EpiVac Pink Book Web-on-Demand Series

Polio and Hib-2020

Immunization Services Division
National Center for Immunization and Respiratory Diseases
Centers for Disease Control and Prevention
Atlanta, GA

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Learning Objectives

- For each vaccine-preventable disease, identify those for whom routine immunization is recommended.
- For each vaccine-preventable disease, describe characteristics of the vaccine used to prevent the disease.
- Describe an emerging immunization issue.
- Locate current immunization resources to increase knowledge of team’s role in program implementation for improved team performance.
- Implement disease detection and prevention health care services (e.g., smoking cessation, weight reduction, diabetes screening, blood pressure screening, immunization services) to prevent health problems and maintain health.
Today’s Agenda

EpiVac Pink Book Web-on-Demand Series: Polio and Hib-2020

Andrew Kroger, MD, MPH, Medical Officer, CDC/NCIRD
Continuing Education Information

- CE credit, go to: www.cdc.gov/GetCE
- Search course number: WD4344-090220
- CE credit expires: July 1, 2022
- CE instructions are available on the EpiVac Pink Book Web-on-Demand Series web page
- Questions and additional help with the online CE system, e-mail CE@cdc.gov
Disclosure Statements

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Disclosure Statements

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CDC does not accept any commercial support.
Polio and *Haemophilus influenzae* type b

*Pink Book Web-on-Demand Series, 2020*

Andrew Kroger, MD, MPH
Medical Officer
Communications and Education Branch
Polio Disease
Poliomyelitis Disease

- First outbreak described in the U.S. in 1843
- Polio epidemics were reported each summer and fall.
- More than 21,000 paralytic cases reported in the U.S. in 1952
Poliovirus

- Three serotypes of wild poliovirus:
  - WPV1
  - WPV2
  - WPV3
- Minimal heterotypic immunity between serotypes
- Rapidly inactivated by heat, chlorine, formaldehyde, and ultraviolet light
Poliomyelitis Pathogenesis

- Enters into mouth
- Replicates in pharynx and GI tract
- Invades local lymphoid tissue and then spreads to the bloodstream
- Viral spread along nerve fibers
- Destruction of motor neurons

Racaniello VR. One hundred years of poliovirus pathogenesis. *Virology* 2006;344:9-16
Outcomes of Poliovirus Infection

- Asymptomatic
- Minor non-specific illness
- Aseptic meningitis
- Flaccid paralysis
Asymmetric paralysis
# Poliovirus Epidemiology

<table>
<thead>
<tr>
<th>Reservoir</th>
<th>Human</th>
</tr>
</thead>
</table>
| Transmission    | Fecal-oral  
|                 | Oral-oral possible |
| Communicability | Most infectious: 7 to 10 days before onset  
|                 | Virus present in stool 3 to 6 weeks |
Poliomyelitis—United States, 1950 through 2010

Source: National Notifiable Disease Surveillance System, CDC
Vaccine–associated paralytic polio = VAPP
Polio Vaccine
Poliovirus Vaccines

- 1955–Inactivated vaccine
- 1963–Live, attenuated vaccine (OPV)
- 1987–Enhanced-potency, inactivated vaccine (IPV)
Enhanced Inactivated Polio Vaccine

- Highly effective in producing immunity to poliovirus
  - ≥90% of recipients immune after 2 doses
  - ≥99% of recipients immune after 3 doses

- Duration of immunity not known with certainty
<table>
<thead>
<tr>
<th>Vaccine Product</th>
<th>IPV Combination</th>
<th>Age Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ipol (SP)</td>
<td>IPV</td>
<td>6 weeks and older, any dose in the series</td>
</tr>
<tr>
<td>Pentacel (SP)</td>
<td>DTaP-IPV/Hib</td>
<td>6 wks through 4 yrs</td>
</tr>
<tr>
<td>Kinrix (GSK), Quadracel (SP)</td>
<td>DTaP-IPV</td>
<td>4 through 6 yrs</td>
</tr>
<tr>
<td>Vaxelis (Merck)</td>
<td>Dtap-IPV-Hib-HepB</td>
<td>6 wks through 4 years</td>
</tr>
<tr>
<td>Pediarix (GSK)</td>
<td>DTaP-HepB-IPV</td>
<td>6 wks through 6 yrs</td>
</tr>
</tbody>
</table>

