



NCC Pediatrics Continuity Clinic Curriculum: **Immunizations**

Goal:

To understand the pediatric immunization schedule—a component of the AAP Periodicity Schedule— and become familiar with special immunization cases.

Pre-Meeting Preparation:

- Review the following enclosures:
 - “Immunizations: Vaccinations in General” (*Pediatrics in Review*, 2015)
 - Recommended Child and Adolescent Immunization Schedule, 2023 (CDC)
 - COVID-19 Vaccine: Interim COVID-19 vaccination schedule for 6 Months of Age and Older (CDC)
- Prepare an example of a **“Vaccine Myth or Misconception”** and your thoughts about how to respond to a parent who has these concerns. *You may use the Extra-credit links or your own experiences as a guide.*

Conference Agenda:

- Complete “Immunization Cases”
- **Round-table discussion** of “Vaccine Myths & Misconceptions”—*each resident should list their example; the group should help offer ways to counsel parents.*
- **Optional:** Review how to transcribe immunizations in MHS Genesis.

Extra-Credit:

- [CDC- Vaccine Safety Concerns](#); [CDC- Parents FAQ's](#)
- "Vaccine Safety: Medical Contraindications, Myths, and Risk Communication" (*PIR*, 2015)
- [AAP & Immunizations](#) (*vaccine-preventable diseases, vaccines & safety, etc.*)
- [CDC Vaccine Abbreviations \(U.S\)](#) (*good for decoding shot records*) and [International Decoding](#)
- "Rationale for the Immunization Schedule:: Why Is It the Way It Is"? (*PIR*, 2019)
- "Association of the COVID-19 Pandemic With Routine Childhood Vaccination Rates and Proportion Up to Date with Vaccinations Across 8 US Health Systems in the Vaccine Safety Datalink" (*JAMA Pediatrics*, 2022)
- [Immunization Coverage](#) (*World Health Organization*)
- "Impact of Routine Childhood Immunization in Reducing Vaccine Preventable Diseases in the United States" (*Pediatrics*, 2022)

Immunizations: Vaccinations in General

Catherine C. Wiley, MD*

*Associate Professor of Pediatrics, University of Connecticut School of Medicine, Connecticut Children's Medical Center, Hartford, CT.

Educational Gap

Despite the great success of the national childhood immunization program, gaps in coverage remain, and vaccine-preventable diseases continue to occur.

Objectives

After completing this article, readers should be able to:

1. Describe the indications, contraindications, and schedule for each of the routine childhood immunizations.
2. Recognize the enhanced immunogenicity of conjugate vaccines.

INTRODUCTION

Immunization is one of the most frequent, complex, and costly activities in the pediatric office. The routine childhood immunization schedule published by the Centers for Disease Control and Prevention (CDC) has burgeoned from vaccines protecting against nine diseases, supplemented by one-half page of explanatory footnotes, 2 decades ago to 16 diseases, three pages of footnotes, and a host of combination vaccines in 2014. Although electronic health record decision support holds promise for streamlining vaccine administration, currently pediatricians must rely on intimate knowledge of immunizations and ready access to resources that address the nuances of the schedule and other special considerations such as contraindications and precautions.

This article reviews the routine childhood vaccine schedule, contraindications and precautions to immunization, and common special considerations in immunization. A full discussion of special circumstances and high-risk populations is beyond the scope of this review. A companion article in this issue of *Pediatrics in Review* – “Vaccine Safety: Medical Contraindications, Myths and Risk Communication,” by Dr Michael Smith – addresses vaccine hesitancy and catch-up schedules for unimmunized and underimmunized children.

GENERAL CONCEPTS

The childhood immunization schedule is reviewed, updated, and approved annually by the Advisory Committee on Immunization Practices (ACIP), the American Academy of Pediatrics, and the American Academy of Family Practice. The schedule is published annually in the *Morbidity and Mortality Weekly Report*. The CDC Recommended Immunization Schedule for Persons Aged 0 through 18

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years – United States 2015, catch-up schedules, and adult immunization schedules are available at www.cdc.gov/vaccines/schedules. The recommended schedule takes into account available evidence regarding vaccine efficacy and safety, immunogenicity (including persistence of passive maternal antibody), and disease prevalence. Although standard recommended intervals should be followed routinely to maximize protection, minimal intervals may be used to “catch up” children with delayed immunizations or if there is concern that a child may not return.

Timeliness of immunization is a challenge. A 2002 study demonstrated that by the age of 24 months, approximately 90% of children had received at least one vaccine late or too early to be considered valid. (1) When immunization is delayed, no routine immunization dose needs to be repeated. For immunizations administered too early, the dose should be repeated at the recommended minimum age and interval following the invalid dose. In accordance with ACIP guidelines, vaccines given within a grace period of 4 or fewer days below the minimum interval may be accepted as valid, but local and state regulations may not recognize this exception.

Most vaccines may be administered simultaneously, but when live vaccines are not given simultaneously, administrations should be separated by at least 28 days. Antigenic content of various vaccine products varies and evidence concerning the interchangeability of products is limited. The same product should be continued if practical, but vaccines should not be delayed if the same product is not available.

Other than local reactions and fever, adverse events to immunization are relatively rare. Parents should be counseled about possible adverse events and provided with the current Vaccine Information Statements published by the CDC. Significant adverse events should be reported to the CDC through the Vaccine Adverse Event Reporting System. (2)

Vaccines should not be administered in the presence of a true contraindication. Only one contraindication is common to all vaccines: anaphylaxis to a previous dose or vaccine component. When a precaution is present, immunization is generally deferred. However, vaccines may be given if the benefit outweighs the risk (eg, community outbreak). The only precaution to all vaccines is moderate-to-severe acute illness at the time that the immunization is due. In these situations, immunization may resume as the acute illness begins to resolve. Deferring vaccines in the absence of true contraindications or precautions (eg, during minor illness) is an important cause of missed opportunities for immunization.

Most routine childhood vaccines contain inactivated subunit antigens or toxins. The introduction of conjugate vaccine

technology has been an important advance in the protection of children younger than 2 years of age as well as immunocompromised individuals. Bacterial polysaccharides, which are poorly immunogenic in younger children, are conjugated to carrier proteins (typically capsular or outer membrane antigens). These proteins improve immune responsivity by triggering T-cell-dependent immunity to polysaccharides, thereby strengthening immune memory.

Live attenuated vaccines include vaccines against measles-mumps-rubella (MMR), varicella, rotavirus, and influenza. Live vaccines generally induce stronger mucosal immunity than inactivated products. Because viral replication occurs, live vaccines are generally contraindicated in immunocompromised patients, in pregnancy, and following recent receipt of antibody-containing blood products (up to 11 months, depending on the dose of antibody received).

INFLUENZA VACCINES

Immunization against influenza poses unique challenges because of the changing circulation of antigenically distinct influenza viruses from year to year. Antigenic drift, due to continual minor influenza virus mutations, is particularly common among influenza A strains. In contrast, antigenic shift introduces a markedly novel influenza strain following a sudden major change in antigens to which there is little or no preexisting immunity in the population. (3) Antigenic shift is much less common than antigenic drift but has the potential to result in pandemics (eg, Spanish flu of 1918 and H1N1 in 2009).

Influenza vaccine is developed annually based on the antigenic composition of strains predicted to circulate most widely in the coming year. Trivalent vaccine historically included one B strain and two A strain lineages. Beginning with the 2013-2014 season, quadrivalent influenza vaccine became available to cover both influenza B strain lineages. In the prior 10 years, the circulating B strain was included in the trivalent vaccine in only 50% of seasons. (3) Quadrivalent influenza vaccines eventually should replace trivalent vaccines.

Childhood influenza immunization historically targeted children 6 months to 2 years of age, who experience severe illness and death at rates similar to other high-risk groups (such as adults >65 years of age), and children with chronic illnesses, including persistent asthma and other chronic respiratory diseases as well as cardiac, neurologic, metabolic, hepatic, renal, and immunologic disorders. However, routine influenza immunization for all children older than 6 months of age has been recommended since 2010. This recommendation is based on the following observations:

- Excess severe illness burden also occurs in children ages 2 to 5 years.

- Influenza causes preventable severe illness and death in previously healthy older children and young adults.
- Influenza immunization confers health benefits for all age groups.
- Children serve as a vehicle of transmission of influenza to unimmunized and unprotected individuals, including very young infants, immunocompromised individuals, and patients with contraindications to immunization.

Immunization of all health-care personnel and office staff is essential to protect vulnerable patients and to keep staff healthy and available to treat patients during community outbreaks. To ensure patient protection, compliance with annual influenza immunization is a condition of employment at many health-care facilities.

Influenza vaccine is administered annually to children ages 6 months and older, beginning as soon as vaccine becomes available. Although waning immunity late in the season is a consideration, missed opportunities to immunize and the challenging logistics of immunizing large numbers of patients in a narrow window of time support early immunization. Continuing immunization throughout the influenza season is also advised (Table 1).

Children ages 9 years and older require one dose of influenza vaccine annually. Younger children receiving either live or inactivated vaccine may require two doses separated by at least 28 days; recommendations vary from year to year. Currently, two doses are indicated if the child has not received two doses before the start of the current influenza season. The only exception to this rule is children who received one dose of influenza vaccine in the 2013-2014 season, who need only one dose in the 2014-2015 season. Because H1N1 has continued to circulate since the 2009-2010 season, children younger than 9 years also need two doses in the current season if at least one prior dose did

not contain H1N1 antigen. H1N1 antigen has been included in all vaccines since 2010 and in monovalent H1N1 vaccine during the 2009-2010 season.

There are few true contraindications to influenza vaccine. Both inactivated and live attenuated influenza vaccines are contraindicated in patients with severe egg allergy. Patients with mild egg allergy without anaphylaxis may receive inactivated influenza vaccine, followed by 30 minutes of in-office observation.

A small increase in the risk of febrile seizures among children ages 6 months to 5 years has been observed in some seasons, particularly with simultaneous administration of pneumococcal conjugate vaccine. Although surveillance for an association between influenza vaccine and febrile seizures continues, current recommendations have not changed. However, one brand of influenza vaccine was more definitively associated with increased incidence of febrile seizures (Afluria, Merck and Co, Inc, Whitehouse Station, NJ) and is not routinely recommended for children younger than 9 years of age. (3)

Guillain-Barré syndrome (GBS) was associated with the 1976 swine influenza vaccine, but recent studies suggest at most a small increased risk of GBS following influenza immunization (approximately 1 additional case per 1 million doses). (4) Immunization of patients with a past history of GBS deserves careful consideration; the potential small increased risk of recurrent GBS must be balanced against the risk of influenza disease, particularly in individuals with other high-risk conditions.

Quadrivalent live attenuated influenza vaccine (LAIV4) has a similar safety profile and efficacy as compared to inactivated influenza vaccine, and is an option for healthy children 2 years of age and older. Adverse events following LAIV4 administration are uncommon and include minor respiratory and gastrointestinal symptoms such as

TABLE 1. Influenza Vaccines Approved for Use in Children 6 Months to 17 Years of Age, 2014-2015 Season

TRADE NAME	MANUFACTURER	FORMULATION	AGES INDICATED	ROUTE
Fluzone	Sanofi Pasteur	IIV3, IIV4, inactivated	≥6 mo	Intramuscular
FluMist	MedImmune	LAIV4, live attenuated	≥2 y (to 49 y)	Intranasal
Fluarix	GlaxoSmithKline	IIV3, IIV4, inactivated	≥3 y	Intramuscular
FluLaval	ID Biomedical Corporation of Quebec	IIV3, IIV4, inactivated	≥3 y	Intramuscular
Fluvirin	Novartis Vaccines and Diagnostics	IIV3, inactivated	≥4 y	Intramuscular
Afluria	CSL Limited	IIV4, inactivated	≥5 y*	Intramuscular

*American Academy of Pediatrics does not recommend routine use before age 9 years due to risk of febrile seizures.

rhinorrhea, cough, abdominal pain, and fever. LAIV4 is contraindicated in pregnancy, egg allergy, and immunosuppression; in recipients of antiviral agents in the preceding 48 hours; and in children being treated with aspirin. Asthma and other underlying conditions that might be associated with a higher risk of influenza complications are precautions for LAIV4 due to the lack of safety evidence in affected patients. Children 2 to 4 years of age who have a history of wheezing in the last 12 months also should not receive LAIV4. Contacts of immunosuppressed patients may receive LAIV4, with the exception of caregivers of individuals with severe immunosuppression requiring a protected environment (eg, bone marrow transplant unit).

