases occur in those aged 15-24 years

Rate per 100,000

<table>
<thead>
<tr>
<th>Race</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>1,741</td>
<td>1,042</td>
</tr>
<tr>
<td>Hispanic</td>
<td>651</td>
<td>235</td>
</tr>
<tr>
<td>White</td>
<td>196</td>
<td>111</td>
</tr>
<tr>
<td>Asian-Pacific</td>
<td>182</td>
<td>79</td>
</tr>
</tbody>
</table>
Chlamydia rates in LA by age and race, FEMALES 2007

- 7,874 → 1 in 13
- 7,113 → 1 in 14
Summary: Chlamydia burden in Los Angeles

- Increases in chlamydia rate since 1996
- Rate of reported cases was 421.6 per 100,000 in 2007 (compared to 378.4 for CA, 370.2 for US)
- Over 40,000 cases of chlamydia were reported in 2007
- Rates among females are over 2X those among males
- Black women have over 9X the rate of white women
- Hispanic women have nearly 3X the rate of white women
- Highest rates among black women aged 15-19 (7,874 per 100,000 or 1 in 13 of this group)
Why have Chlamydia rates been increasing?

1. Availability of NAATS for screening
2. Increased testing volume (chlamydia testing has steadily increased in LA STD clinics)
3. More effective screening (focusing high-risk populations: mobile clinics, high-school based, jail/juvenile hall screening)
4. More complete reporting or improved information systems for reporting
5. True increase in rates?
   - Increased high-risk sexual behavior?
   - Arrested immunity?
Percent of Chlamydia Tests by Test Type

*Other included point of care tests and unspecified tests
† NAATs: Nucleic acid amplification tests
### California (15-24 yr-olds): Direct medical costs

<table>
<thead>
<tr>
<th>STD</th>
<th>Reported new cases</th>
<th>Estimated unreported new cases</th>
<th>Total estimated new cases</th>
<th>Medical cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlamydia</td>
<td>84,186</td>
<td>95,814</td>
<td>180,000</td>
<td>29 million</td>
</tr>
<tr>
<td>Gonorrhea</td>
<td>16,788</td>
<td>16,212</td>
<td>33,000</td>
<td>7.5 million</td>
</tr>
<tr>
<td>Syphilis</td>
<td>313</td>
<td>67</td>
<td>380</td>
<td>0.2 million</td>
</tr>
<tr>
<td>HIV</td>
<td>516</td>
<td>2,384</td>
<td>2,900</td>
<td>560 million</td>
</tr>
<tr>
<td>Hepatitis B</td>
<td>41</td>
<td>479</td>
<td>520</td>
<td>0.5 million</td>
</tr>
<tr>
<td>Genital herpes*</td>
<td>0</td>
<td>67,000</td>
<td>67,000</td>
<td>38 million</td>
</tr>
<tr>
<td>HPV*</td>
<td>0</td>
<td>590,000</td>
<td>590,000</td>
<td>460 million</td>
</tr>
<tr>
<td>Trichomoniasis*</td>
<td>0</td>
<td>250,000</td>
<td>250,000</td>
<td>5.3 million</td>
</tr>
<tr>
<td>Total</td>
<td>101,844</td>
<td>1.02 million</td>
<td>1.12 million</td>
<td>1.11 billion</td>
</tr>
</tbody>
</table>

Reported cases and estimates are for 2005.

*Source: Jerman, 2007

*Non-reportable STDs.
Implications

- Age is the most important risk marker for chlamydia infection
- U.S. Preventive Task Force recommends that clinicians routinely screen all sexually active women aged 25 and younger
- Evidence supports repeat screening every 3 to 4 months for those who test positive as well as continued 6 month screenings in this group
- However, practice falls short of recommendations
- In 2001, California authorized patient-delivered partner therapy (PDPT) and expedited partner therapy (EPT)
Health consequence of Chlamydia

- 40% of females with untreated chlamydia infections develop pelvic inflammatory disease (PID), which can eventually lead to infertility, ectopic pregnancy, and chronic pelvic pain.
- Complications among men are relatively uncommon, but may include epididymitis and urethritis, which can cause pain, fever, and in rare instances, sterility.
- Increased risk of HIV transmission.
Questions/Comments

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