Pertussis

- Highly contagious respiratory infection
- Spread by coughing or sneezing
  – >80% household contacts infected
- Caused by bacteria *Bordatella pertussis*
  – Attach to the cilia in upper respiratory tract
  – Release toxins, damage cilia and cause inflammation

Stages of Pertussis

<table>
<thead>
<tr>
<th>Stage</th>
<th>Length</th>
<th>Clinical Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catarrhal</td>
<td>7–10 days; range 4–21</td>
<td>Runny nose, mild cough</td>
</tr>
<tr>
<td>Paroxysmal</td>
<td>1–6 weeks; up to 10</td>
<td>Paroxysmal cough</td>
</tr>
<tr>
<td>Convalescent</td>
<td>7–10 days; range 4–21</td>
<td>Less persistent cough; secondary infxn</td>
</tr>
</tbody>
</table>
Clinical Case Definition

- Cough illness lasting at least 2 weeks with one of the following:
  - Paroxysms of coughing
  - Inspiratory "whoop"
  - Post-tussive vomiting

Images of Pertussis

Source: www.immunize.org, courtesy of Thomas Schlenker, MD, MPH, Chief Medical Officer, Children's Hospital of Wisconsin and the Pennsylvania Chapter of the American Academy of Pediatrics

Infant Pertussis

- Highest risk for complications
- Atypical symptoms
  - Catarrhal stage and cough minimal or absent
  - Whoop infrequent
  - Apnea (sometimes with seizures)
  - Sneezing
  - Gagging, choking, vomiting
- >50% require hospitalization
- 1% of hospitalized infants die

Pertussis Tests

<table>
<thead>
<tr>
<th>TEST</th>
<th>PROS</th>
<th>CONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCR</td>
<td>Sensitive</td>
<td>False positives</td>
</tr>
<tr>
<td></td>
<td>Fast</td>
<td></td>
</tr>
<tr>
<td>Culture</td>
<td>Specific</td>
<td>Slow</td>
</tr>
<tr>
<td></td>
<td>Gold standard</td>
<td>Low sensitivity</td>
</tr>
<tr>
<td>Serology</td>
<td>Detect late</td>
<td>Not standardized</td>
</tr>
<tr>
<td></td>
<td>after onset</td>
<td></td>
</tr>
<tr>
<td>DFA</td>
<td>None (in 2012)</td>
<td>Low sensitivity</td>
</tr>
</tbody>
</table>

Adapted from http://www.cdc.gov/vaccines/i/di/cinic/Pertussis.htm
Pertussis PCR Pitfalls

- False positives
  - Testing patients without signs/symptoms
  - Contamination of swab with vaccine DNA
- False negatives
  - Testing too late in illness
  - Improper specimen collection

Proper Technique for NP Swab


Pertussis Culture

- High specificity
- Low sensitivity after first two weeks of cough
- Long time to results
- Important for
  - Control measures in outbreak settings
  - Antimicrobial resistance testing
The “Pertussis Epidemic that Wasn’t”

- 134 cases
- No positive cultures
- Confirmatory testing showed no evidence of a pertussis outbreak
- Outbreak of mild respiratory disease with no single etiology

Adapted from Lauri Hicks, CDC, March 17, 2008

Pertussis Labs: Take Home

- There is no perfect test
- Need to educate clinicians about appropriate PCR testing
- Send swabs for culture confirmation to avoid “pseudo-outbreaks”
- Limited role for serologies, DFA

Trends / Burden of Disease

- 30–50 million cases, 300,000 deaths per year worldwide

Reported NNDSS pertussis cases: 1922-2012*

*2012 data are provisional.

Pertussis Trends, 2012

- National
  - 41,880 cases reported
  - 15 infant deaths
  - Highest number of cases since 1955

- North Carolina
  - 625 cases reported
  - 20% from Alamance outbreak
  - 65 counties with cases

Provisional data; subject to change
Reasons for Increase

- Waning immunity from DTaP
- Better diagnostic testing (PCR)
- Increased recognition and reporting
- Natural 3–5 year cycles
- New strains

Proportion of Cases by Age Group

2010 (n=289)
- <1: 32%
- 1-6: 14%
- 7-10: 9%
- 11-19: 22%
- 20+: 22%

Based on date of onset; data are provisional and subject to change.