CONJUGATE VACCINES

Meningococcal Vaccines

Two quadrivalent conjugate vaccines (Menactra [MCV4-D], Sanofi Pasteur, Inc, Swiftwater, PA and Menveo [MCV4-CRM], Novartis Vaccines, Cambridge, MA) are currently available to protect against meningococcal strains A/C/Y and W-135. Nearly 75% of meningococcal infections in children 11 years and older involve these strains. (5) Two non-conjugate vaccines targeting serogroup B have recently been licensed for children and young adults ages 10–25 years (Bexsero, Novartis and Trumenba, Wyeth Pharmaceuticals Inc, Philadelphia, PA). Bexsero is administered in two doses one month apart; Trumenba requires three doses at 0, 2, and 6 months. While these vaccines have been used in outbreaks in New Jersey, California, Rhode Island, and Oregon, formal recommendations for use have not yet been published. Indications will likely include outbreak control and immunocompromise (complement deficiencies and asplenia). (6)

Conjugate meningococcal vaccines are preferred due to strong anamnestic responses to a subsequent booster dose, reduced nasopharyngeal carriage of meningococcus, and longer duration of clinical protection. (7) Quadrivalent meningococcal polysaccharide vaccine (Menomune [MPSV4], Sanofi) may be used when there is a contraindication to MCV4 (eg, severe allergy to diphtheria toxoid). Immunization is recommended at 11 to 12 years of age, with a booster dose at 16 to 18 years of age, at least 8 weeks after the first dose. Cases of meningococcal disease and deaths are significantly fewer with this two-dose regimen. Individuals receiving a first dose of vaccine at 16 years of age or older do not require a second dose, but unimmunized college freshman living in dormitories and those who received a single dose before age 16 years should receive one dose of vaccine. There has been a small increase in GBS clustered 14 days after administration of Menactra (but not Menveo). The risk of GBS is outweighed by

the benefit of protection against meningococcal disease. Accordingly, a prior history of GBS was removed as a precaution to meningococcal vaccination in 2010. (6)

Routine immunization of children younger than 11 years of age is not recommended. Recommendations for meningococcal immunization for patients at increased risk vary with patient age and the specific indication for immunization (eg, potential exposure vs immune compromise). (7) In general, two doses of MCV4 separated by 8 to 12 weeks are recommended for children 2 years of age and older with immunodeficiency and adolescents 11 years of age or older with human immunodeficiency virus (HIV) infection. Only MCV4-D is approved for infants 2 to 9 months old at increased risk of meningococcal disease; either conjugate vaccine may be administered to infants and children older than 9 months. Children with functional or anatomic asplenia, including sickle cell disease, should not receive MCV4-D until after 2 years of age due to immune interference with 13-valent pneumococcal conjugate vaccine (PCV13). (7)

HibMenCY (MenHibrix, GlaxoSmithKline Biologicals, Rixensart, Belgium) is a bivalent meningococcal vaccine conjugated to *Haemophilus influenzae* b (Hib) that protects against strains C and Y. It is approved as a four-dose series for infants 6 weeks to 18 months of age at high risk due to functional or anatomic asplenia (including sickle cell disease), complement deficiencies, or exposure due to local outbreaks. When infants are immunized with HibMenCY, this vaccine should be used for all four doses, and other Hib-containing vaccines should not be given. For high-risk children 2 to 6 years of age, a booster dose with MCV4 is required 3 years after the primary series. Thereafter, and for children 7 years of age and older, a booster of MCV4 is required every 5 years. (7)

Pneumococcal Vaccines

Streptococcus pneumoniae is an important cause of respiratory tract disease (pneumonia, sinusitis, and otitis media), bacteremia, and meningitis. In 2010, PCV13 replaced the former 7-valent vaccine. The polysaccharide capsular antigens in PCV13 are individually conjugated to a diphtheria membrane protein. PCV13 is indicated for immunization of healthy children at 2, 4, 6, and 12 to 15 months of age as well as children and adults with immune compromise and other conditions that increase the risk for invasive pneumococcal disease. (8) Healthy children 15 to 59 months of age and children with underlying medical conditions younger than 72 months of age who were previously fully immunized with PCV7 should receive one dose of PCV13. Older children with immune compromise and other specific high-risk conditions for invasive disease (eg, cochlear implants,

cerebrospinal fluid leaks, and asplenia) should be immunized with one dose of PCV13 if not previously immunized.

A nonconjugate, 23-valent pneumococcal vaccine (PPS23) is also available for high-risk patients to protect against the 13 serotypes in PCV13 as well as 10 additional serotypes. PPS23 is poorly immunogenic in children younger than 24 months of age and is not used in this age group. PPS23 is indicated for patients 2 years of age and older with the following conditions:

- Chronic illnesses such as chronic lung disease (including asthma for those 19 years and older)
- Chronic cardiac, renal, and hepatic disease and diabetes
- Immunocompromising conditions such as sickle cell disease, HIV, and malignancy

For immunocompromised patients, PPS23 should be administered at least 8 weeks following a dose of PCV13. In childhood, only one additional dose of PPS23 is recommended, 5 years after the first dose (eg, for children with timely immunizations, PPS23 is administered at 2 years and 7 years). Pneumococcal vaccine administration is nuanced in patients with chronic disease and immunocompromise, and the reader is directed to the references for additional information. (8)(9)

Haemophilus Influenzae Type B Vaccines

Hib was a leading cause of bacteremia, meningitis, cellulitis, and epiglottitis in the prevaccine era. Hib capsular antigen is conjugated to either a tetanus or *Neisseria meningitidis*-derived carrier protein. Hib vaccine is given in three or four doses (determined by brand) at 2, 4, (6) and 12 to 15 months, either as a monovalent vaccine or in combination with diphtheria-tetanus-acellular pertussis-inactivated poliovirus. A single dose is sufficient for children ages 15 to 59 months of age who have delayed immunizations; a catch-up schedule is available for younger children with incomplete immunizations. Immunization may also be indicated for some older children with immune compromise. Adverse events following Hib vaccine are uncommon and largely limited to minor local reactions.

NONCONJUGATE INACTIVATED VACCINES

Hepatitis Vaccines

Hepatitis B infection is a common cause of acute and chronic liver disease, hepatocellular carcinoma, and death worldwide. Hepatitis B vaccine, composed of recombinant DNA-produced hepatitis B surface antigen (HBsAg), was the first vaccine to provide protection against cancer through prevention of infection with hepatitis B virus. Hepatitis B infection in newborns is rarely symptomatic but results in a chronic carrier state in more than 90% of infected infants.

Prompt neonatal immunization is highly efficacious in preventing neonatal acquisition of hepatitis B. Therefore, for infants weighing at least 2 kg, hepatitis B vaccine is administered at birth, 1 to 2 months, and 6 months of age, with catch-up for unimmunized older children. Combination vaccines should not be used for the birth dose. The final dose should be provided no earlier than 24 weeks of age, at least 8 weeks following the second dose and at least 16 weeks following the first dose. For preterm infants weighing less than 2 kg, hepatitis B immunization is deferred until the infant reaches 1 month of age or hospital discharge (whichever comes first), unless the mother is HBsAg-positive or her status is unknown. In these situations, hepatitis B vaccine is given at birth, but the dose is not “counted” and is repeated when the infant reaches 1 to 2 months of age. (10)

Hepatitis B immune globulin (HBIG) is coadministered with hepatitis B vaccine within 12 hours of birth to infants born to hepatitis B-infected mothers and to preterm infants weighing less than 2 kg if the mother’s results will not be available by 12 hours of age. For infants weighing more than 2 kg, HBIG administration may be deferred for up to 7 days or until the mother is determined to be HBsAg-positive. HBIG should be administered no later than 7 days after birth if the mother’s results remain unavailable. Original maternal laboratory reports should be viewed directly; failure to recognize maternal hepatitis B infection and deferral of immunization outside of the perinatal period have been associated with preventable neonatal hepatitis B infection and rare deaths from fulminant neonatal hepatitis B. Infants born to HBsAg-positive mothers should be tested for hepatitis B surface antibody and HBsAg following the final dose of hepatitis B vaccine (typically at 9 to 12 months).

Hepatitis A infection is also an important cause of preventable liver disease. Two single-antigen inactivated hepatitis A vaccine (HAV) products are currently available for use in children: Havrix (GlaxoSmithKline) and VAQTA (Merck and Co, Inc). HAV is recommended for all children 12 months of age, with a booster dose 6 to 18 months later and catch-up for older children. Immunization is also recommended for household contacts of children adopted from countries with moderate-to-high rates of hepatitis A infection (currently applies to most international adoptees). Adverse events are uncommon. HAV and hepatitis A immune globulin are recommended for postexposure prophylaxis for unimmunized patients.

Diphtheria, Pertussis, and Tetanus Vaccines

Pertussis illness has a variety of presentations, including a nondescript upper respiratory tract infection, the classic

triphasic “100-day cough” syndrome, pneumonia, apnea (in young infants), seizures, and encephalopathy, with mortality occurring predominantly in infants. Tetanus is characterized by severe muscle spasms provoked by a neurotoxin, often progressing to respiratory failure. Diphtheria infection causes an acute membranous pharyngitis that may lead to airway obstruction. Although diphtheria and tetanus are now rare in the United States, pertussis infections remain endemic, with cyclic peaks occurring every 3 to 5 years.

Acellular pertussis vaccines have entirely replaced whole-cell pertussis vaccines. Although acellular pertussis vaccines contain varying pertussis antigens and quantities (Table 2), currently available products are believed to be equivalent in efficacy and safety. These products are associated with fewer adverse effects than whole-cell pertussis vaccines, but recent data also suggest a more rapid decline in immune protection following immunization with acellular pertussis vaccine. (11) Reported cases of pertussis have been increasing, particularly among children 10 years of age and older. Complete protection against pertussis is 98% at 1 year following the fifth dose of pertussis-containing vaccine, declining to 70% at 5 or more years following immunization.

Diphtheria-tetanus-acellular pertussis (DTaP) vaccine is administered in a five-dose series at 2, 4, and 6 months of age; at 15 to 18 months (at least 6 months following the third dose); and upon school entry (4-6 years). Only four doses are required if the fourth dose is given after 4 years of age. DTaP is often administered as a component of combination

vaccines containing inactivated polio vaccine (IPV) and Hib or hepatitis B vaccine. DTaP and diphtheria-tetanus (DT) are not recommended for children 7 years or older.

Beginning in 2005, a single dose of Tdap replaced Td for adolescents 11 to 18 years of age. Since 2010, ACIP has also recommended a single dose of Tdap for unimmunized/underimmunized children 7 to 10 years of age due to lack of a licensed pertussis-containing vaccine for this age group. (12) Tdap is preferred for children 7 years of age and older because it is less reactogenic than DTaP (due to its reduced diphtheria and pertussis antigenic content) (Table 2). A single dose of Tdap is followed by up to three doses of Td for children who require additional doses to complete the routine series.

When indicated, Tdap may be administered with no minimum interval following the last dose of DTaP, DT, or Td. To achieve high antibody concentrations during pregnancy and passive protection of the newborn, mothers should be immunized with Tdap during each pregnancy, preferably during the third trimester. (13) With the exception of pregnancy, no booster doses of Tdap are recommended; subsequent doses should be administered as Td. Booster doses of Tdap may be recommended in the future as additional long-term safety and efficacy data become available.

A booster dose of a tetanus-containing vaccine is recommended for patients with clean wounds incurred 10 or more years since their last tetanus dose and for major or contaminated wounds seen 5 or more years since the last dose. Vaccine should also contain diphtheria and pertussis

TABLE 2. Comparison of Selected Diphtheria and Pertussis-containing Vaccines

TRADE NAME	DAPTACEL DTaP	INFANRIX DTaP	KINRIX DTaP-IPV	ADACEL Tdap	BOOSTRIX Tdap	PENTACEL DTaP-IPV-HIB	PEDIARIX DTaP-IPV-HEP B
Manufacturer	Sanofi Pasteur	GlaxoSmithKline	GlaxoSmithKline	Sanofi Pasteur	GlaxoSmithKline	Sanofi Pasteur	GlaxoSmithKline
Age approved	6 wk – 6 y	6 wk – 6 y	4 – 6 y	10 – 64 y	≥10 y	6 wk – 4 y	6 wk – 6 y
Tetanus toxoid	5 Lf	10 Lf	10 Lf	5 Lf	5 Lf	5 Lf	10 Lf
Diphtheria toxoid	15 Lf	25 Lf	25 Lf	2 Lf	2.5Lf	15 Lf	25 Lf
Pertussis Antigens:							
Filamentous hemagglutinin	5 µg	25 µg	25 µg	5 µg	8 µg	20 µg	25 µg
Inactivated pertussis toxin	10 µg	25 µg	25 µg	2.5 µg	8 µg	120 µg	25 µg
Pertactin	3 µg	8 µg	8 µg	3 µg	2.5 µg	3 µg	8 µg
Fimbriae Types 2 & 3	5 µg	-	-	5 µg	-	5 µg	-

Lf=limit of flocculation (units)

antigens, unless specifically contraindicated. Tetanus immune globulin is indicated only in isolated circumstances: massive or contaminated wounds in patients with unknown immunization status or who received fewer than three doses of tetanus-containing vaccine, persons with HIV or other severe immunocompromise regardless of immunization status, and potential umbilical cord contamination in an infant born to an unimmunized mother outside of a hospital. (14)

The most common reactions to DTaP are local and febrile. A temperature greater than 40.5°C (104.9°F), seizures, hypotonic-hyporesponsive episodes, and inconsolable crying are much less common after DTaP than was observed for whole-cell pertussis vaccine, but such occurrences represent precautions to subsequent doses of DTaP. These events are not associated with later epilepsy or other sequelae. Current evidence does not support a causal relationship between acellular pertussis vaccines and acute neurologic illness, but encephalopathy within 7 days of receipt of any pertussis-containing vaccine remains a contraindication to further pertussis immunization. Vaccination is typically deferred in young infants with evolving neurologic illnesses. If the indication for deferral persists beyond 1 year of age, immunization with DT is recommended up to the age of 7 years, after which time Td is advised. GBS and brachial neuritis are rare adverse events following tetanus toxoid administration but not after DTaP. GBS occurring within 6 weeks following Td or Tdap is a precaution to further doses. Generally, Td or Tdap are not administered in such situations, but individual circumstances should be considered.

Polio Vaccines

Polio vaccine has eliminated paralytic polio from the Western Hemisphere. Only IPV is available in the United States, due to the small but avoidable risk of vaccine-associated paralytic poliomyelitis caused by the live attenuated vaccine strain. The possibility of transmission of vaccine virus to unimmunized or immunocompromised household contacts is also eliminated by use of IPV.

IPV is administered in a four-dose series at 2, 4, 6 to 18 months, and 4 to 6 years of age. Only three doses are required if the third dose is given after 4 years of age, provided that at least 6 months have elapsed since the second dose. IPV is well tolerated and adverse events are rare. Adults are generally presumed to be immune to polio and are only immunized if they are at increased risk of infection (eg, travelers and those with occupational exposures).

Human Papillomavirus Vaccines

Approximately 40 types of human papillomaviruses (HPVs) infect humans, predominantly through sexual contact.

The spectrum of illness ranges from asymptomatic infection to genital warts, genital cancers (particularly cervical cancer), anal and head-and-neck cancers, and rarely, laryngeal papillomatosis (via vertical transmission during vaginal delivery). Two licensed vaccines (Gardasil, Merck and Co, Inc, and Cervarix, GlaxoSmithKline) provide protection against HPV types 16 and 18, which together cause approximately 70% of cervical cancers. Gardasil also provides protection against types 6 and 11, which cause 90% of genital warts. (15) Immunization is recommended routinely for both boys and girls at age 11 to 12 years, ideally before initiation of sexual activity. (16) A newly licensed 9-valent HPV vaccine (Gardasil 9, Merck and Co, Inc) targets the four HPV types in Gardasil, as well as types 31, 33, 45, 52, and 58; these additions extend coverage to approximately 90% of cervical cancer cases. (17) Recommendations for series completion and reimbursement for recipients of Gardasil have not yet been released. HPV immunization can be initiated as early as age 9 years and up to 26 years for those not previously immunized. For all three formulations, three doses are administered, with subsequent doses given 2 months and 6 months following the first dose. Because Gardasil contains *Saccharomyces cerevisiae*, it is contraindicated for those with allergy to baker's yeast. Data on vaccination during pregnancy are limited and, therefore, immunization during pregnancy is not recommended. Observation of patients for 15 minutes following vaccination is advised due to an association with syncope. Syncope is not a contraindication to future administration of any vaccine.

