Fearless Defenders of the Immunocompromised Patient

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Phoenix, AZ

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Objectives

- Describe at least 2 components of the human immune system
- Name two vaccines that are contraindicated in immunocompromised patients
- Name one vaccine that should not be given to contacts of an immunocompromised patient

How Vaccines Are Made

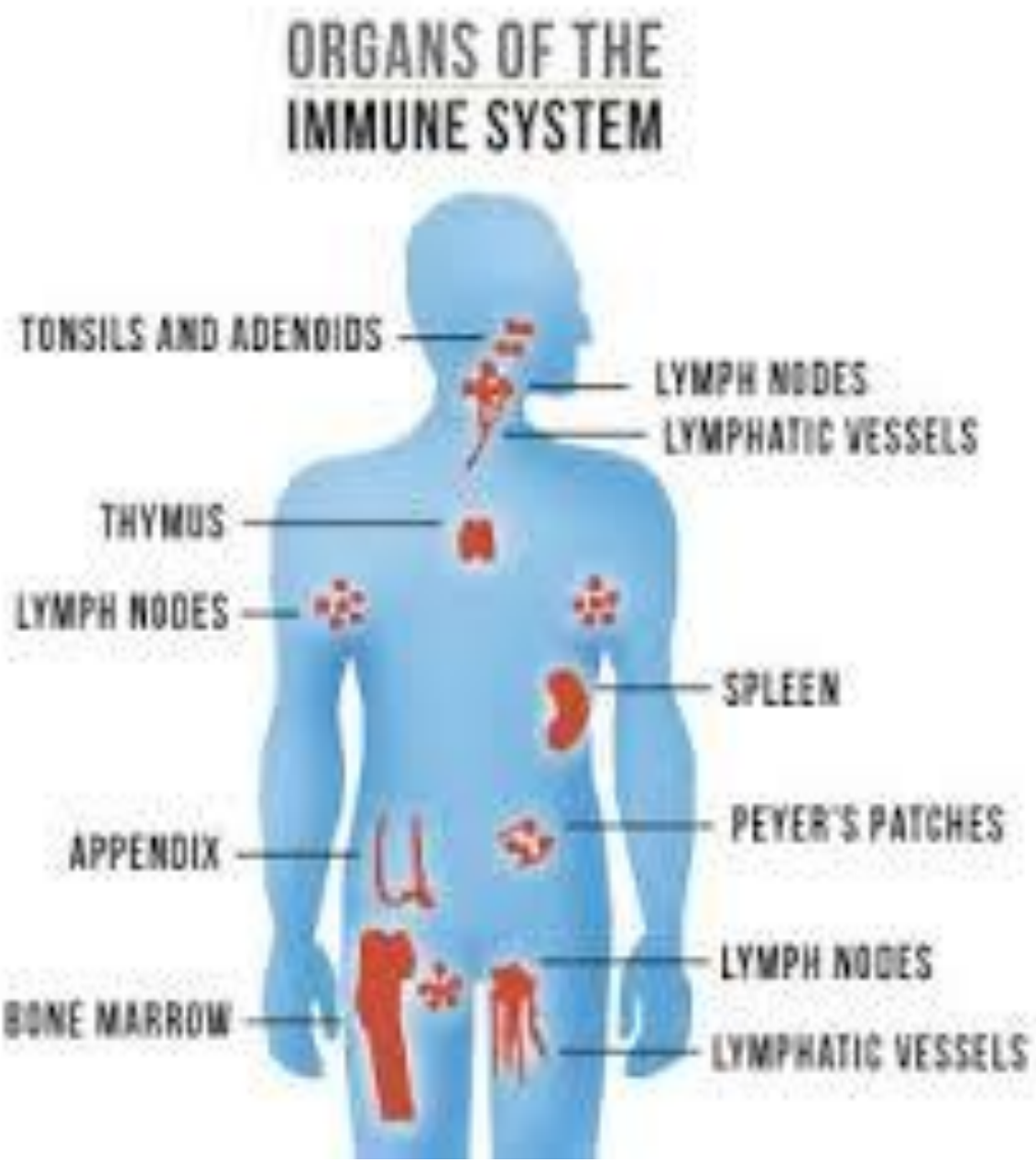
- Toxoids
- Bacterial cultures
- Chicken eggs
- Cell-based
- Recombinant
  - Yeast
  - Insect vector

Live-attenuated Vaccines

- MMR
- Varicella/Zoster
- Nasal influenza (LAIV)
- Rotavirus
- Adenovirus
- Smallpox (vaccinia)
- Yellow fever
- Oral typhoid
- Oral Polio
- BCG

Inactivated/killed vaccines

- Diphtheria-Tetanus-Pertussis
- Inactivated Polio
- *Haemophilus influenzae* type b
- *Streptococcus pneumoniae*
- *Neisseria meningitidis*
- Hepatitis A & B
- Human papillomavirus
- Most influenza
- Rabies
- Inactivated typhoid
- Japanese encephalitis


ORGANS OF THE
IMMUNE SYSTEM
TONSILS AND ADENOIDS
LYMPH NODES
LYMPHATIC VESSELS
THYMUS
LYMPH NODES
SPLEEN
PEYER'S PATCHES
APPENDIX
LYMPH NODES
BONE MARROW
LYMPHATIC VESSELS