**Polio-Containing Vaccine Products**
Clinical Considerations
### ACIP Polio Immunization Recommendations

**Routine Childhood Schedule**

<table>
<thead>
<tr>
<th>IPV Dose</th>
<th>Routinely Recommended Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 months</td>
</tr>
<tr>
<td>2</td>
<td>4 months</td>
</tr>
<tr>
<td>3</td>
<td>6 through 18 months</td>
</tr>
<tr>
<td>4</td>
<td>4 through 6 years</td>
</tr>
</tbody>
</table>
ACIP Polio Immunization Recommendations
Catch-Up Schedule

- Infants 6 months of age and younger, follow the recommended schedule intervals
- If accelerated protection is needed (e.g., travel to polio-endemic area), minimum age and intervals may be followed

<table>
<thead>
<tr>
<th>Dose</th>
<th>Minimum Age</th>
<th>Minimum Interval to the Next Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose 1</td>
<td>6 weeks</td>
<td>4 weeks</td>
</tr>
<tr>
<td>Dose 2</td>
<td>10 weeks</td>
<td>4 weeks</td>
</tr>
<tr>
<td>Dose 3</td>
<td>14 weeks</td>
<td>6 months</td>
</tr>
<tr>
<td>Dose 4</td>
<td>4 years</td>
<td>&quot;</td>
</tr>
</tbody>
</table>
ACIP Polio Immunization Recommendations

4\textsuperscript{th} Dose and the Catch-Up Schedule

- A 4th dose is not necessary if the 3rd dose was administered:
  - At age 4 years or older AND
  - At least 6 months after the previous dose.

- Children who have received 4 doses (or more) before 4 years of age need an additional dose.
  - There should be at least 6 months between last and next-to-last dose.
Schedules that Include Both IPV and OPV

- Mixed-product series containing both OPV and IPV is acceptable
  - Only trivalent OPV (tOPV) counts toward completing the series.

- Children with an incomplete series:
  - Administer IPV to complete a series that includes doses of OPV
  - Ensure doses met minimum ages and intervals

- Administer 1 dose of IPV to children who received 4 doses of OPV (or more) before 4 years of age.
  - There should be at least 6 months the last dose of OPV and the IPV dose.
OPV Administered Outside the U.S.

- Use the date of administration to make a presumptive determination of what type of OPV was received.
- Trivalent OPV was used throughout the world prior to April 1, 2016.
- Persons 18 years of age and younger with doses of OPV that do not count towards the U.S. vaccination requirements should receive IPV.
ACIP Polio Immunization Recommendations
Adolescents and Adults

- Routine vaccination of U.S. residents 18 years of age or older is not necessary or recommended.

- May consider vaccination of travelers to polio-endemic countries and selected lab workers.
ACIP Polio Immunization Recommendations

Unvaccinated Adults

- Use routine IPV schedule if possible
  - 0, 1 through 2 months, 6 through 12 months intervals

- If accelerated protection is needed (e.g., travel to polio-endemic area), use the minimum intervals.

Minimum Intervals to the Next Dose

- Dose 1: 4 weeks
- Dose 2: 6 months
- Dose 3: --------------
ACIP Polio Immunization Recommendations
Previously Vaccinated Adults

- **Previously completed series**
  - Administer 1 dose of IPV to those at risk

- **Incomplete series**
  - Administer remaining doses in series based on immunization history
  - No need to restart a valid, documented series
    - Valid = minimum intervals met
Contraindications and Precautions

- **Contraindication**
  - Severe allergic reaction to a vaccine component or following a prior dose of vaccine

- **Precaution**
  - Moderate to severe acute illness
IPV Adverse Reactions

- Local reactions: 2.8% (pain, redness, swelling)
- Severe reactions: rare
Polio Eradication

- Last case in the United States in 1979
- Western Hemisphere certified polio-free in 1994
- Last isolate of WPV2 was in India in October 1999
- Global eradication goal
Global Polio Eradication Initiative

Who we are

The Global Polio Eradication Initiative is a public-private partnership led by national governments with five partners – the World Health Organization (WHO), Rotary International, the US Centers for Disease Control and Prevention (CDC), the United Nations Children’s Fund (UNICEF), Bill & Melinda Gates Foundation and Gavi, the vaccine alliance. Its goal is to eradicate polio worldwide.