LIVE VACCINES

Measles-Mumps-Rubella Vaccines and Varicella Vaccine

Measles, mumps, and rubella have been largely eliminated from the United States. However, a record-breaking resurgence of measles occurred in 2014, with most case reports related to international travel and importation of disease by unimmunized individuals, followed by spread in unimmunized/underimmunized communities. (18) Varicella infection (chickenpox), varicella meningoencephalitis, and secondary complications of cellulitis and pneumonia have also declined. Because approximately 5% to 10% of individuals fail to seroconvert following immunization, two doses of MMR and varicella are given in childhood (at 12 months and 4 to 6 years of age). However, cases of measles, mumps, and varicella do occur, even in patients who have received two doses of vaccine. (18)(19) The minimum interval between doses is 28 days for MMR and varicella vaccine given at 13 years of age and older and 3 months for measles-

TABLE 3. Additional Vaccines Indicated for Certain International Travelers

VACCINE	TYPE	AGE INDICATED	SCHEDULE	BOOSTER ¹
Japanese encephalitis	Inactivated	≥2 mo	2 doses 28 d apart	Duration of protection unknown, possibly boost after 1–2 y in adults
Measles ²	Live attenuated	≥12 mo 6 – <12 mo	2 doses at least 28 d apart Single dose	Not needed After 12 mo of age: 2 doses at least 28 d apart
Meningococcal	Inactivated	2 – 18 mo 7 – 23 mo 9 – 23 mo ≥24 mo	2, 4, 6, and 14–15 mo 2 doses 3 mo apart (MCV4-CRM ³) 2 doses 3 mo apart, (MCV4-CRM or MCV4-D ⁴) 1 dose MCV4	1 dose in 3 y; then every 5 y thereafter As above As above Every 5 y
Polio ⁵	Inactivated	≥6 wk	If needed, accelerated schedule, doses #2 and #3 in ≥4-wk intervals, #4 ≥6 mo	One dose after 4 y of age, one dose <12 mo before leaving polio-infected or polio-exporting country
Rabies	Inactivated	All	Day 0, 7, 21, or 28	Depends on risk, yes if exposed
Typhoid fever	Live attenuated Inactivated	≥6 y ≥2 y	Day 0, 2, 4, 6 1 dose	Every 5 y Every 2 y
Yellow Fever	Live attenuated	≥9 mo	1 dose	Every 10 y

¹If risk continues.

²Given as MMR in United States; monovalent measles vaccine may be available in other countries.

³MCV4-CRM: Quadrivalent meningococcal conjugate vaccine (Menveo)

⁴MCV4-D: Quadrivalent meningococcal vaccine (Menactra)

⁵Series may be continued in other countries if needed as inactivated polio vaccine or live attenuated oral polio vaccine.

Wallace GS, Seward JF, Pallanash MA. Interim CDC guidance for polio vaccination for travel to and from countries affected by wild poliovirus. *Morb Mortal Wkly Rep.* 2014;63(27):591-594.²⁵

mumps-rubella-varicella (MMRV) (ProQuad, Merck and Co, Inc), and varicella vaccine given to children younger than 13 years of age. Immunization may be accomplished by administering the trivalent MMR and monovalent varicella vaccines separately (but simultaneously) or MMRV to children younger than 13 years. Because MMRV is associated with a higher risk of febrile seizures than MMR, children with a personal or family history of seizure should generally be immunized with MMR and varicella separately for the first dose. (20) Varicella vaccine is contraindicated in individuals with neomycin or gelatin allergy. Egg allergy is not a contraindication because MMR is derived from tissue culture.

During outbreaks, age-appropriate receipt of recommended vaccine should be assured. Postexposure prophylaxis may be efficacious in reducing measles and varicella infection (but not rubella or mumps) if administered within 72 hours of exposure. Potentially exposed children 13 months and older may be given a second dose of vaccine at least 28 days following receipt of the first dose. MMR can be administered to infants at least 6 months of age who are at increased risk of exposure, including international travelers. Because the immune response may be reduced in this age group, a dose of MMR administered before 12 months of

age is not counted as one of the two required doses. The role of a third dose for outbreak control is an area of investigation and is not routinely recommended at present.

MMR and varicella vaccines are not recommended in pregnancy, and pregnancy should be avoided for 28 days following receipt of these vaccines. (20) If either vaccine is inadvertently given, termination of the pregnancy is not specifically advised, but the mother should be counseled that there is a theoretical risk of harm to the fetus. Prior history of idiopathic thrombocytopenic purpura is a precaution to MMR vaccine because affected individuals may be at increased risk for recurrence following immunization. As live attenuated vaccines, MMR and varicella vaccines are not

TABLE 4. Resources for International Travel

CDC Travelers Health Website: www.cdc.gov/travel/
CDC : 1-800-CDC-INFO
CDC Yellow Book: Health Information for International Travel, 2014 (updated every 2 years)
World Health Organization: www.who.int/ith/

recommended for use in immunocompromised individuals, except those with HIV who do not have severe immunosuppression. Measles inclusion body encephalitis has been described rarely in individuals with immunodeficiency. (20) Zoster (shingles) may occur following varicella vaccine administration, but the risk is greatly reduced compared to zoster following wild-type chickenpox, and symptoms are substantially milder.

Varicella immune globulin should be administered as soon as possible (up to 10 days following exposure) to high-risk individuals exposed to varicella virus. High-risk individuals include nonimmune pregnant women, neonates born to mothers with varicella infection from 5 days prior to 2 days after delivery, all hospitalized preterm infants born before 28 weeks' gestation or whose birthweight is 1,000 g or less, and hospitalized preterm infants 28 weeks' gestation or older born to nonimmune mothers. (21)

Rotavirus Vaccines

Rotavirus vaccine is indicated for the prevention of acute diarrheal disease due to rotavirus infection in healthy infants. The vaccine is administered orally on a two-dose (Rotarix, GlaxoSmithKline) or three-dose schedule (Rotateq, Merck and Co, Inc) at 2, 4, (and 6) months of age. The first dose should not be administered after 14 weeks and 6 days of age, and the final dose should not be administered after 8 months of age. Another rotavirus vaccine, RotaShield (Wyeth Laboratories, Inc, Marietta, PA), was withdrawn from the market in 1999 due to an association with intussusception. Reports of intussusception with current rotavirus vaccine cluster 3 to 7 days following the first dose only. (22) The increased risk of intussusception is estimated at 1 to 5 per 100,000 doses. In contrast, rotavirus vaccine prevents 40,000 hospitalizations in the United States annually. Rotavirus vaccine is contraindicated in patients with a history of intussusception due to increased risk of recurrence in this group (23) and in patients with severe combined immunodeficiency. (24)

VACCINES FOR INTERNATIONAL TRAVELERS

Travelers should allow at least 8 weeks before international travel to accomplish appropriate health planning and allow sufficient time for development of immune protection from vaccines. (26) International travelers should be up to date with all routine immunizations. Additional vaccines (Table 3) or immune globulin may be indicated under special circumstances. Yellow fever vaccine is only available at

designated clinics, and cholera and tickborne encephalitis vaccines are currently not available in the United States. Child age, duration of travel, season, presence of infectious disease outbreaks, and contact with local populations (eg, home stay with relatives vs resort accommodations) may influence immunization decisions. The CDC provides excellent, regularly updated resources to assist with immunization and other health considerations for travel planning (Table 4). Consultation with an infectious disease specialist or travel clinic may also be of benefit, particularly for travel to higher-risk areas such as developing countries. In general, written documentation of vaccines administered outside of the United States may be considered valid.

Summary

- The childhood immunization schedule is complex and nuanced. Although serious adverse reactions to immunizations are uncommon, clinicians must be well-versed in these reactions as well as the contraindications and precautions to each vaccine.
- Conjugate vaccine technology links polysaccharide antigens to carrier proteins, triggering T-cell-dependent immunity to polysaccharides, thereby strengthening immune memory.
- On the basis of some research evidence and consensus, live vaccines are generally contraindicated in immunocompromised patients and in pregnancy. (8)(20) Most live vaccines can be administered to household contacts of immunocompromised patients. (8)(20)
- On the basis of some research and consensus, modified administration of meningococcal, pneumococcal, and less commonly, other vaccines may be indicated to protect immunocompromised patients. (2)(3)(7)(8)(20)
- On the basis of disease epidemiology and consensus, international travelers should be up-to-date with all routine immunizations; depending on destination, additional vaccines or immune globulin may be required. (26)

RESOURCES FOR HEALTH-CARE PROFESSIONALS AND FAMILIES:

American Academy of Pediatrics: www.healthychildren.org
Centers for Disease Control and Prevention: www.cdc.gov/vaccines
Immunization Action Coalition: www.immunize.org

References for this article are at <http://pedsinreview.aappublications.org/content/36/6/249.full>.

Recommended Child and Adolescent Immunization Schedule for ages 18 years or younger

UNITED STATES
2022

Vaccines in the Child and Adolescent Immunization Schedule*

Vaccine	Abbreviation(s)	Trade name(s)
Dengue vaccine	DEN4CYD	Dengvaxia®
Diphtheria, tetanus, and acellular pertussis vaccine	DTaP	Daptacel® Infanrix®
Diphtheria, tetanus vaccine	DT	No trade name
<i>Haemophilus influenzae</i> type b vaccine	Hib (PRP-T) Hib (PRP-OMP)	ActHIB® Hiberix® PedvaxHIB®
Hepatitis A vaccine	HepA	Havrix® Vaqta®
Hepatitis B vaccine	HepB	Engerix-B® Recombivax HB®
Human papillomavirus vaccine	HPV	Gardasil 9®
Influenza vaccine (inactivated)	IIV4	Multiple
Influenza vaccine (live, attenuated)	LAIV4	FluMist® Quadrivalent
Measles, mumps, and rubella vaccine	MMR	M-M-R II®
Meningococcal serogroups A, C, W, Y vaccine	MenACWY-D MenACWY-CRM MenACWY-TT	Menactra® Menveo® MenQuadfi®
Meningococcal serogroup B vaccine	MenB-4C MenB-FHbp	Bexsero® Trumenba®
Pneumococcal 13-valent conjugate vaccine	PCV13	Prevnar 13®
Pneumococcal 23-valent polysaccharide vaccine	PPSV23	Pneumovax 23®
Poliovirus vaccine (inactivated)	IPV	IPOL®
Rotavirus vaccine	RV1 RV5	Rotarix® RotaTeq®
Tetanus, diphtheria, and acellular pertussis vaccine	Tdap	Adacel® Boostrix®
Tetanus and diphtheria vaccine	Td	Tenivac® Tdvax™
Varicella vaccine	VAR	Varivax®
Combination vaccines (use combination vaccines instead of separate injections when appropriate)		
DTaP, hepatitis B, and inactivated poliovirus vaccine	DTaP-HepB-IPV	Pediarix®
DTaP, inactivated poliovirus, and <i>Haemophilus influenzae</i> type b vaccine	DTaP-IPV/Hib	Pentacel®
DTaP and inactivated poliovirus vaccine	DTaP-IPV	Kinrix® Quadracel®
DTaP, inactivated poliovirus, <i>Haemophilus influenzae</i> type b, and hepatitis B vaccine	DTaP-IPV-Hib-HepB	Vaxelis®
Measles, mumps, rubella, and varicella vaccine	MMRV	ProQuad®

How to use the child and adolescent immunization schedule

- 1** Determine recommended vaccine by age (**Table 1**)
- 2** Determine recommended interval for catch-up vaccination (**Table 2**)
- 3** Assess need for additional recommended vaccines by medical condition or other indication (**Table 3**)
- 4** Review vaccine types, frequencies, intervals, and considerations for special situations (**Notes**)
- 5** Review contraindications and precautions for vaccine types (**Appendix**)

Recommended by the Advisory Committee on Immunization Practices (www.cdc.gov/vaccines/acip) and approved by the Centers for Disease Control and Prevention (www.cdc.gov), American Academy of Pediatrics (www.aap.org), American Academy of Family Physicians (www.aafp.org), American College of Obstetricians and Gynecologists (www.acog.org), American College of Nurse-Midwives (www.midwife.org), American Academy of Physician Associates (www.aapa.org), and National Association of Pediatric Nurse Practitioners (www.napnap.org).

Report

- Suspected cases of reportable vaccine-preventable diseases or outbreaks to your state or local health department
- Clinically significant adverse events to the Vaccine Adverse Event Reporting System (VAERS) at www.vaers.hhs.gov or 800-822-7967

Questions or comments

Contact www.cdc.gov/cdc-info or 800-CDC-INFO (800-232-4636), in English or Spanish, 8 a.m.–8 p.m. ET, Monday through Friday, excluding holidays



Download the CDC Vaccine Schedules app for providers at www.cdc.gov/vaccines/schedules/hcp/schedule-app.html

Helpful information

- Complete Advisory Committee on Immunization Practices (ACIP) recommendations: www.cdc.gov/vaccines/hcp/acip-recs/index.html
- *General Best Practice Guidelines for Immunization* (including contraindications and precautions): www.cdc.gov/vaccines/hcp/acip-recs/general-recs/index.html
- Vaccine information statements: www.cdc.gov/vaccines/hcp/vis/index.html
- Manual for the Surveillance of Vaccine-Preventable Diseases (including case identification and outbreak response): www.cdc.gov/vaccines/pubs/surv-manual
- ACIP Shared Clinical Decision-Making Recommendations www.cdc.gov/vaccines/acip/acip-scdm-faqs.html



U.S. Department of
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*Administer recommended vaccines if immunization history is incomplete or unknown. Do not restart or add doses to vaccine series for extended intervals between doses. When a vaccine is not administered at the recommended age, administer at a subsequent visit. The use of trade names is for identification purposes only and does not imply endorsement by the ACIP or CDC.