White blood cells

neutrophil eosinophil basophil monocyte lymphocyte

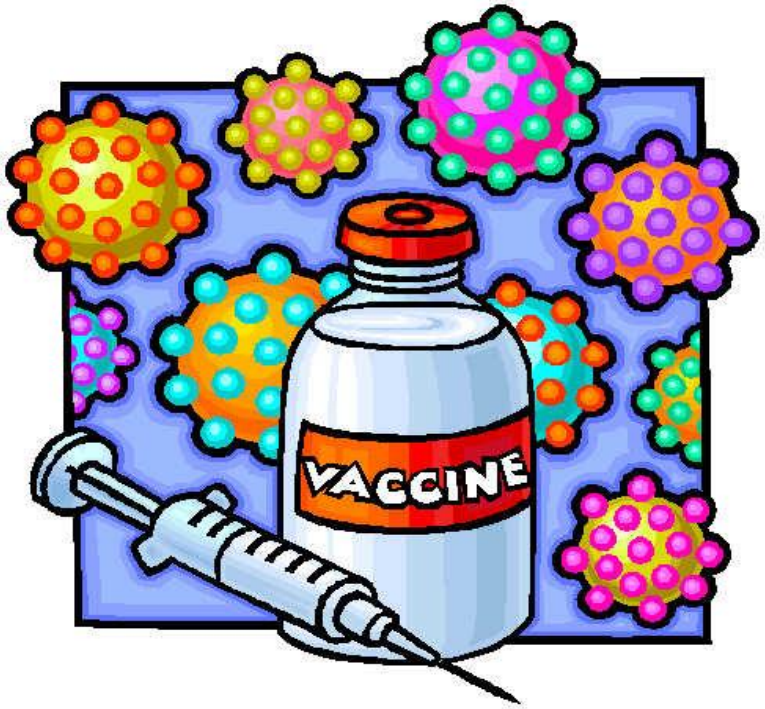
Principles of Vaccines and Immunity

- Live-attenuated vaccines are contraindicated in most cases of immunocompromised
- Inactivated vaccines
  - Safe in immunocompromised
  - Likely less effective when immunocompromised
  - Need more doses to maintain immunity

General Principles with Timing of Immunosuppressive Drugs and Live-Attenuated Vaccines

- Do not give live-attenuated vaccines in most cases on when patient has immunosuppression
- Wait ≥ 4 weeks after vaccine before starting immunosuppression
- Resolve immune suppression for adequate time before giving live-attenuated vaccines

General Principles with Timing of Immunosuppressive Drugs and Inactivated Vaccines



- Stop immune suppression ≥ 1 month before vaccinating
- Wait for 2-3 weeks after vaccinating to begin immunosuppression
- Pneumococcal and influenza vaccines are important even if immunosuppression

Low-level Immunosuppression

- Asymptomatic HIV with CD4 T-cells
  - 200-499 cells/µL for adults and ages ≥ 6 years old
  - 15-24% for infants and children
- Prednisone:
  - < 2 mg/kg/day for < 2 weeks
  - ≤20 mg/day for < 2 weeks
- Azathioprine: ≤ 3 mg/kg/day
- Methotrexate: ≤ 0.4 mg/kg/week
- 6-Mercaptopurine: ≤ 1.5 mg/kg/day

IDSA. Clinical Infectious Diseases. Feb. 1, 2014, p. 12.

High-Level Immunosuppression

- Daily steroids $\geq$ 20 mg for $\geq$ 14 days
  - (Kids < 10 kg: $\geq$ 2mg/kg/day for $\geq$ 14 days)
- HIV: CD4 T-cells < 200 cells/µL (Kids < 15%)
- Cancer chemotherapy
- Immune modulators
- Within 2 months of solid organ transplant
- After Hematopoetic Stem Cell Transplant
  - Variable

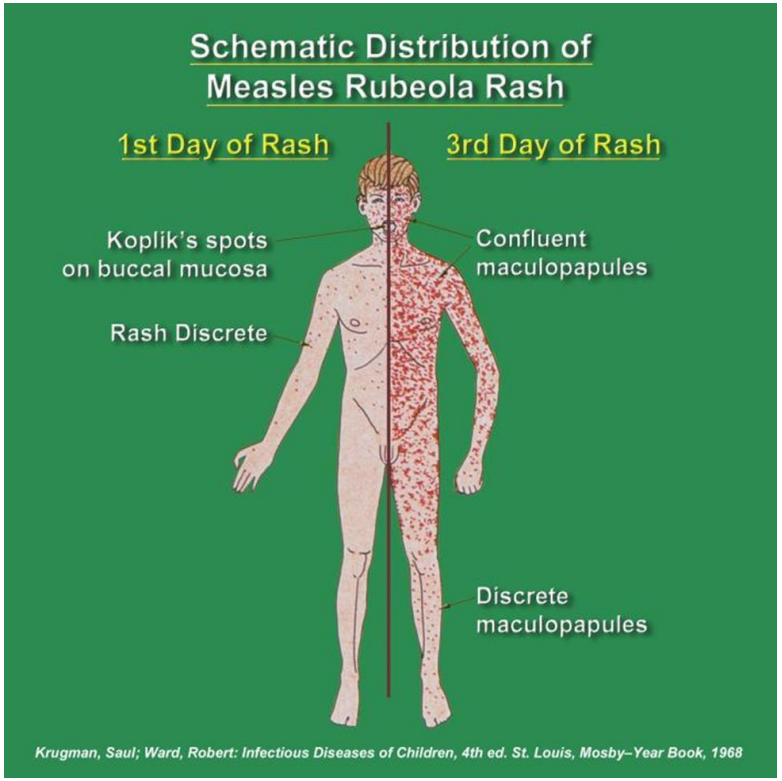
IDSA. Clinical Infectious Diseases. Feb. 1, 2014.

Hematopoietic Stem Cell Transplant

- Inactive vaccines: ≥ 6 months after HSCT
  - DTaP/DT/Tdap/Td; polio; influenza
  - PCV13: Start 6-12 months after HCT: 3 doses
    - F/U with PPSV23 ≥ 8 weeks later
  - Hib: ≥ 6 months after HCT: 3 doses
- Live attenuated
  - MMR: ≥ 24 months
  - Varicella: ≥ 24 months on case-by-case

www.cdc.gov/vaccines/pubs/hemato-cell-transplts.htm

Measles Vaccine and Patients with Immune Suppression



CDC PHIL # 16472

- Risk of overwhelming infection
- MMR OK in HIV with CD4 ≥ 15% or ≥ 200/µL
- If measles exposure:
  - Pregnant or severely immune suppressed: IVIG 400 mg/kg within 6 days
- High dose prednisone: Wait for ≥ 1 month before MMR
- Low dose prednisone: Wait 0-2 weeks before MMR

CDC. 2015 Pink Book

Varicella Vaccine and Patients with Immune Suppression

CDC PHIL # 10486

- Risk of severe infection
- Varicella vaccine OK in HIV with CD4 $\geq$ 15% or $\geq$ 200
- If varicella exposure:
  - VariZIG within 96 hours (up to 10 days) if immune suppressed; pregnant; premies & some newborns
- High dose prednisone: Wait for $\geq$ 1 month before varicella vaccine

CDC. 2015 Pink Book.
MMWR March 30, 2012.

