Pertussis and Pertussis Vaccine
Epidemiology and Prevention of Vaccine-Preventable Diseases
National Immunization Program
Centers for Disease Control and Prevention
Revised January 2006

Note to presenters:
Images of vaccine-preventable diseases are available from the Immunization Action Coalition website at http://www.vaccineinformation.org/photos/index.asp

Pertussis
- Highly contagious respiratory infection caused by Bordetella pertussis
- Outbreaks first described in 16th century
- Bordetella pertussis isolated in 1906
- Estimated 285,000 deaths worldwide in 2001

Bordetella pertussis
- Fastidious gram-negative bacteria
- Antigenic and biologically active components:
  - pertussis toxin (PT)
  - filamentous hemagglutinin (FHA)
  - agglutinogens
  - adenylate cyclase
  - pertactin
  - tracheal cytotoxin

Pertussis Pathogenesis
- Attachment to cilia of ciliated epithelial cells in respiratory tract
- Pertussis antigens allow evasion of host defenses (lymphocytosis promoted but impaired chemotaxis)
- Local tissue damage in respiratory tract
- Systemic disease may be toxin mediated

Pertussis Clinical Features
- Incubation period 7-10 days (range 4-21 days)
- Insidious onset, similar to minor upper respiratory infection with nonspecific cough
- Fever usually minimal throughout course of illness
Pertussis Clinical Features

- Catarrhal stage 1-2 weeks
- Paroxysmal cough stage 1-6 weeks
- Convalescence Weeks to months

Pertussis Among Adolescents and Adults

- Disease often milder than in infants and children
- Infection may be asymptomatic, or may present as classic pertussis
- Adolescents and adults account for more than half of reported cases
- Older persons often source of infection for children

Pertussis Complications*

<table>
<thead>
<tr>
<th>Condition</th>
<th>Percent reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumonia</td>
<td>5.2</td>
</tr>
<tr>
<td>Seizures</td>
<td>0.8</td>
</tr>
<tr>
<td>Encephalopathy</td>
<td>0.1</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>20</td>
</tr>
<tr>
<td>Death</td>
<td>0.2</td>
</tr>
</tbody>
</table>

*Cases reported to CDC 1997-2000 (N=28,187)

Pertussis Complications by Age

Pertussis Epidemiology

- Reservoir Human adolescents and adults
- Transmission Respiratory droplets
- Communicability Maximum in catarrhal stage Secondary attack rate up to 80%

Pertussis—United States, 1940-2005*

*2005 provisional total
Whole-Cell Pertussis Vaccine

- Developed in mid-1930s and combined as DTP in mid-1940s
- 70%-90% efficacy after 3 doses
- Protection for 5-10 years
- Local adverse reactions common

Acellular Pertussis Vaccines

- Purified "subunit" vaccines
- Pediatric formulations (DTaP) licensed for full series in 1996
- Adolescent and adult formulations (Tdap) licensed in 2005

Composition* of Acellular Pertussis Vaccines

<table>
<thead>
<tr>
<th>Product</th>
<th>PT</th>
<th>FHA</th>
<th>PERT</th>
<th>FIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daptacel</td>
<td>10</td>
<td>5</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Infanrix</td>
<td>25</td>
<td>25</td>
<td>8</td>
<td>--</td>
</tr>
<tr>
<td>Tripedia</td>
<td>23</td>
<td>23</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Boostrix</td>
<td>8</td>
<td>8</td>
<td>2.5</td>
<td>--</td>
</tr>
<tr>
<td>Adacel</td>
<td>2.5</td>
<td>5</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

*mcg per dose

DTaP Clinical Trials

<table>
<thead>
<tr>
<th>Product</th>
<th>Location</th>
<th>VE (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daptacel</td>
<td>Sweden</td>
<td>85% (80-89)</td>
</tr>
<tr>
<td>Tripedia</td>
<td>Germany</td>
<td>80% (59-90)</td>
</tr>
<tr>
<td>Infanrix</td>
<td>Italy</td>
<td>84% (76-89)</td>
</tr>
</tbody>
</table>
### Routine DTaP Primary Vaccination Schedule

<table>
<thead>
<tr>
<th>Dose</th>
<th>Age</th>
<th>Minimum Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary 1</td>
<td>2 months</td>
<td>---</td>
</tr>
<tr>
<td>Primary 2</td>
<td>4 months</td>
<td>4 wks</td>
</tr>
<tr>
<td>Primary 3</td>
<td>6 months</td>
<td>4 wks</td>
</tr>
<tr>
<td>Primary 4</td>
<td>15-18 months</td>
<td>6 mos</td>
</tr>
</tbody>
</table>

### DTaP Fourth Dose

- **Recommended at 15-18 months***
- **May be given at 12 months of age if:**
  - child is 12 months of age, and  
  - 6 months since DTaP3, and  
  - unlikely to return at 15-18 months