Table 1 Recommended Child and Adolescent Immunization Schedule for ages 18 years or younger, United States, 2022

These recommendations must be read with the notes that follow. For those who fall behind or start late, provide catch-up vaccination at the earliest opportunity as indicated by the green bars. To determine minimum intervals between doses, see the catch-up schedule (Table 2).

Vaccine	Birth	1 mo	2 mos	4 mos	6 mos	9 mos	12 mos	15 mos	18 mos	19–23 mos	2–3 yrs	4–6 yrs	7–10 yrs	11–12 yrs	13–15 yrs	16 yrs	17–18 yrs		
Hepatitis B (HepB)	1 st dose	← 2 nd dose →			← 3 rd dose →														
Rotavirus (RV): RV1 (2-dose series), RV5 (3-dose series)			1 st dose	2 nd dose	See Notes														
Diphtheria, tetanus, acellular pertussis (DTaP <7 yrs)			1 st dose	2 nd dose	3 rd dose				← 4 th dose →			5 th dose							
Haemophilus influenzae type b (Hib)			1 st dose	2 nd dose	See Notes	← 3 rd or 4 th dose, See Notes →													
Pneumococcal conjugate (PCV13)			1 st dose	2 nd dose	3 rd dose				← 4 th dose →										
Inactivated poliovirus (IPV <18 yrs)			1 st dose	2 nd dose	← 3 rd dose →							4 th dose							
Influenza (IIV4)						Annual vaccination 1 or 2 doses							Annual vaccination 1 dose only						
OR													OR						
Influenza (LAIV4)													Annual vaccination 1 or 2 doses		Annual vaccination 1 dose only				
Measles, mumps, rubella (MMR)					See Notes	← 1 st dose →					2 nd dose								
Varicella (VAR)						← 1 st dose →					2 nd dose								
Hepatitis A (HepA)					See Notes	2-dose series, See Notes													
Tetanus, diphtheria, acellular pertussis (Tdap ≥7 yrs)														1 dose					
Human papillomavirus (HPV)														See Notes					
Meningococcal (MenACWY-D ≥9 mos, MenACWY-CRM ≥2 mos, MenACWY-TT ≥2 years)			See Notes											1 st dose		2 nd dose			
Meningococcal B (MenB-4C, MenB-FHbp)														See Notes					
Pneumococcal polysaccharide (PPSV23)												See Notes							
Dengue (DEN4CYD; 9-16 yrs)														Seropositive in endemic areas only (See Notes)					

Range of recommended ages for all children
 Range of recommended ages for catch-up vaccination
 Range of recommended ages for certain high-risk groups
 Recommended vaccination can begin in this age group
 Recommended vaccination based on shared clinical decision-making
 No recommendation/not applicable

Table 2 Recommended Catch-up Immunization Schedule for Children and Adolescents Who Start Late or Who Are More than 1 Month Behind, United States, 2022

The table below provides catch-up schedules and minimum intervals between doses for children whose vaccinations have been delayed. A vaccine series does not need to be restarted, regardless of the time that has elapsed between doses. Use the section appropriate for the child's age. **Always use this table in conjunction with Table 1 and the Notes that follow.**

Children age 4 months through 6 years					
Vaccine	Minimum Age for Dose 1	Minimum Interval Between Doses			
		Dose 1 to Dose 2	Dose 2 to Dose 3	Dose 3 to Dose 4	Dose 4 to Dose 5
Hepatitis B	Birth	4 weeks	8 weeks and at least 16 weeks after first dose minimum age for the final dose is 24 weeks		
Rotavirus	6 weeks Maximum age for first dose is 14 weeks, 6 days.	4 weeks	4 weeks maximum age for final dose is 8 months, 0 days		
Diphtheria, tetanus, and acellular pertussis	6 weeks	4 weeks	4 weeks	6 months	6 months
<i>Haemophilus influenzae</i> type b	6 weeks	No further doses needed if first dose was administered at age 15 months or older. 4 weeks if first dose was administered before the 1 st birthday. 8 weeks (as final dose) if first dose was administered at age 12 through 14 months.	No further doses needed if previous dose was administered at age 15 months or older 4 weeks if current age is younger than 12 months and first dose was administered at younger than age 7 months and at least 1 previous dose was PRP-T (ActHib®, Pentacel®, Hiberix®), Vaxelis® or unknown 8 weeks and age 12 through 59 months (as final dose) if current age is younger than 12 months and first dose was administered at age 7 through 11 months; OR if current age is 12 through 59 months and first dose was administered before the 1 st birthday and second dose was administered at younger than 15 months; OR if both doses were PedvaxHIB® and were administered before the 1st birthday	8 weeks (as final dose) This dose only necessary for children age 12 through 59 months who received 3 doses before the 1 st birthday.	
Pneumococcal conjugate	6 weeks	No further doses needed for healthy children if first dose was administered at age 24 months or older 4 weeks if first dose was administered before the 1 st birthday 8 weeks (as final dose for healthy children) if first dose was administered at the 1 st birthday or after	No further doses needed for healthy children if previous dose was administered at age 24 months or older 4 weeks if current age is younger than 12 months and previous dose was administered at <7 months old 8 weeks (as final dose for healthy children) if previous dose was administered between 7–11 months (wait until at least 12 months old); OR if current age is 12 months or older and at least 1 dose was administered before age 12 months	8 weeks (as final dose) This dose only necessary for children age 12 through 59 months who received 3 doses before age 12 months or for children at high risk who received 3 doses at any age.	
Inactivated poliovirus	6 weeks	4 weeks	4 weeks if current age is <4 years 6 months (as final dose) if current age is 4 years or older	6 months (minimum age 4 years for final dose)	
Measles, mumps, rubella	12 months	4 weeks			
Varicella	12 months	3 months			
Hepatitis A	12 months	6 months			
Meningococcal ACWY	2 months MenACWY-CRM 9 months MenACWY-D 2 years MenACWY-TT	8 weeks	See Notes	See Notes	
Children and adolescents age 7 through 18 years					
Meningococcal ACWY	Not applicable (N/A)	8 weeks			
Tetanus, diphtheria; tetanus, diphtheria, and acellular pertussis	7 years	4 weeks	4 weeks if first dose of DTaP/DT was administered before the 1 st birthday 6 months (as final dose) if first dose of DTaP/DT or Tdap/Td was administered at or after the 1 st birthday	6 months if first dose of DTaP/DT was administered before the 1 st birthday	
Human papillomavirus	9 years	Routine dosing intervals are recommended.			
Hepatitis A	N/A	6 months			
Hepatitis B	N/A	4 weeks	8 weeks and at least 16 weeks after first dose		
Inactivated poliovirus	N/A	4 weeks	6 months 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.	A fourth dose of IPV is indicated if all previous doses were administered at <4 years or if the third dose was administered <6 months after the second dose.	
Measles, mumps, rubella	N/A	4 weeks			
Varicella	N/A	3 months if younger than age 13 years. 4 weeks if age 13 years or older			
Dengue	9 years	6 months	6 months		

Table 3

Recommended Child and Adolescent Immunization Schedule by Medical Indication, United States, 2022

Always use this table in conjunction with Table 1 and the Notes that follow.

VACCINE	INDICATION									
	Pregnancy	Immunocompromised status (excluding HIV infection)	HIV infection CD4+ count ¹		Kidney failure, end-stage renal disease, or on hemodialysis	Heart disease or chronic lung disease	CSF leak or cochlear implant	Asplenia or persistent complement deficiencies	Chronic liver disease	Diabetes
			<15% or total CD4 cell count of <200/mm ³	≥15% and total CD4 cell count of ≥200/mm ³						
Hepatitis B	Yellow	Yellow	Yellow		Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
Rotavirus	Yellow	Red (SCID ²)	Orange		Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
Diphtheria, tetanus, and acellular pertussis (DTaP)	Yellow	Yellow	Yellow		Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
<i>Haemophilus influenzae</i> type b	Yellow	Yellow with dots	Yellow with dots		Yellow	Yellow	Yellow	Yellow with dots	Yellow	Yellow
Pneumococcal conjugate	Yellow	Yellow with dots	Yellow with dots		Yellow with dots	Yellow with dots	Yellow with dots	Yellow with dots	Yellow with dots	Yellow with dots
Inactivated poliovirus	Orange	Yellow	Yellow		Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
Influenza (IIV4)	Yellow	Yellow	Yellow		Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
or Influenza (LAIV4)	Red (*)	Red	Red		Orange	Orange (Asthma, wheezing: 2–4yrs ³)	Red	Red	Orange	Orange
Measles, mumps, rubella	Red (*)	Red	Red	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
Varicella	Red (*)	Red	Red	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
Hepatitis A	Yellow	Yellow	Yellow		Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
Tetanus, diphtheria, and acellular pertussis (Tdap)	Yellow with dots	Yellow	Yellow		Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
Human papillomavirus	Red (*)	Yellow with dots	Yellow with dots		Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
Meningococcal ACWY	Yellow	Yellow	Yellow with dots		Yellow	Yellow	Yellow	Yellow with dots	Yellow	Yellow
Meningococcal B	Orange	Purple	Purple		Purple	Purple	Purple	Yellow with dots	Purple	Purple
Pneumococcal polysaccharide	Purple	Yellow with dots	Yellow with dots		Yellow with dots	Yellow with dots	Yellow with dots	Yellow with dots	Yellow with dots	Yellow with dots
Dengue	Orange	Red	Red	Orange	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow

Yellow Vaccination according to the routine schedule recommended
Purple Recommended for persons with an additional risk factor for which the vaccine would be indicated
Yellow with dots Vaccination is recommended, and additional doses may be necessary based on medical condition or vaccine. See Notes.
Orange Precaution—vaccine might be indicated if benefit of protection outweighs risk of adverse reaction
Red Contraindicated or not recommended—vaccine should not be administered
Lightgray No recommendation/not applicable
 *Vaccinate after pregnancy

¹ For additional information regarding HIV laboratory parameters and use of live vaccines, see the *General Best Practice Guidelines for Immunization*, "Altered Immunocompetence," at www.cdc.gov/vaccines/hcp/acip-recs/general-recs/immunocompetence.html and Table 4-1 (footnote J) at www.cdc.gov/vaccines/hcp/acip-recs/general-recs/contraindications.html.

² Severe Combined Immunodeficiency

³ LAIV4 contraindicated for children 2–4 years of age with asthma or wheezing during the preceding 12 months

For vaccination recommendations for persons ages 19 years or older, see the Recommended Adult Immunization Schedule, 2022.

Additional information

COVID-19 Vaccination

COVID-19 vaccines are recommended for use within the scope of the Emergency Use Authorization or Biologics License Application for the particular vaccine. ACIP recommendations for the use of COVID-19 vaccines can be found at www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/covid-19.html.

CDC's interim clinical considerations for use of COVID-19 vaccines can be found at www.cdc.gov/vaccines/covid-19/clinical-considerations/covid-19-vaccines-us.html.

- Consult relevant ACIP statements for detailed recommendations at www.cdc.gov/vaccines/hcp/acip-recs/index.html.
- For calculating intervals between doses, 4 weeks = 28 days. Intervals of ≥4 months are determined by calendar months.
- Within a number range (e.g., 12–18), a dash (–) should be read as “through.”
- Vaccine doses administered ≤4 days before the minimum age or interval are considered valid. Doses of any vaccine administered ≥5 days earlier than the minimum age or minimum interval should not be counted as valid and should be repeated as age appropriate. **The repeat dose should be spaced after the invalid dose by the recommended minimum interval.** For further details, see Table 3-1, Recommended and minimum ages and intervals between vaccine doses, in *General Best Practice Guidelines for Immunization* at www.cdc.gov/vaccines/hcp/acip-recs/general-recs/timing.html.
- Information on travel vaccination requirements and recommendations is available at www.cdc.gov/travel/.
- For vaccination of persons with immunodeficiencies, see Table 8-1, Vaccination of persons with primary and secondary immunodeficiencies, in *General Best Practice Guidelines for Immunization* at www.cdc.gov/vaccines/hcp/acip-recs/general-recs/immunocompetence.html, and Immunization in Special Clinical Circumstances (In: Kimberlin DW, Brady MT, Jackson MA, Long SS, eds. *Red Book: 2018 Report of the Committee on Infectious Diseases*. 31st ed. Itasca, IL: American Academy of Pediatrics; 2018:67–111).
- For information about vaccination in the setting of a vaccine-preventable disease outbreak, contact your state or local health department.
- The National Vaccine Injury Compensation Program (VICP) is a no-fault alternative to the traditional legal system for resolving vaccine injury claims. All routine child and adolescent vaccines are covered by VICP except for pneumococcal polysaccharide vaccine (PPSV23). For more information, see www.hrsa.gov/vaccinecompensation/index.html.

Dengue vaccination (minimum age: 9 years)

Routine vaccination

- Age 9–16 years living in dengue endemic areas **AND** have laboratory confirmation of previous dengue infection
 - 3-dose series administered at 0, 6, and 12 months
- Endemic areas include Puerto Rico, American Samoa, US Virgin Islands, Federated States of Micronesia, Republic of Marshall Islands, and the Republic of Palau. For updated guidance on dengue endemic areas and pre-vaccination laboratory testing see www.cdc.gov/mmwr/volumes/70/rr/rr7006a1.htm?s_cid=rr7006a1_w and www.cdc.gov/dengue/vaccine/hcp/index.html

Diphtheria, tetanus, and pertussis (DTaP) vaccination (minimum age: 6 weeks [4 years for Kinrix® or Quadracel®])

Routine vaccination

- 5-dose series at age 2, 4, 6, 15–18 months, 4–6 years
 - Prospectively:** Dose 4 may be administered as early as age 12 months if at least 6 months have elapsed since dose 3.
 - Retrospectively:** A 4th dose that was inadvertently administered as early as age 12 months may be counted if at least 4 months have elapsed since dose 3.

Catch-up vaccination

- Dose 5 is not necessary if dose 4 was administered at age 4 years or older and at least 6 months after dose 3.
- For other catch-up guidance, see Table 2.

Special situations

- Wound management in children less than age 7 years with history of 3 or more doses of tetanus-toxoid-containing vaccine: For all wounds except clean and minor wounds, administer DTaP if more than 5 years since last dose of tetanus-toxoid-containing vaccine. For detailed information, see www.cdc.gov/mmwr/volumes/67/rr/rr6702a1.htm.

