Polio and Polio Vaccine

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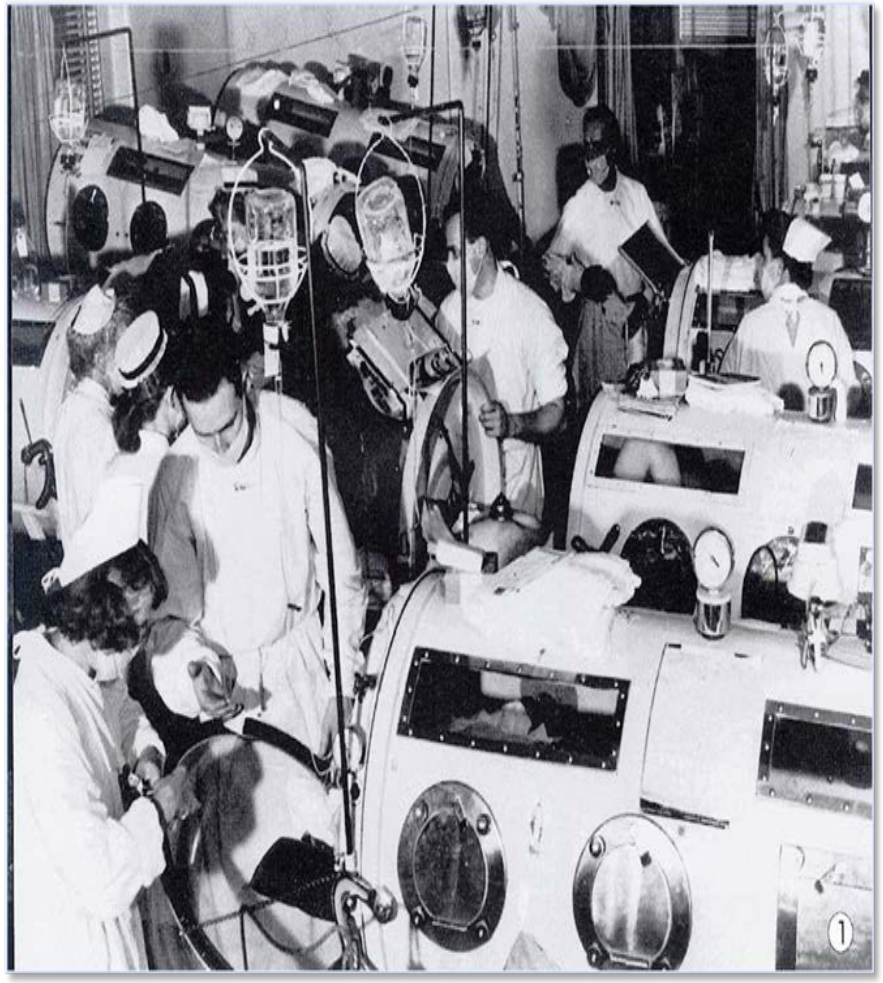
Poliomyelitis Disease



First outbreak described in the U.S. in 1843

More than 21,000 paralytic cases reported in the U.S. in 1952

Global eradication within this decade

Poliovirus

Three serotypes of wild polio virus:

