Vaccines and Pregnancy
Part 2: TDaP

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Objectives

- Clinical manifestations of tetanus, diphtheria, and pertussis
- TDaP vaccination rates
- Vaccine mechanism of action in pregnancy
- Benefits of TDaP vaccination
- Safety considerations
The TDaP Vaccine

- Offers protection against three mostly toxin-driven bacterial diseases
  - Tetanus: *Clostridium tetani*
  - Diphtheria: *Corynebacterium diphtheriae*
  - Pertussis: *Bordetella pertussis*

- Acellular pertussis: vaccine used to have whole-cell killed pertussis but caused high incidence SEs including severe swelling and erythema at injection site, and in very small percentage, long crying spells and febrile seizures

CDC Pinkbook, p. 297
Vaccination Rates: Pregnant Women

- Based 2016 National Health Interview Survey, **26.6%** of adults reported receiving Tdap vaccination

- Based on 2018 CDC survey-based study, **54.9%** of pregnant women reported receiving Tdap vaccination
  - Rate was **70.5%** among those who received offer to vaccinate or referral

CDC Survey 2016
Vaccination Rates: Children

- Based on a CDC study for 2017-2018 academic year
  - Nationally: 95.1% of kindergarteners received state-required vaccine doses (ranging from 3-5 doses)
  - California: 96.4% of kindergarteners received 4-5 doses (state requires 5 unless 4th dose was on or after 4 y)

Mellerson et all 2018
Tetanus Infection
Symptoms of Tetanus

- Gram+ anaerobe; releases tetanospasmin exotoxin, forms very hardy spores
- Found in soil and intestinal tract of multiple animals
- Typically enters body through a wound
- Three forms
  - **Localized:** persistent contractions in the same area as location of injury (uncommon and rarely fatal)
  - **Cephalic:** affects facial nerves, can be transmitted via head/facial injuries or otitis media (very rare)
  - **Generalized:** most common form

CDC Pinkbook, p. 341
Generalized Tetanus

- Causes descending pattern of paralysis: trismus (lockjaw) → neck stiffness → dysphagia → abdominal muscle rigidity

- Neonatal tetanus
  - Form of generalized tetanus affecting infants
  - Typically contracted via infected umbilical stump, particularly when unsterilized instruments are used
  - Mostly seen in parts of developing world; rare in US
  - Occurs in infants w/o passive immunity; ie from non-immune mothers

CDC Pinkbook, pp. 341-343
Complications of Tetanus Infection

- Laryngospasm
- Fractures
- Nosocomial infections (from prolonged hospitalization)
- Aspiration pneumonia
- Arrhythmias
- Pulmonary embolism
- Death

CDC Pinkbook, p. 343
Diphtheria Infection
Symptoms of Diphtheria

- Gram+ aerobe
- Can infect any mucosal tissue in the body including genital and ocular
  - Most common sites are pharynx and tonsils
  - Systemic absorption varies, more likely to cause complications
- Causes localized tissue destruction and pseudomembrane formation
  - Causes fever, pharyngitis, cough, lymphadenopathy, submandibular edema
  - Pseudomembrane formation can cause respiratory compromise

CDC Pinkbook, pp. 107-108
Complications of Diphtheria Infection

- Neuritis
  - Affects motor neurons
  - Can cause paralysis of soft palate, eyes, limbs, diaphragm
- Myocarditis
  - Arrhythmias, heart failure
- Secondary pneumonia
- Respiratory failure
- Case fatality rate: 5-10%, 20% in children <5 y

CDC Pinkbook, p. 109
Pertussis Infection
Symptoms of Pertussis

- Gram negative aerobic rod
- Attaches to cilia of pulmonary epithelial cells and releases toxin to paralyze cilia
  - Causes inflammation of respiratory tract and inhibits respiratory secretion clearance
- Disease progresses through three stages
- Catarrhal
  - First 1-2 weeks: rhinorrhea, sneezing, mild cough, mild fever → like common cold

CDC Pinkbook, pp. 261-263
Symptoms of Pertussis

- **Paroxysmal**
  - Next 1-6 weeks: spasms of frequent, short coughs followed by long inspiratory effort f/b characteristic “whoop” sound
  - When people are usually diagnosed
  - **Children <6 mo may not make “whoop” noise**

- **Convalescence**
  - Weeks to months: gradual decrease in sx but may get paroxysms of cough w/ subsequent respiratory infections

CDC Pinkbook, pp. 261-263
Complications of Pertussis Infection

- Secondary bacterial pneumonia
  - Most common complication and cause of death in pertussis infection
- Neurologic: seizures, encephalopathy, insomnia
- Pressure-related: pneumothorax, subdural hematoma, hernia, rectal prolapse, urinary incontinence
- Death