Antibody-Containing Products & MMR and Varicella Vaccines

TABLE 5. Recommended intervals between administration of antibody-containing products and measles- or varicella-containing vaccine, by product and indication for vaccination

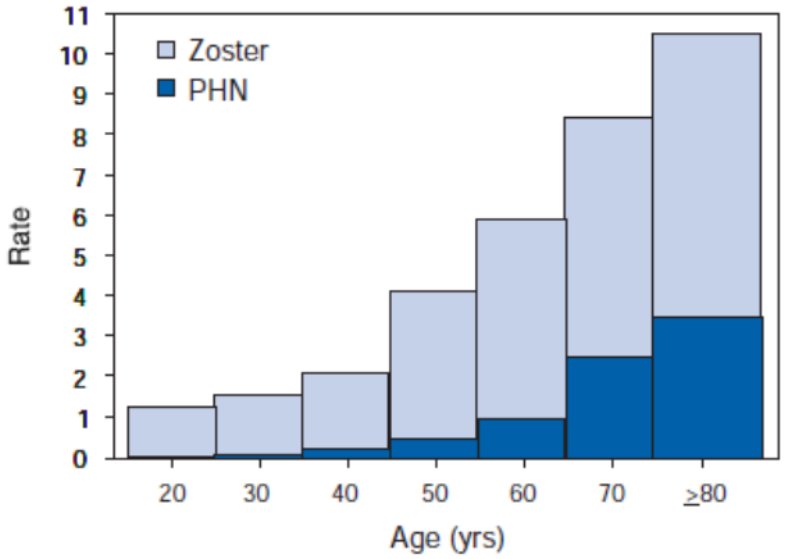
Product/Indication	Dose (mg IgG/kg) and route*	Recommended interval before measles- or varicella-containing vaccine† administration (months)
Tetanus IG	250 units (10 mg IgG/kg) IM	3
Hepatitis A IG		
Contact prophylaxis	0.02 mL/kg (3.3 mg IgG/kg) IM	3
International travel	0.06 mL/kg (10 mg IgG/kg) IM	3
Hepatitis B IG	0.06 mL/kg (10 mg IgG/kg) IM	3
Rabies IG	20 IU/kg (22 mg IgG/kg) IM	4
Varicella IG	125 units/10 kg (60–200 mg IgG/kg) IM, maximum 625 units	5
Measles prophylaxis IG		
Standard (i.e., nonimmunocompromised) contact	0.25 mL/kg (40 mg IgG/kg) IM	5
Immunocompromised contact	0.50 mL/kg (80 mg IgG/kg) IM	6
Blood transfusion		
RBCs, washed	10 mL/kg, negligible IgG/kg IV	None
RBCs, adenine-saline added	10 mL/kg (10 mg IgG/kg) IV	3
Packed RBCs (hematocrit 65%)§	10 mL/kg (60 mg IgG/kg) IV	6
Whole blood (hematocrit 35%–50%)§	10 mL/kg (80–100 mg IgG/kg) IV	6
Plasma/platelet products	10 mL/kg (160 mg IgG/kg) IV	7
Cytomegalovirus IGIV	150 mg/kg maximum	6
IGIV		
Replacement therapy for immune deficiencies¶	300–400 mg/kg IV¶	8
Immune thrombocytopenic purpura treatment	400 mg/kg IV	8
Postexposure varicella prophylaxis**	400 mg/kg IV	8
Immune thrombocytopenic purpura treatment	1000 mg/kg IV	10
Kawasaki disease	2 g/kg IV	11
Monoclonal antibody to respiratory syncytial virus F protein (Synagis [MedImmune])††	15 mg/kg IM	None

MMWR. January 28, 2011. RR-2.
CDC. 2015 Pink Book, Appendix A-24.
AAP 2015 Red Book, p. 39.

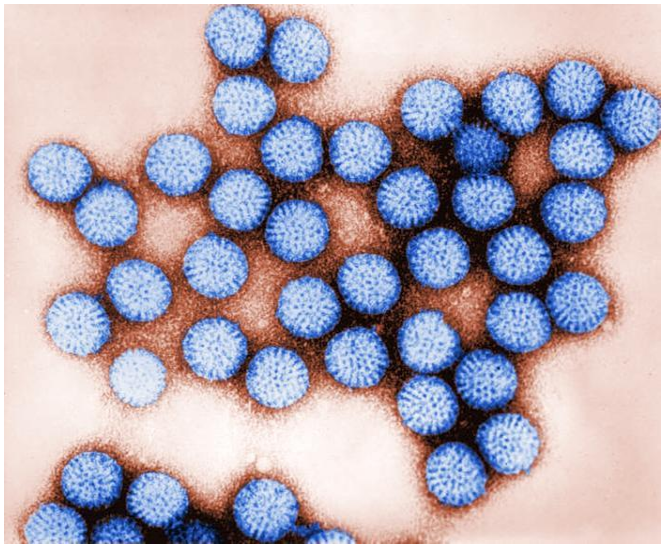
Zoster Vaccine and Patients with Immune Suppression

- Vaccine decreases Zoster by 51%
- Prolonged pain by 66.5%
- Decreasing efficacy with increasing age
- Vaccine OK in HIV with CD4 $\geq$ 15% or $\geq$ 200
- OK in low-level immune suppression

FIGURE 3. Rate* of zoster and postherpetic neuralgia (PHN)†, by age — United States



Rotavirus Vaccine and Immune Suppression



CDC PHIL # 178

- Do not give to infants with known or suspected immune deficiency
- Screen for family history of SCID
- OK to give to HIV-exposed infants
- OK to give if household has immune suppressed person
- Evaluate patients if persistent diarrhea after rotavirus vaccine

CID. 2015 Pink Book.