Haemophilus influenzae type b vaccination (minimum age: 6 weeks)

Routine vaccination

- ActHIB®, Hiberix®, Pentacel®, or Vaxelis®:** 4-dose series (3 dose primary series at age 2, 4, and 6 months, followed by a booster dose* at age 12–15 months)
 - *Vaxelis® is not recommended for use as a booster dose. A different Hib-containing vaccine should be used for the booster dose.
- PedvaxHIB®:** 3-dose series (2-dose primary series at age 2 and 4 months, followed by a booster dose at age 12–15 months)

Catch-up vaccination

- Dose 1 at age 7–11 months:** Administer dose 2 at least 4 weeks later and dose 3 (final dose) at age 12–15 months or 8 weeks after dose 2 (whichever is later).
- Dose 1 at age 12–14 months:** Administer dose 2 (final dose) at least 8 weeks after dose 1.

- Dose 1 before age 12 months and dose 2 before age 15 months:** Administer dose 3 (final dose) at least 8 weeks after dose 2.
- 2 doses of PedvaxHIB® before age 12 months:** Administer dose 3 (final dose) at 12–59 months and at least 8 weeks after dose 2.
- 1 dose administered at age 15 months or older:** No further doses needed
- Unvaccinated at age 15–59 months:** Administer 1 dose.
- Previously unvaccinated children age 60 months or older who are not considered high risk:** Do not require catch-up vaccination

For other catch-up guidance, see Table 2. Vaxelis® can be used for catch-up vaccination in children less than age 5 years. Follow the catch-up schedule even if Vaxelis® is used for one or more doses. For detailed information on use of Vaxelis® see www.cdc.gov/mmwr/volumes/69/wr/mm6905a5.htm.

Special situations

Chemotherapy or radiation treatment:

Age 12–59 months

- Unvaccinated or only 1 dose before age 12 months: 2 doses, 8 weeks apart
- 2 or more doses before age 12 months: 1 dose at least 8 weeks after previous dose

Doses administered within 14 days of starting therapy or during therapy should be repeated at least 3 months after therapy completion.

Hematopoietic stem cell transplant (HSCT):

- 3-dose series 4 weeks apart starting 6 to 12 months after successful transplant, regardless of Hib vaccination history

Anatomic or functional asplenia (including sickle cell disease):

Age 12–59 months

- Unvaccinated or only 1 dose before age 12 months: 2 doses, 8 weeks apart
- 2 or more doses before age 12 months: 1 dose at least 8 weeks after previous dose

Unvaccinated* persons age 5 years or older

- 1 dose

Elective splenectomy:

Unvaccinated* persons age 15 months or older

- 1 dose (preferably at least 14 days before procedure)

HIV infection:

Age 12–59 months

- Unvaccinated or only 1 dose before age 12 months: 2 doses, 8 weeks apart
- 2 or more doses before age 12 months: 1 dose at least 8 weeks after previous dose

Unvaccinated* persons age 5–18 years

- 1 dose

Immunoglobulin deficiency, early component complement deficiency:

Age 12–59 months

- Unvaccinated or only 1 dose before age 12 months: 2 doses, 8 weeks apart
- 2 or more doses before age 12 months: 1 dose at least 8 weeks after previous dose

*Unvaccinated = Less than routine series (through age 14 months) OR no doses (age 15 months or older)

Hepatitis A vaccination

(minimum age: 12 months for routine vaccination)

Routine vaccination

- 2-dose series (minimum interval: 6 months) at age 12–23 months

Catch-up vaccination

- Unvaccinated persons through age 18 years should complete a 2-dose series (minimum interval: 6 months).
- Persons who previously received 1 dose at age 12 months or older should receive dose 2 at least 6 months after dose 1.
- Adolescents age 18 years or older may receive the combined HepA and HepB vaccine, **Twinrix**[®], as a 3-dose series (0, 1, and 6 months) or 4-dose series (3 doses at 0, 7, and 21–30 days, followed by a booster dose at 12 months).

International travel

- Persons traveling to or working in countries with high or intermediate endemic hepatitis A (www.cdc.gov/travel/):
 - **Infants age 6–11 months:** 1 dose before departure; revaccinate with 2 doses, separated by at least 6 months, between age 12–23 months.
 - **Unvaccinated age 12 months or older:** Administer dose 1 as soon as travel is considered.

Hepatitis B vaccination

(minimum age: birth)

Birth dose (monovalent HepB vaccine only)

- **Mother is HBsAg-negative:**
 - **All** medically stable infants $\geq 2,000$ grams: 1 dose within 24 hours of birth
 - Infants $< 2,000$ grams: Administer 1 dose at chronological age 1 month or hospital discharge (whichever is earlier and even if weight is still $< 2,000$ grams).
- **Mother is HBsAg-positive:**
 - Administer **HepB vaccine** and **hepatitis B immune globulin (HBIG)** (in separate limbs) within 12 hours of birth, regardless of birth weight. For infants $< 2,000$ grams, administer 3 additional doses of vaccine (total of 4 doses) beginning at age 1 month.
 - Test for HBsAg and anti-HBs at age 9–12 months. If HepB series is delayed, test 1–2 months after final dose.
- **Mother's HBsAg status is unknown:**
 - Administer **HepB vaccine** within 12 hours of birth, regardless of birth weight.
 - For infants $< 2,000$ grams, administer **HBIG** in addition to HepB vaccine (in separate limbs) within 12 hours of birth. Administer 3 additional doses of vaccine (total of 4 doses) beginning at age 1 month.
 - Determine mother's HBsAg status as soon as possible. If mother is HBsAg-positive, administer **HBIG** to infants $\geq 2,000$ grams as soon as possible, but no later than 7 days of age.

Routine series

- 3-dose series at age 0, 1–2, 6–18 months (use monovalent HepB vaccine for doses administered before age 6 weeks)
- Infants who did not receive a birth dose should begin the series as soon as feasible (see Table 2).

- Administration of **4 doses** is permitted when a combination vaccine containing HepB is used after the birth dose.
- **Minimum age** for the final (3rd or 4th) dose: 24 weeks
- **Minimum intervals:** dose 1 to dose 2: 4 weeks / dose 2 to dose 3: 8 weeks / dose 1 to dose 3: 16 weeks (when 4 doses are administered, substitute "dose 4" for "dose 3" in these calculations)

Catch-up vaccination

- Unvaccinated persons should complete a 3-dose series at 0, 1–2, 6 months.
- Adolescents age 11–15 years may use an alternative 2-dose schedule with at least 4 months between doses (adult formulation **Recombivax HB**[®] only).
- Adolescents age 18 years or older may receive a 2-dose series of HepB (**Heplisav-B**[®]) at least 4 weeks apart.
- Adolescents age 18 years or older may receive the combined HepA and HepB vaccine, **Twinrix**[®], as a 3-dose series (0, 1, and 6 months) or 4-dose series (3 doses at 0, 7, and 21–30 days, followed by a booster dose at 12 months).
- For other catch-up guidance, see Table 2.

Special situations

- Revaccination is not generally recommended for persons with a normal immune status who were vaccinated as infants, children, adolescents, or adults.
- **Post-vaccination serology testing and revaccination** (if anti-HBs < 10 mIU/mL) is recommended for certain populations, including:
 - **Infants born to HBsAg-positive mothers**
 - **Hemodialysis patients**
 - **Other immunocompromised persons**

For detailed revaccination recommendations, see www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/hepb.html.

Human papillomavirus vaccination

(minimum age: 9 years)

Routine and catch-up vaccination

- HPV vaccination routinely recommended at **age 11–12 years (can start at age 9 years)** and catch-up HPV vaccination recommended for all persons through age 18 years if not adequately vaccinated
- 2- or 3-dose series depending on age at initial vaccination:
 - **Age 9–14 years at initial vaccination:** 2-dose series at 0, 6–12 months (minimum interval: 5 months; repeat dose if administered too soon)
 - **Age 15 years or older at initial vaccination:** 3-dose series at 0, 1–2 months, 6 months (minimum intervals: dose 1 to dose 2: 4 weeks / dose 2 to dose 3: 12 weeks / dose 1 to dose 3: 5 months; repeat dose if administered too soon)
- **Interrupted schedules:** If vaccination schedule is interrupted, the series does not need to be restarted.
- No additional dose recommended when any HPV vaccine series has been completed using the recommended dosing intervals.

Special situations

- **Immunocompromising conditions, including HIV infection:** 3-dose series, even for those who initiate vaccination at age 9 through 14 years.
- **History of sexual abuse or assault:** Start at age 9 years.

- **Pregnancy:** Pregnancy testing not needed before vaccination; HPV vaccination not recommended until after pregnancy; no intervention needed if vaccinated while pregnant

Influenza vaccination

(minimum age: 6 months [IIV], 2 years [LAIV4], 18 years [recombinant influenza vaccine, RIV4])

Routine vaccination

- Use any influenza vaccine appropriate for age and health status annually:
 - 2 doses, separated by at least 4 weeks, for **children age 6 months–8 years** who have received fewer than 2 influenza vaccine doses before July 1, 2021, or whose influenza vaccination history is unknown (administer dose 2 even if the child turns 9 between receipt of dose 1 and dose 2)
 - 1 dose for **children age 6 months–8 years** who have received at least 2 influenza vaccine doses before July 1, 2021
 - 1 dose for **all persons age 9 years or older**
- For the 2021–2022 season, see www.cdc.gov/mmwr/volumes/70/rr/rr7005a1.htm.
- For the 2022–23 season, see the 2022–23 ACIP influenza vaccine recommendations.

Special situations

- **Egg allergy, hives only:** Any influenza vaccine appropriate for age and health status annually
- **Egg allergy with symptoms other than hives** (e.g., angioedema, respiratory distress) or required epinephrine or another emergency medical intervention: see Appendix listing contraindications and precautions
- **Severe allergic reaction (e.g., anaphylaxis) to a vaccine component or a previous dose of any influenza vaccine:** see Appendix listing contraindications and precautions

Measles, mumps, and rubella vaccination

(minimum age: 12 months for routine vaccination)

Routine vaccination

- 2-dose series at age 12–15 months, age 4–6 years
- MMR or MMRV may be administered
- Note:** For dose 1 in children age 12–47 months, it is recommended to administer MMR and varicella vaccines separately. MMRV may be used if parents or caregivers express a preference.

Catch-up vaccination

- Unvaccinated children and adolescents: 2-dose series at least 4 weeks apart
- The maximum age for use of MMRV is 12 years.
- Minimum interval between MMRV doses: 3 months

Special situations**International travel**

- **Infants age 6–11 months:** 1 dose before departure; revaccinate with 2-dose series at age 12–15 months (12 months for children in high-risk areas) and dose 2 as early as 4 weeks later.
- **Unvaccinated children age 12 months or older:** 2-dose series at least 4 weeks apart before departure

Meningococcal serogroup A,C,W,Y vaccination
(minimum age: 2 months [MenACWY-CRM, Menveo], 9 months [MenACWY-D, Menactra], 2 years [MenACWY-TT, MenQuadfi])

Routine vaccination

- 2-dose series at age 11–12 years; 16 years

Catch-up vaccination

- Age 13–15 years: 1 dose now and booster at age 16–18 years (minimum interval: 8 weeks)
- Age 16–18 years: 1 dose

Special situations

Anatomic or functional asplenia (including sickle cell disease), HIV infection, persistent complement component deficiency, complement inhibitor (e.g., eculizumab, ravulizumab) use:

- **Menveo**
 - Dose 1 at age 2 months: 4-dose series (additional 3 doses at age 4, 6 and 12 months)
 - Dose 1 at age 3–6 months: 3- or 4- dose series (dose 2 [and dose 3 if applicable] at least 8 weeks after previous dose until a dose is received at age 7 months or older, followed by an additional dose at least 12 weeks later and after age 12 months)
 - Dose 1 at age 7–23 months: 2-dose series (dose 2 at least 12 weeks after dose 1 and after age 12 months)
 - Dose 1 at age 24 months or older: 2-dose series at least 8 weeks apart
- **Menactra**
 - **Persistent complement component deficiency or complement inhibitor use:**
 - Age 9–23 months: 2-dose series at least 12 weeks apart
 - Age 24 months or older: 2-dose series at least 8 weeks apart
 - **Anatomic or functional asplenia, sickle cell disease, or HIV infection:**
 - Age 9–23 months: Not recommended
 - Age 24 months or older: 2-dose series at least 8 weeks apart
 - **Menactra**® must be administered at least 4 weeks after completion of PCV13 series.
- **MenQuadfi**®
 - Dose 1 at age 24 months or older: 2-dose series at least 8 weeks apart

Travel in countries with hyperendemic or epidemic meningococcal disease, including countries in the African meningitis belt or during the Hajj (www.cdc.gov/travel/):

- Children less than age 24 months:
 - **Menveo**® (age 2–23 months)
 - Dose 1 at age 2 months: 4-dose series (additional 3 doses at age 4, 6 and 12 months)
 - Dose 1 at age 3–6 months: 3- or 4- dose series (dose 2 [and dose 3 if applicable] at least 8 weeks after previous dose until a dose is received at age 7 months or older, followed by an additional dose at least 12 weeks later and after age 12 months)
 - Dose 1 at age 7–23 months: 2-dose series (dose 2 at least 12 weeks after dose 1 and after age 12 months)
 - **Menactra**® (age 9–23 months)
 - 2-dose series (dose 2 at least 12 weeks after dose 1; dose 2 may be administered as early as 8 weeks after dose 1 in travelers)
- Children age 2 years or older: 1 dose Menveo®, Menactra®, or MenQuadfi®

First-year college students who live in residential housing (if not previously vaccinated at age 16 years or older) or military recruits:

- 1 dose **Menveo**®, **Menactra**®, or **MenQuadfi**®

Adolescent vaccination of children who received MenACWY prior to age 10 years:

- **Children for whom boosters are recommended** because of an ongoing increased risk of meningococcal disease (e.g., those with complement deficiency, HIV, or asplenia): Follow the booster schedule for persons at increased risk.
- **Children for whom boosters are not recommended** (e.g., a healthy child who received a single dose for travel to a country where meningococcal disease is endemic): Administer MenACWY according to the recommended adolescent schedule with dose 1 at age 11–12 years and dose 2 at age 16 years.