CDC Pinkbook, pp. 261-263
Complications of Pertussis Infection

- Teens and adults typically have milder complications (incontinence, insomnia, etc)
- Children, and especially infants, are highest risk for severe morbidity and mortality
- In one study from the CDC from 2008-2011, >80% of all deaths from pertussis were among those < 3 months old
  - Do not yet have fully developed immune systems
  - Infants typically need 2 doses of DTaP before they are adequately protected from infection

CDC Pinkbook, pp. 261-263, Fouda et al 2018
TDaP Vaccination: Mechanism of Action
Vaccination of Pregnant Women

1. Give mom Tdap & flu shots
2. Mom creates antibodies
3. Antibodies pass to baby
4. Mom & baby protected

www.immunizeca.org
Mechanism of action of TDaP vaccination

- Pregnant woman receives injection of Tdap vaccine
- Develops humoral immune response → protective IgG antibodies (against various proteins of each of the three vaccine components)
Maternal Antibody Transfer

- IgG antibodies are transferred across the placenta to the fetus (via neonatal Fc receptors)
- Takes 2 weeks after Tdap vaccination for antibodies in mother to reach protective levels and transfer to fetus
- IgA antibodies can be transferred to babies via breast milk, but take a couple weeks to become protective
  - Causes potential gap in protection level for infants if mom is vaccinated postpartum rather than while pregnant

Silverman N, 2014; Fouda et al 2018, Schnirring 2011
Maternal Antibody Transfer

- Ideal time to vaccinate pregnant women: 32 wks GA (or between 27-36 wks)
  - Based primarily on pertussis component
  - Vaccinate too early= immunity wanes before infant gets first vaccine but vaccinate too late= not enough time to provide get adequate antibody levels
  - However, any vaccination in mother is better than none

- Passive pertussis immunity is NOT long-lasting
  - Antibody levels take weeks to peak in fetus and wane in months→ can become undetectable in infants as early as 4 months old

Silverman N, 2014; Fouda et al 2018, Schnirring 2011
TDaP Vaccination: Benefits, Safety Considerations
Benefits of TDaP Vaccination

- 3rd trimester Tdap vaccination
  - 77.7% effective in preventing pertussis in infants <2 mo
  - 90.5% effective in preventing pertussis hospitalizations in infants <2 mo
  - When infants do get pertussis, it's less severe than if mother did not get vaccine
- Prevention of tetanus, diphtheria, and pertussis, which cause severe morbidity/mortality on their own
- Relatively little data for fetal effects of any of these infections

Lindley et al, 2019, NCIRD 2017
Public Health Benefits of TDaP Vaccination

- 92% drop in neonatal tetanus mortality globally since tetanus vaccine introduced in 1960s
- Near-eradication of diphtheria worldwide
- Decreased severity of pertussis infection among vaccinated

Fouda et al 2018
Vaccine Frequency

- Tetanus and diphtheria immunity
  - Typically wanes after 10 y in most people, though can be lifelong (need Td boosters q10y)

- Pertussis immunity
  - Wanes significantly within a year (so need w/ each pregnancy)
  - Everyone coming into close contact w/ a newborn should be vaccinated (at least 2 wks before anticipated close contact)

CDC Pinkbook pp. 271 & 348
Side Effects of TDaP Vaccination

- Localized reaction—pain, redness, swelling at injection site (20-40%)
- Fever, to as high as 101 (3-5%)
- Entire arm swelling
- Localized reactions more common after 4th and 5th doses in kids (NOT a contraindication to further vaccination)
- Severe SEs very rare

CDC Pinkbook pp. 275-276
Safety Considerations

- Precaution when administrating TDaP
  - Hx GBS within 6 wks of TDaP/DTaP
  - Hx of severe local reaction following prior dose
  - Moderate to severe acute illness

- Contraindications to future TDaP doses
  - Severe allergic reaction to vaccine components
  - Encephalopathy not due to another identifiable cause occurring within a week of TDaP or DTaP vaccination

CDC Pinkbook pp. 274-275
The Role of Providers

- Based on a CDC survey of pregnant women from March-April 2019
  - 76% reported receiving an offer or referral for Tdap vaccine (70.5%)
  - 5.8% reported receiving a recommendation but no offer for vaccine (19.5%)
  - 18.1% reported receiving no recommendation or offer for vaccine (1.0%)
- Among non-vaccinated, reasons women who reported not getting Tdap vaccination
  - Not knowing it was needed (37.9%)
  - Concerns over safety risks to infant (17.1%)

Lindley et al, 2019, CDC Survey 2016
Always recommend and offer the Tdap shot (and flu shot) to your pregnant patients (and any other vaccines if/as indicated)!!!