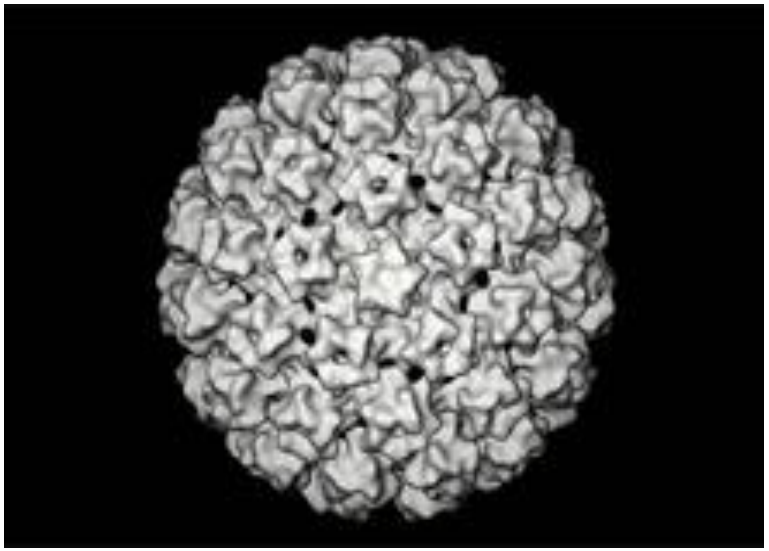
Human Papillomavirus Vaccine
Age and Immune Competence

2 doses HPV Vaccine

- 1st dose 9-14 years old

3 doses HPV Vaccine

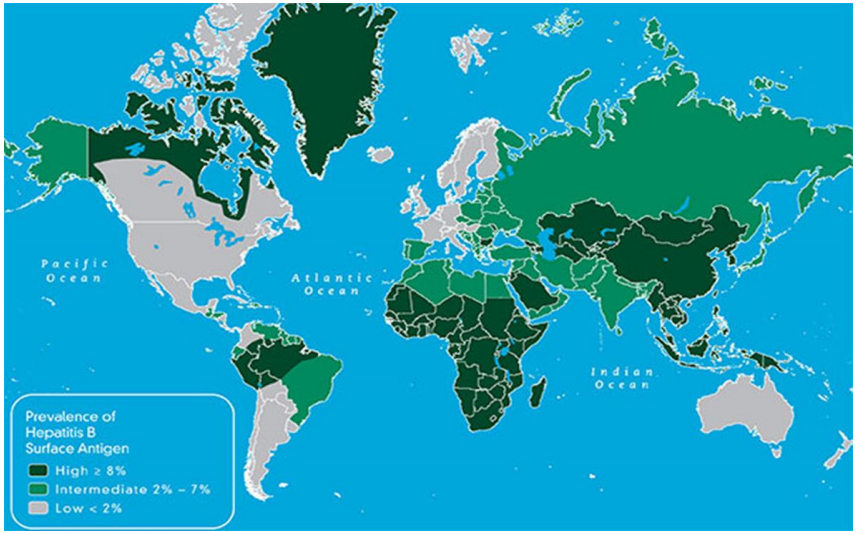
- 1st dose 15-26 years old
- Immune compromised



MMWR, December 16, 2016

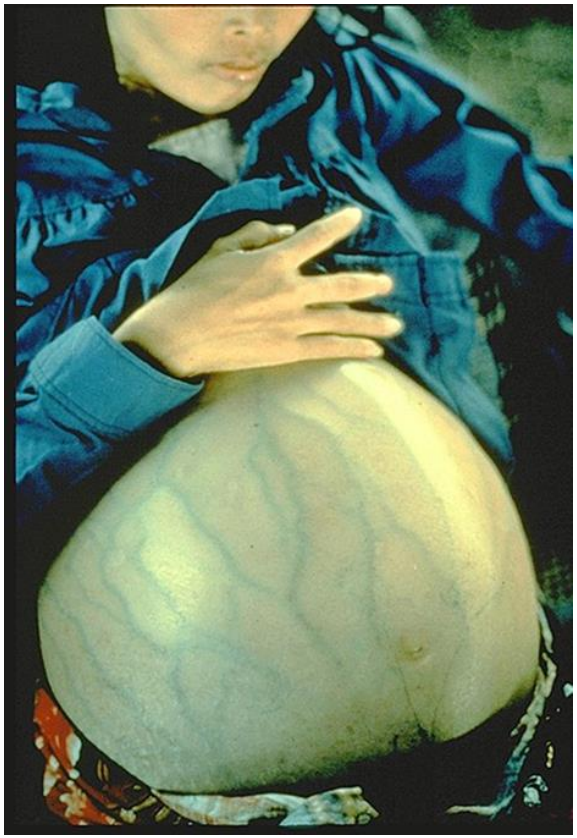
Hepatitis B Virus Vaccine
Age and Immune Competence