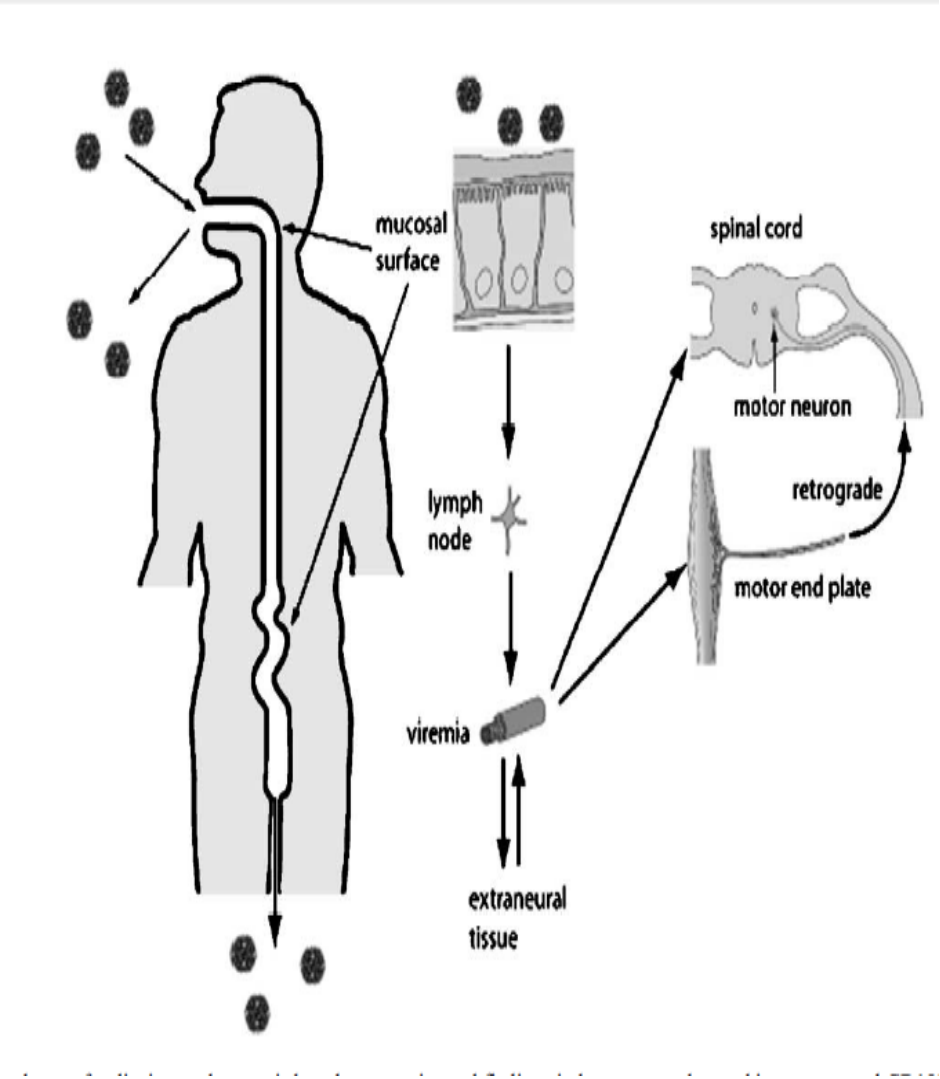
- WPV1
- WPV2
- WPV3

Minimal heterotypic immunity between serotypes

Rapidly inactivated by heat, chlorine, formaldehyde, and ultraviolet light

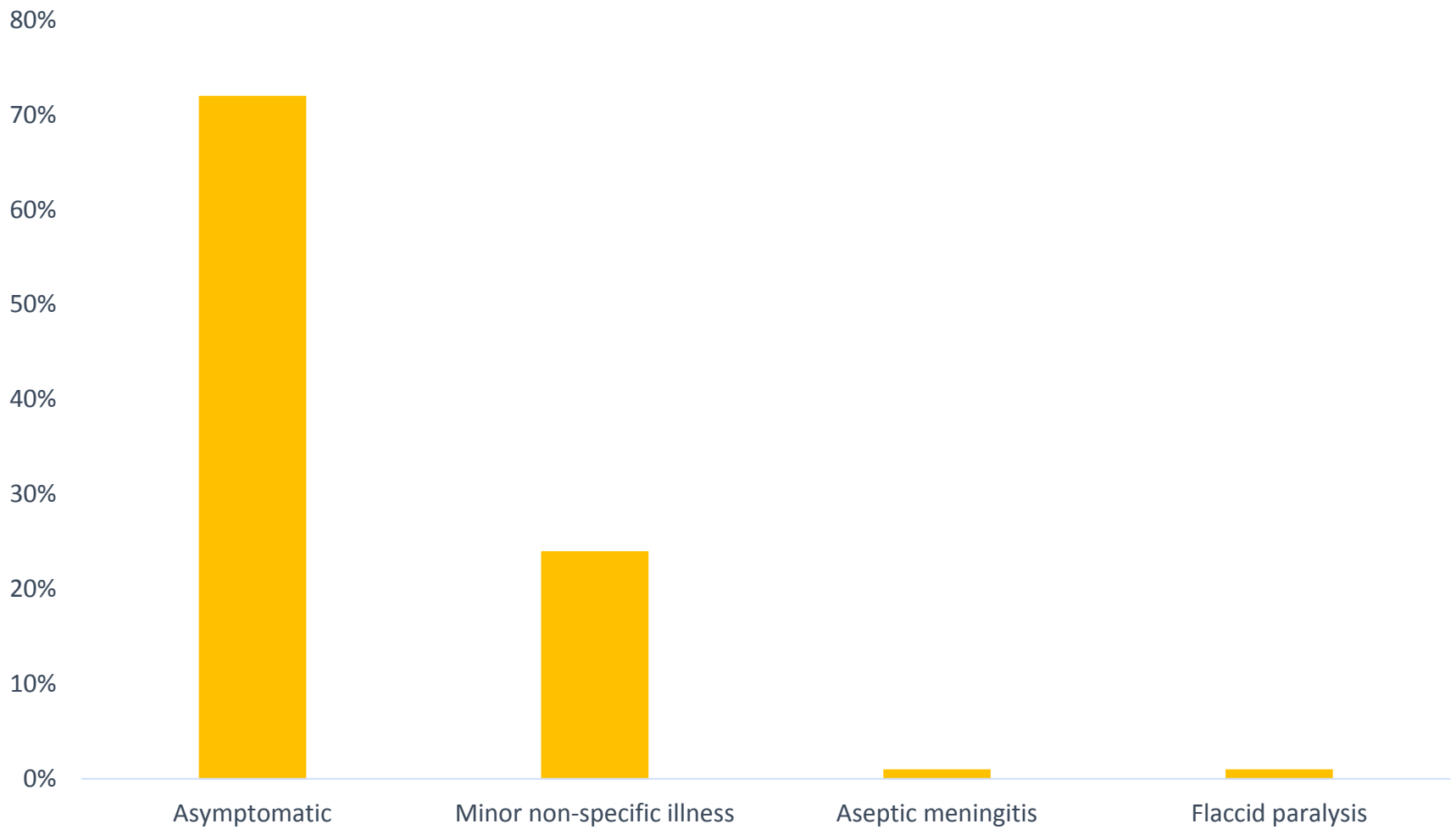
Poliomyelitis Pathogenesis

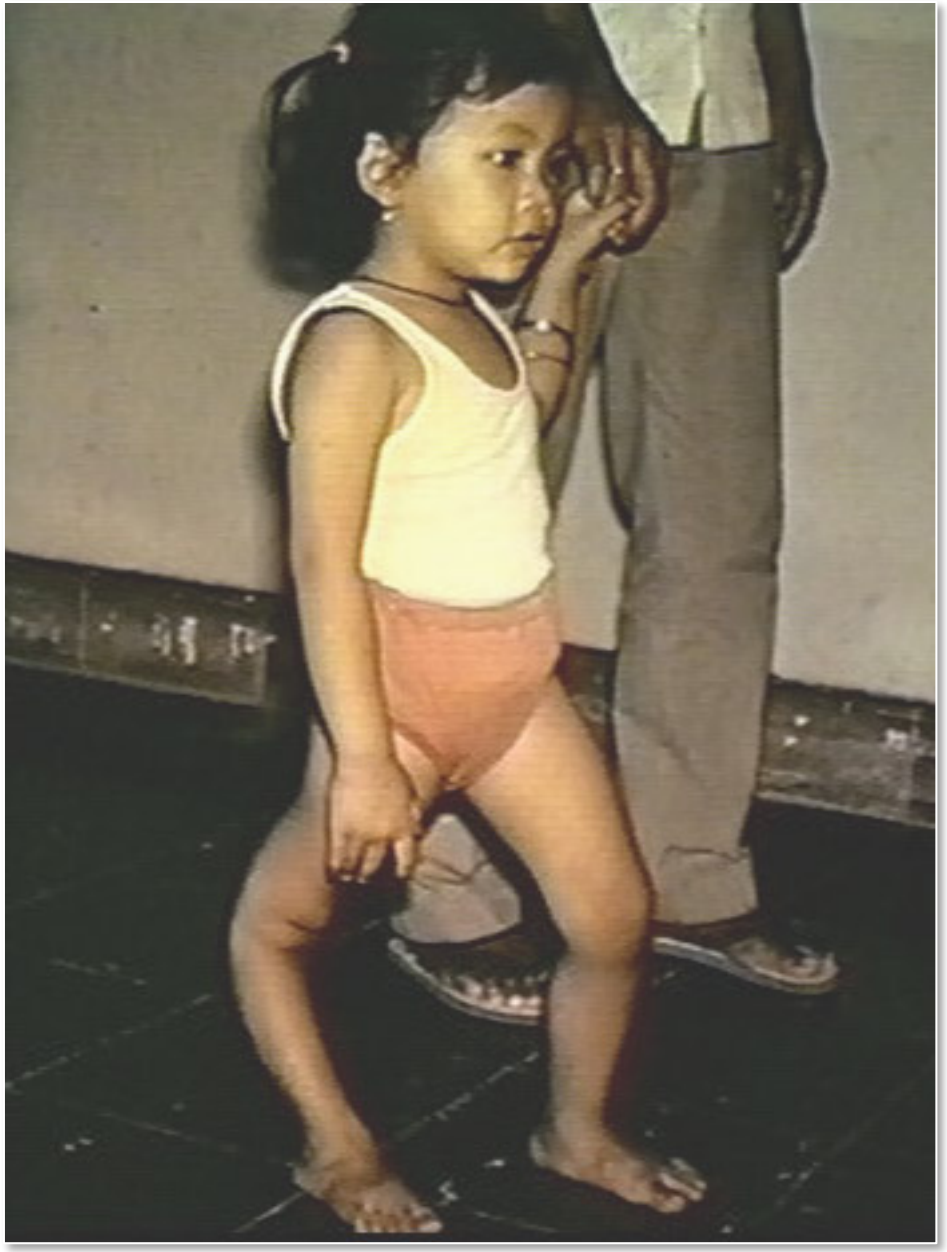
- Entry into mouth
- Replication in pharynx and GI tract
- Hematologic spread to lymphatics and c
- Viral spread along nerve fibers
- Destruction of motor neurons