Note: **Menactra**® should be administered either before or at the same time as DTaP. MenACWY vaccines may be administered simultaneously with MenB vaccines if indicated, but at a different anatomic site, if feasible.

For MenACWY **booster dose recommendations** for groups listed under “Special situations” and in an outbreak setting and additional meningococcal vaccination information, see www.cdc.gov/mmwr/volumes/69/rr/rr6909a1.htm.

Meningococcal serogroup B vaccination
(minimum age: 10 years [MenB-4C, Bexsero®; MenB-FHbp, Trumenba®])

Shared clinical decision-making

- **Adolescents not at increased risk** age 16–23 years (preferred age 16–18 years) based on shared clinical decision-making:
 - **Bexsero**®: 2-dose series at least 1 month apart
 - **Trumenba**®: 2-dose series at least 6 months apart; if dose 2 is administered earlier than 6 months, administer a 3rd dose at least 4 months after dose 2.

Special situations

Anatomic or functional asplenia (including sickle cell disease), persistent complement component deficiency, complement inhibitor (e.g., eculizumab, ravulizumab) use:

- **Bexsero**®: 2-dose series at least 1 month apart
- **Trumenba**®: 3-dose series at 0, 1–2, 6 months

Note: **Bexsero**® and **Trumenba**® are not interchangeable; the same product should be used for all doses in a series.

For MenB **booster dose recommendations** for groups listed under “Special situations” and in an outbreak setting and additional meningococcal vaccination information, see www.cdc.gov/mmwr/volumes/69/rr/rr6909a1.htm.

Pneumococcal vaccination
(minimum age: 6 weeks [PCV13], 2 years [PPSV23])

Routine vaccination with PCV13

- 4-dose series at age 2, 4, 6, 12–15 months

Catch-up vaccination with PCV13

- 1 dose for healthy children age 24–59 months with any incomplete* PCV13 series
- For other catch-up guidance, see Table 2.

Special situations

Underlying conditions below: When both PCV13 and PPSV23 are indicated, administer PCV13 first. PCV13 and PPSV23 should not be administered during same visit.

Chronic heart disease (particularly cyanotic congenital heart disease and cardiac failure); chronic lung disease (including asthma treated with high-dose, oral corticosteroids); diabetes mellitus:

Age 2–5 years

- Any incomplete* series with:
 - 3 PCV13 doses: 1 dose PCV13 (at least 8 weeks after any prior PCV13 dose)
 - Less than 3 PCV13 doses: 2 doses PCV13 (8 weeks after the most recent dose and administered 8 weeks apart)
- No history of PPSV23: 1 dose PPSV23 (at least 8 weeks after completing all recommended PCV13 doses)

Age 6–18 years

- No history of PPSV23: 1 dose PPSV23 (at least 8 weeks after completing all recommended PCV13 doses)

Cerebrospinal fluid leak, cochlear implant:

Age 2–5 years

- Any incomplete* series with:
 - 3 PCV13 doses: 1 dose PCV13 (at least 8 weeks after any prior PCV13 dose)
 - Less than 3 PCV13 doses: 2 doses PCV13 (8 weeks after the most recent dose and administered 8 weeks apart)
- No history of PPSV23: 1 dose PPSV23 (at least 8 weeks after any prior PCV13 dose)

Age 6–18 years

- No history of either PCV13 or PPSV23: 1 dose PCV13, 1 dose PPSV23 at least 8 weeks later
- Any PCV13 but no PPSV23: 1 dose PPSV23 at least 8 weeks after the most recent dose of PCV13
- PPSV23 but no PCV13: 1 dose PCV13 at least 8 weeks after the most recent dose of PPSV23

Sickle cell disease and other hemoglobinopathies; anatomic or functional asplenia; congenital or acquired immunodeficiency; HIV infection; chronic renal failure; nephrotic syndrome; malignant neoplasms, leukemias, lymphomas, Hodgkin disease, and other diseases associated with treatment with immunosuppressive drugs or radiation therapy; solid organ transplantation; multiple myeloma:

Age 2–5 years

- Any incomplete* series with:
 - 3 PCV13 doses: 1 dose PCV13 (at least 8 weeks after any prior PCV13 dose)
 - Less than 3 PCV13 doses: 2 doses PCV13 (8 weeks after the most recent dose and administered 8 weeks apart)
- No history of PPSV23: 1 dose PPSV23 (at least 8 weeks after any prior PCV13 dose) and a dose 2 of PPSV23 5 years later

Age 6–18 years

- No history of either PCV13 or PPSV23: 1 dose PCV13, 2 doses PPSV23 (dose 1 of PPSV23 administered 8 weeks after PCV13 and dose 2 of PPSV23 administered at least 5 years after dose 1 of PPSV23)
- Any PCV13 but no PPSV23: 2 doses PPSV23 (dose 1 of PPSV23 administered 8 weeks after the most recent dose of PCV13 and dose 2 of PPSV23 administered at least 5 years after dose 1 of PPSV23)
- PPSV23 but no PCV13: 1 dose PCV13 at least 8 weeks after the most recent PPSV23 dose and a dose 2 of PPSV23 administered 5 years after dose 1 of PPSV23 and at least 8 weeks after a dose of PCV13

Chronic liver disease, alcoholism:**Age 6–18 years**

- No history of PPSV23: 1 dose PPSV23 (at least 8 weeks after any prior PCV13 dose)

**Incomplete series* = Not having received all doses in either the recommended series or an age-appropriate catch-up series. See Tables 8, 9, and 11 in the ACIP pneumococcal vaccine recommendations (www.cdc.gov/mmwr/pdf/rr/rr5911.pdf) for complete schedule details.

Poliovirus vaccination

(minimum age: 6 weeks)

Routine vaccination

- 4-dose series at ages 2, 4, 6–18 months, 4–6 years; administer the final dose on or after age 4 years and at least 6 months after the previous dose.
- 4 or more doses of IPV can be administered before age 4 years when a combination vaccine containing IPV is used. However, a dose is still recommended on or after age 4 years and at least 6 months after the previous dose.

Catch-up vaccination

- In the first 6 months of life, use minimum ages and intervals only for travel to a polio-endemic region or during an outbreak.
- IPV is not routinely recommended for U.S. residents age 18 years or older.

Series containing oral polio vaccine (OPV), either mixed OPV-IPV or OPV-only series:

- Total number of doses needed to complete the series is the same as that recommended for the U.S. IPV schedule. See www.cdc.gov/mmwr/volumes/66/wr/mm6601a6.htm?s_cid=mm6601a6_w.
- Only trivalent OPV (tOPV) counts toward the U.S. vaccination requirements.
 - Doses of OPV administered before April 1, 2016, should be counted (unless specifically noted as administered during a campaign).
 - Doses of OPV administered on or after April 1, 2016, should not be counted.
 - For guidance to assess doses documented as "OPV," see www.cdc.gov/mmwr/volumes/66/wr/mm6606a7.htm?s_cid=mm6606a7_w.
- For other catch-up guidance, see Table 2.

Rotavirus vaccination

(minimum age: 6 weeks)

Routine vaccination

- **Rotarix**[®]: 2-dose series at age 2 and 4 months
- **RotaTeq**[®]: 3-dose series at age 2, 4, and 6 months
- If any dose in the series is either **RotaTeq**[®] or unknown, default to 3-dose series.

Catch-up vaccination

- Do not start the series on or after age 15 weeks, 0 days.
- The maximum age for the final dose is 8 months, 0 days.
- For other catch-up guidance, see Table 2.

Tetanus, diphtheria, and pertussis (Tdap) vaccination

(minimum age: 11 years for routine vaccination, 7 years for catch-up vaccination)

Routine vaccination

- **Adolescents age 11–12 years:** 1 dose Tdap
- **Pregnancy:** 1 dose Tdap during each pregnancy, preferably in early part of gestational weeks 27–36.
- Tdap may be administered regardless of the interval since the last tetanus- and diphtheria-toxoid-containing vaccine.

Catch-up vaccination

- **Adolescents age 13–18 years who have not received Tdap:** 1 dose Tdap, then Td or Tdap booster every 10 years
- **Persons age 7–18 years not fully vaccinated* with DTaP:** 1 dose Tdap as part of the catch-up series (preferably the first dose); if additional doses are needed, use Td or Tdap.
- **Tdap administered at age 7–10 years:**
 - **Children age 7–9 years** who receive Tdap should receive the routine Tdap dose at age 11–12 years.
 - **Children age 10 years** who receive Tdap do not need the routine Tdap dose at age 11–12 years.
- **DTaP inadvertently administered on or after age 7 years:**
 - **Children age 7–9 years:** DTaP may count as part of catch-up series. Administer routine Tdap dose at age 11–12 years.
 - **Children age 10–18 years:** Count dose of DTaP as the adolescent Tdap booster.
- For other catch-up guidance, see Table 2.

Special situations

- **Wound management** in persons age 7 years or older with history of 3 or more doses of tetanus-toxoid-containing vaccine: For clean and minor wounds, administer Tdap or Td if more than 10 years since last dose of tetanus-toxoid-containing vaccine; for all other wounds, administer Tdap or Td if more than 5 years since last dose of tetanus-toxoid-containing vaccine. Tdap is preferred for persons age 11 years or older who have not previously received Tdap or whose Tdap history is unknown. If a tetanus-toxoid-containing vaccine is indicated for a pregnant adolescent, use Tdap.
- For detailed information, see www.cdc.gov/mmwr/volumes/69/wr/mm6903a5.htm.

**Fully vaccinated* = 5 valid doses of DTaP OR 4 valid doses of DTaP if dose 4 was administered at age 4 years or older

Varicella vaccination

(minimum age: 12 months)

Routine vaccination

- 2-dose series at age 12–15 months, 4–6 years
- VAR or MMRV may be administered*
- Dose 2 may be administered as early as 3 months after dose 1 (a dose inadvertently administered after at least 4 weeks may be counted as valid)

***Note:** For dose 1 in children age 12–47 months, it is recommended to administer MMR and varicella vaccines separately. MMRV may be used if parents or caregivers express a preference.

Catch-up vaccination

- Ensure persons age 7–18 years without evidence of immunity (see *MMWR* at www.cdc.gov/mmwr/pdf/rr/rr5604.pdf) have a 2-dose series:
 - **Age 7–12 years:** routine interval: 3 months (a dose inadvertently administered after at least 4 weeks may be counted as valid)
 - **Age 13 years and older:** routine interval: 4–8 weeks (minimum interval: 4 weeks)
 - The maximum age for use of MMRV is 12 years.

Guide to Contraindications and Precautions to Commonly Used Vaccines

Adapted from Table 4-1 in Advisory Committee on Immunization Practices (ACIP) General Best Practice Guidelines for Immunization: Contraindication and Precautions available at www.cdc.gov/vaccines/hcp/acip-recs/general-recs/contraindications.html and ACIP's Recommendations for the Prevention and Control of 2021-22 seasonal influenza with Vaccines available at www.cdc.gov/mmwr/volumes/70/rr/rr7005a1.htm.

Interim clinical considerations for use of COVID-19 vaccines including contraindications and precautions can be found at www.cdc.gov/vaccines/covid-19/clinical-considerations/covid-19-vaccines-us.html

Vaccine	Contraindications ¹	Precautions ²
Influenza, egg-based, inactivated injectable (IIV4)	<ul style="list-style-type: none"> Severe allergic reaction (e.g., anaphylaxis) after previous dose of any influenza vaccine (i.e., any egg-based IIV, cclIV, RIV, or LAIV of any valency) Severe allergic reaction (e.g., anaphylaxis) to any vaccine component³ (excluding egg) 	<ul style="list-style-type: none"> Guillain-Barré syndrome (GBS) within 6 weeks after a previous dose of any type of influenza vaccine Persons with egg allergy with symptoms other than hives (e.g., angioedema, respiratory distress) or required epinephrine or another emergency medical intervention: Any influenza vaccine appropriate for age and health status may be administered. If using egg-based IIV4, administer in medical setting under supervision of health care provider who can recognize and manage severe allergic reactions. May consult an allergist. Moderate or severe acute illness with or without fever
Influenza, cell culture-based inactivated injectable [(cclIV4), Fluceelvax® Quadrivalent]	<ul style="list-style-type: none"> Severe allergic reaction (e.g., anaphylaxis) to any cclIV of any valency, or to any component³ of cclIV4 	<ul style="list-style-type: none"> Guillain-Barré syndrome (GBS) within 6 weeks after a previous dose of any type of influenza vaccine Persons with a history of severe allergic reaction (e.g., anaphylaxis) after a previous dose of any egg-based IIV, RIV, or LAIV of any valency. If using cclIV4, administer in medical setting under supervision of health care provider who can recognize and manage severe allergic reactions. May consult an allergist. Moderate or severe acute illness with or without fever
Influenza, recombinant injectable [(RIV4), Flublok® Quadrivalent]	<ul style="list-style-type: none"> Severe allergic reaction (e.g., anaphylaxis) to any RIV of any valency, or to any component³ of RIV4 	<ul style="list-style-type: none"> Guillain-Barré syndrome (GBS) within 6 weeks after a previous dose of any type of influenza vaccine Persons with a history of severe allergic reaction (e.g., anaphylaxis) after a previous dose of any egg-based IIV, cclIV, or LAIV of any valency. If using RIV4, administer in medical setting under supervision of health care provider who can recognize and manage severe allergic reactions. May consult an allergist. Moderate or severe acute illness with or without fever
Influenza, live attenuated [LAIV4, Flumist® Quadrivalent]	<ul style="list-style-type: none"> Severe allergic reaction (e.g., anaphylaxis) after previous dose of any influenza vaccine (i.e., any egg-based IIV, cclIV, RIV, or LAIV of any valency) Severe allergic reaction (e.g., anaphylaxis) to any vaccine component³ (excluding egg) Children age 2 – 4 years with a history of asthma or wheezing Anatomic or functional asplenia Immunocompromised due to any cause including, but not limited to, medications and HIV infection Close contacts or caregivers of severely immunosuppressed persons who require a protected environment Pregnancy Cochlear implant Active communication between the cerebrospinal fluid (CSF) and the oropharynx, nasopharynx, nose, ear or any other cranial CSF leak Children and adolescents receiving aspirin or salicylate-containing medications Received influenza antiviral medications oseltamivir or zanamivir within the previous 48 hours, peramivir within the previous 5 days, or baloxavir within the previous 17 days 	<ul style="list-style-type: none"> Guillain-Barré syndrome (GBS) within 6 weeks after a previous dose of any type of influenza vaccine Asthma in persons aged 5 years old or older Persons with egg allergy with symptoms other than hives (e.g., angioedema, respiratory distress) or required epinephrine or another emergency medical intervention: Any influenza vaccine appropriate for age and health status may be administered. If using LAIV4 (which is egg based), administer in medical setting under supervision of health care provider who can recognize and manage severe allergic reactions. May consult an allergist. Persons with underlying medical conditions (other than those listed under contraindications) that might predispose to complications after wild-type influenza virus infection [e.g., chronic pulmonary, cardiovascular (except isolated hypertension), renal, hepatic, neurologic, hematologic, or metabolic disorders (including diabetes mellitus)] Moderate or severe acute illness with or without fever