Hepatitis B Virus Prevalence



2012 CDC Yellow Book

Liver Cancer due to Hepatitis B

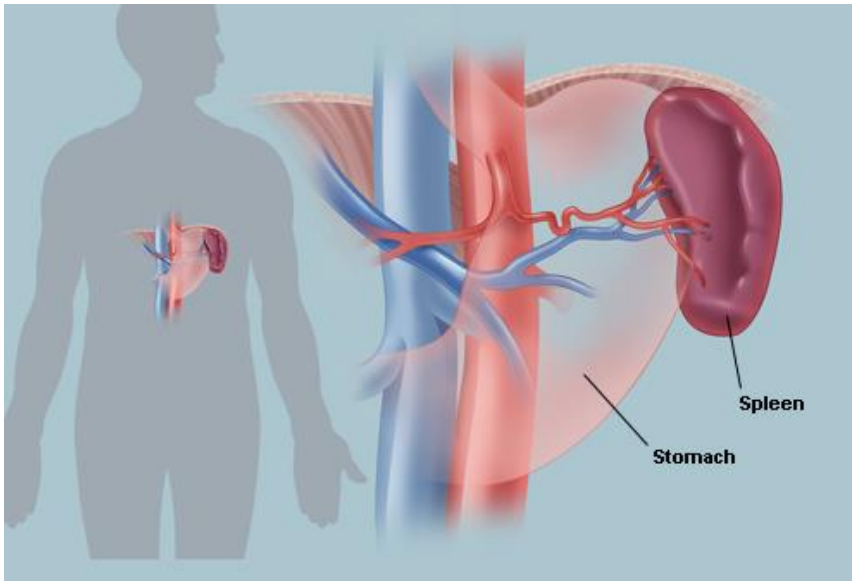


CDC PHIL # 5606

Age-based and Immune Status Response to Influenza Vaccine

- Not < 6 months old
- If 1st influenza vaccine in ages 6 months to 8 years old needs two doses
- Pandemic vaccine
- ≥ 65 year olds
- After hematopoietic cell transplantation

Asplenia or Splenic Dysfunction



CDC PHIL # 2840

Vaccines Needed for Asplenia and Splenic Dysfunction

Prevnar®13 (PCV13)

Pneumovax®23 (PCV23)

Meningococcal Vaccines
(MCV4 and Men B)

***Haemophilus influenzae* type b (Hib)**

Pediatric PCV13 Schedule

- Standard: 2, 4, 6 months, 12-15 months

  If no previous PCV13

- 7-11 months: Two→ booster 12-15 months
- 12-23 months: Two
- 24-59 months and healthy: One
- **24-71 months (at higher risk): Two**

www.immunize.org Item # P2016
Pediatrics, July 2010.
CDC. 2015 Pink Book

Unimmunized 24 Months-71 Months Who Need 2 doses PCV13

- Chronic heart disease (esp. cyanotic & CHF), diabetes mellitus, chronic lung disease, asthma (with prolonged high dose oral steroids)
- Cochlear implant, cerebrospinal fluid leak
- Functional or anatomic asplenia
- Immune compromising conditions including chronic renal failure

➢ Children with risk factors: PPSV23 once 2 y.o

Pediatrics, July 2010.
CDC. 2015 Pink Book.

Pneumococcal Vaccines in 6 yo-18 yo Give 1 dose PPSV23*

- Chronic heart disease
  - Especially cyanotic congenital heart disease and cardiac failure
- Chronic lung disease
  - Asthma if prolonged high dose oral steroids
- Chronic liver disease
- Diabetes mellitus
- Alcoholism

*If not previously immunized with PPSV23

2017 CDC Schedule

Unimmunized 6 yo-18 yo Needs 1 dose PCV 13 and 1 dose PPSV23 if:

PHIL # 13522

- Cochlear implant
- Cerebrospinal fluid leak

➢ PCV13 first when possible

2017 CDC Schedule

Unimmunized 6 yo – 18 yo
Need PCV13, PPSV23, and PPSV23 "Booster"

- Asplenia
- Sickle cell disease & hemaglobinopathies
- Immunodeficiency including HIV
- Chronic renal failure
- Nephrotic syndrome
- Leukemia, lymphoma
- Hodgkin disease
- Generalized malignancy
- Solid organ transplant
- Multiple myeloma
- Iatrogenic immune suppression
  - Medicines
  - Radiation

Pediatrics, December 2014.
CDC 2017 Vaccine Schedule

Adult (19-64 yo) Risk Factors Needing Just PPSV23*

- Chronic heart disease (excluding hypertension)
- Chronic lung disease
  - Includes asthma, COPD, emphysema
- Chronic liver disease, cirrhosis
- Diabetes mellitus
- Alcoholism
- Cigarette smoking

*If PPSV23 was not previously given

MMWR, Oct. 12, 2012

Patient Risk Factors Needing Both PCV13* & PPSV23* but No PPSV23 Booster

CDC PHIL 13488

- Cochlear implant
- Cerebrospinal fluid leak

*If PCV13 and PPSV23 were not previously given

MMWR, October 12, 2012

Patient Risk Factors (2 yo – 64 yo) Needing PCV13, PPSV23, and PPSV23 "Booster"

- Asplenia
- Sickle cell disease & hemaglobinopathies
- Immunodeficiency
- HIV
- Chronic renal failure
- Nephrotic syndrome
- Leukemia, lymphoma
- Hodgkin disease
- Generalized malignancy
- Solid organ transplant
- Multiple myeloma
- Iatrogenic immune suppression
  - Medicines
  - Radiation

MMWR, October 12, 2012
CDC 2017 Vaccine Schedule

Pneumococcal Vaccination Tools

Recommendations for Pneumococcal Vaccine Use in Children and Teens

Table 1. Recommended Schedule for Administering Pneumococcal Conjugate Vaccine (PCV13)

Child's age now	Vaccination history of PCV13 and/or PCV7	Recommended PCV13 Schedule (For minimum interval guidance for catch-up vaccination, see * below)
2 through 6 months	0 doses	3 doses, 8 weeks* apart; 4th dose at age 12–15 months
	1 dose	2 doses, 8 weeks* apart; 4th dose at age 12–15 months
	2 doses	1 dose, 8 weeks* after the most recent dose; 4th dose at age 12–15 months
7 through 11 months	0 doses	2 doses, 8 weeks apart* and a 3rd dose at age 12–15 months
	1 or 2 doses before age 7 months	1 dose at age 7–11 months and a 2nd dose at age 12–15 months, at least 8 weeks after the most recent dose
	1 dose at age 7–11 months	2 doses: 1 dose at age 7–11 months and a 2nd dose at age 12–15 months, at least 8 weeks after the most recent dose
	2 doses at age 7–11 months	1 dose at age 12–15 months
12 through 23 months	0 doses	2 doses, at least 8 weeks apart
	1 dose before age 12 months	2 doses, at least 8 weeks apart
	1 dose at or after age 12 months	1 dose, at least 8 weeks after the most recent dose
	2 or 3 doses before age 12 months	1 dose, at least 8 weeks after the most recent dose
	2 doses at or after age 12 months	0 doses
24 through 59 months (healthy children)	0 doses	1 dose
	Any incomplete schedule	1 dose, at least 8 weeks after the most recent dose
24 through 71 months (children with underlying medical condition as described in Table 3 below)	Unvaccinated or any incomplete schedule of less than 3 doses	2 doses: 1st dose at least 8 weeks after most recent dose and a 2nd dose at least 8 weeks later
	Any incomplete schedule of 3 doses	1 dose, at least 8 weeks after the most recent dose
	4 doses of PCV7 or other age-appropriate complete PCV7 schedule	1 dose
6 through 18 years with immunocompromising condition, functional or anatomic asplenia (see specific conditions in Table 3 below), cerebrospinal fluid leak, or cochlear implant	No history of PCV13	1 dose