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

Outcomes of Poliovirus Infection

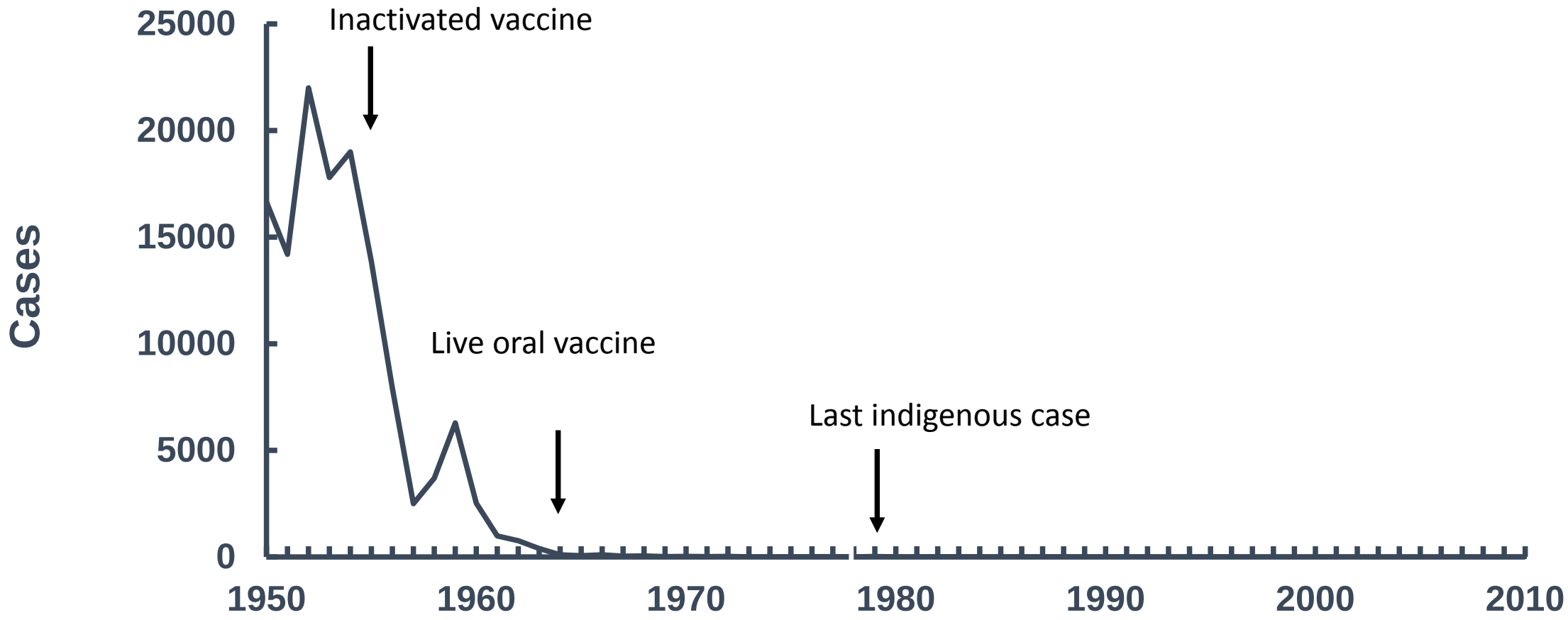




Poliovirus Epidemiology

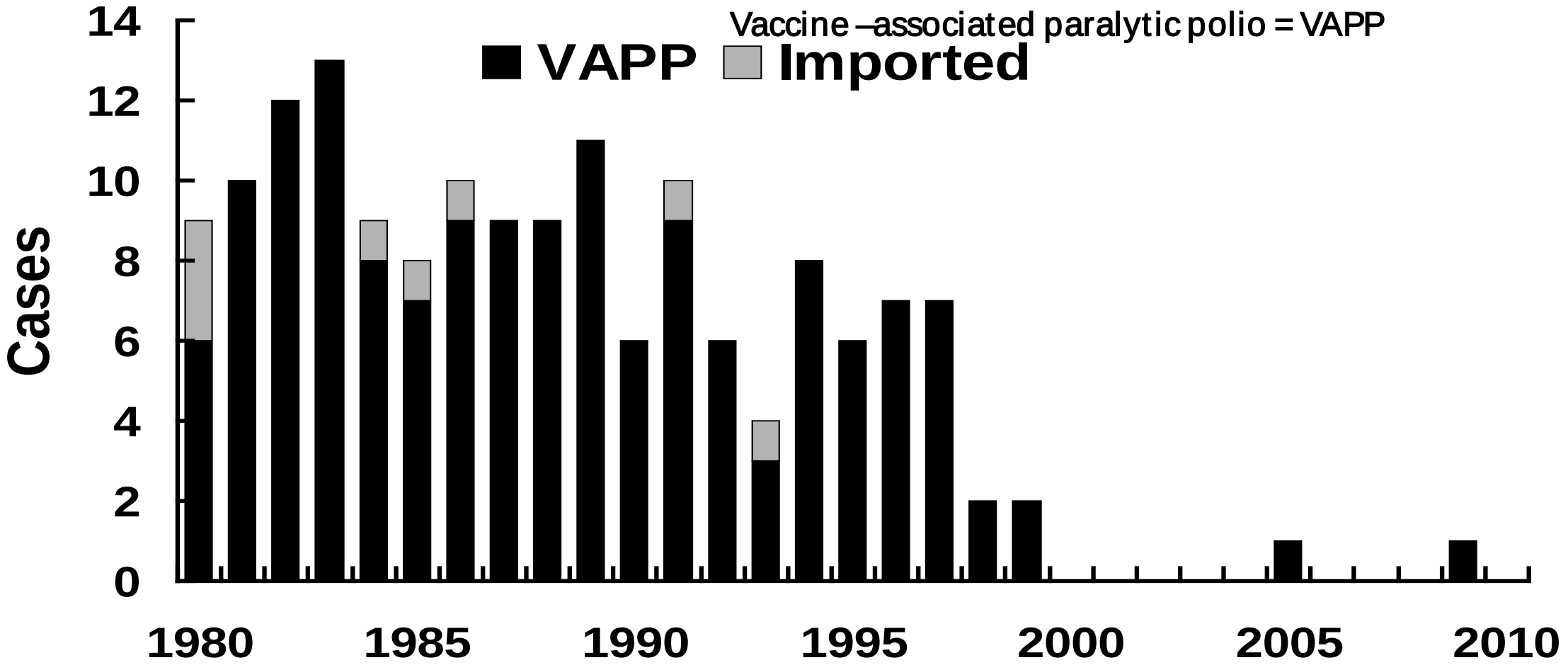
Reservoir	Human
Transmission	Fecal-oral Oral-oral possible
Communicability	Most infectious: 7-10 days before onset Virus present in stool 3-6 weeks

Poliomyelitis—United States



Source: National Notifiable Disease Surveillance System, CDC

Poliomyelitis—United States, 1980-2010

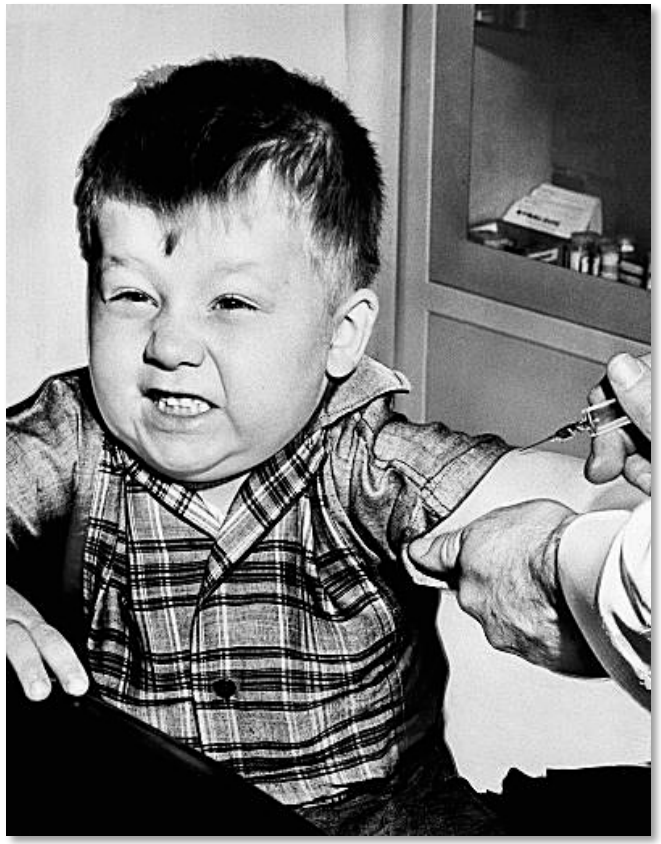


Poliovirus Vaccines

1955 - Inactivated vaccine

1963 - Trivalent OPV

1987 – Enhanced-potency (IPV)