- When a contraindication is present, a vaccine should NOT be administered. Kroger A, Bahta L, Hunter P. ACIP General Best Practice Guidelines for Immunization. www.cdc.gov/vaccines/hcp/acip-recs/general-recs/contraindications.html
- When a precaution is present, vaccination should generally be deferred but might be indicated if the benefit of protection from the vaccine outweighs the risk for an adverse reaction. Kroger A, Bahta L, Hunter P. ACIP General Best Practice Guidelines for Immunization. www.cdc.gov/vaccines/hcp/acip-recs/general-recs/contraindications.html
- Vaccination providers should check FDA-approved prescribing information for the most complete and updated information, including contraindications, warnings, and precautions. Package inserts for U.S.-licensed vaccines are available at www.fda.gov/vaccines-blood-biologics/approved-products/vaccines-licensed-use-united-states

Vaccine	Contraindications ¹	Precautions ²
Dengue (DEN4CYD)	<ul style="list-style-type: none"> Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component³ Severe immunodeficiency (e.g., hematologic and solid tumors, receipt of chemotherapy, congenital immunodeficiency, long-term immunosuppressive therapy or patients with HIV infection who are severely immunocompromised) 	<ul style="list-style-type: none"> Pregnancy HIV infection without evidence of severe immunosuppression Moderate or severe acute illness with or without fever
Diphtheria, tetanus, pertussis (DTaP) Tetanus, diphtheria (DT)	<ul style="list-style-type: none"> Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component³ For DTaP only: Encephalopathy (e.g., coma, decreased level of consciousness, prolonged seizures) not attributable to another identifiable cause within 7 days of administration of previous dose of DTP or DTaP 	<ul style="list-style-type: none"> Guillain-Barré syndrome (GBS) within 6 weeks after previous dose of tetanus-toxoid-containing vaccine History of Arthus-type hypersensitivity reactions after a previous dose of diphtheria-toxoid—containing or tetanus-toxoid—containing vaccine; defer vaccination until at least 10 years have elapsed since the last tetanus-toxoid-containing vaccine For DTaP only: Progressive neurologic disorder, including infantile spasms, uncontrolled epilepsy, progressive encephalopathy; defer DTaP until neurologic status clarified and stabilized Moderate or severe acute illness with or without fever
<i>Haemophilus influenzae</i> type b (Hib)	<ul style="list-style-type: none"> Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component³ For Hiberix, ActHib, and PedvaxHIB only: History of severe allergic reaction to dry natural latex Less than age 6 weeks 	<ul style="list-style-type: none"> Moderate or severe acute illness with or without fever
Hepatitis A (HepA)	<ul style="list-style-type: none"> Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component³ including neomycin 	<ul style="list-style-type: none"> Moderate or severe acute illness with or without fever
Hepatitis B (HepB)	<ul style="list-style-type: none"> Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component³ including yeast For HepLisav-B only: Pregnancy 	<ul style="list-style-type: none"> Moderate or severe acute illness with or without fever
Hepatitis A- Hepatitis B vaccine [HepA-HepB, (Twinrix®)]	<ul style="list-style-type: none"> Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component³ including neomycin and yeast 	<ul style="list-style-type: none"> Moderate or severe acute illness with or without fever
Human papillomavirus (HPV)	<ul style="list-style-type: none"> Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component³ 	<ul style="list-style-type: none"> Moderate or severe acute illness with or without fever
Measles, mumps, rubella (MMR)	<ul style="list-style-type: none"> Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component³ Severe immunodeficiency (e.g., hematologic and solid tumors, receipt of chemotherapy, congenital immunodeficiency, long-term immunosuppressive therapy or patients with HIV infection who are severely immunocompromised) Pregnancy Family history of altered immunocompetence, unless verified clinically or by laboratory testing as immunocompetent 	<ul style="list-style-type: none"> Recent (≤11 months) receipt of antibody-containing blood product (specific interval depends on product) History of thrombocytopenia or thrombocytopenic purpura Need for tuberculin skin testing or interferon-gamma release assay (IGRA) testing Moderate or severe acute illness with or without fever
Meningococcal ACWY (MenACWY) [MenACWY-CRM (Menveo®); MenACWY-D (Menactra®); MenACWY-TT (MenQuadfi®)]	<ul style="list-style-type: none"> Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component³ For MenACWY-D and Men ACWY-CRM only: severe allergic reaction to any diphtheria toxoid- or CRM197-containing vaccine For MenACWY-TT only: severe allergic reaction to a tetanus toxoid-containing vaccine 	<ul style="list-style-type: none"> For MenACWY-CRM only: Preterm birth if less than age 9 months Moderate or severe acute illness with or without fever
Meningococcal B (MenB) [MenB-4C (Bexsero®); MenB-FHbp (Trumenba®)]	<ul style="list-style-type: none"> Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component³ 	<ul style="list-style-type: none"> Pregnancy For MenB-4C only: Latex sensitivity Moderate or severe acute illness with or without fever
Pneumococcal conjugate (PCV13)	<ul style="list-style-type: none"> Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component³ Severe allergic reaction (e.g., anaphylaxis) to any diphtheria-toxoid-containing vaccine or its component³ 	<ul style="list-style-type: none"> Moderate or severe acute illness with or without fever
Pneumococcal polysaccharide (PPSV23)	<ul style="list-style-type: none"> Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component³ 	<ul style="list-style-type: none"> Moderate or severe acute illness with or without fever
Poliovirus vaccine, inactivated (IPV)	<ul style="list-style-type: none"> Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component³ 	<ul style="list-style-type: none"> Pregnancy Moderate or severe acute illness with or without fever
Rotavirus (RV) [RV1 (Rotarix®), RV5 (RotaTeq®)]	<ul style="list-style-type: none"> Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component³ Severe combined immunodeficiency (SCID) History of intussusception 	<ul style="list-style-type: none"> Altered immunocompetence other than SCID Chronic gastrointestinal disease RV1 only: Spina bifida or bladder exstrophy Moderate or severe acute illness with or without fever
Tetanus, diphtheria, and acellular pertussis (Tdap) Tetanus, diphtheria (Td)	<ul style="list-style-type: none"> Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component³ For Tdap only: Encephalopathy (e.g., coma, decreased level of consciousness, prolonged seizures) not attributable to another identifiable cause within 7 days of administration of previous dose of DTP, DTaP, or Tdap 	<ul style="list-style-type: none"> Guillain-Barré syndrome (GBS) within 6 weeks after a previous dose of tetanus-toxoid-containing vaccine History of Arthus-type hypersensitivity reactions after a previous dose of diphtheria-toxoid—containing or tetanus-toxoid—containing vaccine; defer vaccination until at least 10 years have elapsed since the last tetanus-toxoid-containing vaccine For Tdap only: Progressive or unstable neurological disorder, uncontrolled seizures, or progressive encephalopathy until a treatment regimen has been established and the condition has stabilized Moderate or severe acute illness with or without fever
Varicella (VAR)	<ul style="list-style-type: none"> Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component³ Severe immunodeficiency (e.g., hematologic and solid tumors, receipt of chemotherapy, congenital immunodeficiency, long-term immunosuppressive therapy or patients with HIV infection who are severely immunocompromised) Pregnancy Family history of altered immunocompetence, unless verified clinically or by laboratory testing as immunocompetent 	<ul style="list-style-type: none"> Recent (≤11 months) receipt of antibody-containing blood product (specific interval depends on product) Receipt of specific antiviral drugs (acyclovir, famciclovir, or valacyclovir) 24 hours before vaccination (avoid use of these antiviral drugs for 14 days after vaccination) Use of aspirin or aspirin-containing products Moderate or severe acute illness with or without fever

- When a contraindication is present, a vaccine should NOT be administered. Kroger A, Bahta L, Hunter P. ACIP General Best Practice Guidelines for Immunization. www.cdc.gov/vaccines/hcp/acip-recs/general-recs/contraindications.html
- When a precaution is present, vaccination should generally be deferred but might be indicated if the benefit of protection from the vaccine outweighs the risk for an adverse reaction. Kroger A, Bahta L, Hunter P. ACIP General Best Practice Guidelines for Immunization. www.cdc.gov/vaccines/hcp/acip-recs/general-recs/contraindications.html
- Vaccination providers should check FDA-approved prescribing information for the most complete and updated information, including contraindications, warnings, and precautions. Package inserts for U.S.-licensed vaccines are available at www.fda.gov/vaccines-blood-biologics/approved-products/vaccines-licensed-use-united-states.

COVID-19 Vaccine

Interim COVID-19 Immunization Schedule for 6 Months of Age and Older



The table below provides guidance for COVID-19 vaccination schedules based on age and medical condition. Scheduling considerations include:

- Administer the appropriate vaccine product based on the recipient's age and the product's age indications.
- COVID-19 vaccines may be administered on the same day as other vaccines.
- Doses administered at any time after the intervals outlined below are valid.

Detailed information can be found in CDC's Interim Clinical Considerations for Use of COVID-19 Vaccines Currently Approved or Authorized in the United States, see: www.cdc.gov/vaccines/covid-19/clinical-considerations/covid-19-vaccines-us.html

Table 1. Immunization Schedule for Children 6 Months through 17 Years of Age

Type	Product*	Recipient Age	For Most People		Those Who ARE Moderately or Severely Immunocompromised	
			Doses	Interval Between Doses ^{†‡}	Doses	Interval Between Doses ^{†‡}
mRNA vaccine	Moderna (Blue vial cap with magenta-bordered label)	6 months through 5 years	Total doses: 2 doses		Total doses: 3 doses	
			Dose 1 to 2	At least 4–8 weeks [†]	Dose 1 to 2	At least 4 weeks
					Dose 2 to 3	At least 4 weeks
	Moderna (Blue vial cap with purple-bordered label)	6 through 11 years	Total doses: 2 doses		Total doses: 3 doses	
			Dose 1 to 2	At least 4–8 weeks [†]	Dose 1 to 2	At least 4 weeks
					Dose 2 to 3	At least 4 weeks
	Moderna (Red vial cap with blue-bordered label)	12 through 17 years	Total doses: 2 doses		Total doses: 3 doses	
			Dose 1 to 2	At least 4–8 weeks [†]	Dose 1 to 2	At least 4 weeks
					Dose 2 to 3	At least 4 weeks
	Pfizer-BioNTech (Maroon vial cap with maroon-bordered label)	6 months through 4 years	Total number: 3 doses		Total number: 3 doses	
			Dose 1 to 2	At least 3–8 weeks [†]	Dose 1 to 2	At least 3 weeks
			Doses 2 and 3	At least 8 weeks	Dose 2 to 3	At least 8 weeks
Pfizer-BioNTech (Orange vial cap with orange-bordered label)	5 through 11 years	Total number: 3 doses		Total number: 4 doses		
		Dose 1 to 2	At least 3–8 weeks [†]	Dose 1 to 2	At least 3 weeks	
		Dose 2 to 3	At least 5 months	Dose 2 to 3	At least 4 weeks	
		Dose 3 to 4	At least 3 months			
Pfizer-BioNTech (Purple vial cap with a purple-bordered label or gray vial cap with gray-bordered label)	12 years through 17 years	Total number: 3 doses		Total number: 5 doses		
		Dose 1 to 2	At least 3-8 weeks [†]	Dose 1 to 2	At least 3 weeks	
		Dose 2 to 3	At least 5 months	Dose 2 to 3	At least 4 weeks	
				Dose 3 to 4	At least 3 months	
		Dose 4 to 5	At least 4 months			

* Complete the primary series with same product. If the vaccine product previously administered cannot be determined or is no longer available, any age-appropriate mRNA COVID-19 vaccine product may be administered at least 28 days after the first dose. Any COVID-19 vaccine product (age appropriate) may be administered for a booster dose. It does not need to be the same product used for the primary series.

† Persons with a recent SARS-CoV-2 infection may consider delaying a primary series or booster dose by 3 months from symptom onset or positive test (if infection was asymptomatic).

‡ Some studies in adolescents and adults have shown the small risk of myocarditis associated with mRNA COVID-19 vaccines might be reduced and peak antibody responses and vaccine effectiveness may be increased with an interval longer than 4 weeks. An 8-week interval may be optimal for people who are not moderately or severely immunocompromised and ages 6 months–64 years, especially for males ages 12–39 years.