* Minimum interval between doses: For children younger than age 12 months: 4 weeks; for children age 12 months and older: 8 weeks.

Table 2. Recommended Schedule for Administering Pneumococcal Polysaccharide Vaccine (PPSV23)

Risk Group	Schedule for PPSV23	Revaccination with PPSV23
Immunocompetent children and teens with underlying medical condition (see Table 3 at right)	Give 1 dose of PPSV23 at age 2 years or older and at least 8 weeks after last dose of PCV13	Not indicated
Children and teens with immunocompromising condition, functional or anatomic asplenia (see specific conditions in Table 3 at right)	Give 1 dose of PPSV23 at age 2 years or older and at least 8 weeks after last dose of PCV13	Give 1 additional dose of PPSV23 at least 5 years following the first PPSV23; the next recommended dose would be at age 65 years

Table 3. Underlying Medical Conditions that Are Indications for Pneumococcal Vaccination

Risk Group	Condition
Immunocompetent children and teens with risk condition	Chronic heart disease (particularly cyantoic congenital heart disease and cardiac failure); chronic lung disease (including asthma if treated with prolonged high-dose oral corticosteroids); diabetes mellitus; cerebrospinal fluid leak; cochlear implant
Children and teens with functional or anatomic asplenia	• Sickle cell disease and other hemoglobinopathies • Congenital or acquired asplenia, or splenic dysfunction
Children and teens with immuno-compromising condition	• HIV infection • Chronic renal failure and nephrotic syndrome • Diseases associated with treatment with immunosuppressive drugs or radiation therapy (e.g., malignant neoplasms, leukemias, lymphomas, and Hodgkin disease; or solid organ transplantation) • Congenital immunodeficiency (includes B- [humoral] or T-lymphocyte deficiency; complement deficiencies, particularly C1, C2, C3, or C4 deficiency; and phagocytic disorders [excluding chronic granulomatous disease])

Technical content reviewed by the Centers for Disease Control and Prevention

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www.immunize.org/catg.d/p2016.pdf • Item #P2016 (6/16)

Pneumococcal Vaccination Recommendations for Children[1] and Adults by Age and/or Risk Factor

Routine Recommendations

for Pneumococcal Conjugate Vaccine (PCV13) and Pneumococcal Polysaccharide Vaccine (PPSV23)

For children age 2 months and older — Administer PCV13 series to all children beginning at age 2 months, followed by doses at 4 months, 6 months, and 12–15 months (booster dose).

For adults age 65 years and older — Administer 1-time dose to PCV13-naïve adults at age 65 years, followed by a dose of PPSV23 12 months later.

Risk-based Recommendations

People with Underlying Medical Conditions or Other Risk Factors

		PCV13			PPSV23	
Risk Group	**Underlying medical condition or other risk factor**	Administer PCV13 doses needed to complete series to children through age 71 months	Administer 1 dose to PCV13-naïve children age 6 through 18 years	Administer 1 dose to PCV13-naïve adults age 19 through 64 years	Administer 1 dose of PPSV23 at age 2 through 64 years	Administer a second dose of PPSV23 5 years after first dose if age younger than 65 years
Immuno-competent	Chronic heart disease[2]	X			X	
	Chronic lung disease[3]	X			X	
	Diabetes mellitus	X			X	
	Cerebrospinal fluid leak	X	X	X	X	
	Cochlear implant	X	X	X	X	
	Alcoholism				X	
	Chronic liver disease, cirrhosis				X	
	Cigarette smoking (≥19 yrs)				X	
Functional or anatomic asplenia	Sickle cell disease/other hemoglobinopathy	X	X	X	X	X
	Congenital or acquired asplenia	X	X	X	X	X
Immuno-compromised	Congenital or acquired immunodeficiency[4]	X	X	X	X	X
	HIV	X	X	X	X	X
	Chronic renal failure	X	X	X	X	X
	Nephrotic syndrome	X	X	X	X	X
	Leukemia	X	X	X	X	X
	Lymphoma	X	X	X	X	X
	Hodgkin disease	X	X	X	X	X
	Generalized malignancy	X	X	X	X	X
	Iatrogenic immunosuppression[5]	X	X	X	X	X
	Solid organ transplant	X	X	X	X	X
	Multiple myeloma	X	X	X	X	X

1 For PCV13 vaccination of healthy children, see "Recommendations for Pneumococcal Vaccine Use in Children" at www.immunize.org/catg.d/p2016.pdf.

2 Particularly cyanotic congenital heart disease and cardiac failure in children; including congestive heart failure and cardiomyopathy in all ages; excluding hypertension in adults.

3 Including asthma in children if treated with high-dose oral corticosteroid therapy, as well as chronic obstructive pulmonary disease (COPD), emphysema, and asthma in adults.

4 Includes B- (humoral) or T-lymphocyte deficiency, complement deficiencies (particularly C1, C2, C3, and C4 deficiencies), and phagocytic disorders (excluding chronic granulomatous disease).