Inactivated Polio Vaccine

Highly effective in producing immunity to poliovirus

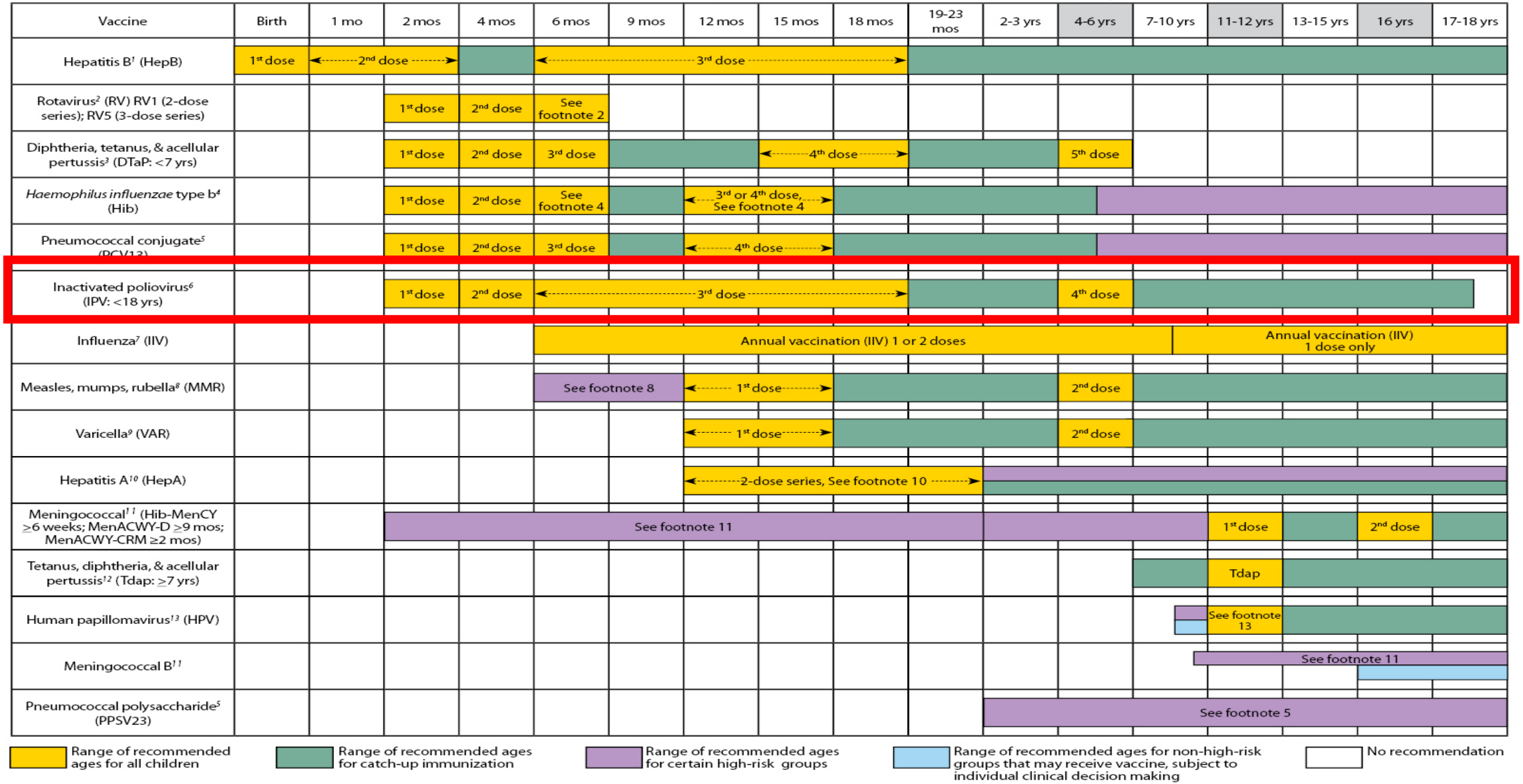
- ≥90% of recipients immune after 2 doses
- ≥99% of recipients immune after 3 doses

Duration of immunity not known with certainty

Figure 1. Recommended Immunization Schedule for Children and Adolescents Aged 18 Years or Younger—United States, 2017.

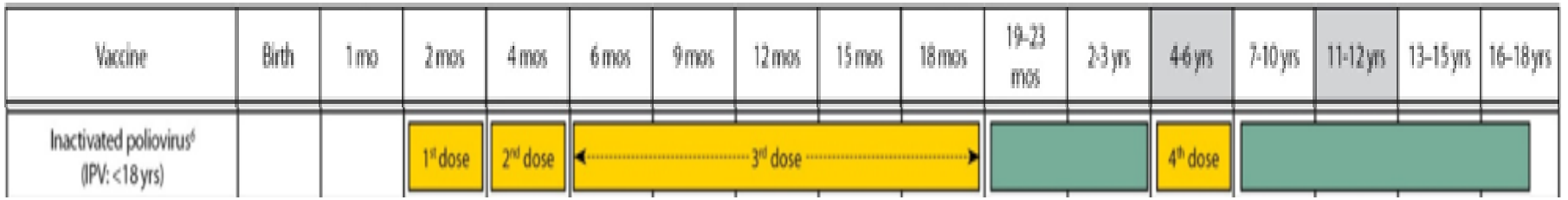
(FOR THOSE WHO FALL BEHIND OR START LATE, SEE THE CATCH-UP SCHEDULE [FIGURE 2]).

These recommendations must be read with the footnotes that follow. For those who fall behind or start late, provide catch-up vaccination at the earliest opportunity as indicated by the green bars in Figure 1. To determine minimum intervals between doses, see the catch-up schedule (Figure 2). School entry and adolescent vaccine age groups are shaded in gray.



NOTE: The above recommendations must be read along with the footnotes of this schedule.

Childhood Polio Vaccination Schedule



IPV Dose	Routinely Recommended at	Minimum Interval
1	2 months of age	----------
2	4 months of age	4 weeks
3	6- 18 months of age	4 weeks
4	4-6 years of age	6 months

Catch-up IPV Vaccination

In the first 6 months of life, minimum age and minimum intervals are only recommended if the person is at risk of imminent exposure to circulating poliovirus

If 4 or more doses are administered before age 4 years, an additional dose should be administered at age 4 through 6 years and at least 6 months after the previous dose

A fourth dose is not necessary if the third dose was administered at age 4 years or older and at least 6 months after the previous dose

www.cdc.gov/vaccines/schedules/downloads/child/0-18yrs-child-combined-schedule.pdf

Schedules that Include Both IPV and OPV

Only IPV is available in the United States

If both OPV and IPV were administered as part of a series, the series should be completed with IPV. Any combination of 4 doses of OPV and IPV by 4 to 6 years of age constitutes a complete series

If only OPV doses were administered, and all doses were given prior to 4 years of age, one dose of IPV should be given at 4 years or older, at least ~~4 weeks~~ 6 months after the last OPV dose

Only trivalent OPV (tOPV) counts toward the U.S. vaccination requirements (tOPV was used for routine poliovirus vaccination in all OPV-using countries until April 1, 2016).

Poliovirus-containing Vaccine Products

Single component vaccine - IPV (IPOL)

FOUR polio-containing combination vaccine products:

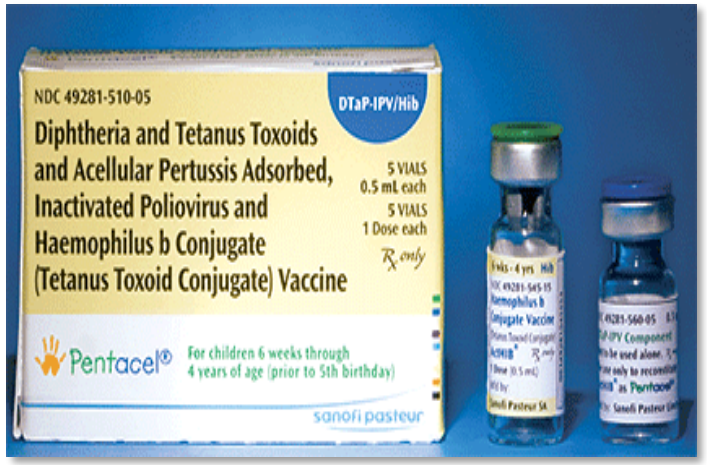
- DTaP-IPV/Hib (Pentacel)
- DTaP-HepB-IPV (Pediarix)
- DTaP-IPV (Kinrix)
- DTaP-IPV (Quadracel)

DTaP-IPV/Hib (Pentacel)

FDA-approved for:

- IPV doses 1 through 4
- Children 6 weeks through 4 years of age

Use DTaP-IPV diluent to reconstitute the Hib component



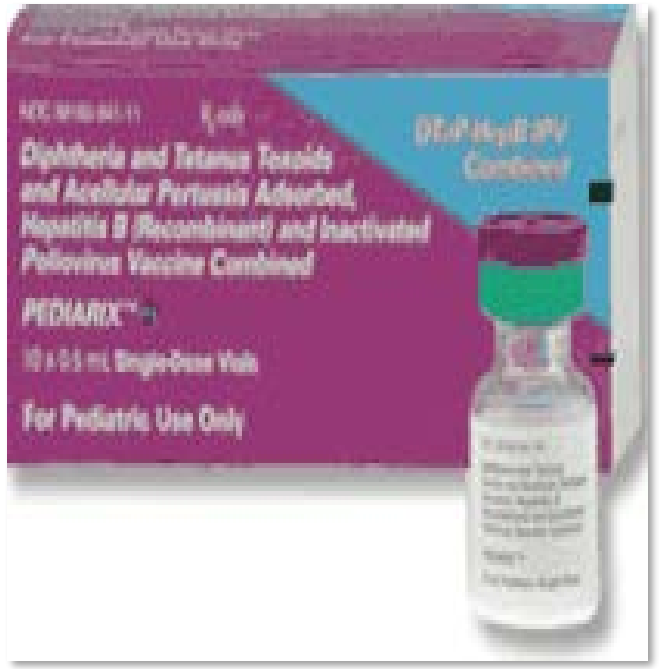
Reminder: Only use the manufacturer's supplied diluent

DTaP-HepB-IPV (Pediarix)

FDA-approved for:

IPV doses 1 through 3

Children 6 weeks through 6 years of age

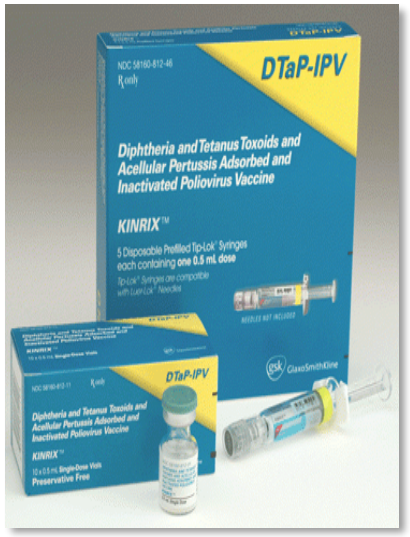


DTaP-IPV (Kinrix & Quadracel)

Kinrix

IPV dose 4

Children 4 through 6 years of age



Quadracel

IPV dose 4 or 5

4 through 6 years of age

Vaccine Administration error: Do NOT use Quadracel to reconstitute the Hib component of Pentacel vaccine

Polio Vaccination of Adolescents

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

Polio Vaccination of Unvaccinated Adults

Use standard IPV schedule if possible

- 0, 1-2 months, 6-12 months intervals

May separate first and second doses by 4 weeks if accelerated schedule needed

The minimum interval between the second and third doses is 6 months

Polio Vaccination of 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

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

Moderate to severe acute illness

IPV Adverse Reactions

Local reactions	2.8% (pain, redness, swelling)
Severe reactions	rare

Polio Eradication

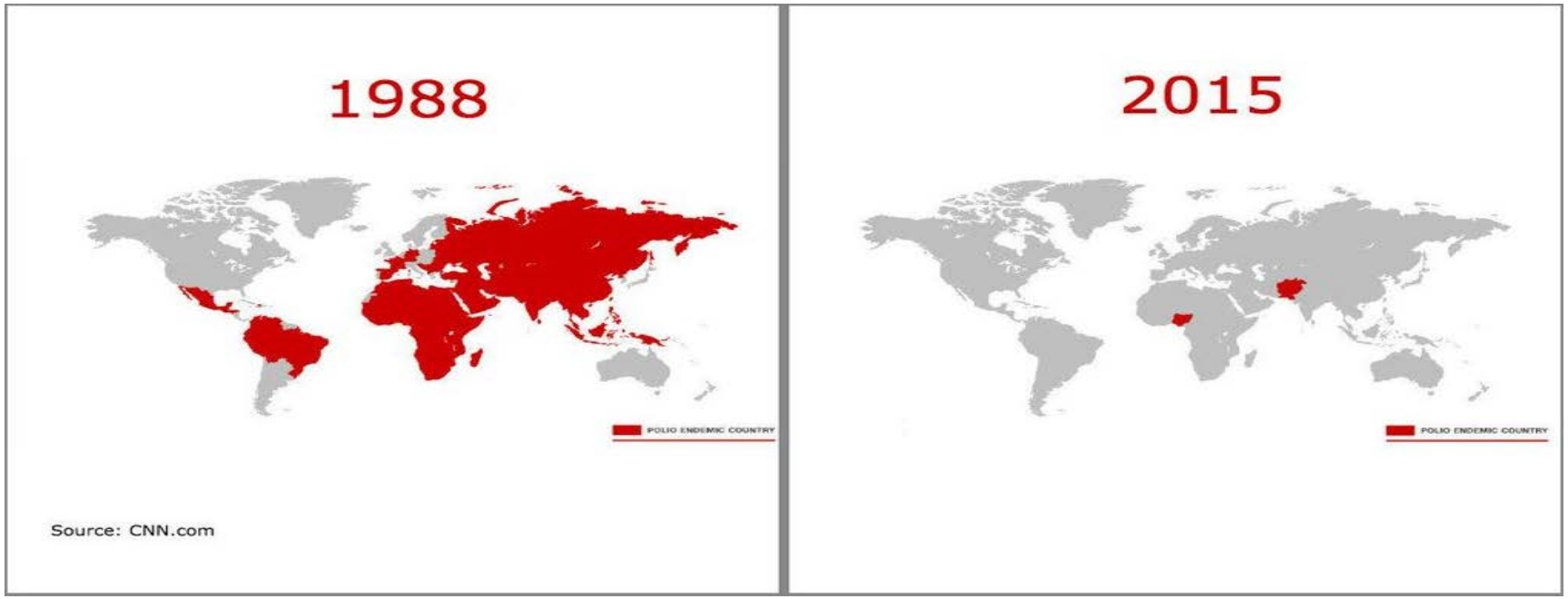
Last case in the United States in 1979

Western Hemisphere certified polio-free in 1994

Last isolate of WPV2 was in India in October 1999

Global eradication goal

Global Polio Efforts



The number of worldwide reported cases has decreased from an estimated 350,000 in 1988 to 8 as of August 9, 2017

Afghanistan – 5 cases of WPV1

Pakistan – 3 cases of WPV1

Nigeria – Polio-free

http://www.polioeradication.org
http://polioeradication.org/polio-today/polio-now/this-week/

Additional Polio Resources

- **Polio Eradication:** www.cdc.gov/polio/
- **Polio Infection:** www.cdc.gov/vaccines/vpd/polio/index.html

Haemophilus influenzae Type b and Hib Vaccine

National Center for Immunization & Respiratory Diseases Immunization Services Division

Haemophilus influenzae

Severe bacterial infection, particularly among infants

Aerobic gram-negative bacteria

Polysaccharide capsule

6 different serotypes (a-f) of polysaccharide capsule

95% of invasive disease caused by type b (prevaccine era)