*17-20 months for Daptacel

### School Entry (Fifth) Dose

- Fifth dose recommended when 4th dose given before age 4 years
- Infanrix and Tripedia licensed for 5th dose after DTaP series

### Interchangeability of Different Brands of DTaP Vaccine

- Series should be completed with same brand of vaccine if possible
- Limited data suggest that “mix and match” DTaP schedules do not adversely affect safety and immunogenicity
- Use different brand of DTaP if necessary

### Provisional ACIP Recommendations for Tdap Vaccines

- Adolescents 11-18 years of age should receive a single dose of Tdap instead of Td, preferably at 11-12 years of age*
- Adolescents who received a Td booster should receive a single dose of Tdap to provide protection against pertussis*

*If the person has completed the recommended childhood DTaP/DTP vaccination series

### Provisional ACIP Recommendations for Tdip Vaccines

- Adults should receive a single dose of Tdap to replace a single dose of Td*
- Adults who have or who anticipate having close contact with an infant 12 months of age or younger (e.g., parents, child care providers, healthcare providers) should receive a single dose of Tdap*
- Any woman who might become pregnant is encouraged to receive a single dose of Tdap

*If the person has completed the recommended childhood DTaP/DTP vaccination series
**TriHIBit**

- DTaP-Hib combination
- Do not use for primary immunization at 2, 4, or 6 months of age
- May be used as the booster dose of the Hib series at ≥12 months of age following any Hib vaccine*

*booster dose should follow prior dose by ≥2 months

**Pediariix**

- DTaP – Hep B – IPV combination
- Approved for 3 doses at 2, 4 and 6 months
- Not approved for booster doses
- Licensed for children 6 weeks to 7 years of age

**Pediariix**

- May be used interchangeably with other pertussis-containing vaccines if necessary
- Can be given at 2, 4, and 6 months in infants who received a birth dose of hepatitis B vaccine (total of 4 doses)
- May be used in infants whose mothers are HBsAg positive or status unknown

**Pertussis Vaccine Use in Children with Underlying Neurologic Disorders**

<table>
<thead>
<tr>
<th>Underlying Condition</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior seizure</td>
<td>Delay and assess*</td>
</tr>
<tr>
<td>Suspected neurologic disorder</td>
<td>Delay and assess*</td>
</tr>
<tr>
<td>Neurologic event between doses</td>
<td>Delay and assess*</td>
</tr>
<tr>
<td>Stable/resolved neurologic condition</td>
<td>Vaccinate</td>
</tr>
</tbody>
</table>

*vaccinate after treatment initiated and condition stabilized

**Pertussis Vaccination of Children Who Have Recovered From Pertussis**

- If documented disease, do not need additional doses of pertussis vaccine
- Satisfactory documentation of disease:
  - recovery of *B. pertussis* on culture, or
  - typical symptoms and clinical course when epidemiologically linked to a culture-proven case

**DTaP Adverse Reactions**

- Local reactions (pain, redness, or swelling at the site of injection)
- Low-grade fever
- More severe adverse reactions not common
- Local reactions more common following 4th and 5th doses
**Adverse Reactions Following the 4th and 5th DTaP Dose**
- Local adverse reactions and fever increased with 4th and 5th doses of DTaP
- Reports of swelling of entire limb
- Extensive swelling after 4th dose NOT a contraindication to 5th dose

**Tdap Adverse Reactions**
- Local reactions (pain, redness, or swelling at the site of injection)
- Low-grade fever
- Adverse reactions occur at approximately the same rate as Td alone (without acellular pertussis vaccine)

**DTaP Contraindications**
- Severe allergic reaction to vaccine component or following a prior dose
- Encephalopathy not due to another identifiable cause occurring within 7 days after vaccination

**DTaP Precautions**
- Moderate or severe acute illness
- Temperature \( \geq 105°F (40.5°C) \) or higher within 48 hours with no other identifiable cause
- Collapse or shock-like state (hypotonic hyporesponsive episode) within 48 hours
- Persistent, inconsolable crying lasting \( \geq 3 \) hours, occurring within 48 hours
- Convulsions with or without fever occurring within 3 days

**Tdap Contraindications**
- Severe allergic reaction to vaccine component or following a prior dose
- Encephalopathy not due to another identifiable cause occurring within 7 days after vaccination with a pertussis-containing vaccine

**Tdap Precautions**
- History of Guillain-Barré syndrome within 6 weeks after a previous dose of tetanus toxoid-containing vaccine
- Progressive neurological disorder until the condition has stabilized
- History of a severe local reaction (Arthus reaction) following a prior dose of a tetanus and/or diphtheria toxoid-containing vaccine
- Moderate or severe acute illness
National Immunization Program
Contact Information

• Telephone  800.CDC.INFO
• Email      nipinfo@cdc.gov
• Website    www.cdc.gov/nip