COVID-19 Vaccine

Interim COVID-19 Immunization Schedule
for 6 Months of Age and Older



Table 2. Immunization Schedule for Persons 18 Years of Age

Type	Product*	Recipient Age	For Most People		Those Who ARE Moderately or Severely Immunocompromised	
			Doses	Interval Between Doses [†]	Doses	Interval Between Doses ^{††}
mRNA vaccine	Moderna (Red vial cap with a blue-bordered label)	18 years and older	Total number: 3 or 4 doses		Total number: 5 doses	
			Dose 1 to 2	At least 4–8 weeks [†]	Dose 1 to 2	At least 4 weeks
			Dose 2 to 3	At least 5 months	Dose 2 to 3	At least 4 weeks
			Dose 3 to 4	At least 4 months for persons ages 50 years and older	Dose 3 to 4	At least 3 months
	Dose 4 to 5	At least 4 months				
	Pfizer-BioNTech (Purple vial cap with a purple-bordered label or gray vial cap with gray-bordered label)	18 years and older	Total number: 3 or 4 doses		Total number: 5 doses	
Dose 1 to 2			At least 3-8 weeks [†]	Dose 1 to 2	At least 3 weeks	
Dose 2 to 3			At least 5 months	Dose 2 to 3	At least 4 weeks	
Dose 3 to 4			At least 4 months for persons ages 50 years and older	Dose 3 to 4	At least 3 months	
	Dose 4 to 5	At least 4 months				
Viral vector vaccine	Janssen [§]	18 years and older	Total number: 2 or 3 doses		Total number: 4 doses	
			Dose 1 to 2	At least 8 weeks	Dose 1 to 2	At least 4 weeks (mRNA vaccine) [¶]
			Dose 2 to 3	At least 4 months for persons ages 50 years and older (mRNA vaccine) ^{**}	Dose 2 to 3	At least 8 weeks [§]
Dose 3 to 4	At least 4 months (mRNA vaccine) [¶]					

* Complete the primary series with same product. If the vaccine product previously administered cannot be determined or is no longer available, any age-appropriate mRNA COVID-19 vaccine product may be administered at least 28 days after the first dose. Any COVID-19 vaccine product (age appropriate) may be administered for a booster dose. It does not need to be the same product used for the primary series. An mRNA COVID-19 vaccine is preferred.

† Persons with a recent SARS-CoV-2 infection may consider delaying a primary series or booster dose by 3 months from symptom onset or positive test (if infection was asymptomatic).

‡ Some studies in adolescents and adults have shown the small risk of myocarditis associated with mRNA COVID-19 vaccines might be reduced and peak antibody responses and vaccine effectiveness may be increased with an interval longer than 4 weeks. An 8-week interval may be optimal for people who are not moderately or severely immunocompromised and ages 6 months–64 years, especially for males ages 12–39 years.

§ Age-appropriate mRNA COVID-19 vaccines are preferred over the Janssen COVID-19 Vaccine for all vaccine doses for all vaccine-eligible people 18 years of age and older. Janssen COVID-19 vaccine should only be used in limited situations. See: www.cdc.gov/vaccines/covid-19/clinical-considerations/covid-19-vaccines-us.html

¶ mRNA vaccine must be used.

** People ages 18–49 years: Those who received Janssen COVID-19 Vaccine as both their primary series dose and booster dose may receive a second booster dose using an mRNA COVID-19 vaccine at least 4 months after the Janssen booster dose.

COVID-19 Vaccine

Interim COVID-19 Immunization Schedule for 6 Months of Age and Older



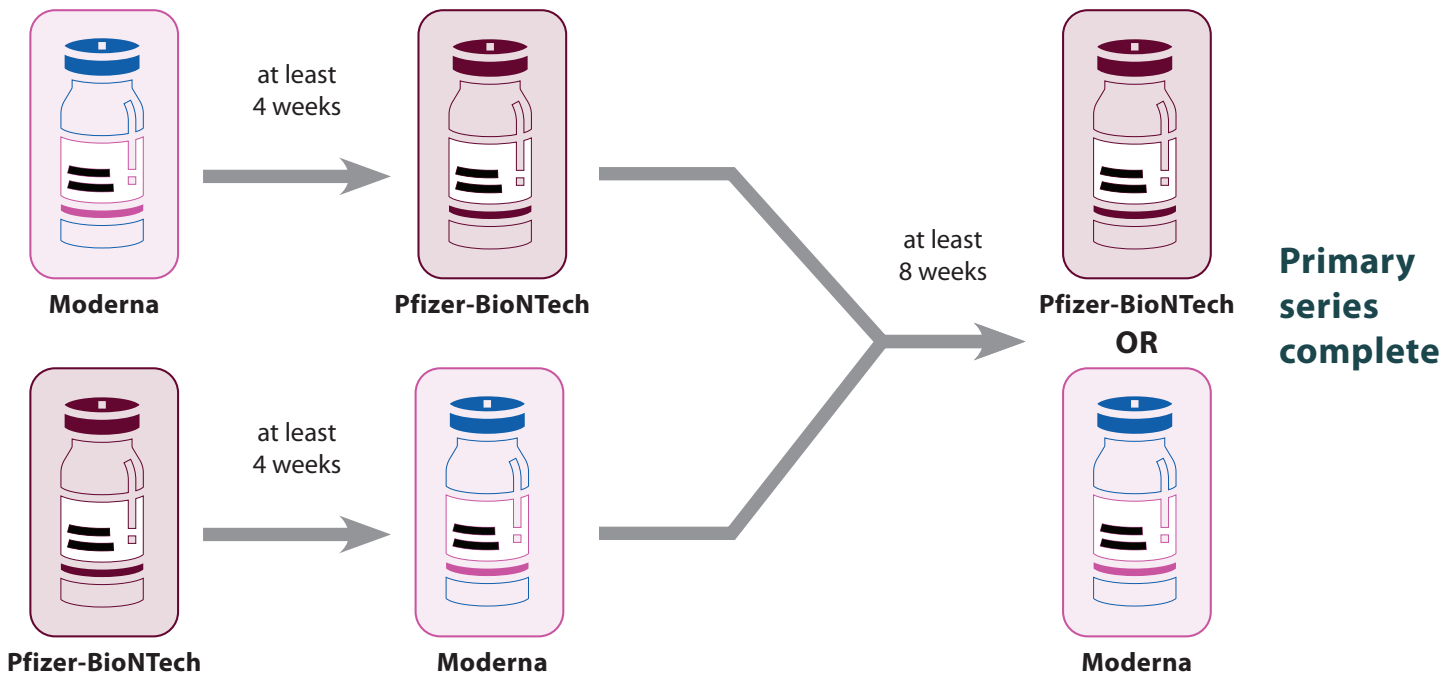
Special Situations When Vaccinating Children

1. Vaccine from Different Manufacturers Given to a Child 6 months through 4 Years of Age: COVID-19 vaccine from the same manufacturer should be used for the primary series. If a different manufacturer is inadvertently administered, follow the guidance below:

- If a dose of the age-appropriate product from BOTH Moderna and Pfizer-BioNTech COVID-19 is inadvertently given, count both doses if the recommended interval between doses has been met.
 - Complete the series following the Pfizer-BioNTech 3-dose schedule using an age-appropriate vaccine from either manufacturer. See examples.
 - Repeating doses is not recommended.
- This guidance applies to:
 - All eligible children, including those who are moderately or severely immunocompromised.
 - Vaccines from both manufacturers, regardless which vaccine was given first.

Examples:

Vaccination history: 1 dose of Pfizer-BioNTech and 1 dose of Moderna COVID-19 vaccines.



2. Children who have a birthday before completing the primary series

- Vaccine product and dosage (amount of vaccine given) is determined by the recipient's age.
- CDC recommends administering the age-appropriate product based on the child's age the day the vaccine will be administered – even if the series was started with a vaccine with younger age indications.
- If a dose(s) of the vaccine product indicated for the younger age group is administered, count the dose(s). Revaccination is not indicated. It is NOT considered a vaccine administration error.
- For detailed guidance see:
 - Pfizer-BioNTech COVID-19 Vaccine: For Children who Transition from a Younger to Older Age Group (www.cdc.gov/vaccines/covid-19/downloads/Pfizer-Child-Age-Transition-508.pdf)
 - Moderna COVID-19 Vaccine: For Children who Transition from a Younger to Older Age Group (www.cdc.gov/vaccines/covid-19/downloads/Moderna-Child-Age-Transition-508.pdf)

COVID-19 Vaccine

Interim COVID-19 Immunization Schedule
for 6 Months of Age and Older



Table 3. COVID-19 Vaccine Products Summary

Product ^{††}	Age Indications ^{‡‡}	Diluent	Dosage (amount injected)	
Type: mRNA vaccine				
Moderna (Blue vial cap with magenta-bordered label)	6 months through 5 years	NONE	Any dose in the primary series. Booster doses are not recommended for this age group.	0.25 mL
Moderna (Blue vial cap with purple-bordered label)	6 through 11 years	NONE	Any dose in the primary series.	0.5 mL
	18 years and older	NONE	Booster dose only.	0.5 mL
Moderna (Red vial cap with blue-bordered label)	12 years and older	NONE	Any dose in the primary series.	0.5 mL
	18 years and older	NONE	Any dose in the primary series.	0.5 mL
			Booster dose	0.25 mL
Pfizer-BioNTech (Maroon vial cap with maroon-bordered label)	6 months through 4 years	2.2 mL 0.9% sodium chloride (normal saline, preservative-free)	Any dose in the primary series. Booster doses are not recommended for this age group.	0.2 mL
Pfizer-BioNTech (Orange vial cap with orange-bordered label)	5 through 11 years	1.3 mL 0.9% sodium chloride (normal saline, preservative-free)	Any dose in the primary series and booster doses.	0.2 mL
Pfizer-BioNTech (Purple vial cap with a purple-bordered label)	12 years and older	1.8 mL 0.9% sodium chloride (normal saline, preservative-free)	Any dose in the primary series and booster doses.	0.3 mL
Pfizer-BioNTech (Gray vial cap with a gray-bordered label)	12 years and older	NONE	Any dose in the primary series and booster doses.	0.3 mL
Product	Age Indications	Diluent	Dosage (amount injected)	
Type: Viral Vector Vaccine				
Janssen^{§§} (Blue Cap)	18 years and older	NONE	Primary and booster dose.	0.5 mL

†† Complete the primary series using the same product. Every effort should be made to determine which vaccine product was received as the first dose. If the vaccine product previously administered cannot be determined or is no longer available, any age-appropriate mRNA COVID-19 vaccine product may be administered at least 28 days after the first dose.

‡‡ Administer the appropriate vaccine product based on the recipient's age and the vaccine product's age indications.

§§ An age-appropriate mRNA COVID-19 vaccine is preferred over the Janssen COVID-19 Vaccine for all vaccine doses for all vaccine-eligible people 18 years of age and older. Janssen COVID-19 vaccine should only be used in limited situations. An mRNA vaccine must be used for the 2nd booster dose. See: www.cdc.gov/vaccines/covid-19/clinical-considerations/covid-19-vaccines-us.html

CDC Resources

CDC COVID-19 vaccine clinical training and materials at: www.cdc.gov/vaccines/covid-19/info-by-product/index.html

CDC Interim Clinical Considerations for the Use of COVID-19 Vaccines Currently Approved or Authorized in the United States at: www.cdc.gov/vaccines/covid-19/clinical-considerations/covid-19-vaccines-us.html#primary-series

CDC Vaccine administration clinical materials at: www.cdc.gov/vaccines/hcp/admin/resource-library.html

CDC Vaccine Storage and Handling Toolkit at: www.cdc.gov/vaccines/hcp/admin/storage/toolkit/index.html

Immunization Case Scenarios

Case I

You are seeing 3 yo Dana for a well child visit. She has never received any vaccine, but after much soul-searching, her parents have agreed to ensure she is up to date. What vaccine would you prescribe today?

When would you schedule the next visit? What would you prescribe at that visit?

Case II

You are seeing 4 yo DeAndre who has sickle cell anemia. He has received DTaP x 4, IPV x 3, MMR, Varivax, and Hib x 3. What vaccines would you prescribe today?

Case III

You are seeing 17 yo Anthony for a college physical. He has received DTaP x 5, IPV x 4, MMR x 2, Hib x 2. What vaccines would you prescribe?

Case IV

You are seeing 22 mo Maggie who was adopted from China. Her translated immunization booklet indicates

that she received DTap x 3, IPV x 3, Hib x 3, HepB x 3, MMR x 1, **BCG x 1**, and varivax x 1. What would you prescribe today?

Board Review Questions:

1. A family comes to your office for consultation regarding a 3-week trip to India they are planning to take in 3 months. The children, a 9-year-old boy and a 7-month-old girl, are well, and their immunizations are up to date.

Of the following, the MOST appropriate prophylaxis to provide in preparation for travel is :

- A. chloroquine for both children
- B. hepatitis A vaccination for both children
- C. measles vaccination for the girl
- D. polio vaccination for the boy
- E. typhoid vaccine for both children

2. A 14-year-old girl presents to your emergency department for evaluation of a 3-week history of progressive episodes of coughing spasms. She reports several episodes of post-tussive vomiting and difficulty sleeping at night. She denies night sweats or weight loss and says she was previously well. She does not take any medications.

Of the following, the MOST important additional information to obtain is a history of:

- A. gastroesophageal reflux disease
- B. international travel over the past year
- C. pet or animal exposures
- D. spelunking trips in the last 6 months
- E. vaccinations received since 11 years of age

3. A 6-month-old boy presents to the emergency department with a 2-day history of fever and a 1-day history of left cheek swelling. You discover that his parents do not believe in providing their children with immunizations. Despite this, the boy has never been ill. He has two older siblings, and nobody is sick at home. The mother denies any recent bug bites or trauma to the area on his cheek. Physical examination reveals a mildly toxic-appearing child who has a temperature of 103.0°F (39.4°C), heart rate of 145 beats/min, respiratory rate of 26 breaths/min, and blood pressure of 80/45 mm Hg. His anterior fontanelle is slightly bulging, his tympanic membranes are erythematous, his left cheek is indurated and appears erythematous to slightly violaceous, and he is irritable.

Of the following, the MOST likely organism to cause this child's illness is:

- A. Haemophilus influenzae type b
- B. Neisseria meningitidis
- C. Staphylococcus aureus
- D. Streptococcus pneumoniae
- E. Streptococcus pyogenes

4. A mother calls you to report that her 7-year-old son came home with a notice from school stating that a child in his class was diagnosed with mumps. The mother does not know the immunization status of the infected child but states that her son has received two measles-mumps-rubella (MMR) vaccines and is up to date on all his other immunizations. Her son has been asymptomatic, with no fever or other systemic complaints.

Of the following, the MOST appropriate action is to:

- A. administer a dose of mumps immune globulin to her son
- B. confirm that her son has received two doses of MMR vaccine
- C. keep her son home from school for 9 days to observe for the development of symptoms
- D. treat her son with a course of ribavirin
- E. vaccinate her son immediately with another dose of MMR to prevent infection from this exposure

5. You are hiring a pediatrician as a hospitalist at a community hospital.

Of the following, the disease for which immune status MUST be documented at the time of employment is:

- A. diphtheria
- B. hepatitis A
- C. measles
- D. meningococcal disease
- E. tetanus