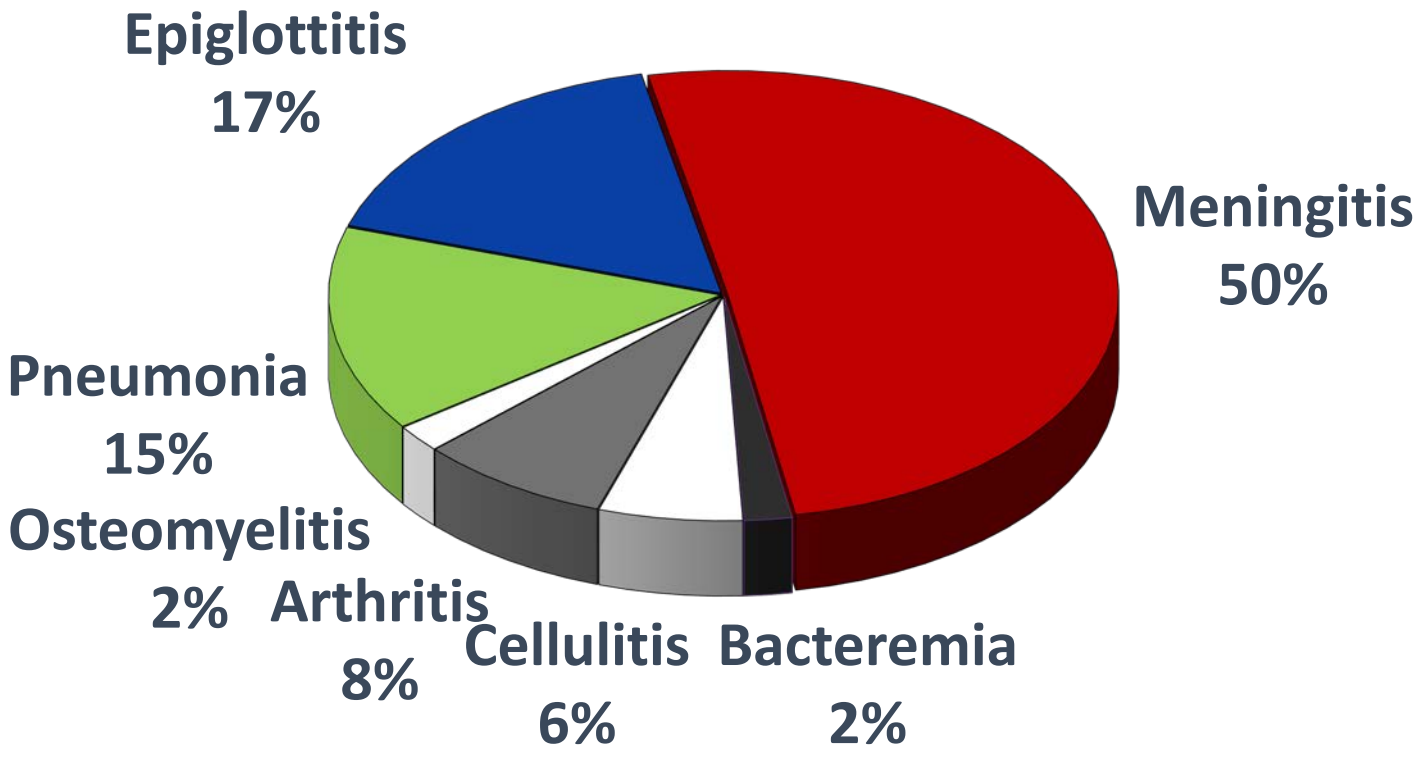
Impact of *Haemophilus influenzae* Type b Disease

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

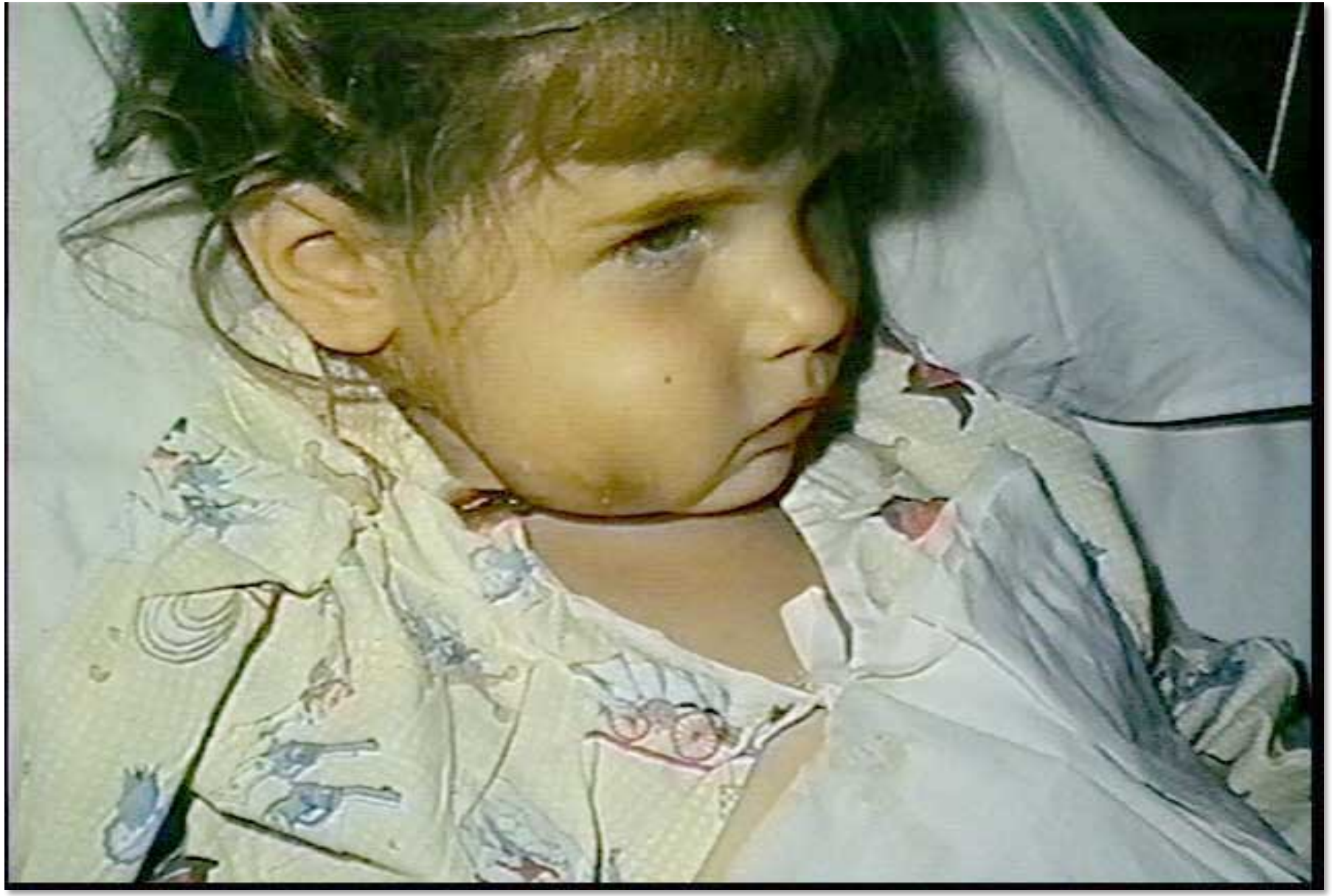
Approximately 1 in 200 children developed invasive Hib disease

