Tetanus, Diphtheria and Pertussis Vaccines

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Current Issues in Immunization

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OVERVIEW

- Diphtheria, tetanus and pertussis overview
- Vaccinating Children (DTaP)
- Vaccinating Adolescents and Adults (Tdap)
  - General recommendation/updates
  - Protecting infants from pertussis
    - Pregnant women
Diphtheria

- Toxin-mediated disease: *Corynebacterium diphtheriae*
- Pharynx/Tonsils: Exudate and pseudomembrane
- Death in 5% to 10% of cases
- Vaccine coverage high
  - Diphtheria is rare in US
- Outbreaks in other countries

![Pseudomembrane](image)
Tetanus

- A toxin-mediated disease: *Clostridium tetani*
- Found in soil
- Generalized tetanus:
  - Trismus (lockjaw), difficulty swallowing, muscle rigidity, spasms
- Death: 10–20% of cases
Pertussis (whooping cough)

- Highly contagious respiratory disease
- “100 day cough”
- Highest morbidity and mortality among infants
  - Often lack classic symptoms
- Worldwide, ~16 million cases of pertussis and about 195,000 deaths per year
- Vaccine-preventable
- Poorly controlled, despite high vaccine coverage

Illustration of *B. pertussis* attached to cilia
U.S. REPORTED PERTUSSIS CASES: 1922-2017

*2017 data are provisional and subject to change.

SOURCE: CDC, National Notifiable Diseases Surveillance System and 1922-1949, passive reports to the Public Health Service
Vaccinating Children

In the battle against whooping cough, she needs more than cute.

She needs the safe, proven protection of vaccines.
For more reasons to vaccinate, talk to your child's doctor or go to http://www.cdc.gov/vaccines or call 1-800-CDC-INFO.

Immunization. Power to Protect.
ACIP recommendations: 2 months to 6 years

- No recent changes
- 3 primary doses: ages 2, 4, and 6 months
- 4\textsuperscript{th} dose (first booster): 15–18 months
- 5\textsuperscript{th} dose (second booster): 4–6 years
### Composition of DTaP Vaccines

<table>
<thead>
<tr>
<th>Vaccine Type</th>
<th>Trade name</th>
<th>Manufacturer</th>
<th>Pertussis antigens (μg)</th>
<th>Diphtheria toxoids (Lf)</th>
<th>Tetanus toxoids (Lf)</th>
<th>Age for licensed use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>PT  FHA   PRN  FIM</td>
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<tr>
<td>Single DTaP Vaccines</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>DTaP</td>
<td>INFANRIX</td>
<td>GSK</td>
<td>25  25   8  25</td>
<td>25</td>
<td>10</td>
<td>X¹  X  X  X  X</td>
</tr>
<tr>
<td>DTaP</td>
<td>DAPTACEL²</td>
<td>Sanofi</td>
<td>10  5     3  5</td>
<td>15</td>
<td>5</td>
<td>X¹  X  X  X  X</td>
</tr>
<tr>
<td>Combination DTaP vaccines</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DTaP-IPV-Hib</td>
<td>PENTACEL</td>
<td>Sanofi</td>
<td>20  20   3  5</td>
<td>15</td>
<td>5</td>
<td>X¹  X  X  X  X</td>
</tr>
<tr>
<td>DTaP-IPV-HepB</td>
<td>PEDIARIX³</td>
<td>GSK</td>
<td>25  25   8  25</td>
<td>25</td>
<td>10</td>
<td>X¹  X  X  X  X</td>
</tr>
<tr>
<td>DTaP-IPV</td>
<td>Kinrix</td>
<td>GSK</td>
<td>25  25   8  25</td>
<td>25</td>
<td>10</td>
<td>X</td>
</tr>
<tr>
<td>DTaP-IPV</td>
<td>Quadracel</td>
<td>Sanofi</td>
<td>20  20   3  5</td>
<td>15</td>
<td>5</td>
<td>X</td>
</tr>
</tbody>
</table>

Abbreviations: Pertussis toxin (PT); filamentous haemagglutinin (FHA); pertactin (PRN); fimbriae (FIM)

¹ Licensed for use in infants as young as 6 weeks
² DAPTACEL can be used for the fifth dose for a child who has received 1 or more doses of DTP
³ First three doses at 6- to 8-week intervals beginning at 2 months of age; then 2 doses of DTaP are needed to complete the 5-dose series before 7 years of age
Vaccinating Adolescents and Adults
Waning DTaP immunity?