5 Diseases requiring treatment with immunosuppressive drugs, including long-term systemic corticosteroids and radiation therapy.

immunization action coalition IAC immunize.org

Technical content reviewed by the Centers for Disease Control and Prevention

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www.immunize.org/catg.d/p2019.pdf • Item #P2019 (11/15)

Immunization Action Coalition. www.immunize.org

Pediatric vs Adult Intervals between PCV13 and PPSV23

- Pediatric 2-18 yo
  - PCV13→PPSV23: Minimum of 8 weeks
  - PPSV23→PCV13: Minimum of **8 weeks**
- High Risk Adults 19-64 yo
  - PCV13→PPSV23: Minimum of 8 weeks
  - PPSV23→PCV13: Minimum of **1 year**
- Adults ≥ 65 yo
  - PCV13→PPSV23: Minimum of 1 year (Not high risk)
  - PPSV23→PCV13: Minimum of **1 year**

Pediatrics, Dec 2014;
MMWR Oct 12, 2012; MMWR Sept 4, 2015

Meningococcal Vaccines and Immunocompromised Patients

CDC PHIL # 1335

- Quadrivalent (MCV4)
  - At least two doses for initial series
  - Indicated for HIV
- Mengincococcal B
  - Trumenba needs three doses
- Asplenics need both MCV4 and Men B

Immunization Action Coalition Standing Orders

Meningococcal B

Meningococcal Vaccine Recommendations by Age and Risk Factor for Serogroup B Protection

This document covers MenB vaccine. For information on vaccine that provides protection against meningococcal serogroup A, C, W, and Y disease, see www.immunize.org/catg.d/p2018.pdf.

Meningococcal serogroup type B vaccines:
- **Bexsero** (MenB-4C, GlaxoSmithKline)
- **Trumenba** (MenB-FHbp, Pfizer)

Routine Recommendations for Meningococcal Serogroup B Vaccination	
For teens and young adults ages 16 through 23 years who wish to be vaccinated. The preferred age is 16 through 18 years.	Give either 2 doses of Bexsero 4 weeks apart, or 2 doses of Trumenba on a 0- and 6-month schedule.

Risk-based Recommendations for Persons with Underlying Medical Conditions or Other Risk Factors	
For people ages 10 years or older with • persistent complement component deficiencies[1] • anatomic or functional asplenia, including sickle cell disease, For people ages 10 years or older who • are present during outbreaks caused by serogroup B[2] • have prolonged increased risk for exposure (e.g., microbiologists routinely working with *Neisseria meningitidis*)	Give either 2 doses of Bexsero 4 weeks apart, or 3 doses of Trumenba on a 0-, 2-, and 6-month schedule.

Note: The two brands of meningococcal B vaccine are not interchangeable. The series must be started and completed with the same brand of vaccine.

FOOTNOTES
1. Persistent complement component deficiencies include inherited or chronic deficiencies in C3, C5–C9, properdin, factor D, and factor H, or taking eculizumab (Soliris)
2. Seek advice of local public health authorities to determine if vaccination is recommended.

www.immunize.org

Meningococcal ACWY

Meningococcal Vaccine Recommendations by Age and Risk Factor for Serogroups A, C, W, or Y Protection

A separate vaccine is needed for protection against meningococcal serogroup B disease.

MenACWY = Menactra (Sanofi Pasteur) and Menveo (GlaxoSmithKline)
MenACWY-D = Menactra Hib-MenCY = MenHibrix (GlaxoSmithKline)
MenACWY-CRM = Menveo MPSV = Menomune (Sanofi Pasteur)

Routine Recommendations for Quadrivalent Meningococcal Conjugate Vaccine (MenACWY)	
For preteens age 11 through 12 years	Give dose #1 of 2-dose MenACWY series. (Dose #2 is recommended at age 16 years.)
For teens age 13 through 15 years	Give catch-up dose #1 of 2-dose MenACWY series. (Dose #2 will be due at age 16 years.[1])
For teens at age 16 years	Give dose #2 of MenACWY.[1] (Separate from dose #1 by at least 8 weeks.)
Catch-up for teens age 17 through 18 years	If dose #2 not given at age 16 years, give dose #2 of MenACWY as catch-up.
Catch-up for teens age 16 through 18 years	If no history of prior vaccination with MenACWY, give 1 dose of MenACWY.
For first year college students, age 19 through 21 years, living in residence halls	If no history of prior vaccination with MenACWY, give 1 dose of MenACWY. If history of 1 dose of MenACWY given when younger than age 16 years, give dose #2 of MenACWY.