If you can't offer a vaccine, give them a prescription!
### Table 2: Recommended Adult Immunization Schedule by Medical Condition and Other Indications

**United States, 2019**

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Medical Condition/Other Indications</th>
<th>HIV infection (CD4 count)</th>
<th>Asplenia, complement deficiencies</th>
<th>End-stage renal disease, on hemodialysis</th>
<th>Heart or thoracic aortic disease</th>
<th>Chronic liver disease</th>
<th>Diabetes</th>
<th>Health care personnel[^1]</th>
<th>Men who have sex with men</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tdap or Td</td>
<td>CONTRAINDICATED</td>
<td>1 dose annually</td>
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<tr>
<td>MMR</td>
<td>CONTRAINDICATED</td>
<td>1 or 2 doses depending on indication</td>
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<tr>
<td>VAR</td>
<td>CONTRAINDICATED</td>
<td>2 doses</td>
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<tr>
<td>RCV (preferred)</td>
<td>DELAY</td>
<td>2 doses at age ≥50 yrs</td>
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<tr>
<td>ZVL</td>
<td>CONTRAINDICATED</td>
<td>1 dose at age ≥60 yrs</td>
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<tr>
<td>HPV Female</td>
<td>DELAY</td>
<td>3 doses through age 26 yrs</td>
<td>2 or 3 doses through age 26 yrs</td>
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<tr>
<td>HPV Male</td>
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<td>3 doses through age 26 yrs</td>
<td>2 or 3 doses through age 21 yrs</td>
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<td>PCV13</td>
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<td>1 dose</td>
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<tr>
<td>PPSV23</td>
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<td>1, 2, or 3 doses depending on age and indication</td>
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<td>HepA</td>
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<td>2 or 3 doses depending on vaccine</td>
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<tr>
<td>HepB</td>
<td></td>
<td>2 or 3 doses depending on vaccine</td>
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<tr>
<td>MenACWY</td>
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<td>2 or 3 doses depending on indication, then booster every 5 yrs if risk remains</td>
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<tr>
<td>MenB</td>
<td>PRECAUTION</td>
<td>2 or 3 doses depending on vaccine and indication</td>
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<tr>
<td>Hib</td>
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<td>3 doses MSSC recipients only</td>
<td>1 dose</td>
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</table>

[^1]: Men who have sex with men should be considered as having sexual partners of the same sex.

Legend:
- *Recommended vaccination for adults who meet age requirement, lack documentation of vaccination, or lack evidence of past infection*
- *Recommended vaccination for adults with an additional risk factor or another indication*
- *Precaution—vaccine might be indicated if benefit of protection outweighs risk of adverse reaction*
- *Delay vaccination until after pregnancy if vaccine is indicated*
- *Contraindicated—vaccine should not be administered because of risk for serious adverse reaction*
- *No recommendation*

**Notes:**
- Recommendations are based on the best available evidence and are subject to change.
- Vaccines may be administered concurrently unless contraindicated or otherwise specified.
- For more information, please consult the latest immunization guidelines from the Centers for Disease Control and Prevention (CDC).

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**Vaccine Schedule**

*Image showing a table with details on recommended adult immunizations by medical condition and other indications.*
### 2019 Recommended Immunizations for Children from Birth Through 6 Years Old

<table>
<thead>
<tr>
<th>1 month</th>
<th>2 months</th>
<th>4 months</th>
<th>6 months</th>
<th>12 months</th>
<th>15 months</th>
<th>18 months</th>
<th>19-23 months</th>
<th>2-3 years</th>
<th>4-6 years</th>
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</thead>
<tbody>
<tr>
<td>HepB</td>
<td>HepB</td>
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<td>HepB</td>
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</table>

**NOTE:**
- If your child electron a shot, don’t start another one. Just go back to your child’s doctor for the next shot. Talk with your child’s doctor if you have questions about vaccines.

**FOOTNOTES:**
- **Two doses given at least four weeks apart are recommended for children age 6 months through 6 years of age who are getting an influenza vaccine for the first time and for some other children in this age group.**
- **Two doses of Influenza vaccine are needed for lifelong protection. The first dose should be given at least 4 weeks after the last dose.**
- **MMR vaccine should be given to all children at least 12 months of age to protect against measles, mumps, and rubella.**
- **Varicella vaccine should be given to all children at least 12 months of age to protect against chickenpox.**

For more information, call toll-free 1-800-CDC-INFO (1-800-232-4636) or visit www.cdc.gov/vaccines/parents

See back page for more information on vaccine-preventable diseases and the vaccines that prevent them.

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**Vaccine Schedule**

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U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

American Academy of Pediatrics
Dedicated to the health of all children.
The End

THANK YOU FOR YOUR TIME!


Works Cited


Image Credits

- Pregnancy antibodies graphic: http://www.immunizeca.org/pregnant-women/
- Table 1. Recommended Adult Immunization Schedule for ages 19 years or older, United States, 2019, 5 Feb 2019. https://www.cdc.gov/vaccines/schedules/hcp/imz/adult.html