- **6** CORE PARTNERS
- **200** COUNTRIES INVOLVED
- **20** MILLION VOLUNTEERS
- **over 2.5 BILLION CHILDREN VACCINATED**
- **US$ 17 BILLION INTERNATIONAL INVESTMENT**
- **GOAL** A POLIO – FREE WORLD
Clinical Considerations for IPV-Containing Vaccines

- **Storage:** refrigerate between 2°C and 8°C (36°F and 46°F)
- **Preparation:** prepare the vaccine just prior to administration
  - Pentacel requires reconstitution
  - Reconstitute the lyophilized vaccine with the DTaP-IPV liquid diluent supplied by the manufacturer. Do NOT use Kinrix or Quadracel.
- **Route:** IM injection*
- **Site:**
  - 11 months and younger: Anterolateral thigh muscle
  - 12 months and older: Anterolateral thigh muscle or deltoid muscle of arm
- **Needle:**
  - Children: 22 through 25 gauge, 1-inch needle
  - Adults: 22 through 25 gauge, length varies by weight

*IPV may be administered by subcutaneous injection using a 5/8-inch needle given in the fatty tissue over the upper, outer triceps or anterolateral thigh
Polio: Vaccine Administration Errors

- **Schedule errors: Dose 4 administered too soon**
  - Doses administered 5 or more days before the minimum age and/or interval do not count and should be repeated when age-appropriate.
  - Wait the minimum interval from the invalid dose before giving the repeat dose.
  - Minimum age/interval: at/after age 4 AND 6 months after dose 3

- **Age/dose errors: Kinrix or Quadracel for doses 1 through 3**
  - If the minimum age and interval from the last dose of polio vaccine has been met, the dose can count and does not need to be repeated.

- **Preparation errors: wrong diluent to reconstitute DTaP-IPV/Hib (Pentacel)**
  - Do not use Kinrix or Quadracel to reconstitute Pentacel
**Haemophilus influenzae type b**

- Severe bacterial infection, particularly among infants
- Aerobic gram-negative bacteria
- Polysaccharide capsule
- 6 different serotypes (a through f) of polysaccharide capsule
- 95% of invasive disease caused by type b (prevaccine era)
Impact of *Haemophilus influenzae* type b Disease

- Formerly the leading cause of bacterial meningitis among children younger than 5 years of age

- Approximately 1 in 200 children developed invasive Hib disease

- Almost all infections among children younger than 5 years
**Haemophilus influenzae** type b
Clinical Manifestations*

*Prevaccine era*

- **Bacteremia**: 2%
- **Cellulitis**: 6%
- **Arthritis**: 8%
- **Osteomyelitis**: 2%
- **Pneumonia**: 15%
- **Epiglottitis**: 17%
- **Cellulitis**: 6%
- **Bacteremia**: 2%

- **Meningitis**: 50%
Facial cellulitis or infection of the soft tissues of the face, caused by Hib
**Haemophilus influenzae type b** Epidemiology

- **Reservoir**: Human asymptomatic carriers
- **Transmission**: Respiratory droplets presumed
- **Temporal pattern**: Peaks in Sept. through Dec. and March through May
- **Communicability**: Generally limited but higher in some circumstances (e.g., household, child care)
Estimated Annual Incidence (per 100,000) of Invasive *Haemophilus influenzae* type b (Hib) Disease in Children Aged <5 Years—U.S., 1980 through 2012

First polysaccharide Hib vaccine licensed for use in children aged ≥18 months

First conjugate Hib vaccine licensed for use in children aged ≥18 months

First Hib vaccines licensed for use in infants aged ≥2 months

MMWR 2014;63(RR1):1–14
Haemophilus influenzae, Invasive Disease Incidence of Reported Cases (per 100,000), by serotype Among Children aged <5 years—U.S., 2000 through 2013

Healthy People 2020 Goal
Hib Vaccine
Haemophilus influenzae type b Polysaccharide Vaccine

- Available 1985 until 1988
- Not effective in children younger than 18 months of age
- Efficacy in older children varied
- Age-dependent immune response
- Not consistently immunogenic in children 2 years of age and younger
- No booster response
Conjugation improves immunogenicity
- Immune response with booster doses

Same polysaccharide capsule linked to different carrier proteins

3 single-component conjugate Hib vaccine products

1 combination vaccine products available that contain Hib conjugate vaccine
Hib-Containing Vaccine Products

PRP-T (polysaccharide, tetanus toxoid)

- ActHIB
- Pentacel (SP)
- Hiberix (GSK)

PRP-OMP (polysaccharide, outer membrane protein)

- PedVaxHIB (Merck)
- Vaxelis (Merck)

DTaP-IPV/Hib

All doses and primary schedule and booster dose 2 through 5 years
For doses one through 4, 6 weeks through 4 years of age
All doses and primary schedule, 6 weeks through four years of age
All doses of primary schedule and booster dose 2 through 4 years of age
ACIP Hib Immunization Recommendations

Routine Schedule

- Routinely recommended for all infants beginning at 2 months of age*

- Schedule varies based on the product used
  - ActHib, Pentacel, Hiberix: follow the 4-dose schedule at 2, 4, 6, and 12 through 15 months of age
  - PedvaxHIB: follow the 3-dose schedule at 2, 4, and 12 through 15 months of age

- If any dose in the series is ActHIB, Pentacel, Hiberix or the product is not known, follow the 4-dose schedule.

*Minimum age for the 1st dose is 6 weeks
Unvaccinated Healthy Children 7 months of Age and Older

- Children starting late may not need entire 3- or 4-dose series
- Number of doses child requires depends on current age
- Resources:
  - 2018 catch-up schedule
  - Catch-up guidance for healthy children
  - Detailed schedule p. 128 of Pink Book

Catch-Up Guidance for Healthy Children 4 Months through 4 Years of Age [www.cdc.gov/vaccines/schedules/downloads/child/job-aids/hib-actHib.pdf]
ACIP Hib Immunization Recommendations
Older Children and Adults

- Generally not recommended for healthy persons older than 59 months of age
- Vaccinate high-risk older children and adolescents if incompletely or previously unvaccinated
  - Asplenia
  - Immunodeficiency
  - HIV infection
  - Receipt of chemotherapy or radiation therapy
### ACIP Hib Immunization Recommendations
#### High-Risk Children and Adults

<table>
<thead>
<tr>
<th>High-Risk Children and Adults</th>
<th>Hib Vaccine Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elective splenectomy</td>
<td>If unvaccinated: 1 dose prior to procedure</td>
</tr>
<tr>
<td>Asplenic patient</td>
<td>If unvaccinated: 1 dose</td>
</tr>
<tr>
<td>HIV-infected children</td>
<td>If unvaccinated: 1 dose</td>
</tr>
<tr>
<td>Hematopoietic cell transplant</td>
<td>3 doses (at least 4 weeks apart) beginning 6–12 months after transplant</td>
</tr>
<tr>
<td>HIV-infected adults</td>
<td>Hib vaccination is not recommended</td>
</tr>
</tbody>
</table>
“Unvaccinated” and High-Risk Catch-Up

- “Unvaccinated” means someone who meets both criteria:
  
  Less than the routine series through 14 months;

  AND

  No doses after 14 months of age.
Special Populations

- **Children less than 24 months of age with invasive Hib disease**
  - Administer complete series as recommended for child’s age
  - Vaccinate during the convalescent phase of the illness

- **American Indian/Alaska natives**
  - Hib disease peaks earlier in infancy.
  - PedVaxHIB vaccine produces protective antibody after first dose/early protection
  - PedVaxHIB vaccine is specifically recommended for primary series doses.
Hib Vaccine Interchangeability

- All single-component conjugate Hib vaccines are interchangeable for primary series and booster dose.

- 3-dose primary series (4 doses total) if more than one brand of vaccine used at 2 or 4 months of age

- Whenever feasible, use same combination vaccine for subsequent doses

- If vaccine used for earlier doses is not known or not available, any brand may be used to complete the series.
A 20 year old was in an automobile accident and required an emergency splenectomy. Her Hib vaccination history is a single dose of Hib vaccine after 14 months of age. Is she recommended for another dose now?
A) Yes
B) No
A 20 year old was in an automobile accident and required an emergency splenectomy. Her Hib vaccination history is a single dose of Hib vaccine after 14 months of age. Is she recommended for another dose now?

No
Contraindications and Precautions

- Severe allergic reaction to vaccine component or following previous dose
- Moderate to severe acute illness
- Age younger than 6 weeks
Hib Vaccine Adverse Reactions

- Swelling, redness, or pain in 5 to 30% of recipients
- Systemic reactions infrequent
- Serious adverse reactions rare
Clinical Considerations for Hib-Containing Vaccine

- **Storage:** refrigerate between 2°C and 8°C (36°F and 46°F)
- **Preparation:** prepare vaccine just prior to administration
  - ActHIB, Pentacel, and Hiberix require reconstitution
  - Reconstitute the lyophilized vaccine with the diluent supplied by the manufacturer.
- **Route:** IM injection
- **Site:**
  - 11 months and younger: Anterolateral thigh muscle
  - 12 months and older: Anterolateral thigh muscle or deltoid muscle of arm
- **Needle:** 22 through 25 gauge, 1-inch needle
Hib: Vaccine Administration Errors

- Preparation errors: Using the wrong diluent to reconstitute the lyophilized component

CDC vaccine storage label examples [https://www.cdc.gov/vaccines/hcp/admin/storage/guide/vaccine-storage-labels.pdf](https://www.cdc.gov/vaccines/hcp/admin/storage/guide/vaccine-storage-labels.pdf)
Resource
- Provide the polio and Hib vaccine information statement (VIS) when a combination vaccine is administered.
  - There are no VISs specific for Kinrix, Pediarix, Pentacel, or Quadracel.
- Other option: multiple vaccines VIS
  - May be used in place of the individual VISs for DTaP, Hib, hepatitis B, polio, and PCV13 when two or more of these vaccines are administered during the same visit
  - It may be used for infants through children receiving their routine 4- to 6-year vaccines

Additional Resource
- CDC vaccine information statements [www.cdc.gov/vaccines/hcp/vis/vis-statements/multi.html](http://www.cdc.gov/vaccines/hcp/vis/vis-statements/multi.html)
Questions and Answers
Continuing Education Information

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E-mail Your Immunization Questions to Us

NIPINFO@cdc.gov

Write “Web-on-Demand—Polio/Hib” in the subject line
Comprehensive list of resources for ALL sessions

Located on the web page for this web-on-demand session at www.cdc.gov/vaccines/ed/webinar-epv/index.html

Additional materials located on this webpage include:

- Polio/Hib slide set
- Web-on-demand questions and answers
- Transcript of this session
- Continuing education instructions

Course Resources

Epidemiology and Prevention of Vaccine-Preventable Diseases

Overall Resources

- Current childhood and adult immunization schedules: www.cdc.gov/vaccines/schedules/schedules.html
- Advisory Committee on Immunization Practices (ACIP) recommendations: www.cdc.gov/vaccines/acip/index.html
- CDC General Best Practice Guidelines for Immunization: www.cdc.gov/vaccines/hcp/acip-recs/vacc-recs/general-guidelines.html
- CDC Continuing Education Information: www.cdc.gov/vaccines/ed/accredit.html
- Health Care Personnel: Immunization Recommendations: www.immunizationinfo.org/acip.html
- Pink Book Webinar Series: www.cdc.gov/vaccineinfo/pinkbook/index.html

Course Intro and Objectives

- What is the Advisory Committee on Immunization Practices (ACIP)?
- CDC Immunization Resources for You and Your Patients: www.cdc.gov/vaccines/hcp/acip-recs/vacc-recs/acipobjectives.html
- The History of Vaccines: How Vaccines Work: www.cdc.gov/vaccines/hcp/immunize/history.html

Principles of Vaccination

- Insertion System Research: www.cdc.gov/vaccines/hcp/immunize/insertion-system-research.html
- What is the Immune System? www.cdc.gov/vaccines/hcp/immunize/immunization-basics.html

General Best Practice Guidelines

- Ask the Experts: Scheduling Vaccines FAQs: www.immunizationinfo.org/experts/requests/scheduling-vaccines.asp
- Ask the Experts: Combination Vaccines FAQs: www.immunizationinfo.org/experts/requests/combo.asp
- Ask the Experts: Precautions and Contraindications FAQs: www.immunizationinfo.org/experts/requests/contraindications.asp
- Foreign Language Vaccine-Preventable Disease Terms: www.cdc.gov/vaccines/vbc/vacfields/downloads/appendices/foreign-lang-vacfields.pdf
- Interval Between Antibody-Containing Products and Measles and Varicella: www.cdc.gov/vaccines/healthcare/appendixes/intradermal-measlesvaricella.pdf
Thank You From Atlanta!