Risk-based Recommendations for Persons with Underlying Medical Conditions or Other Risk Factors		
TARGETED GROUP BY AGE/OR RISK FACTOR	PRIMARY DOSE(S)	BOOSTER DOSE(S)
Travelers to or residents of countries where meningococcal disease is hyperendemic or epidemic,[2] people present during outbreaks caused by a vaccine serogroup,[3] and other people with prolonged increased risk for exposure (e.g., microbiologists routinely working with *Neisseria meningitidis*)		
For age 2 through 6 months	Give 3 doses of MenACWY-CRM or Hib-MenCY,[4] 8 weeks apart, and a 4th dose at 12–15 months. If possible, vaccination should begin at age 2 months.	If risk continues, give initial booster after 3 years followed by boosters every 5 years.
For age 7 through 23 months who have not initiated a series of MenACWY-CRM	Give 2 doses of MenACWY-CRM[5] or HibMenCY[4,6] or, if 9–23 months, MenACWY-D.[7] Separate the 2 doses by at least 12 weeks.[8]	
For age 2 through 55 years	Give 1 dose of MenACWY.	Boost every 5 years with MenACWY.[9,10]
For age 56 years and older	If no previous MenACWY dose and either short-term travel or outbreak-related, give 1 dose of MPSV; all others, give 1 dose of MenACWY.	Boost every 5 years with MenACWY.[10]
People with persistent complement component deficiencies[11]		
For age 2 through 6 months	Give 3 doses of MenACWY-CRM or Hib-MenCY, 8 weeks apart, and a 4th dose at 12–15 months. If possible, vaccination should begin at age 2 months.	Give MenACWY booster after 3 years followed by boosters every 5 years thereafter.
For age 7 through 23 months who have not initiated a series of MenACWY-CRM	Give 2 doses of MenACWY-CRM[5] or Hib-MenCY[6] or, if age 9–23 months, MenACWY-D.[7] Separate the 2 doses by at least 12 weeks.	
For ages 2 through 55 years	Give 2 doses of MenACWY, 8 weeks apart.	Boost every 5 years with MenACWY.[9,12]
For age 56 years and older	Give 2 doses of MenACWY, 8 weeks apart.	Boost every 5 years with MenACWY.[12]
People with HIV infection or functional or anatomic asplenia (including sickle cell disease)		
For age 2 through 6 months	Give 3 doses of MenACWY-CRM or Hib-MenCY, 8 weeks apart, and a 4th dose at 12–15 months. If possible vaccination should begin at age 2 months.	Give MenACWY booster after 3 years followed by boosters every 5 years thereafter.[9]
For age 7 through 23 months who have not initiated a series of MenACWY-CRM	Give 2 doses of MenACWY-CRM[5] or Hib-MenCY.[6] Separate the 2 doses by at least 12 weeks. Or, if using MenACWY-D, give dose #1 at least 4 weeks following completion of pneumococcal conjugate vaccine series, and dose #2 at least 12 weeks after dose #1.[7]	
For ages 2 through 55 years	Give 2 doses of MenACWY, 8 weeks apart.	Boost every 5 years with MenACWY.[9,12]
For age 56 years and older	Give 2 doses of MenACWY, 8 weeks apart.	Boost every 5 years with MenACWY.[12]

Haemophilus influenzae type b Conjugate Vaccines

- Primary series
  - 2 doses PRP-OMP
  - 3 doses PRP-Tetanus toxoid
- All brands use same schedule ≥ 7 months old
- PRP-OMP preferred in Native American children for primary series
- Hib vaccine usually only ≤ 59 months

People Who Need 1 Dose Hib Vaccine At Ages ≥ 5 Years Old

- "Unimmunized"
  - Not received primary series and booster, OR
  - Not received at least one dose of Hib vaccine at ≥ 15 months
- Asplenia
- Sickle cell disease, etc.
- HIV infection (< 19 yo)
- After HSCT (3 doses)

MMWR. February 28, 2014 (RR-1)

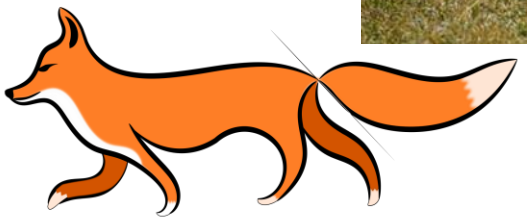
Post-exposure Rabies Vaccine

4 Doses

- Vaccine: 0, 3, 7, 14 days
- Rabies immune globulin
  - Day 0

Five doses

- Immune compromised
- Days 0, 3, 7, 14, 21-28
- Rabies immune globulin
  - Day 0



MMWR, March 19, 2010 (RR-2)

Yellow Fever Vaccine
Age and Immune Competence

- **Contraindicated**
  - < 6 months
  - Thymus disorder
  - Immunosuppression
  - HIV CDV < 200/µL
- **Precautions**
  - 6-8 months
  - ≥ 60 years old
  - Pregnancy
  - Breast feeding
  - Asymptomatic HIV
    - CD4 200-499/ µL
    - CD4 15%-24% (< 6 y.o.)

CDC. 2016 Yellow Book

HIV/AIDS and Vaccines

- All recommended <u>inactivated</u> vaccines including influenza
- PCV13 and PPSV23
- Meningococcal (MCV4)
- MMR &/or Varicella once CD4 cells are:
  - ≥ 15% (< 5 y.o.)
  - ≥ 200/µL (≥ 5 y.o.)
- Zoster vaccine OK if CD4 cells ≥ 200 /µL

CDC. 2017 Immunization Schedule AAP 2015 Red Book

Chronic Granulomatous Disease

- White blood cells engulf bacteria
- Lysosomes in white blood cells lack hydrogen peroxide
- Unable to kill some bacteria and fungi
- Cannot have live bacterial vaccines; other vaccines OK

Immune Compromised Household Contacts and Vaccines

- Contraindicated
  - Smallpox (vaccinia)
  - Oral polio virus
- Precaution
  - ± Varicella vaccine
  - ± LAIV
  - ± Oral typhoid vaccine
  - ± Rotavirus vaccine
  - ± Adenovirus

Pregnancy and Vaccines

Influenza

Tdap

Breastfeeding and Vaccines

- Contraindications
  - Smallpox (Vaccinia) Vaccine
- Precautions
  - Yellow fever vaccine
- Allowed
  - Other live-attenuated viral and bacterial vaccines

MMWR, January 28, 2011 (RR-2), p. 26.

Questions?

CASE STUDY

- A 19-year-old man is on chemotherapy for Hodgkin's lymphoma. What vaccines can he receive and what vaccines should he not receive?

CASE STUDY

- A 30-year-old woman is on chemotherapy for acute lymphocytic leukemia. She has several young children at home.
- What routine childhood immunizations should her children not receive?

CASE STUDY

- A 15-month-old boy with sickle cell anemia has just received his final Prevnar®13.
- When does he need to get Pneumovax®23?
- How many doses of Pneumovax®23 does he need?

CASE STUDY

- A 62-year-old man with asthma received a course of prednisone, starting with a high dose (60 mg) and tapering off prednisone over twelve days. His last dose of prednisone was five days ago.
- Can this man receive a zoster vaccine today?

CASE STUDY

- A 24-year-old man has well-controlled HIV infection (CD4 cells > 500/µL, low viral load). He received all of his childhood vaccines, but he is seronegative for measles, varicella, and hepatitis B surface antibodies.
- Can he receive vaccines for any of these diseases?
- What other vaccines may he need?

THANK YOU

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