Tdap and Td vaccines

- **Tdap**
  - Two formulations
  - First pertussis vaccines for adolescents and adults
  - Combined with tetanus and diphtheria toxoids
  - Licensed for single use only

- **Td**
  - Tenivac (Sanofi Pasteur)
  - Generic (MassBiologics)
Current ACIP recommendations

- **Single Tdap dose**
  - **Adolescents 11–18 years**, preferred 11–12 years (2005)
  - **Adults ≥19 years** (2005)
  - No minimal time interval since last Td vaccine

- **Pregnant women**: Tdap every pregnancy (2012)

- **Decennial Td booster** for those who have received 1 Tdap
  - 5 years for wound management

Catch-up schedule and recent updates

Catch-up schedule:

- **Persons aged 7–18 years not fully immunized with DTaP**: 1 dose of Tdap as part of the catch-up series (preferably the first dose).
  - If additional doses are needed, use Td.
  - Similar to recommendations for adults

- **Change from previous guidance**:
  - **Children 7–10 years** who receive Tdap inadvertently or as part of the catch-up series **SHOULD** receive routine Tdap dose at 11–12 years
Vaccinating pregnant women
Pertussis incidence among infants, 2001-2011

Hospitalizations and Deaths in Infants <12 Months of Age, % Total Cases, 2004-2015, United States

* 2015 data are provisional and subject to change
Source: CDC, National Notifiable Diseases Surveillance System and Supplemental Pertussis Surveillance System
“Cocooning” strategy

- Vaccinating all close contacts of infants with Tdap to reduce the risk of transmission of pertussis to these infants
  - Parents, siblings, grandparents, child-care providers and health-care personnel if they have not previously received Tdap
- Source of pertussis
  - ~50% of time, source cannot be identified
  - Parents previously primary source of transmission
  - Siblings now identified more frequently

ACIP Tdap recommendation for pregnant women

- A dose of Tdap during EACH pregnancy
  - Previous Tdap history not considered
- Maximize maternal antibody response and passive antibody transfer to the infant
- Optimal timing for Tdap administration: 27 and 36 weeks gestation

Studies show that maternal Tdap vaccination very effective at preventing infant pertussis infection

<table>
<thead>
<tr>
<th>Vaccine effectiveness (95% confidence intervals)</th>
<th>Infant age at pertussis onset</th>
<th>Mother gestational age received Tdap</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>United Kingdom</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observational(^1), screening method</td>
<td>91% (83%-95%)</td>
<td>&lt;3 mths</td>
</tr>
<tr>
<td>Case-Control(^2), retrospective</td>
<td>91% (77%-97%), unadjusted</td>
<td>&lt;2 mths</td>
</tr>
<tr>
<td></td>
<td>93% (81%-97%), adjusted(^6)</td>
<td></td>
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<tr>
<td><strong>United States</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cohort(^3), retrospective</td>
<td>85% (33%-98%)</td>
<td>&lt;2 mths</td>
</tr>
<tr>
<td>Case-Control(^4), retrospective</td>
<td>78% (44%-91%)</td>
<td>&lt;2 mths</td>
</tr>
</tbody>
</table>

*2012 UK recommendation: Tdap between 28 and 38 weeks
¶ Adjusted for sex, geographical area, and birth period

Maternal Tdap Decreases Disease Severity in Infants

Infants born to vaccinated mothers:

- Older when developed pertussis
- Less likely have classic symptoms
- Lower risk of hospitalization and ICU admission
- No deaths due to pertussis

Vaccination coverage

*CDC National Immunization Survey: DTaP among children aged 19 through 35 months, Tdap coverage among adolescents aged 13 through 17 years; ¶ Coverage among adults aged 19 through 64 years from National Health Information Survey

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Barriers to vaccinating pregnant women

- Tdap coverage in pregnant women suboptimal
- Undocumented Tdap vaccine history
- Some programs still focused on postpartum Tdap
- Getting the message out
  - Initiatives to improve vaccination of pregnant women
- Provider recommendation best predictor of vaccination
- Optimal if provider recommends vaccine AND offers it


Conclusions

- DTaP coverage high in children
- Tdap coverage
  - Adolescent coverage high
  - Adult coverage and coverage in pregnant women could be improved
  - Remove barriers to vaccination of pregnant women and increase Tdap coverage during pregnancy
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Thank you

For more information, contact CDC
1-800-CDC-INFO (232-4636)

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