Almost all infections among children younger than 5 years

Haemophilus influenzae Type b Clinical Manifestations*



*Prevaccine era

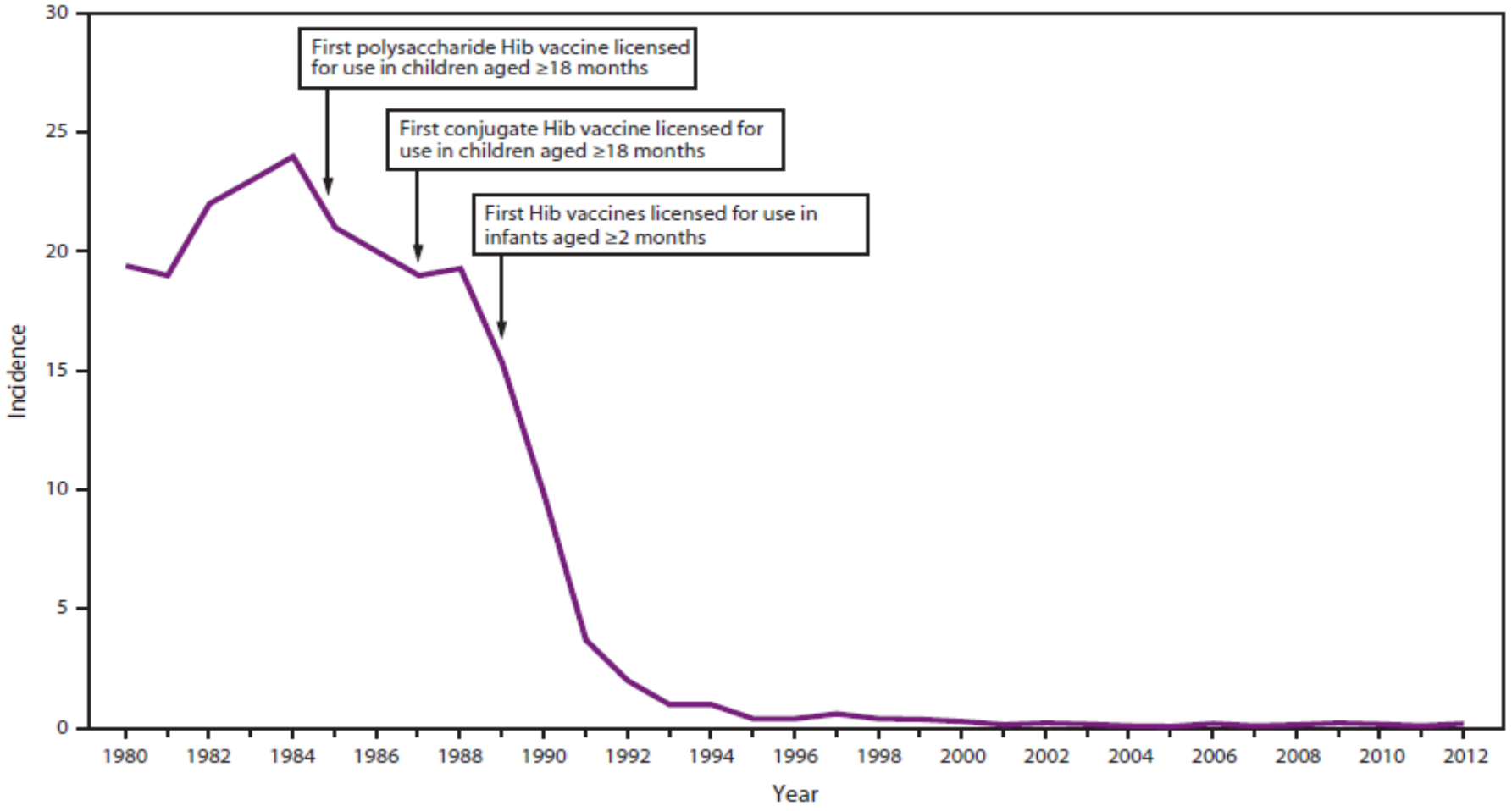


Hib facial cellulitis

Haemophilus influenzae Type b Epidemiology

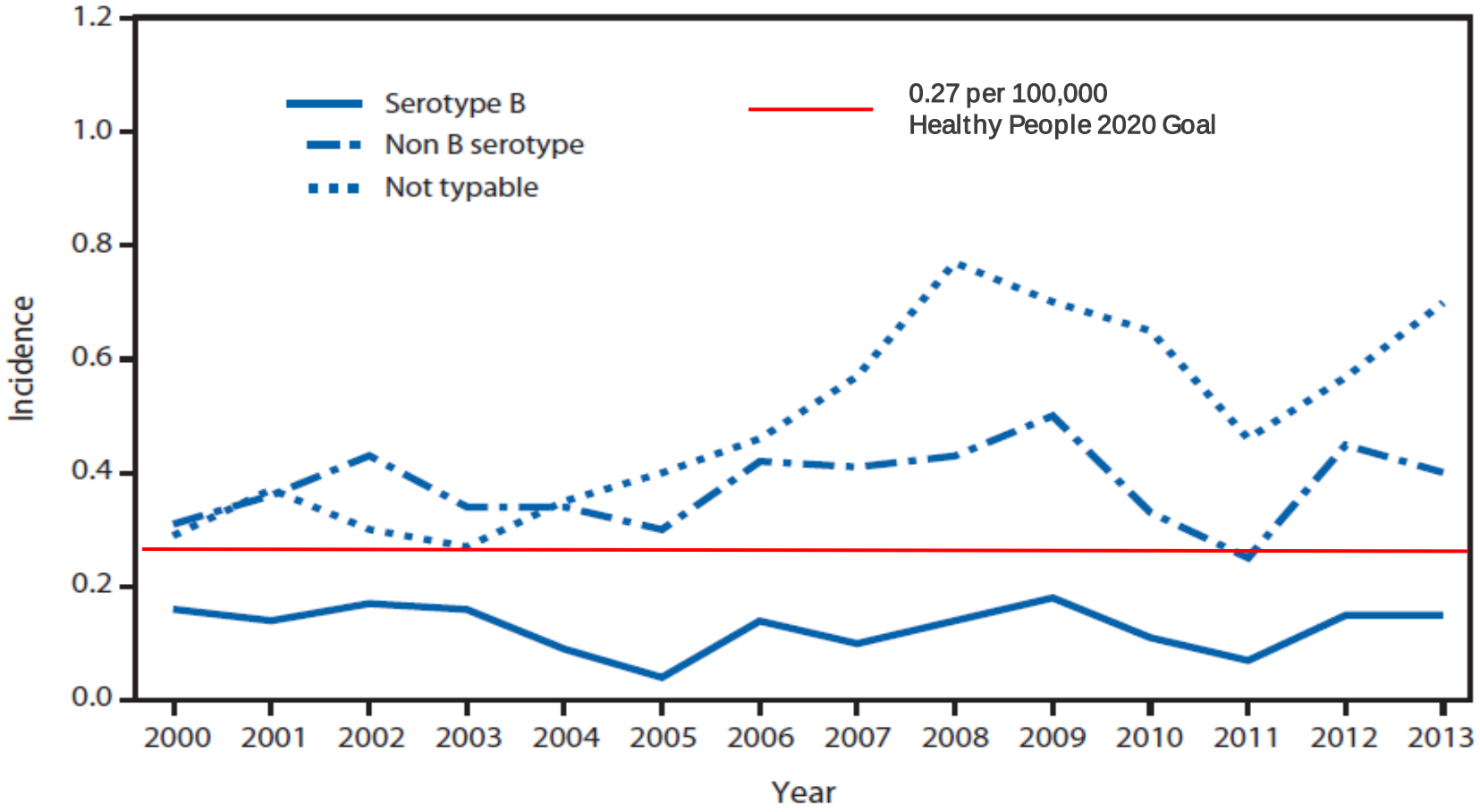
Reservoir	Human asymptomatic carriers
Transmission	Respiratory droplets presumed
Temporal pattern	Peaks in Sept-Dec and March-May
Communicability	Generally limited but higher in some circumstances (e.g., household, child care)

Estimated Annual Incidence (per 100,000) of Invasive *Haemophilus influenzae* Type b (Hib) Disease in Children Aged <5 Years — United States, 1980–2012



MMWR 2014;63(RR1):1-14.

Haemophilus influenzae, Invasive Disease
Incidence of reported cases (per 100,000), by serotype among children aged <5 years — United States, 2000–2013



MMWR 2015;62(53):1-119.