Proportion of Cases by Age Group

2011 (n=205)
- <1: 32%
- 1-6: 12%
- 7-10: 20%
- 11-19: 20%
- 20+: 18%

Based on date of onset; data are provisional and subject to change.
Proportion of Cases by Age Group

Based on date of onset; data are provisional and subject to change

Pertussis Vaccines

- Most effective way to prevent pertussis
- DTP (1940s) and DTaP (1990s) for infants and children
- Tdap (2005) for pre-teens, teens and adults

DTaP: Effectiveness and Duration

- DTaP efficacy 80%–85%*
  - Highly effective, but can’t rule out infection based on vaccination status
- Protection fades over time
  - General estimate 4–12 years
  - Recent studies suggest shorter duration with DTaP

*Following 3 doses
Pertussis Disease among Unvaccinated compared to Vaccinated Children – California, 2010

<table>
<thead>
<tr>
<th>Pertussis Vaccination Status</th>
<th>Case</th>
<th>Control</th>
<th>OR (95% CI) *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unvaccinated</td>
<td>53</td>
<td>19</td>
<td>8.8 (4.9 – 16.1)</td>
</tr>
<tr>
<td>5 DTaP doses</td>
<td>629</td>
<td>1,997</td>
<td></td>
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* Accounting for clustering by county and provider

Overall Vaccine Effectiveness — California, 2010

<table>
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<tr>
<th>Model *</th>
<th>Case (n)</th>
<th>Control (n)</th>
<th>VE, %</th>
<th>95% CI</th>
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<td>Overall VE, All Ages</td>
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<td>0 dose</td>
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<tr>
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<td>12 – 23 months</td>
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Tdap: Recommendations

• Adolescents 11–18
  – Preferably at age 11–12

• Adults ≥19, especially if in close contact with infants

• Children 7–10 who are not fully immunized against pertussis
**Tdap: Effectiveness and Duration**

- Effectiveness 66–78% in field observational studies
- Preliminary data suggest effectiveness wanes within 3–4 years among acellular recipients

**Tdap: Recent Changes**

- Recently approved for
  - Pregnant women
  - People ≥65 years of age
- Expectant mothers should receive Tdap during each pregnancy, preferably at 27–36 weeks

Pertussis Vaccines: Take Home

- Best way to prevent pertussis
  - Decreased severity, duration, and infectivity with breakthrough cases
- DTaP and Tdap protection wanes within 5 years
  - Likely contributor to increasing incidence, especially among children 7–10
  - Highlights need for booster doses

Post-Exposure Prophylaxis (PEP)

- Primary objective: Prevent death and serious complications in individuals at increased risk of severe disease

Post-Exposure Prophylaxis (PEP)

- No data to indicate that widespread use of PEP effectively controls or limits the scope of pertussis outbreaks
- Concerns re: overuse of antibiotics

Who Gets PEP?

- All household contacts
- Close contact at high risk for severe illness
  - Infants, women in 3rd trimester
  - Those with pre-existing health conditions that may be exacerbated by a pertussis infection
- Close contact who are themselves in close contact with a someone else at high risk for severe illness
Who Gets PEP?

- All contacts in high risk settings that include infants aged <12 months or women in the third trimester of pregnancy
- Examples:
  - Neonatal intensive care units
  - Childcare settings
  - Maternity wards

Broader Use of PEP?

- Consider in situations with
  - Small number of cases
  - Limited closed settings
  - No ongoing, community-wide outbreak
- Consultation with health department

Summary

- Pertussis is an increasing problem
  - Increasing incidence likely related to shorter duration of immunity with current vaccines
- There is no perfect test for pertussis
- Vaccination is the best tool for prevention, but we need for new strategies for prevention and response

Acknowledgments

Questions?

Not Vaccinated? No Kisses!
Get the adult whooping cough vaccine.
www.VaccinateYourFamily.org

Vaccine Preventable Diseases:
Transition from NC Immunization Branch to Communicable Disease Branch

Why?
- Increased responsibility for site visits
- Increased complexities in diseases
Benefits

• One place to call

• Physician support

• Etc., Etc., Etc.,

Who to call?

Communicable Disease Branch:
• Vaccine Preventable Disease control and outbreak support

Immunization Branch:
• Vaccine clinical questions
• Ordering, storage, and handling
• Coverage criteria