Haemophilus influenzae Type b Polysaccharide Vaccine

Available 1985-1988

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

Haemophilus influenzae Type b Conjugate Vaccines

Conjugation improves immunogenicity

- Immune response with booster doses

Same polysaccharide capsule linked to different carrier proteins

3 monovalent conjugate vaccines

2 combination vaccines available that contain Hib vaccine

Conjugate Hib Vaccines

PRP-T	ActHIB Hiberix Pentacel MenHibrix
PRP-OMP	PedvaxHIB

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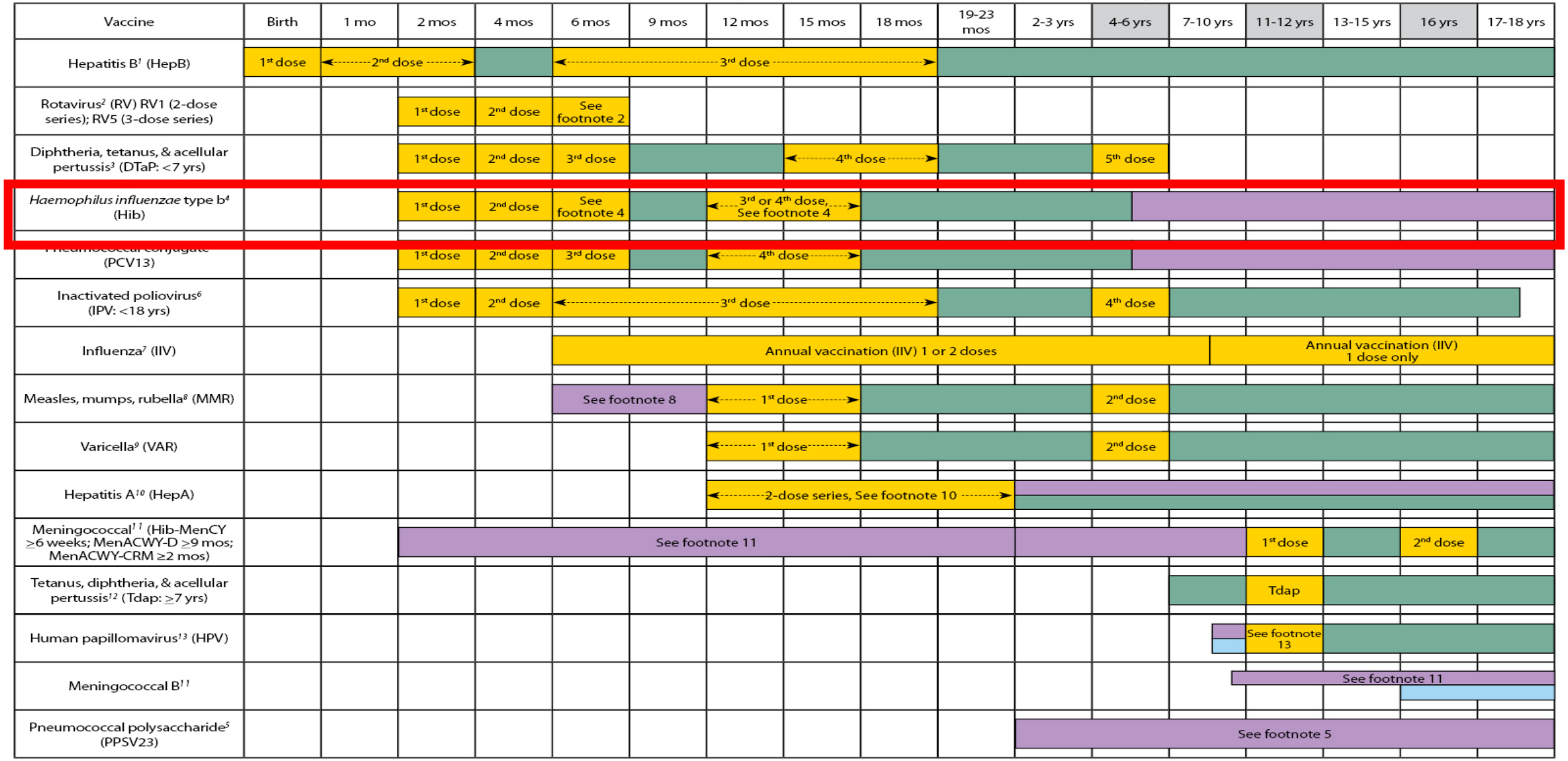

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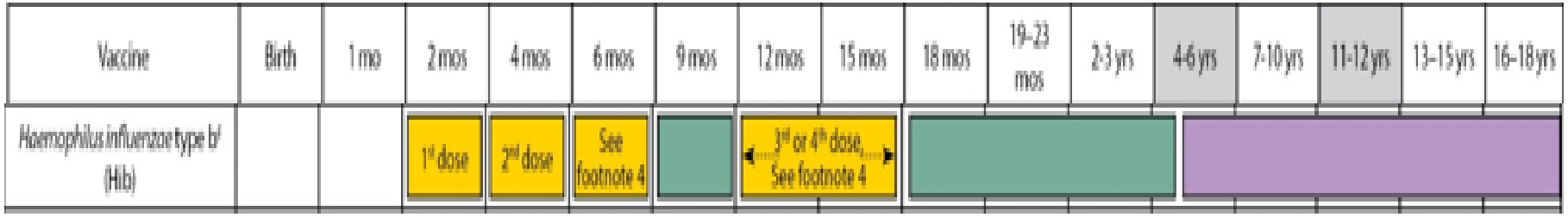
Hib Vaccine



Recommended interval 8 weeks for primary series

Minimum interval 4 weeks for primary series

Minimum age 6 weeks

Booster dose at 12-15 months

Hib Vaccine Routine Schedule

Vaccine	2 months	4 months	6 months	12-18 months
PRP-T	X	X	X	X
PRP-OMP	X	X	NA	X

Unvaccinated 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

See detailed schedule p. 128 of Pink Book, and 2017 catch-up schedule

Hib Vaccine
Use in Older Children and Adults

Generally not recommended for persons older than 59 months of age

High-risk older children and adolescents may be vaccinated if not vaccinated in childhood

- Asplenia
- Immunodeficiency
- HIV infection
- Receipt of chemotherapy or radiation therapy

Special populations

Guidance for Hib Vaccination in High-risk Groups

High-risk group	Hib vaccine guidance
Elective splenectomy	If unimmunized: 1 dose, prior to procedure
Asplenic patient	If unimmunized: 1 dose
HIV-infected children	If unimmunized: 1 dose
HIV-infected adults	Hib vaccination not recommended
Hematopoietic cell transplant	3 doses (at least 4 weeks apart) beginning 6-12 months after transplant

Special Populations

Children aged <24 months 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

- PRP-OMP vaccines specifically recommended for primary series doses
- Hib disease peaks earlier in infancy
- PRP-OMP vaccines produce protective antibody after first dose/early protection

Monovalent Hib Vaccines

ActHIB (PRP-T)

Hiberix (PRP-T)

PedvaxHIB (PRP-OMP)

ActHIB (PRP-T)

Approved for all doses of primary schedule and booster dose

Can be used for previously unvaccinated children per the catch-up schedule

Must be reconstituted only with 0.4% sodium chloride (NaCl) ActHIB diluent

Hiberix (PRP-T)

Approved for all doses of primary schedule and booster dose

Can be used for previously unvaccinated children per the catch-up schedule

PedvaxHIB (PRP-OMP

Approved for all doses of primary schedule and booster dose

Remember primary series for PRP-OMP vaccines is 2 doses

Can be used for previously unvaccinated children per the catch-up schedule

Hib-containing Combination Vaccines

- DTaP- IPV/Hib (Pentacel)

- Hib-MenCY (MenHIBrix)

Pentacel

Contains DTaP, Hib (PRP-T), and IPV

Approved for doses 1 through 4 among children 6 weeks through 4 years of age

Do NOT use for children 5 years or older

Package contains lyophilized Hib (ActHIB) that is reconstituted with a liquid DTaP-IPV solution

MenHibrix

Contains Hib (PRP-T) and *Neisseria meningitidis* serogroups C and Y

Approved for 4 doses between 6 weeks and 18 months of age

Only recommended for routine meningococcal vaccination of infants who are at increased risk for meningococcal disease

- Persistent complement pathway deficiencies
- Anatomic or functional asplenia, including sickle cell disease

Hib Vaccine Interchangeability

All monovalent 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

Contraindications and Precautions

Severe allergic reactions 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%-30% of recipients

Systemic reactions infrequent

Serious adverse reactions rare

Additional Hib Resources

Haemophilus influenzae Disease (Including Hib): www.cdc.gov/hi-disease/index.html

Hib (*Haemophilus influenzae* type b) Vaccination:
www.cdc.gov/vaccines/vpd/hib/index.html

For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov