NCC Pediatrics Continuity Clinic Curriculum:
Immunizations
Faculty Guide

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:
  - "Rationale for the Immunization Schedule: Why Is It the Way It Is?" (*Pediatrics in Review, 2019*)
  - Recommended Child and Adolescent Immunization Schedule, 2024 (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)*
- Immunization Coverage *(World Health Organization)*
- "Impact of Routine Childhood Immunization in Reducing Vaccine Preventable Diseases in the United States" *(Pediatrics, 2022)*
- "Strategies for Improving Vaccine Communication and Uptake" *(AAP Clinical Report, 2024)*
- "Contribution of vaccination to improved survival and health: modelling 50 years of the Expanded Programme on Immunization" *(Lancet, 2024)*

Parent Handouts: Immunize.org CHOP Vaccine Refusal Document (AAP)

 Updated 2015 by LT Sebastian Lara, 2016 by LT Jack McDonnell, 2025 by Cassie Carr

Rationale for the Immunization Schedule: Why Is It the Way It Is?

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Education Gaps

1. Clinicians must understand the rationale for the current immunization schedule.
2. Clinicians must understand the basic immunologic responses associated with the various vaccine components.

Objectives

After completing this article, readers should be able to:

1. Understand the basic concepts of vaccination immunology.
2. Provide the rationale for age at first vaccine dose.
3. Provide the rationale for spacing out vaccines at 4 to 8 weeks.
4. Explain the rationale for primary series and booster combination.
5. Explain why vaccinations do not need to be started over again during catch-up.

AUTHOR DISCLOSURE Drs Shetty, Chaudhury, and Sabella have disclosed no financial relationships relevant to this article. This commentary does not contain a discussion of an unapproved/investigative use of a commercial product/device.

ABBREVIATIONS

APC	antigen-presenting cell
BCG	bacille Calmette-Guérin
CDC	Centers for Disease Control and Prevention
DC	dendritic cell
DTaP	diphtheria-tetanus-acellular pertussis
Hep B	hepatitis B
Hib	*Haemophilus influenzae* type b
IPV	inactivated polio vaccine
MMR	measles-mumps-rubella
OPV	oral polio vaccine
PCV13	13-valent pneumococcal conjugate vaccine
PS	polysaccharide
Tfh	follicular T helper cell
VAPP	vaccine-associated paralytic poliomyelitis
WHO	World Health Organization

INTRODUCTION

Vaccines use the knowledge of the immune system to mimic infection, generate immunologic memory, and prepare the body for future infections. An ideal vaccine provides lifelong immunity from disease and protects against multiple strains of the same disease; it is safe, inexpensive, stable, and preferably not administered via injection. (1)

The main objective of the vaccination schedule is to protect individuals from disease by providing immunity before they acquire disease. (2) Long-term immunity is important in determining the effectiveness of the immunization schedule. Along with this, short-term protection, local prevalence and incidence, disease epidemiology, safety, and programmatic aspects (including number of doses, funding, organization, and cost) are important factors in determining the immunization schedule. (3)(4)

Development of vaccine schedules is based on a large body of basic sciences and epidemiologic research. There is constant review of evidence, adverse events, and epidemiology by a panel of experts.

To understand how vaccines provide protection, it is important to understand the essential components that compose the immune system and how the immune system generates a response to perceived pathogens.

OVERVIEW OF THE IMMUNE SYSTEM

The immune system can be classified into innate and adaptive immune systems (Fig 1). The innate immune system is a more primitive form of defense that includes physical, physiological, and cellular barriers. Although the innate immune system is the body's first line of defense and can act quickly, it is nonspecific. In contrast, the adaptive immune system is a sophisticated, highly specific form of defense that is capable of recognizing billions of antigens. (5)

The cellular component of innate immunity predominantly involves cells such as natural killer cells and immature dendritic cells (DCs) that attack and phagocytose foreign antigens and damaged cells of the body. (5) However, recognition of foreign/pathogenic antigens by these cells is limited to common pathogen structures that are readily recognized as non-self or dangerous. (3)(5)(6)(7) This innate response is followed by an adaptive response, with antigen-presenting cells (APCs) forming a critical link between the 2 systems. (7) The APCs specialize in processing and presenting antigens to T cells. The DCs are important examples of APCs. Components that activate APCs and the remainder of the innate immune system are similar. (7)

An immature DC undergoes activation when it encounters an antigen identified as foreign. Activated DCs experience a change in their surface homing receptors, resulting in migration to lymph nodes, where they encounter T and B cells and begin an immune reaction cascade. At this point, the adaptive immune system takes over from the innate immune system. Sometimes, the adaptive immune system can directly act on an antigen without needing an APC to present the antigen. A common example of this is the production of antibodies to polysaccharide (PS) vaccine antigens by B lymphocytes.

The adaptive system response takes more time to develop but lasts longer and produces a more robust immune response to foreign antigens. The adaptive immune system involves a targeted response to foreign antigens via T and B cells, and it interacts with the innate immune system. (3)(8) Immunologic memory (mainly B-cell memory, discussed later herein) allows rapid recognition and production of antibodies to pathogenic antigens when encountered in the future, and prevents disease. (3) This response is the major target of vaccinations. The basic tenet of vaccines is to induce effective, long-lasting immunity by triggering the adaptive immune response.

PROCESS OF GENERATION OF IMMUNITY TO VACCINE ANTIGENS

There are 2 types of responses to vaccine antigens: T-cell–dependent responses and T-cell–independent responses. The vaccine antigen is critical in determining whether the response is T-cell–dependent or T-cell–independent and, therefore, its immunogenicity (Fig 2). If the vaccine antigen is a protein antigen, such as a live attenuated virus or a protein such as hepatitis A vaccine, it will activate both B cells (that produce antibodies) and T cells. This is called a T-cell–dependent response. Polysaccharide vaccines such as 23-valent pneumococcal vaccine antigens directly trigger B cells, resulting in the production of antibodies by B cells

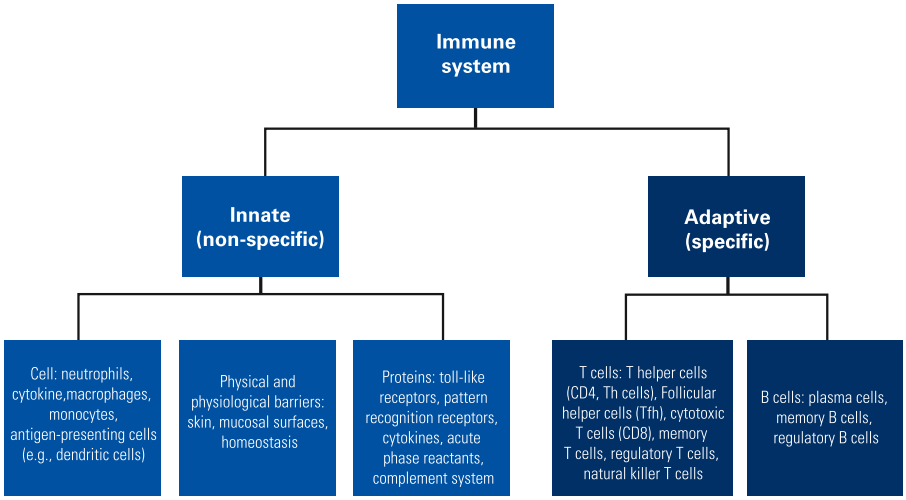


Figure 1. The immune system can be broadly classified into innate and adaptive, and both systems work with much interaction with each other.

without generation of immune memory. This is called a T-cell–independent response because it does not require T cells to mediate its action. Understanding the process of generation of immunity to vaccine antigens is important in understanding the vaccination schedule (Fig 3). T-cell involvement or T-cell–dependent reactions are indispensable for effective immune memory. Immune memory allows the immune system to act rapidly and specifically when the same infection is encountered in the future.

T-CELL–DEPENDENT REACTION

Live vaccines, killed vaccines, proteins, and PS conjugates generate a T-cell–dependent response. The DCs interact with the vaccine antigen when it is first delivered. The DCs are found abundantly in muscle tissue, which is why the intramuscular route is preferred during vaccination. (3) Once in contact with a foreign antigen, DCs exhibit several different receptors on their cell surfaces. These activated DCs travel to the lymph node germinal centers and activate follicular T helper cells (Tfh cells) and B cells. The B cells in the lymph nodes are not naive but have already encountered the antigen while circulating through blood. After their encounter with the antigen, they become antigen-specific and migrate to lymph nodes, where they are then ready to receive further stimuli from Tfh cells.

The Tfh cells induce massive proliferation of B cells. An initial reaction results in the production of antibodies by B

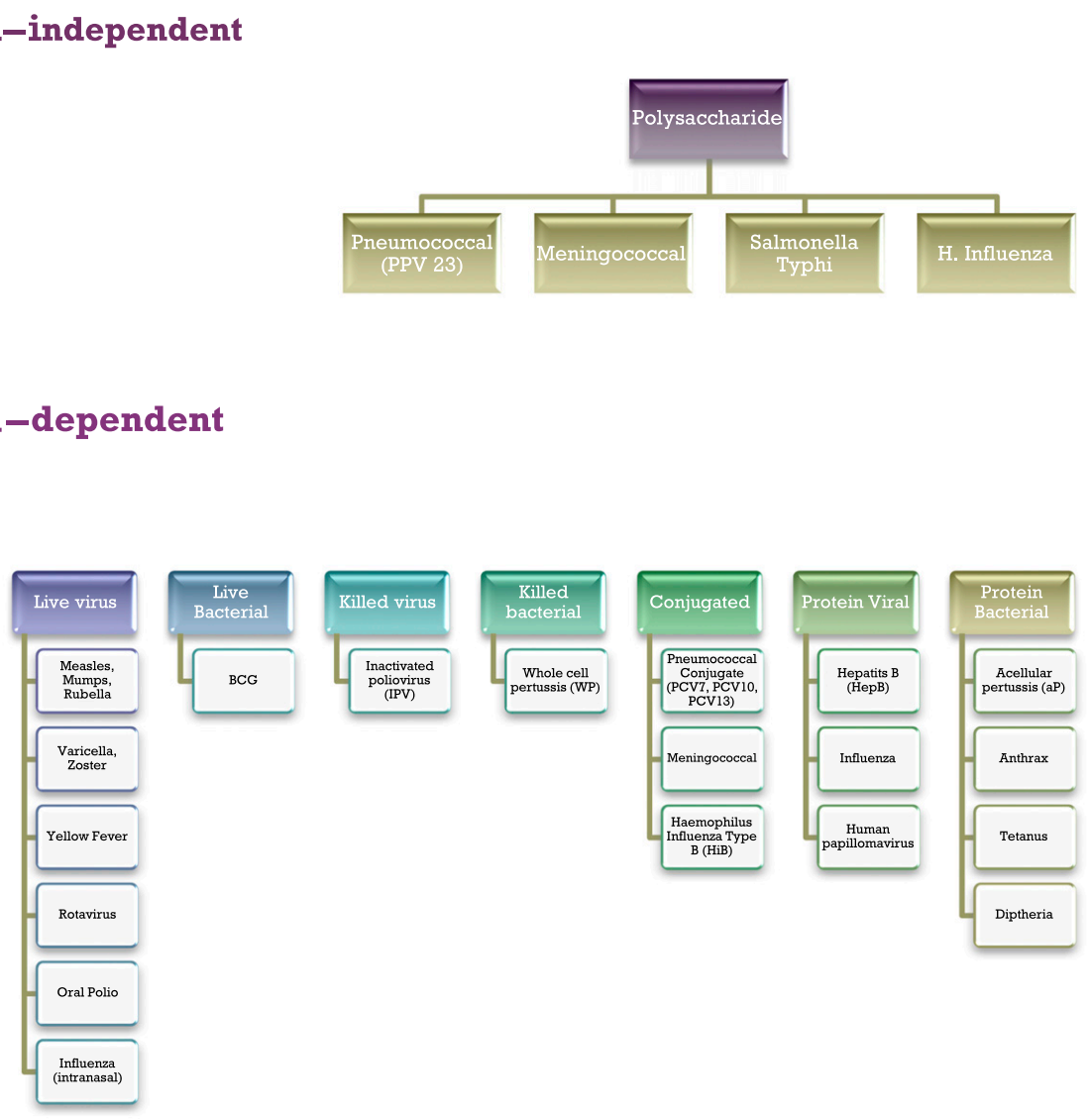


Figure 2. Vaccine antigens trigger either a T-cell–dependent response or a T-cell–independent response. T-cell–dependent responses result in immune memory, the reason why most vaccines today are live, protein, or conjugate vaccines that generate T-cell–dependent responses. Only polysaccharide antigens generate T-cell–independent responses.

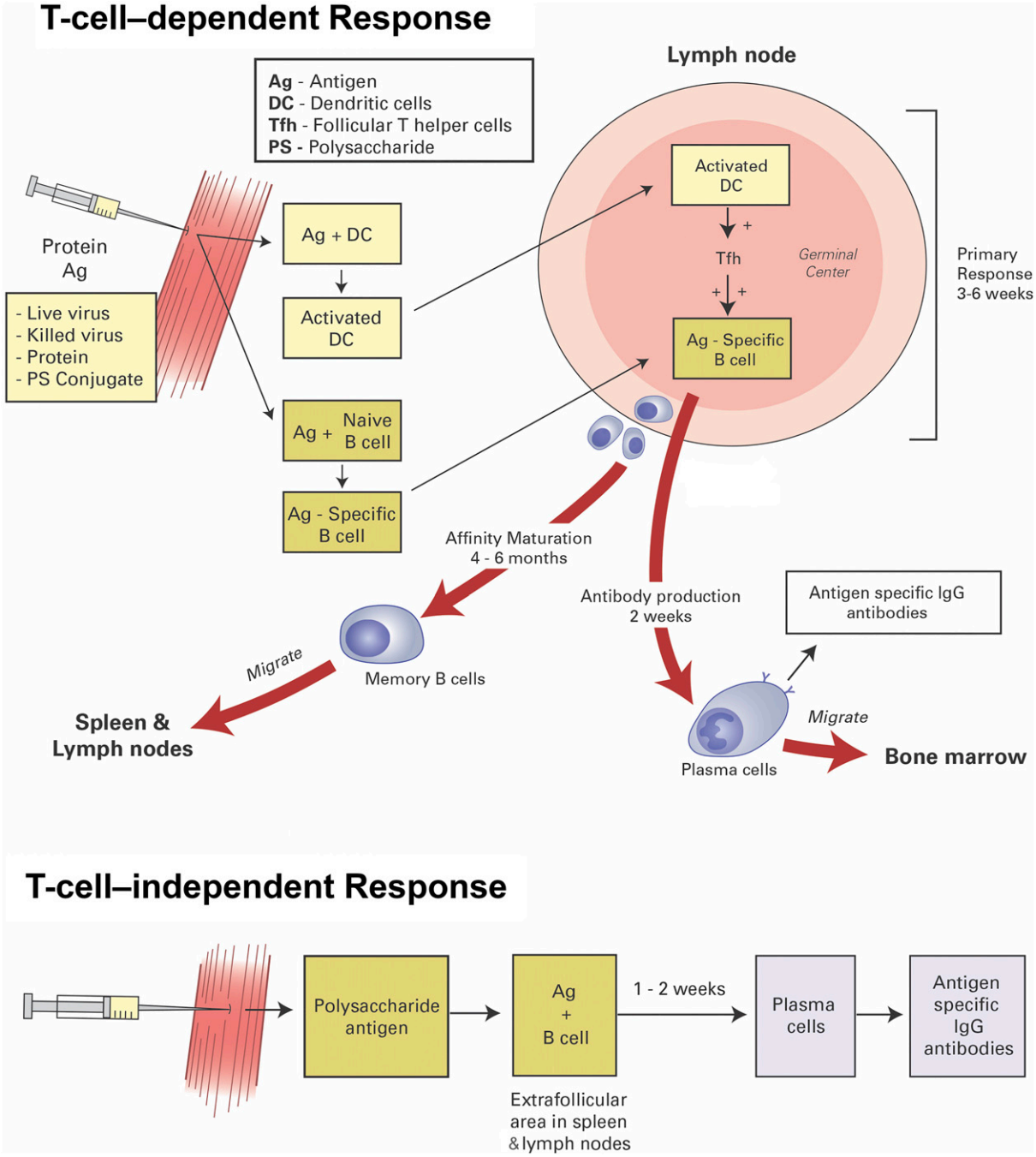


Figure 3. Overview of T-cell–dependent and T-cell–independent responses to vaccine antigen: T-cell–dependent response is triggered by protein antigens (live viruses, surface proteins, etc). The antigen activates dendritic cells and B cells, both of which travel to lymph node germinal centers. Here, activated dendritic cells stimulate follicular T helper cells, which then induce massive proliferation of B cells, which then become either memory B cells or plasma cells that produce antibodies.

cells 2 weeks after the first antigen exposure. (3)(9) A significant portion of these B cells become either plasma cells that produce antigen-specific immunoglobulin G antibodies or memory B cells that will lie dormant until faced with the exact antigen for which they were made. (3)(5)

Antigen exposure and subsequent interactions of B cells, Tfh cells, and DCs in the lymph nodes form the germinal center reaction, which is a critical part of the primary response. It takes approximately 3 to 6 weeks before the primary response self-terminates through feedback mechanisms. Doses in the priming series of vaccines are

separated by a minimum of 4 weeks (usually 8 weeks or 2 months) so that they do not interfere with primary response waves in germinal centers.

After the germinal center reaction, B cells get signals from T cells and become either memory B cells or plasma cells that produce antigen-specific antibodies. The plasma cells then migrate to the bone marrow. Memory B cells take months to develop antigen specificity. For example, memory B cells generated from the measles vaccine will be active only against measles. These memory B cells do not produce antibodies. Instead, they find homes in the spleen and lymph nodes and wait until presented with an antigen, and then rapidly differentiate to plasma cells and produce antibodies specifically targeting that antigen. Over a person's lifetime there may be several billion memory B-cell types created that target specific antigens. (5) The efficient specificity that memory B cells possess results from a process called *affinity maturation* that takes approximately 4 to 6 months to develop. (3)

Memory B-cell production is important, as quantitative levels of antibodies to protein antigens wane over time. The exception to this is antibodies against live viruses; protective titers can be found decades after vaccination. (3) This may be because of the self-propagation of live viruses that results in continued stimulation of the immune system and explains the lifelong immunity to live virus vaccines such as measles vaccine after immunization.

The success of a vaccine depends on its ability to elicit a specific, robust, and long-lasting T-cell–dependent response. Most vaccines in use today are live attenuated viruses such as measles-mumps-rubella (MMR), varicella, rotavirus, and oral polio vaccine (OPV); protein antigens such as diphtheria-tetanus-acellular pertussis (DTaP) and hepatitis B (Hep B); or PS conjugates such as 13-valent pneumococcal conjugate vaccine (PCV13) and *Haemophilus influenzae* type b (Hib).

T-CELL–INDEPENDENT REACTION

Vaccines that use PS antigens elicit T-cell–independent immune responses. Most PS vaccines in use today use a carbohydrate "piece" from the bacterial cell wall. After injection into muscle, the PS antigen finds its way to B cells in the spleen and lymph nodes and triggers differentiation of B cells into plasma cells, which eventually leads to the production of poor-affinity antibodies. This takes approximately 1 week, results in the production of antibodies, is independent of signals from Th cells, and is quick to produce antibodies without generation of immune memory.

Several pure PS vaccines were used in the past. However, because of the poor immune response they generate, most PS vaccines are now conjugated with a protein or a substance that enhances immunogenicity (adjuvant). (3) When a PS is conjugated with a protein or adjuvant, it acts like a protein antigen and generates a T-cell–dependent response. Immunogenicity of pure PS vaccines before age 2 years is poor. (10) The PCV13, a PS conjugate vaccine, is recommended at 2, 4, and 6 months because it generates good immunity before age 2 years. However, the 23-valent pneumococcal PS, a pure PS vaccine against pneumococcus, is given only after 2 years of age. A pure PS vaccine is suitable when rapid induction of immunity is required; for example, a traveler wanting temporary but rapid immunity from *Salmonella typhi* when visiting an endemic region.

RATIONALE FOR THE IMMUNIZATION SCHEDULE

The underlying goal of the immunization schedule is to achieve effective, lasting immunity against diseases. This means inducing lasting immunologic memory and production of persistent antibodies. Although a prerequisite for understanding the rationale for the immunization schedule, learning the immune response to a vaccine antigen is not sufficient by itself. One needs to know local epidemiologic patterns of disease to optimize the timing of priming and booster doses. Programmatic considerations, such as grouping of vaccines, cold chain storage, number of doses, and interference by competing antigens in generating immune responses, all play roles in developing a vaccination schedule.

We will consider dosing regimens of some important vaccines used in the regimen and explain why they are dosed in their current form.

Age at First Dose and the 2-, 4-, 6-month Schedule

Priming doses are required to generate immune memory. These are the initial doses that generate a germinal center reaction and result in production of memory B cells and plasma cells that produce antibodies.

In the United States, priming doses of DTaP, Hib, rotavirus, PCV13, and inactivated polio vaccine (IPV) are all given at 2, 4, and 6 months, although some formulations of Hib and rotavirus are given at 2 and 4 months. Infants younger than 1 year have the greatest risk of mortality from pertussis, and mortality from diphtheria is highest in those younger than 10 years. (11)(12) Similarly, the prevalence of bacterial meningitis before the widespread use of Hib and pneumococcal conjugate vaccines was the highest in the

first year of life. Therefore, protection against these infections throughout the first year of life is essential.

Immunization before 6 weeks of age for most antigens results in a weaker response and poorer immune persistence, mainly because of the immaturity of the immune system. (3)(13) The *magnitude* of an antibody response, ie, antibody titers, is higher with increasing age at first dose. (13) However, the 6-, 10-, 14-week schedule along with the addition of a booster dose generates equivalent immune memory compared with schedules that start at or after 2 months of age and is more appropriate depending on local epidemiology of disease. (14)(15)(16) Thus, the recommended age to give most vaccines is at 2 months in the United States, at 3 months in some European countries, and at 6 weeks where the burden of disease is high. (13)(17)(18) Hepatitis B, bacille Calmette-Guérin (BCG), and OPV are exceptions to this; they are all given at birth and are discussed in more detail later in this article.

A minimum of 3 weeks between primary doses prevents interference of primary waves of immune response. (3) This is because a primary response self-terminates in 3 to 6 weeks. Vaccines are spaced out at 4- to 8-week intervals to avoid competing immune responses between primary waves of germinal center reaction. Several studies have examined different priming schedules (eg, a 3- and 5-month 2-dose schedule, as well as 2-, 4-, 6-month and 2-, 3-, 4-month schedules), and these studies suggest that all schedules generate immune memory. (13)

The longer the interval between doses, and the older the infant, the longer the persistence of response to the vaccine. (3) Closely spaced vaccine doses (1–2 weeks) would give protection sooner, which is useful when rapid induction of immunity is required. (3) But this immune response would not be as long-lasting as when the doses are spaced out at 4 to 8 weeks. Vaccine schedules try to achieve a balance between early protection and best immune response by spacing out vaccines enough to allow immune maturity but early enough to protect before acquisition of disease.

The World Health Organization (WHO) Expanded Program on Immunization schedule recommends beginning diphtheria-tetanus-pertussis whole cell or DTaP vaccine as early as 6 weeks, and providing 3 priming doses at least 4 weeks apart, with the first booster dose between 12 and 23 months. (17) This is used by many developing countries where the incidence and prevalence of diphtheria and pertussis are higher than in industrialized nations. Starting at 6 weeks provides very early immunity, but the immune system is not as mature as it would be if started at 2 months. However, studies have shown that the 6-, 10-, 14-week schedule provides good immune response and that the addition of a booster dose generates equivalent immune memory compared with schedules that start at or after 2 months of age and is more appropriate for local epidemiology of disease. (13)(19)

Regimens in different countries are based on principles of vaccination immunology and differ according to local epidemiology and programmatic preferences (Table 1).

Table 2 lists priming dose regimens for diphtheria-tetanus-pertussis vaccine in various countries. Although this list is not exhaustive, it demonstrates the use of knowledge of vaccination immunology and local epidemiology to develop a vaccine regimen. Note that the doses are separated by a minimum of 4 weeks in all recommended schedules to prevent interference in primary waves of immune response.

Prime-Boost Schedule

As reviewed previously herein, affinity maturation is the process by which memory B cells complete the process of developing antigen specificity. This process takes approximately 4 to 6 months. Antibodies generated in the initial wave of primary response during priming doses eventually wane over a period of months.

Allowing at least a 6-month gap between the last primary dose and the first booster dose allows completion of the affinity maturation process and development of highly specific memory B cells. The longer the gap between the primary and booster doses, the better the immune persistence. (3)

TABLE 1. Factors Influencing the Vaccination Schedule (4)

Vaccination immunology:
• Immune maturity, maternal antibodies, magnitude of immune response, and immune memory are important considerations in determining vaccination schedules
Local epidemiology:
• Ideally, the dose of vaccine should precede the earliest, most susceptible age at acquisition of disease
• High incidence and prevalence generally favors earlier immunization
• Eradication of disease/infection could lead to elimination of use of certain vaccines, eg, small pox vaccine
Programmatic considerations:
• Organization of vaccination drives, educating local practitioners
• Availability of combined vaccines
• Cost (eg, acellular pertussis is more expensive than whole cell pertussis), maintaining cold storage, and heat stability are some important factors influencing the inclusion and timing of vaccines in the schedule

TABLE 2. **Comparison of Diphtheria-Tetanus-Pertussis Priming Dose Regimens**

COUNTRY	PRIMING DOSE REGIMEN
United States	2 mo (8 wk), 4 mos (16 wk), 6 mo (24 wk)
United Kingdom	2 mo (8 weeks), 3 mo (12 wk), 4 months (16 wk) (13)
Italy	3 mo (12 wk), 5–6 mo (20–24 wk) (13)
World Health Organization Expanded Program on Immunization	Begin at 6 wk, 4-wk minimum interval between doses, 3 priming doses in total

A booster dose stimulates immune memory and triggers memory B cells to become plasma cells and generate antibodies. These antibodies persist in the blood for several months, even years, and neutralize antigens produced by pathogenic microbial agents before they have an opportunity to cause disease.

Spreading out vaccine doses for better immune memory needs to be balanced with providing effective protection before an exposed child develops disease. Therefore, local epidemiology must be taken into consideration when determining vaccine timing.

All schedules recommend booster dose administration at least 6 months after the last priming dose. (2)(17) Most schedules space out booster doses further from priming doses because longer intervals between doses result in longer immune memory. For example, in the United States, the DTaP booster is given 9 months after the last priming dose and the Hib booster is given at least 6 months after the last priming dose. (18) The WHO Expanded Program on Immunization schedule also recommends pertussis booster at 1 to 6 years of age, although it states that the booster dose must be separated by at least 6 months. (17) The Centers for Disease Control and Prevention (CDC) also recommends spacing out the booster dose by at least 6 months in the case of delayed immunizations. (18) This is to allow for earlier protection without compromising on immune memory.

In summary, booster doses allow for maintenance of sustained antibody levels and should be given at least 6 months after the last priming dose to allow for affinity maturation.

MMR and Varicella Vaccines

The MMR and varicella vaccines are examples of how giving a live virus vaccine generates longer immunologic memory. Although live virus, killed virus (eg, IPV), protein (eg, tetanus toxoid), and PS conjugate (eg, Hib, PCV13) vaccines all elicit T-cell–dependent responses, generate immunologic memory, and offer effective, long-lasting protection, live vaccines always generate the most powerful immune responses. This is because the amount of antigen exposure results in multiple primary responses all over the body, as well as persistent exposure to the pathogen that generates more powerful antibody responses. Live virus vaccine is also the only type of vaccine that generates a CD8 response, which results in direct killing of infected cells and indirect destruction of cells via cytokines. (3) Live vaccines generate lifelong immunity not only because they generate the T-cell–dependent response that generates immune memory but also because the virus multiplies and persists in the body, thus constantly exposing the host to the antigen and stimulating the immune system. This results in survival of plasma cells in bone marrow for long periods, which generate antibodies for decades. Only live vaccines generate an antibody response that is detectable for decades, even in the absence of subsequent antigen exposure.

The MMR and varicella vaccines are given only after 6 months of age (preferably after 12 months). This is to avoid neutralization by maternal antibodies and a poor immune response from an immature immune system. Presence of maternal antibodies plays an important role in the ability of the MMR vaccine to generate immunogenicity. These antibodies usually disappear between 6 and 9 months of age. They interfere in replication of the live attenuated measles virus, thereby preventing the development of multiple foci of primary reaction. Maternal antibodies to measles significantly reduce immune response and can affect vaccine efficacy. In addition, studies have demonstrated that infants younger than 6 months of age do not mount a good immune response to the MMR vaccine, even in the absence of maternal antibodies. (20)

Multiple studies have shown the effect of maternal antibodies on the efficacy of the MMR vaccine: 98% of children developed protective antibodies to measles if vaccinated after 12 months of age, (20) and almost all children developed protective antibodies to measles with a first vaccine dose at 6 months and a second dose at 12 months or a first dose at 15 to 17 months and a second at 4 to 6 years. (20) A second dose is given to protect the minority of children (~5%) who do not develop protective antibodies with the first dose. A booster dose, therefore, is not required for MMR vaccine in childhood.

The CDC and the American Academy of Pediatrics, therefore, recommend administration of MMR and varicella vaccines at 12 months of age, with a second dose at 4 to 6 years. However, if the child is traveling to a

measles-endemic area, MMR vaccine can be given as early as 6 months of age. In such cases, revaccinating at 12 to 15 months and giving a third dose at least 4 weeks later are required.

Vaccines at Birth

In the United States, only the Hep B vaccine is given at birth. Studies have shown that in children with birthweight of more than 2,000 g, a dose of Hep B at birth with subsequent doses at 1 to 2 months and 6 to 12 months demonstrated an excellent immune response. (21) Before the routine use of Hep B vaccines, 30% to 40% of children with chronic Hep B acquired the disease via perinatal or early childhood transmission. (22) Moreover, almost half of all new mothers who are positive for Hep B surface antigen are not identified. (22) This underscores the need to protect infants and children when they are most vulnerable. Although preterm infants weighing less than 2,000 g do not have good immune responses with a birth dose of Hep B vaccine, all premature infants, irrespective of gestational age or birthweight, are protected with the 3-dose Hep B vaccine series started at 1 month of chronological age. (21) Therefore, the CDC recommends that all infants weighing more than 2,000 g must get the first dose of Hep B within 24 hours of birth and preterm infants weighing less than 2,000 g at birth must get the first dose at 1 month of age. (23)

Vaccines given at birth in other countries include OPV and BCG. The OPV has been shown to generate good gut immunity when given at birth even in the presence of maternal antibodies. (24) It is safe and provides the earliest protection to infants from polio. (24)(25) It is indispensable in areas where poliomyelitis is endemic, such as Nigeria, Afghanistan, and Pakistan, or where there is risk of importation of disease from neighboring countries. (26) However, OPV is associated with rare adverse effects of vaccine-associated paralytic poliomyelitis (VAPP) and vaccine-derived polioviruses. The incidence of VAPP was higher in industrialized countries with the first dose of OPV, most likely due to higher immunogenicity of vaccine antigen compared with low- to middle-income countries. The reason for this is not understood well, but a higher prevalence of maternal antibodies in low-income settings, and competing infections might be contributing factors. (27)(28) Therefore, although OPV has been very effective in eradication of polio, it is not necessary in countries that have already achieved poliomyelitis eradication, have low risk of polio importation and transmission, and continue to have good rates of immunization. The IPV does not cause VAPP. It is recommended that an IPV-only schedule may be considered in such countries, including the United States. (27)

The CDC does not recommend routine BCG vaccine to children born in the United States because the general risk of transmission of tuberculosis is low. (29) The WHO does acknowledge the limited efficacy of BCG in that it does not protect from primary infection or reactivation of latent tuberculosis, a major source of tuberculosis infection in the community. (30) However, BCG vaccine does protect children from miliary tuberculosis and tuberculous meningitis in the first 5 years of life. (25) The BCG vaccine also is safe, which is why it continues to be recommended at birth in regions where risk of tuberculosis transmission remains high. (25) The OPV and BCG vaccines are good examples of how local epidemiology of disease influences timing as well as type of vaccines included in vaccination schedules.

Catch-up Vaccines

It is not recommended that the immunization schedule be started again in patients with delayed immunization. This is due to the generation of immune memory. Although antibody titers wane with time, memory B cells in the spleen and lymph nodes readily recognize the antigen with subsequent exposures to vaccine antigens and produce antibodies. A long time between priming doses induces better immunologic memory. However, because of the long time between doses, children with delayed vaccines are susceptible to serious vaccine-preventable infections. Therefore, the CDC catch-up schedule recommends a minimum of 4 weeks between catch-up doses of vaccines and that the vaccination schedule does not have to be started all over again. (18)

The same CDC catch-up schedule can be applied to children who have no immunizations until a later stage. Because the primary reaction in lymph nodes lasts 3 to 6 weeks, an accelerated schedule with priming doses separated by a minimum of 4 weeks can be used. However, age at the start of vaccines, epidemiology, and national immunization schedule recommendations should be considered when deciding on the optimal vaccine schedule for such children.

VACCINE EXEMPTIONS AND DELAYS

There is strong evidence that skipping vaccine doses increases the risk of acquiring vaccine-preventable diseases such as measles and pertussis. (31)(32) According to the American Academy of Pediatrics, "There is no 'alternative' immunization schedule. Delaying vaccines only leaves a child at risk of disease for a longer period of time; it does not make vaccinating safer." (33) It is best to adhere to

recommended schedules and discourage alternate, unvalidated schedules.

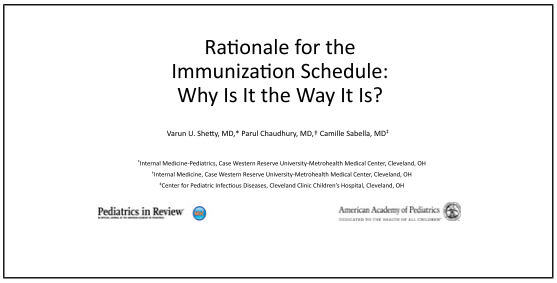
CONCLUSION

Development of vaccine schedules is based on a large body of basic sciences and epidemiologic research. There is constant review of evidence, adverse events, and epidemiology by panels of experts. The immunization schedule is updated accordingly. It is critical that we understand the basis of the vaccination schedule so that we can better educate ourselves and our patients, and use available evidence to best protect them.

Summary

- Based on consensus, the main objective of vaccines is to provide protection against vaccine-preventable diseases by providing effective short- and long-term immunity from disease. (4)
- Based on strong evidence, there are 2 types of responses to vaccine antigens: T-cell–dependent and T-cell–independent responses. The T-cell–dependent response is critical in generating effective immunologic memory. (3)
- Based on strong evidence, T-cell–independent response is triggered by polysaccharide (PS) vaccine antigens. PS antigens trigger B cells to differentiate into plasma cells that produce antigen-specific antibodies that are short-lived. There is no generation of immune memory in this type of response.
- Most vaccines are developed with the goal of triggering a T-cell–dependent response.
- Based on strong evidence, vaccine antigen type is crucial in determining whether the generated response will be T-cell–-dependent or T-cell–-independent. Live virus, protein, and polysaccharide conjugate vaccines all generate T-cell–dependent responses. (3)(5)
- Based on strong evidence, immune response and memory are both better with administering vaccines after 2 months of age. (13)
- Based on strong evidence, vaccines can be started at 6 weeks of age if the risk of contracting disease is high, provided all 3 priming doses and booster doses are appropriately given thereafter. (13)(17)
- Based on strong evidence, immune memory generation allows us to continue vaccine schedules rather than start over in children with delayed vaccinations. (3)
- Based on strong evidence, vaccine exemption increases the risk of acquiring vaccine-preventable diseases. (31)(32)
- The immunization schedule is based on the guiding principles of vaccination immunology, local disease epidemiology, and programmatic needs, which ultimately result in an effective and pragmatic vaccination schedule.

To view teaching slides that accompany this article, visit http://pedsinreview.aappublications.org/content/40/1/26.supplemental.


Rationale for the
Immunization Schedule:
Why Is It the Way It Is?

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Pediatrics in Review

American Academy of Pediatrics

References for this article are at http://pedsinreview.aappublications.org/content/40/1/26.

PIR Quiz

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1. While reviewing your daily schedule you note that a patient is scheduled to return for vaccines just 2 weeks after the previous dose. You ask your nurse to reschedule the patient and explain that the minimum interval between doses of all vaccines is at least 4 weeks. Which of the following best describes the reason a minimum of 4 weeks is required between vaccine doses?
    A. Antigen-presenting cells of the innate immune system require approximately 4 weeks to attack vaccine antigens.
    B. Antigen-presenting cells of the innate immune system require approximately 4 weeks to travel to muscle.
    C. Interference between successive waves of priming responses in the lymph nodes is avoided by minimum spacing of 4 weeks.
    D. Memory B cells need approximately 4 weeks to develop antigen specificity.
    E. Memory B cells need approximately 4 weeks to migrate to the spleen and lymph nodes.
2. A patient is seen in the clinic for a 6-month health supervision visit. After receiving the required immunizations, the clinician provided the mother with anticipatory guidance and instructed her that the baby will be due for a health supervision visit at 9 months of age, at which time he does not need any vaccines. Booster vaccines will be provided at the 12- and 15-month health supervision visits. The nurse informs the clinician that at checkout the mother is inquiring whether the diphtheria-tetanus-acellular pertussis (DTaP) #4 can be given at the 9-month health supervision visit to space out the vaccines. The clinician explains to the nurse that the interval between DTaP #3 and DTaP #4 must be at least 6 months. Which of the following is the most appropriate explanation for the rationale of this recommendation?
    A. A shorter interval between the primary series and booster dose will result in a severe local reaction at the injection site.
    B. A shorter interval between the primary series and booster dose will result in a strong immune reaction.
    C. A shorter interval between the primary series and booster dose will increase immune persistence.
    D. A 6-month interval before the booster dose allows the development of highly specific memory B cells for longer immune memory.
    E. A 6-month interval before the booster dose is necessary to generate the T-cell–independent antibody response.
3. The mother of a 6-month-old boy brings him to the clinic because the family will be traveling internationally next month and will be abroad for 8 weeks. Which of the following is the best plan for immunizing this patient?
    A. Give measles immune globulin now.
    B. Give measles immune globulin 1 week before travel.
    C. Give measles-mumps-rubella (MMR) #1 now and MMR #2 at 4 to 6 years of age.
    D. Give MMR #1 now and MMR #2 at 12 to 15 months of age.
    E. Give MMR #1 now, MMR #2 at 12 to 15 months, and MMR #3 at least 4 weeks later.

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4. While reviewing the records of a new patient from Africa, you note that he received his first dose of oral polio vaccine (OPV) at birth. Which of the following best explains the approach to immunization of newborns?
    A. Newborns in other countries may appropriately receive OPV and/or bacille Calmette-Guérin (BCG) vaccines based on the local epidemiology of disease.
    B. Newborns should not receive any vaccines other than hepatitis B due to the immaturity of their immune system.
    C. Newborns should not receive any vaccines other than hepatitis B due to interference by maternal antibodies.
    D. Newborns should not receive BCG due to risk of dangerous adverse effects.
    E. Newborns should routinely receive hepatitis B vaccine at birth only if the mother is known to be hepatitis B surface antigen positive.
5. A 4-year-old boy has returned to your practice after living in Haiti for several years. His mother reports that he had no medical care during that time. Your records indicate that he received his 2- and 4-month vaccines only before leaving the United States. Which of the following describes the most appropriate approach to further immunization of this child?
    A. Further immunization should be deferred until the next visit to determine whether the parent can obtain documentation of additional vaccines.
    B. Some immunizations should be deferred to avoid overwhelming the immune system with too many antigens.
    C. The vaccine schedule should be restarted because the interruption in the schedule is too long.
    D. The vaccine schedule should be restarted because the priming series is incomplete.
    E. The vaccine schedule should be resumed today, giving all age-appropriate and catch-up vaccines without repeating any previous doses.

Rationale for the Immunization Schedule: Why Is It the Way It Is?

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

UNITED STATES
2025

Vaccines and Other Immunizing Agents in the Child and Adolescent Immunization Schedule*

Monoclonal antibody	Abbreviation(s)	Trade name(s)
Respiratory syncytial virus monoclonal antibody (Nirsevimab)	RSV-mAb	Beyfortus
Vaccine	**Abbreviation(s)**	**Trade name(s)**
COVID-19 vaccine	1vCOV-mRNA	Comirnaty/Pfizer-BioNTech COVID-19 Vaccine
		Spikevax/Moderna COVID-19 Vaccine
	1vCOV-aPS	Novavax COVID-19 Vaccine
Dengue vaccine	DEN4CYD	Dengvaxia
Diphtheria, tetanus, and acellular pertussis vaccine	DTaP	Daptacel Infanrix
Haemophilus influenzae type b vaccine	Hib (PRP-T)	ActHIB Hiberix
	Hib (PRP-OMP)	PedvaxHIB
Hepatitis A vaccine	HepA	Havrix Vaqta
Hepatitis B vaccine	HepB	Engerix-B Recombivax HB
Human papillomavirus vaccine	HPV	Gardasil 9
Influenza vaccine (inactivated: egg-based)	IIV3	Multiple
Influenza vaccine (inactivated: cell-culture)	ccIIV3	Flucelvax
Influenza vaccine (live, attenuated)	LAIV3	FluMist
Measles, mumps, and rubella vaccine	MMR	M-M-R II Priorix
Meningococcal serogroups A, C, W, Y vaccine	MenACWY-CRM	Menveo
	MenACWY-TT	MenQuadfi
Meningococcal serogroup B vaccine	MenB-4C	Bexsero
	MenB-FHbp	Trumenba
Meningococcal serogroup A, B, C, W, Y vaccine	MenACWY-TT/ MenB-FHbp	Penbraya
Mpox vaccine	Mpox	Jynneos
Pneumococcal conjugate vaccine	PCV15 PCV20	Vaxneuvance Prevnar 20
Pneumococcal polysaccharide vaccine	PPSV23	Pneumovax 23
Poliovirus vaccine (inactivated)	IPV	Ipol
Respiratory syncytial virus vaccine	RSV	Abrysvo
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 *Haemophilus influenzae* type b vaccine	DTaP-IPV/Hib	Pentacel
DTaP and inactivated poliovirus vaccine	DTaP-IPV	Kinrix Quadracel
DTaP, inactivated poliovirus, *Haemophilus influenzae* type b, and hepatitis B vaccine	DTaP-IPV-Hib-HepB	Vaxelis
Measles, mumps, rubella, and varicella vaccine	MMRV	ProQuad

*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.

11/21/2024

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)**

6 Review new or updated ACIP guidance **(Addendum)**

Recommended by the Advisory Committee on Immunization Practices (www.cdc.gov/acip/index.html) 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/hcp/imz-schedules/app.html

Helpful information

- Complete Advisory Committee on Immunization Practices (ACIP) recommendations: www.cdc.gov/acip-recs/hcp/vaccine-specific/index.html
- ACIP Shared Clinical Decision-Making Recommendations: www.cdc.gov/acip/vaccine-recommendations/shared-clinical-decision-making.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/surv-manual/php/

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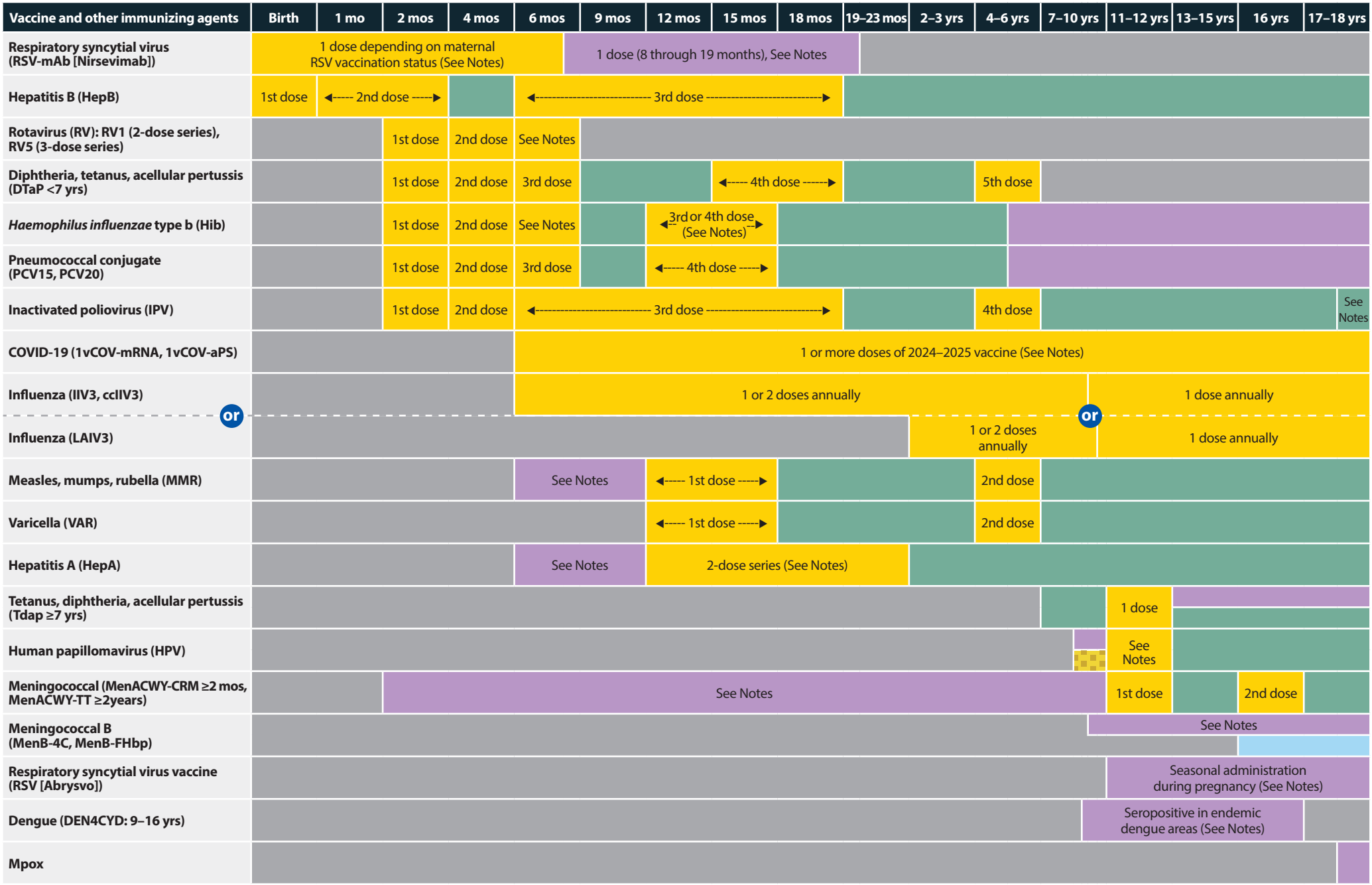
Table 1 Recommended Child and Adolescent Immunization Schedule for Ages 18 Years or Younger, United States, 2025

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).



Range of recommended ages for all children
Range of recommended ages for catch-up vaccination
Range of recommended ages for certain high-risk groups or populations
Recommended vaccination can begin in this age group
Recommended vaccination based on shared clinical decision-making
No Guidance/ 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, 2025

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.**

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
Children age 4 months through 6 years					
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** A fifth dose is not necessary if the fourth dose was administered at age 4 years or older ***and*** at least 6 months after dose 3
Haemophilus influenzae 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 1st 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 1st 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 1st 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 1st birthday **8 weeks (as final dose for healthy children)** if first dose was administered at the 1st 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 is only necessary for children age 12 through 59 months regardless of risk, or age 60 through 71 months with any risk, who received 3 doses before age 12 months.	
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 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 1st birthday **6 months (as final dose)** if first dose of DTaP/DT or Tdap/Td was administered at or after the 1st birthday	**6 months** if first dose of DTaP/DT was administered before the 1st 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, 2025

Always use this table in conjunction with Table 1 and the Notes that follow. Medical conditions are often not mutually exclusive. If multiple conditions are present, refer to guidance in all relevant columns. See Notes for medical conditions not listed.

Vaccine and other immunizing agents	Pregnancy	Immunocompromised (excluding HIV infection)	HIV infection CD4 percentage and count[a]		CSF leak or cochlear implant	Asplenia or persistent complement component deficiencies	Heart disease or chronic lung disease	Kidney failure, End-stage renal disease or on dialysis	Chronic liver disease	Diabetes
			<15% or <200/mm³	≥15% and ≥200/mm³						
RSV-mAb (nirsevimab)		2nd RSV season		1 dose depending on maternal RSV vaccination status (See Notes)			2nd RSV season for chronic lung disease (See Notes)	1 dose depending on maternal RSV vaccination status (See Notes)		
Hepatitis B										
Rotavirus		SCID[b]								
DTaP/Tdap	DTaP Tdap: 1 dose each pregnancy									
Hib		HSCT: 3 doses	See Notes			See Notes				
Pneumococcal										
IPV										
COVID-19		See Notes								
Influenza inactivated		Solid organ transplant: 18yrs (See Notes)								
LAIV3							Asthma, wheezing: 2–4 years[c]			
MMR	*									
VAR	*									
Hepatitis A										
HPV	*	3-dose series (See Notes)								
MenACWY										
MenB										
RSV (Abrysvo)	Seasonal administration (See Notes)									
Dengue										
Mpox	See Notes									

Recommended for all age-eligible children who lack documentation of a complete vaccination series

Not recommended for all children, but recommended for some children based on increased risk for or severe outcomes from disease

Recommended for all age-eligible children, and additional doses may be necessary based on medical condition or other indications. See Notes.

Precaution: Might be indicated if benefit of protection outweighs risk of adverse reaction

Contraindicated or not recommended
*Vaccinate after pregnancy, if indicated

No Guidance/ Not Applicable

a. 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.

b. Severe Combined Immunodeficiency

c. LAIV3 contraindicated for children 2–4 years of age with asthma or wheezing during the preceding 12 months

Notes

For vaccination recommendations for persons ages 19 years or older, see the Recommended Adult Immunization Schedule, 2025.

Additional information

- 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 3-2, 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, Barnett ED, Lynfield Ruth, Sawyer MH, eds. *Red Book: 2021–2024 Report of the Committee on Infectious Diseases*. 32nd ed. Itasca, IL: American Academy of Pediatrics; 2021:72–86).
- 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 vaccines included in the child and adolescent vaccine schedule are covered by VICP except dengue, PPSV23, RSV, Mpox and COVID-19 vaccines. Mpox and COVID-19 vaccines are covered by the Countermeasures Injury Compensation Program (CICP). For more information, see www.hrsa.gov/vaccinecompensation or www.hrsa.gov/cicp.

COVID-19 vaccination

(minimum age: 6 months [Moderna and Pfizer-BioNTech COVID-19 vaccines], 12 years [Novavax COVID-19 Vaccine])

Routine vaccination

Age 6 months–4 years

All vaccine doses should be from the same manufacturer.

- **Unvaccinated:**
  - 2 doses 2024–25 Moderna at 0, 4–8 weeks
  - 3 doses 2024–25 Pfizer-BioNTech at 0, 3–8, and at least 8 weeks after dose 2
- **Incomplete initial vaccination series before 2024–25 vaccine with:**
  - **1 dose Moderna:** complete initial series with 1 dose 2024–25 Moderna 4–8 weeks after most recent dose
  - **1 dose Pfizer-BioNTech:** complete initial series with 2 doses 2024–25 Pfizer-BioNTech 8 weeks apart (administer dose 1 3–8 weeks after most recent dose).
  - **2 doses Pfizer-BioNTech:** complete initial series with 1 dose 2024–25 Pfizer-BioNTech at least 8 weeks after the most recent dose.
- **Completed initial vaccination series before 2024–25 vaccine with:**
  - **2 or more doses Moderna:** 1 dose 2024–25 Moderna at least 8 weeks after the most recent dose.
  - **3 or more doses Pfizer-BioNTech:** 1 dose 2024–25 Pfizer-BioNTech at least 8 weeks after the most recent dose.

Age 5–11 years

- **Unvaccinated:** 1 dose 2024–25 Moderna or Pfizer-BioNTech
- **Previously vaccinated before 2024–25 vaccine with 1 or more doses Moderna or Pfizer-BioNTech:** 1 dose 2024–25 Moderna or Pfizer-BioNTech at least 8 weeks after the most recent dose.

Age 12–18 years

- **Unvaccinated:**
  - 1 dose 2024–25 Moderna or Pfizer-BioNTech
  - 2 doses 2024–25 Novavax at 0, 3–8 weeks
- **Previously vaccinated before 2024–25 vaccine with:**
  - **1 or more doses Moderna or Pfizer-BioNTech:** 1 dose 2024–25 Moderna or Novavax or Pfizer-BioNTech at least 8 weeks after the most recent dose.
  - **1 dose Novavax:** 1 dose 2024–25 Novavax 3–8 weeks after most recent dose. If more than 8 weeks after most recent dose, administer 1 dose 2024–25 Moderna or Novavax or Pfizer-BioNTech.
  - **2 or more doses Novavax:** 1 dose 2024–25 Moderna or Novavax or Pfizer-BioNTech at least 8 weeks after the most recent dose.

Special situation

Persons who are moderately or severely immunocompromised.

Age 6 months–4 years

*Use vaccine from the same manufacturer for all doses **(initial vaccination series and additional doses*)**.*

- **Unvaccinated:**
  - 4 doses (**3-dose initial series 2024–25 Moderna** at 0, 4 weeks, and at least 4 weeks after dose 2, followed by 1 dose 2024–25 Moderna 6 months later [minimum interval 2 months]).May administer additional doses.*
  - 4 doses (**3-dose initial series 2024–25 Pfizer-BioNTech** at 0, 3 weeks, and at least 8 weeks after dose 2, followed by 1 dose 2024–25 Pfizer-BioNTech 6 months later [minimum interval 2 months]). May administer additional doses.*
- **Incomplete initial 3-dose vaccination series before 2024–25 vaccine:**
  - **Previous vaccination with Moderna**
    - **1 dose Moderna:** complete initial series with 2 doses 2024–25 Moderna at least 4 weeks apart (administer dose 1 4 weeks after most recent dose), followed by 1 dose 2024–25 Moderna 6 months later (minimum interval 2 months). May administer additional doses of Moderna.*
    - **2 doses Moderna:** complete initial series with 1 dose 2024–25 Moderna at least 4 weeks after most recent dose, followed by 1 dose 2024–25 Moderna 6 months later (minimum interval 2 months). May administer additional doses of Moderna.*
  - **Previous vaccination with Pfizer-BioNTech**
    - **1 dose Pfizer-BioNTech:** complete initial series with 2 doses 2024–25 Pfizer-BioNTech at least 8 weeks apart (administer dose 1 3 weeks after most recent dose), followed by 1 dose 2024–25 Pfizer-BioNTech 6 months later (minimum interval 2 months). May administer additional doses of Pfizer-BioNTech.*
    - **2 doses Pfizer-BioNTech:** complete initial series with 1 dose 2024–25 Pfizer-BioNTech at least 8 weeks after most recent dose, followed by 1 dose 2024–25 Pfizer-BioNTech 6 months later (minimum interval 2 months). May administer additional doses of Pfizer-BioNTech.*

COVID-19 vaccination - *continued*

- **Completed initial 3-dose vaccination series before 2024–25 vaccine with:**
  - **3 or more doses Moderna:** 2 doses 2024–25 Moderna 6 months apart (minimum interval 2 months). Administer dose 1 at least 8 weeks after the most recent dose. May administer additional doses of Moderna.*
  - **3 or more doses Pfizer-BioNTech:** 2 doses 2024–25 Pfizer-BioNTech 6 months apart (minimum interval 2 months). Administer dose 1 at least 8 weeks after the most recent dose. May administer additional doses of Pfizer-BioNTech.*

Age 5–11 years

Use vaccine from the same manufacturer for all doses in the initial vaccination series.

- **Unvaccinated:**
  - 4 doses (**3-dose initial series 2024–25 Moderna** at 0, 4 weeks, and at least 4 weeks after dose 2, followed by 1 dose 2024–25 Moderna or Pfizer-BioNTech 6 months later [minimum interval 2 months]). May administer additional doses.*
  - 4 doses (**3-dose initial series 2024–25 Pfizer-BioNTech** at 0, 3 weeks, and at least 4 weeks after dose 2, followed by 1 dose 2024–25 Moderna or Pfizer-BioNTech 6 months later [minimum interval 2 months]). May administer additional doses.*
- **Incomplete initial 3-dose vaccination series before 2024–25 vaccine:**
  - **Previous vaccination with Moderna**
    - **1 dose Moderna:** complete initial series with 2 doses 2024–25 Moderna at least 4 weeks apart (administer dose 1 4 weeks after most recent dose), followed by 1 dose 2024–25 Moderna or Pfizer-BioNTech 6 months later (minimum interval 2 months). May administer additional doses of Moderna or Pfizer-BioNTech.*
    - **2 doses Moderna:** complete initial series with 1 dose 2024–25 Moderna at least 4 weeks after most recent dose, followed by 1 dose 2024–25 Moderna or Pfizer-BioNTech 6 months later (minimum interval 2 months). May administer additional doses of Moderna or Pfizer-BioNTech.*
  - **Previous vaccination with Pfizer-BioNTech**
    - **1 dose Pfizer-BioNTech:** complete initial series with 2 doses 2024–25 Pfizer-BioNTech at least 4 weeks apart (administer dose 1 3 weeks after most recent dose), followed by 1 dose 2024–25 Moderna or Pfizer-BioNTech 6 months later (minimum interval 2 months). May administer additional doses of Moderna or Pfizer-BioNTech.*
    - **2 doses Pfizer-BioNTech:** complete initial series with 1 dose 2024–25 Pfizer-BioNTech at least 4 weeks after most recent dose, followed by 1 dose 2024–25 Moderna or Pfizer-BioNTech 6 months later (minimum interval 2 months). May administer additional doses of Moderna or Pfizer-BioNTech.*
- **Completed initial 3-dose vaccination series before 2024–25 vaccine with:**
  - **3 or more doses Moderna or 3 or more doses Pfizer-BioNTech:** 2 doses 2024–25 Moderna or Pfizer-BioNTech 6 months apart (minimum interval 2 months). Administer dose 1 at least 8 weeks after the most recent dose. May administer additional doses of Moderna or Pfizer-BioNTech.*

Age 12–18 years

Use vaccine from the same manufacturer for all doses in the initial vaccination series.

- **Unvaccinated:**
  - 4 doses (**3-dose initial series Moderna** at 0, 4 weeks, and at least 4 weeks after dose 2, followed by 1 dose 2024–25 Moderna or Novavax or Pfizer-BioNTech 6 months later [minimum interval 2 months]). May administer additional doses of Moderna or Novavax or Pfizer-BioNTech.*
  - 4 doses (**3-dose initial series Pfizer-BioNTech** at 0, 3 weeks, and at least 4 weeks after dose 2, followed by 1 dose 2024–25 Moderna or Novavax or Pfizer-BioNTech 6 months later [minimum interval 2 months]). May administer additional doses of Moderna or Novavax or Pfizer-BioNTech.*
  - 3 doses (**2-dose initial series Novavax** at 0, 3 weeks, followed by 1 dose Moderna or Novavax or Pfizer-BioNTech 6 months later [minimum interval 2 months]). May administer additional doses of Moderna or Novavax or Pfizer-BioNTech.*
- **Incomplete initial vaccination series before 2024–25 vaccine:**
  - **Previous vaccination with Moderna**
    - **1 dose Moderna:** complete initial series with 2 doses 2024–25 Moderna at least 4 weeks apart (administer dose 1 4 weeks after most recent dose), followed by 1 dose 2024–25 Moderna or Novavax or Pfizer-BioNTech 6 months later (minimum interval 2 months). May administer additional doses of Moderna or Novavax or Pfizer-BioNTech.*
    - **2 doses Moderna:** complete initial series with 1 dose 2024–25 Moderna at least 4 weeks after most recent dose, followed by 1 dose 2024–25 Moderna or Novavax or Pfizer-BioNTech 6 months later (minimum interval 2 months). May administer additional doses of Moderna or Novavax or Pfizer-BioNTech.*
  - **Previous vaccination with Pfizer-BioNTech**
    - **1 dose Pfizer-BioNTech:** complete initial series with 2 doses 2024–25 Pfizer-BioNTech at least 4 weeks apart (administer dose 1 3 weeks after most recent dose), followed by 1 dose 2024–25 Moderna or Novavax or Pfizer-BioNTech 6 months later (minimum interval 2 months). May administer additional doses of Moderna or Novavax or Pfizer-BioNTech.*
    - **2 doses Pfizer-BioNTech:** complete initial series with 1 dose 2024–25 Pfizer-BioNTech at least 4 weeks after most recent dose, followed by 1 dose 2024–25 Moderna or Novavax or Pfizer-BioNTech 6 months later (minimum interval 2 months). May administer additional doses of Moderna or Novavax or Pfizer-BioNTech.*
  - **Previous vaccination with Novavax**
    - **1 dose Novavax:** complete initial series with 1 dose 2024–25 Novavax at least 3 weeks after most recent dose, followed by 1 dose 2024–25 Moderna or Novavax or Pfizer-BioNTech 6 months later (minimum interval 2 months). May administer additional doses of Moderna or Novavax or Pfizer-BioNTech.*

COVID-19 vaccination - *continued*

- **Completed initial 3-dose vaccination series before 2024–25 vaccine with:**
  - **3 or more doses Moderna or 3 or more doses Pfizer-BioNTech:** 2 doses 2024–25 Moderna or Novavax or Pfizer-BioNTech 6 months apart (minimum interval 2 months). Administer dose 1 at least 8 weeks after the most recent dose. May administer additional doses of Moderna or Novavax or Pfizer-BioNTech.*
  - **2 or more doses Novavax:** 2 doses 2024–25 Moderna or Novavax or Pfizer-BioNTech 6 months apart (minimum interval 2 months). Administer dose 1 at least 8 weeks after the most recent dose. May administer additional doses of Moderna or Novavax or Pfizer-BioNTech.*

***Additional doses of 2024–25 COVID-19 vaccine for moderately or severely immunocompromised:** based on shared clinical decision-making and administered at least 2 months after the most recent dose (see Table 2 at www.cdc.gov/vaccines/covid-19/clinical-considerations/interim-considerations-us.html#table-02.). For description of moderate and severe immunocompromising conditions and treatment, see www.cdc.gov/vaccines/covid-19/clinical-considerations/interim-considerations-us.html#immunocompromising-conditions-treatment.

Unvaccinated persons have never received any COVID-19 vaccine doses. There is no preferential recommendation for the use of one COVID-19 vaccine over another when more than one recommended age-appropriate vaccine is available. Administer an age-appropriate COVID-19 vaccine product for each dose.

For information about transition from age 4 years to age 5 years or age 11 years to age 12 years during COVID-19 vaccination series, see Tables 1 and 2 at www.cdc.gov/vaccines/covid-19/clinical-considerations/interim-considerations-us.html.

For information about interchangeability of COVID-19 vaccines, see www.cdc.gov/vaccines/covid-19/clinical-considerations/interim-considerations-us.html#Interchangeability.

Current COVID-19 schedule and dosage formulation available at www.cdc.gov/covidschedule. For more information on Emergency Use Authorization (EUA) indications for COVID-19 vaccines, see www.fda.gov/emergency-preparedness-and-response/coronavirus-disease-2019-covid-19/covid-19-vaccines.

Dengue vaccination (minimum age: 9 years)

Routine vaccination

- Age 9–16 years living in areas with endemic dengue **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/index.html
- Dengue vaccine should not be administered to children traveling to or visiting endemic dengue areas.

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

Routine vaccination

- 5-dose series (3-dose primary series at age 2, 4, and 6 months, followed by booster doses at ages 15–18 months and 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

- **Children younger than age 7 years with a contraindication specific to the pertussis component of DTaP:** May administer Td for all recommended remaining doses in place of DTaP. Encephalopathy within 7 days of vaccination when not attributable to another identifiable cause is the only contraindication specific to the pertussis component of DTaP. For additional information, see www.cdc.gov/pertussis/hcp/vaccine-recommendations/td-offlabel.html.
- **Wound management in children younger 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)
- **American Indian and Alaska Native infants:** Vaxelis and PedvaxHIB preferred over other Hib vaccines for the primary series.

Catch-up vaccination

- **Dose 1 at age 7–11 months:** Administer dose 2 at least 4 weeks later and dose 3 (final dose) at age12–15 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 age12–59 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:** Catch-up vaccination not required.

For other catch-up guidance, see Table 2. Vaxelis can be used for catch-up vaccination in children younger 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.

Haemophilus influenzae type b vaccination - *continued*

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, or early component complement inhibitor use:**
  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 HepA-HepB (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)

Routine vaccination

- **Mother is HBsAg-negative**
  - 3-dose series at age 0, 1–2, 6–18 months **(use monovalent HepB vaccine for doses administered before age 6 weeks)**
    - Birth weight ≥2,000 grams: 1 dose within 24 hours of birth if medically stable
    - Birth weight <2,000 grams: 1 dose at chronological age 1 month or hospital discharge (whichever is earlier and even if weight is still <2,000 grams)
  - Infants who did not receive a birth dose should begin the series as soon as possible (see Table 2 for minimum intervals).
  - Administration of 4 doses is permitted when a combination vaccine containing HepB is used after the birth dose.
  - **Minimum intervals (see Table 2):** when 4 doses are administered, substitute "dose 4" for "dose 3" in these calculations.
  - **Final (3rd or 4th) dose:** age 6–18 months **(minimum age 24 weeks)**
- **Mother is HBsAg-positive**
  - **Birth dose (monovalent HepB vaccine only):** administer **HepB vaccine** and **hepatitis B immune globulin (HBIG)** in separate limbs within 12 hours of birth, regardless of birth weight.
  - **Birth weight <2000 grams:** administer 3 additional doses of HepB vaccine beginning at age 1 month (total of 4 doses).
  - **Final (3rd or 4th) dose:** administer at age 6 months **(minimum age 24 weeks)**.
  - Test for HBsAg and anti-HBs at age 9–12 months. If HepB series is delayed, test 1–2 months after final dose. Do not test before age 9 months.

Hepatitis B vaccination - *continued*

- **Mother is HBsAg-unknown**

  If other evidence suggestive of maternal hepatitis B infection exists (e.g., presence of HBV DNA, HBeAg-positive, or mother known to have chronic hepatitis B infection), manage infant as if mother is HBsAg-positive.
  - **Birth dose (monovalent HepB vaccine only):**
    - Birth weight ≥2,000 grams: administer **HepB vaccine** within 12 hours of birth. Determine mother's HBsAg status as soon as possible. If mother is determined to be HBsAg-positive, administer **HBIG** as soon as possible (in separate limb), but no later than 7 days of age.
    - Birth weight <2,000 grams: administer **HepB vaccine** and **HBIG** (in separate limbs) within 12 hours of birth. Administer 3 additional doses of **HepB vaccine** beginning at age 1 month (total of 4 doses).
  - **Final (3rd or 4th) dose:** administer at age 6 months **(minimum age 24 weeks)**.
  - If mother is determined to be HBsAg-positive or if status remains unknown, test for HBsAg and anti-HBs at age 9–12 months. If HepB series is delayed, test 1–2 months after final dose. Do not test before age 9 months.

Catch-up vaccination

- Unvaccinated persons should complete a 3-dose series at 0, 1–2, 6 months. See Table 2 for minimum intervals.
- 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 may receive:
  - **Heplisav-B:** 2-dose series at least 4 weeks apart
  - **PreHevbrio*:** 3-dose series at 0, 1, and 6 months
  - **HepA-HepB (Twinrix):** 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).

Special situations

- Revaccination is generally not 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 <10mIU/mL) is recommended for certain populations, including:
  - Infants born to HBsAg-positive mothers
  - Persons who are predialysis or on maintenance dialysis
  - Other immunocompromised persons
  - For detailed revaccination recommendations, see www.cdc.gov/mmwr/volumes/67/rr/rr6701a1.htm.
- **Note:** PreHevbrio is not recommended in pregnancy due to lack of safety data in pregnant women.

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)
- No additional dose recommended when any HPV vaccine series **of any valency** has been completed using 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 [IIV3], 2 years [LAIV3],18 years [recombinant influenza vaccine, RIV3])

Routine vaccination

- Use any influenza vaccine appropriate for age and health status annually:
  - **Age 6 months–8 years** who have received fewer than 2 influenza vaccine doses before July 1, 2024, or whose influenza vaccination history is unknown: 2 doses, separated by at least 4 weeks. Administer dose 2 even if the child turns 9 years between receipt of dose 1 and dose 2.
  - **Age 6 months–8 years** who have received at least 2 influenza vaccine doses before July 1, 2024: 1 dose.
  - **Age 9 years or older:** 1 dose
  - **Age 18 years solid organ transplant recipients receiving immunosuppressive medications:** high-dose inactivated (HD-IIV3) and adjuvanted inactivated (aIIV3) influenza vaccines are acceptable options. No preference over other age-appropriate IIV3 or RIV3.
- For the 2024–25 season, see www.cdc.gov/mmwr/volumes/73/rr/rr7305a1.htm.
- For the 2025–26 season, see the 2025–26 ACIP influenza vaccine recommendations.

Special situations

- **Close contacts (e.g., household contacts) of severely immunosuppressed persons who require a protected environment:** should not receive LAIV3. If LAIV3 is given, they should avoid contact with, or caring for such immunosuppressed persons for 7 days after vaccination.

Note: Persons with an egg allergy can receive any influenza vaccine (egg-based or non-egg based) appropriate for age and health status.

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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.

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.*
  - **Children age 12 months or older:**
    - Unvaccinated: 2-dose series (separated by at least 4 weeks*) before departure
    - Previously received 1 dose: administer dose 2 at least 4 weeks after dose 1*
- In mumps outbreak settings, for information about additional doses of MMR (including 3rd dose of MMR), see www.cdc.gov/mmwr/volumes/67/wr/mm6701a7.htm

***Note:** If MMRV is used, the minimum interval between MMRV doses is 3 months.

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Meningococcal serogroup A,C,W,Y vaccination
(minimum age: 2 months [MenACWY-CRM, Menveo], 2 years [MenACWY-TT, MenQuadfi]), 10 years [MenACWY-TT/MenB-FHbp, Penbraya])

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
- **MenQuadfi**
  - Dose 1 at age 24 months or older: 2-dose series at least 8 weeks apart

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

- **Children younger 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)
- **Children age 2 years or older:** 1 dose Menveo* 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* 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 component 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.

**Menveo has two formulations: lyophilized and liquid. The liquid formulation should not be used before age 10 years. See www.cdc.gov/vaccines/vpd/mening/downloads/menveo-single-vial-presentation.pdf.*

Note: 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.

Children age 10 years or older may receive a single dose of Penbraya as an alternative to separate administration of MenACWY and MenB when both vaccines would be given on the same clinic day (see "Meningococcal serogroup B vaccination" section below for more information).

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

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 or Trumenba (use same brand for all doses):** 2-dose series at least 6 months apart (if dose 2 is administered earlier than 6 months, administer dose 3 at least 4 months after dose 2)

*To optimize rapid protection (e.g., for students starting college in less than 6 months), a 3-dose series (0, 1–2, 6 months) may be administered.

For additional information on shared clinical decision-making for MenB, see www.cdc.gov/vaccines/hcp/admin/downloads/isd-job-aid-scdm-mening-b-shared-clinical-decision-making.pdf

Special situations

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

- **Bexsero or Trumenba (use same brand for all doses including booster doses)** 3-dose series at 0, 1–2, 6 months (if dose 2 was administered at least 6 months after dose 1, dose 3 not needed; if dose 3 is administered earlier than 4 months after dose 2, a 4th dose should be administered at least 4 months after dose 3)

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.

Note: MenB vaccines may be administered simultaneously with MenACWY vaccines if indicated, but at a different anatomic site, if feasible.

Children age 10 years or older may receive a dose of Penbraya (MenACWY–TT/MenB–FHbp) as an alternative to separate administration of MenACWY and MenB when both vaccines would be given on the same clinic day. For age-eligible children not at increased risk, if Penbraya is used for dose 1 MenB, MenB-FHbp (Trumenba) should be administered for dose 2 MenB. For age-eligible children at increased risk of meningococcal disease, Penbraya may be used for additional MenACWY and MenB doses (including booster doses) if both would be given on the same clinic day **and** at least 6 months have elapsed since most recent Penbraya dose.

Mpox vaccination
(minimum age: 18 years [Jynneos])

Special situations

- **Age 18 years and at risk for mpox infection:** complete 2-dose series, 28 days apart.

  Risk factors for mpox infection include:
  - Persons who are gay, bisexual, and other MSM, transgender or nonbinary people who in the past 6 months have had:
    - A new diagnosis of at least 1 sexually transmitted disease
    - More than 1 sex partner
    - Sex at a commercial sex venue
    - Sex in association with a large public event in a geographic area where mpox transmission is occurring
  - Persons who are sexual partners of the persons described above
  - Persons who anticipate experiencing any of the situations described above
- **Pregnancy:** There is currently no ACIP recommendation for Jynneos use in pregnancy due to lack of safety data in pregnant women. Pregnant women with any risk factor described above may receive Jynneos.

For detailed information, see www.cdc.gov/mpox/hcp/vaccine-considerations/vaccination-overview.html

Pneumococcal vaccination
(minimum age: 6 weeks [PCV15], [PCV 20]; 2 years [PPSV23])

Routine vaccination with PCV

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

Catch-up vaccination with PCV

- Healthy children ages 2–4 years with any incomplete* PCV series: 1 dose PCV
- For other catch-up guidance, see Table 2.

Note: For children **without** risk conditions, PCV20 is not indicated if they have received 4 doses of PCV13 or PCV15 or another age appropriate complete PCV series.

Special situations

Children and adolescents with cerebrospinal fluid leak; chronic heart disease; chronic kidney disease (excluding maintenance dialysis and nephrotic syndrome); chronic liver disease; chronic lung disease (including moderate persistent or severe persistent asthma); cochlear implant; or diabetes mellitus:

Age 2–5 years

- Any incomplete* PCV series with:
  - 3 PCV doses: 1 dose PCV (at least 8 weeks after the most recent PCV dose)
  - Less than 3 PCV doses: 2 doses PCV (at least 8 weeks after the most recent dose and administered at least 8 weeks apart)
- Completed recommended PCV series but have not received PPSV23.
  - Previously received at least 1 dose of PCV20: no further PCV or PPSV23 doses needed
  - Not previously received PCV20: administer 1 dose PCV20 or 1 dose PPSV23 administer at least 8 weeks after the most recent PCV dose.

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Pneumococcal vaccination - *continued*

Age 6–18 years

- Not previously received any dose of PCV13, PCV15, or PCV20: administer 1 dose of PCV15 or PCV20. If PCV15 is used and no previous receipt of PPSV23, administer 1 dose of PPSV23 at least 8 weeks after the PCV15 dose.**
- Received PCV before age 6 years but have not received PPSV23
  - Previously received at least 1 dose of PCV20: no further PCV or PPSV23 doses needed
  - Not previously received PCV20: 1 dose PCV20 or 1 dose PPSV23 administer at least 8 weeks after the most recent PCV dose.
- Received PCV13 only at or after age 6 years: administer 1 dose PCV20 or 1 dose PPSV23 at least 8 weeks after the most recent PCV13 dose.
- Received 1 dose PCV13 and 1 dose PPSV23 at or after age 6 years: no further doses of any PCV or PPSV23 indicated.

Children and adolescents on maintenance dialysis, or with immunocompromising conditions such as nephrotic syndrome; congenital or acquired asplenia or splenic dysfunction; congenital or acquired immunodeficiencies; diseases and conditions treated with immunosuppressive drugs or radiation therapy, including malignant neoplasms, leukemias, lymphomas, Hodgkin disease, and solid organ transplant; HIV infection; or sickle cell disease or other hemoglobinopathies:

Age 2–5 years

- Any incomplete* PCV series:
  - 3 PCV doses: 1 dose PCV (at least 8 weeks after the most recent PCV dose)
  - Less than 3 PCV doses: 2 doses PCV (at least 8 weeks after the most recent dose and administered at least 8 weeks apart)
- Completed recommended PCV series but have not received PPSV23
  - Previously received at least 1 dose of PCV20: no further PCV or PPSV23 doses needed
  - Not previously received PCV20: administer 1 dose PCV20 or 1 dose PPSV23 at least 8 weeks after the most recent PCV dose. If PPSV23 is used, administer 1 dose of PCV20 or dose 2 PPSV23 at least 5 years after dose 1 PPSV23.

Age 6–18 years

- Not previously received any dose of PCV13, PCV15, or PCV20: administer 1 dose of PCV15 or 1 dose of PCV20. If PCV15 is used and no previous receipt of PPSV23, administer 1 dose of PPSV23 at least 8 weeks after the PCV15 dose.**
- Received PCV before age 6 years but have not received PPSV23
  - Previously received at least 1 dose of PCV20: no additional dose of PCV or PPSV23
  - Not previously received PCV20: administer 1 dose PCV20 or 1 dose PPSV23 at least 8 weeks after the most recent PCV dose. If PPSV23 is used, administer either PCV20 or dose 2 PPSV23 at least 5 years after dose 1 PPSV23.
- Received PCV13 only at or after age 6 years: administer 1 dose PCV20 or 1 dose PPSV23 at least 8 weeks after the most recent PCV13 dose. If PPSV23 is used, administer 1 dose of PCV20 or dose 2 PPSV23 at least 5 years after dose 1 PPSV23.
- Received 1 dose PCV13 and 1 dose PPSV23 at or after age 6 years: administer 1 dose PCV20 or 1 dose PPSV23 at least 8 weeks after the most recent PCV13 dose and at least 5 years after dose 1 PPSV23.

Pregnancy: no recommendation for PCV or PPSV23 due to limited data. Summary of existing data on pneumococcal vaccination during pregnancy can be found at www.cdc.gov/mmwr/volumes/72/rr/rr7203a1.htm

For guidance on determining which pneumococcal vaccines a patient needs and when, please refer to the mobile app, which can be downloaded here: wcms-wp.cdc.gov/pneumococcal/hcp/vaccine-recommendations/app.html

**Incomplete series* = Not having received all doses in either the recommended series or an age-appropriate catch-up series. See Table 2 in ACIP pneumococcal recommendations at stacks.cdc.gov/view/cdc/133252

***When both PCV15 and PPSV23 are indicated, administer all doses of PCV15 first. PCV15 and PPSV23 should not be administered during the same visit.*

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.
- **Adolescents age 18 years known or suspected to be unvaccinated or incompletely vaccinated:** administer remaining doses (1, 2, or 3 IPV doses) to complete a 3-dose primary series.* Unless there are specific reasons to believe they were not vaccinated, most persons aged 18 years or older born and raised in the United States can assume they were vaccinated against polio as children.

Series containing oral poliovirus 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_%20cid=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.

Special situations

- **Adolescents aged 18 years at increased risk of exposure to poliovirus and completed primary series*:** may administer one lifetime IPV booster

***Note:** Complete primary series consist of at least 3 doses of IPV or trivalent oral poliovirus vaccine (tOPV) in any combination.

For detailed information, see: www.cdc.gov/vaccines/vpd/polio/hcp/recommendations.html

Respiratory syncytial virus immunization
(minimum age: birth [Nirsevimab, RSV-mAb, Beyfortus])

Routine immunization

- **Infants born October – March in most of the continental United States***
  - Mother did not receive RSV vaccine or mother's RSV vaccination status is unknown or mother received RSV vaccine in previous pregnancy: administer 1 dose nirsevimab within 1 week of birth—ideally during the birth hospitalization.
  - Mother received RSV vaccine **less than 14 days** prior to delivery: administer 1 dose nirsevimab within 1 week of birth—ideally during the birth hospitalization.
  - Mother received RSV vaccine **at least 14 days** prior to delivery: nirsevimab not needed but can be considered in rare circumstances at the discretion of healthcare providers (see www.cdc.gov/vaccines/vpd/rsv/hcp/child-faqs.html)
- **Infants born April–September in most of the continental United States***
  - Mother did not receive RSV vaccine or mother's RSV vaccination status is unknown or mother received RSV vaccine in previous pregnancy: administer 1 dose nirsevimab shortly before start of RSV season.*
  - Mother received RSV vaccine **less than 14 days** prior to delivery: administer 1 dose nirsevimab shortly before start of RSV season.*
  - Mother received RSV vaccine **at least 14 days** prior to delivery: nirsevimab not needed but can be considered in rare circumstances at the discretion of healthcare providers (see www.cdc.gov/vaccines/vpd/rsv/hcp/child-faqs.html)

Infants with prolonged birth hospitalization** (e.g., for prematurity) discharged October through March should be immunized shortly before or promptly after discharge.

Special situations

- **Ages 8–19 months with chronic lung disease of prematurity requiring medical support (e.g., chronic corticosteroid therapy, diuretic therapy, or supplemental oxygen) any time during the 6-month period before the start of the second RSV season; severe immunocompromise; cystic fibrosis with either weight for length <10th percentile or manifestation of severe lung disease (e.g., previous hospitalization for pulmonary exacerbation in the first year of life or abnormalities on chest imaging that persist when stable)**:**
  - 1 dose nirsevimab shortly before start of second RSV season*
- **Ages 8–19 months who are American Indian or Alaska Native:** 1 dose nirsevimab shortly before start of second RSV season*
- **Age-eligible and undergoing cardiac surgery with cardiopulmonary bypass**:** 1 additional dose of nirsevimab after surgery. See www.accessdata.fda.gov/drugsatfda_docs/label/2023/761328s000lbl.pdf

***Note:** While the timing of the onset and duration of RSV season may vary, administration of nirsevimab is recommended October through March in most of the continental United States (optimally October through November or within 1 week of birth). Providers in jurisdictions with RSV seasonality that differs from most of the continental United States (e.g., Alaska, jurisdiction with tropical climate) should follow guidance from public health authorities (e.g., CDC, health departments) or regional medical centers on timing of administration based on local RSV seasonality.

****Note:** Nirsevimab can be administered to children who are eligible to receive palivizumab. Children who have received nirsevimab should not receive palivizumab for the same RSV season.

For further guidance, see www.cdc.gov/mmwr/volumes/72/wr/mm7234a4.htm and www.cdc.gov/vaccines/vpd/rsv/hcp/child-faqs.html

Respiratory syncytial virus vaccination
(RSV [Abrysvo])

Routine vaccination

- **Pregnant at 32 weeks 0 days through 36 weeks and 6 days gestation from September through January in most of the continental United States*:** 1 dose Abrysvo. Administer RSV vaccine regardless of previous RSV infection.
  - Either maternal RSV vaccination with Abrysvo or infant immunization with nirsevimab (RSV monoclonal antibody) is recommended to prevent severe respiratory syncytial virus disease in infants.
- **All other pregnant women:** RSV vaccine not recommended
- **Subsequent pregnancies:** additional doses not recommended. No data are available to inform whether additional doses are needed in subsequent pregnancies. Infants born to pregnant women who received RSV vaccine during a previous pregnancy should receive nirsevimab.

***Note:** Providers in jurisdictions with RSV seasonality that differs from most of the continental United States (e.g., Alaska, jurisdictions with tropical climate) should follow guidance from public health authorities (e.g., CDC, health departments) or regional medical centers on timing of administration based on local RSV seasonality.

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.

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Tetanus, diphtheria, and pertussis (Tdap) vaccination (minimum age: 11 years for routine vaccination, 7 years for catch-up vaccination)

Routine vaccination

- **Age 11–12 years:** 1 dose Tdap (adolescent booster)
- **Pregnancy:** 1 dose Tdap during each pregnancy, preferably in early part of gestational weeks 27–36

Note: Tdap may be administered regardless of the interval since the last tetanus- and diphtheria-toxoid-containing vaccine.

Catch-up vaccination

- **Age 13–18 years who have not received Tdap:** 1 dose Tdap (adolescent booster)
- **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:**
  - **Age 7–9 years** who receive Tdap should receive the adolescent Tdap booster dose at age 11–12 years
  - **Age 10 years** who receive Tdap do not need the adolescent Tdap booster dose at age 11–12 years
- **DTaP inadvertently administered on or after age 7 years**:
  - **Age 7–9 years**: DTaP may count as part of catch-up series. Administer adolescent Tdap booster dose at age 11–12 years.
  - **Age 10–18 years**: Count dose of DTaP as the adolescent Tdap booster dose.
- 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.

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Appendix Recommended Child and Adolescent Immunization Schedule for Ages 18 Years or Younger, United States, 2025

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, Prevention and Control of Seasonal Influenza with Vaccines: Recommendations of the Advisory Committee on Immunization Practices—United States, 2024–25 Influenza Season | MMWR (cdc.gov), *and* Contraindications and Precautions for COVID-19 Vaccination

Vaccines and other Immunizing Agents	Contraindicated or Not Recommended[1]	Precautions[2]
COVID-19 mRNA vaccines [Pfizer-BioNTech, Moderna]	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a component of an mRNA COVID-19 vaccine[3]	• Diagnosed non-severe allergy (e.g., urticaria beyond the injection site) to a component of an mRNA COVID-19 vaccine[3]; or non-severe, immediate (onset less than 4 hours) allergic reaction after administration of a previous dose of an mRNA COVID-19 vaccine • Myocarditis or pericarditis within 3 weeks after a dose of any COVID-19 vaccine • Multisystem inflammatory syndrome in children (MIS-C) or multisystem inflammatory syndrome in adults (MIS-A) • Moderate or severe acute illness, with or without fever
COVID-19 protein subunit vaccine [Novavax]	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a component of a Novavax COVID-19 vaccine[3]	• Diagnosed non-severe allergy (e.g., urticaria beyond the injection site) to a component of Novavax COVID-19 vaccine[3]; or non-severe, immediate (onset less than 4 hours) allergic reaction after administration of a previous dose of a Novavax COVID-19 vaccine • Myocarditis or pericarditis within 3 weeks after a dose of any COVID-19 vaccine • Multisystem inflammatory syndrome in children (MIS-C) or multisystem inflammatory syndrome in adults (MIS-A) • Moderate or severe acute illness, with or without fever
Influenza, egg-based, inactivated injectable (IIV3)	• Severe allergic reaction (e.g., anaphylaxis) after previous dose of any influenza vaccine (i.e., any egg-based IIV, ccIIV, RIV, or LAIV of any valency) • Severe allergic reaction (e.g., anaphylaxis) to any vaccine component[4] (excluding egg)	• Guillain-Barré syndrome (GBS) within 6 weeks after a previous dose of any type of influenza vaccine • Moderate or severe acute illness with or without fever
Influenza, cell culture-based inactivated injectable (ccIIV3) [Flucelvax]	• Severe allergic reaction (e.g., anaphylaxis) to any ccIIV of any valency, or to any component[4] of ccIIV3	• 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 ccIIV3, 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 (RIV3) [Flublok]	• Severe allergic reaction (e.g., anaphylaxis) to any RIV of any valency, or to any component[4] of RIV3	• 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, ccIIV, or LAIV of any valency. If using RIV3, 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 (LAIV3) [Flumist]	• Severe allergic reaction (e.g., anaphylaxis) after previous dose of any influenza vaccine (i.e., any egg-based IIV, ccIIV, RIV, or LAIV of any valency) • Severe allergic reaction (e.g., anaphylaxis) to any vaccine component[4] (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	• Guillain-Barré syndrome (GBS) within 6 weeks after a previous dose of any type of influenza vaccine • Asthma in persons age 5 years old or older • 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

1. When a contraindication is present, a vaccine should **NOT** be administered. Kroger A, Bahta L, Hunter P. ACIP General Best Practice Guidelines for Immunization.
2. 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.
3. See package inserts and FDA EUA fact sheets for a full list of vaccine ingredients. mRNA COVID-19 vaccines contain polyethylene glycol (PEG).
4. Vaccination providers should check FDA-approved prescribing information for the most complete and updated information, including contraindications, warnings, and precautions. See Package inserts for U.S.-licensed vaccines.

Appendix Recommended Child and Adolescent Immunization Schedule for Ages 18 Years or Younger, United States, 2025

Vaccines and other Immunizing Agents	Contraindicated or Not Recommended[1]	Precautions[2]
Dengue (DEN4CYD)	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component[3] • 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) • Lack of laboratory confirmation of a previous dengue infection	• Pregnancy • HIV infection without evidence of severe immunosuppression • Moderate or severe acute illness with or without fever
Diphtheria, tetanus, pertussis (DTaP)	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component[3] • 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	• 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
Haemophilus influenzae type b (Hib)	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component[3] • Younger than age 6 weeks	• Moderate or severe acute illness with or without fever
Hepatitis A (HepA)	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component[3] including neomycin	• Moderate or severe acute illness with or without fever
Hepatitis B (HepB)	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component[3] including yeast • Pregnancy: PreHevbrio is not recommended due to lack of safety data in pregnant women. Use other hepatitis B vaccines if HepB is indicated[4]	• Moderate or severe acute illness with or without fever
Hepatitis A-Hepatitis B vaccine (HepA-HepB) [Twinrix]	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component[3] including neomycin and yeast	• Moderate or severe acute illness with or without fever
Human papillomavirus (HPV)	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component[3] • *Pregnancy: HPV vaccination not recommended.*	• Moderate or severe acute illness with or without fever
Measles, mumps, rubella (MMR) Measles, mumps, rubella, and varicella (MMRV)	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component[3] • 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 • For MMRV only: HIV infection of any severity	• 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 • For MMRV only: Personal or family (i.e., sibling or parent) history of seizures of any etiology • If using MMRV, see Varicella/MMRV for additional precautions
Meningococcal ACWY (MenACWY) MenACWY-CRM [Menveo] MenACWY-TT [MenQuadfi]	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component[3] • For 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	• For MenACWY-CRM only: Preterm birth if younger than age 9 months • Moderate or severe acute illness with or without fever
Meningococcal B (MenB) MenB-4C [Bexsero] MenB-FHbp [Trumenba]	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component[3]	• Pregnancy • For MenB-4C only: Latex sensitivity • Moderate or severe acute illness with or without fever
Meningococcal ABCWY (MenACWY-TT/MenB-FHbp) [Penbraya]	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component[3] • Severe allergic reaction to a tetanus toxoid-containing vaccine	• Moderate or severe acute illness, with or without fever
Mpox [Jynneos]	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component[3]	• Moderate or severe acute illness, with or without fever
Pneumococcal conjugate (PCV)	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component[3] • Severe allergic reaction (e.g., anaphylaxis) to any diphtheria-toxoid-containing vaccine or its component[3]	• Moderate or severe acute illness with or without fever
Pneumococcal polysaccharide (PPSV23)	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component[3]	• Moderate or severe acute illness with or without fever
Poliovirus vaccine, inactivated (IPV)	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component[3]	• Pregnancy • Moderate or severe acute illness with or without fever
RSV monoclonal antibody (RSV-mAb)	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component[5]	• Moderate or severe acute illness with or without fever
Respiratory syncytial virus vaccine (RSV)	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component[3]	• Moderate or severe acute illness with or without fever
Rotavirus (RV) RV1 [Rotarix] RV5 [RotaTeq]	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component[3] • Severe combined immunodeficiency (SCID) • History of intussusception	• 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)	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component[3] • 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	• 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) Measles, mumps, rubella, and varicella (MMRV)	• Severe allergic reaction (e.g., anaphylaxis) after a previous dose or to a vaccine component[3] • 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 • For MMRV only: HIV infection of any severity	• 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 • If using MMRV, see MMR/MMRV for additional precautions

1. 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.
2. 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.
3. 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.
4. For information on the pregnancy exposure registry for persons who were inadvertently vaccinated with PreHevbrio while pregnant, please visit www.prehevbrio.com/#safety.
5. Full prescribing information for BEYFORTUS (nirsevimab-alip) www.accessdata.fda.gov/drugsatfda_docs/label/2023/761328s000lbl.pdf.

Addendum Recommended Child and Adolescent Immunization Schedule for Ages 18 Years or Younger, United States, 2025

In addition to the recommendations presented in the previous sections of this immunization schedule, ACIP has approved the following recommendations by majority vote since October 24, 2024. The following recommendations have been adopted by the CDC Director and are now official. Links are provided if these recommendations have been published in *Morbidity and Mortality Weekly Report (MMWR)*.

Vaccines	Recommendations	Effective Date of Recommendation*
No new vaccines or vaccine recommendations to report		

*The effective date is the date when the CDC director adopted the recommendation and when the ACIP recommendation became official.

Vaccines & Immunizations

Catch-up Immunization Schedule for Children and Adolescents (Addendum updated August 7, 2025)

Recommendations for Ages 18 Years or Younger, United States, 2025

Health Care Providers
JULY 2, 2025

PURPOSE

Guide health care providers in determining recommended catch-up schedule for children/adolescents whose vaccination is delayed.

How to use the schedule

Vaccines and Other Immunizing Agents in the Child and Adolescent Immunization Schedule

To make vaccination recommendations, healthcare providers should:

1. Determine recommended vaccine by age (**Table 1 – By Age**)
2. Determine recommended interval for catch-up vaccination (**Table 2 - Catch-up**)
3. Assess need for additional recommended vaccines by medical condition or other indication (**Table 3 – By Medical Indication**)
4. Review vaccine types, frequencies, intervals, and considerations for special situations (**Notes**)
5. Review contraindications and precautions for vaccine types (**Appendix**)
6. Review new or updated ACIP guidance (**Addendum**)

Get email updates

Vaccine Catch-Up Guidance

CDC has developed catch-up guidance job aids to assist healthcare providers in interpreting Table 2 in the child and adolescent immunization schedule.

Download the Schedule

- Print the schedule, color PDF
- Print the schedule, black & white PDF
- Download the mobile app

Children age 4 months through 6 years

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.**

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		

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
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** A fifth dose is not necessary if the fourth dose was administered at age 4 years or older ***and*** at least 6 months after dose 3
Haemophilus influenzae 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 1st 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 1st 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 1st 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 1st birthday **8 weeks (as final dose for healthy children)** if first dose was administered at the 1st 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 is only necessary for children age 12 through 59 months regardless of risk, or age 60 through 71 months with any risk, who received 3 doses before age 12 months.	
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 2 years MenACWY-TT	**8 weeks**	See Notes	See Notes	

Children and adolescents age 7 through 18 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
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 1st birthday **6 months (as final dose)** if first dose of DTaP/DT or Tdap/Td was administered at or after the 1st birthday	**6 months** if first dose of DTaP/DT was administered before the 1st 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	

To make vaccination recommendations, healthcare providers should:

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

Additional Information

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.

Helpful information

- Complete Advisory Committee on Immunization Practices (ACIP) recommendations
- ACIP Shared Clinical Decision-Making Recommendations
- General Best Practice Guidelines for Immunization (including contraindications and precautions)
- Vaccine information statements
- Manual for the Surveillance of Vaccine-Preventable Diseases (including case identification and outbreak response)

SOURCES

CONTENT SOURCE:
National Center for Immunization and Respiratory Diseases

Immunization Case Scenarios

Case I

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

Also: Beyfortus at birth, seasonal

Should Have Received	Can Receive Today
–3 HepB @ birth, 1-2 mo, & 6-18 mo	1 Hep B
–3 RotaTeq@ 2, 4, & 6mo	NONE (don't give >32 wks)
–4 DTaP@ 2, 4, 6mo & 15-18mo	1 DTaP (no 5th dose if 4th >4yr)
–4 Hib@ 2, 4, 6 & 12-15 mo	1 Hib (no 2nd dose if 1st >15mo)
–4 PCV-20 @ 2, 4, 6, & 12-15 mo	1 PCV (no 2nd dose if 1st>24mo)
–3 IPV @ 2, 4, & 6-18 mo	1 IPV (no 4th dose if 3rd >4yr)
–1 MMR @ 12mo	1 MMR
–1 Varicella@ 12mo	1 VZV
–2 HepA @ 12-23mo	1 Hep A

Discussion Points

* Residents can discuss which of the vaccines in the "can receive today" column would be "most important" to receive, since all 8 vaccines probably should not be received at once. This decision may be based on prevalence of disease in community, likely exposures, etc. Also discuss which vaccines are available in combination (Vaxelis MMRV.)

Emphasize the importance of recommending the annual Flu shot and COVID-19 vaccination as well.

* **Combination Vaccine Table**

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

4 weeks. HepB, DTaP, IPV. (MMR and VZV given per usual at 4-6yrs; HepA in 6mo).

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?

Should Have Received	Y/N	Can Receive Today
–3 HepB @ birth, 1-2 mo, & 6-18 mo	0	1 Hep B
–3 RotaTeq@ 2, 4, & 6mo	0	NONE (don't give >32 wks)
–4 DTaP@ 2, 4, 6mo & 15-18mo + *1DTaP (4-6 yr)*	4	1 DTaP
–3 Hib@ 2, 4, & 12-15 mo *if PRP-OMP series*	3	1 Hib? (4th dose only if #1-3 @<12mo)
–4 PCV-13 @2, 4, 6, & 12-18 mo ***+ 1 PPV23 (>2yr)***	0	**1 PCV-13**
–3 IPV @ 2, 4, & 6-18 mo + *1 IPV (4-6yrs)*	3	1 IPV
–1 MMR @ 12mo + *1 MMR (4-6yrs)*	1	1 MMR
–1 Varicella@ 12mo + *1 VZV (4-6yrs)*	1	1 VZV
- Yearly Influenza, 3 COVID-19	0	1 Influenza, COVID-19
–2 HepA @ 12-23mo	0	1 Hep A
- 2 MCV4 @ ≥2yrs	0	**1 MCV4**

Key Points for Sickle Cell Patients:

- In patients 6mo or older, **influenza and COVID vaccine** should be given annually.
- **Prevnar** (PCV13) should be administered as for children without sickle cell disease.
  * For children 24-59 months, *not previously immunized* with PCV7, 13 or PPV23, give TWO doses of PCV13 2 months apart, followed by 1st dose of PPSV23 2 months later, followed by 2nd dose of PPSV23 3-5 years later.
  * For children 5+ yrs *not previously immunized* with PCV7, 13, 20 or PPSV23, give ONE dose of PCV20, followed by 1st dose of PPSV23 2 months later, followed by 2nd dose of PPSV-23 3-5 years later (if <10yrs) or 5 years later (if ≥10 yrs)

- **Meningitis Vaccines**
- **MCV-4:** **Menveo** was approved by the FDA in Aug 2013 for age 2-23mo (previously >2yrs), and is given to at-risk children at 2, 4, 6, and 12 months of age. **Menactra**'s minimum age is 9 months. **MenQuadfi** was licensed in 2020, minimum age of administration is 2 years.
  *For children >2yrs (this patient!) who have not received a complete meningococcal series, administer 2 primary doses of MCV-4 at least 8 weeks apart.
- **Serotype B meningococcal vaccine:** **Trumenba** 2 doses, 6 months apart and **Bexero**, 2 doses, 6 month apart intended for pts ≥10yrs with complement deficiency, asplenia, or amidst an outbreak.

Emphasize the importance of recommending the annual Flu shot and COVID-19 vaccination as well.

Case III

You are seeing a 17 yo Anthony for a college physical. He has received DTaP x 5,

Should Have Received	**Y/N**	**Can Receive Today**
–3 HepB @ birth, 1-2 mo, & 6-18 mo	0	1 Hep B
–3 RotaTeq@ 2, 4, & 6mo	0	NONE (don't give >32 wks)
–5 DTaP@ 2, 4, 6, 15-18mo & 4-6yr + **1Tdap (11-12yr)**	5	**1 Tdap**
–4 Hib@ 2, 4, 6, & 12-15 mo	4	not given beyond 60 months
–4 PCV-13 @ 2, 4, 6, & 12-15 mo	0	not given beyonf 60 months
–4 IPV @ 2, 4, 6-18 mo & 4-6yrs	4	COMPLETE
–2 MMR @ 12mo & 4-6yrs	2	COMPLETE
–2 Varicella@ 12mo & 4-6yrs	0	1 VZV
- Yearly Influenza, 3 COVID-19	0	1 Influenza, COVID-19
–2 HepA @ 12-23mo	0	1 Hep A
- 2 HPV @ 11-12yrs (6 months apart)	0	**1 HPV (will need 2 more doses)**
-1 MCV4 @11-12yrs	0	**1 MCV4 and 1 MenB**

Also: Beyfortus at birth, seasonal

Tdap, HPV, and MCV4 are key immunizations for adolescents. Below are other notes to consider when developing "catch-up schedule" for this patient:

* HepB: Complete 3-shot series (4 weeks, 8 weeks between doses)
* Tdap: Can give booster 5 years after last DTaP
* Varicella: Complete 2-shot series (4 weeks between doses), *if no evidence of immunity*
* Hep A: Complete 2-shot series (6mo between doses)
* HPV: Complete 3-shot series (2mo, 6mo between doses)
* MCV4: 2 doses at least 8 weeks apart
* Men B: Bexsero is 2 doses at least 1 month apart. Trumemba is 2 doses 6 months apart. For high risk patients, 3 doses with one month bbetween doses 1 and 2, and six months between doses 1 and 3.

Emphasize the importance of recommending the annual Flu shot and COVID-19 vaccination as well.

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?

Should Have Received	Y/N	Can Receive Today
–3 HepB @ birth, 1-2 mo, & 6-18 mo	3	"COMPLETED"
-Rotavirus, 2 or three doses	0	NONE (don't give >32 wks)
–4 DTaP@ 2, 4, 6mo & 15-18mo	3	1 DTaP
–3 Hib@ 2, 4, & 12-15 mo	3	1 Hib? (4th dose only if #1-3 @<12mo)
–4 PCV-13 @ 2, 4, 6, & 12-15 mo	0	1 PCV-13
–3 IPV @ 2, 4, & 6-18 mo	3	"COMPLETED"
–1 MMR @ 12mo	0	"COMPLETED"
–1 Varicella@ 12mo	0	"COMPLETED"
–2 HepA @ 12-23mo	0	1 Hep A

From Red Book: Medical Evaluation of Internationally Adopted Children for Infectious Diseases.

- **PPD** or serum quatiferon (this should be done even if the child was immunized with the **BCG vaccine**).
- Evaluate immunization status by **checking antibody titers** for vaccines previously given (eg, diphtheria, tetanus, polio neutralizing titers) **OR repeat immunizations.** *(Exceptions may include children from foster homes in Korea and Guatemala.)*

Testing for **tuberculosis, Hepatitis B, Hepatitis C, and HIV** should be repeated after the child has been home 6 months. (Some children may not respond initially if the incubation period is inadequate or if they are malnourished.)

See CDC website for other options: **https://www.cdc.gov/immigrantrefugeehealth**

"**Written records are more likely to predict protection if the vaccines, dates of administration, intervals between doses, and age at the time of vaccination are comparable to U.S. recommendations.** Although vaccines with inadequate potency have been produced in other countries, the majority of vaccines used worldwide are produced with adequate quality control standards and are potent. . . Health-care providers may use one of multiple approaches if the immunogenicity of vaccines administered to persons outside the United States is in question. Repeating the vaccinations is an acceptable option that usually is safe and prevents the need to obtain and interpret serologic tests. If avoiding unnecessary injections is desired, judicious use of serologic testing might help determine which vaccinations are needed. For some vaccines, the most readily available serologic tests cannot document protection against infection."

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

Protection against infectious diseases is an important issue in preparing children and adults for international travel. Clinicians can obtain specific knowledge of available vaccines and prophylaxis for certain conditions from the American Academy of Pediatrics *2009 Report of the Committee on Infectious Diseases (Red Book®)* and the travelers' health site of the Centers for Disease Control and Prevention. Travel to India involves a potentially increased exposure to malaria, hepatitis A, measles, polio, and *Salmonella typhi*. However, there are other considerations in recommending various preventive measures for travelers.

Measles may be encountered more commonly in many parts of the world, including India. Accordingly, measles vaccine is recommended for 6- to 11-month-old children, and the 7-month-old girl in the vignette should be given a dose of measles vaccine. She still will require two doses of measles-containing vaccine after 1 year of age because the immune response may be suboptimal at her young age. If the 9-year-old boy is up to date on immunizations, he requires no additional measles vaccination.

Although exposure to malaria is a concern on a prolonged trip to India, resistance to chloroquine is a major concern in this region, as it is in all of South and Southeast Asia, sub-Saharan Africa, and tropical areas of South America. Available agents for resistant malaria prophylaxis in infants and children include atovaquone/proguanil and mefloquine. Doxycycline can be used in children older than 8 years of age.

Hepatitis A is a concern, but hepatitis A vaccine is not approved in children younger than 1 year of age. Intramuscular immunoglobulin is recommended for children younger than 1 year of age, as the baby in the vignette, traveling to an endemic area. The boy should receive his first dose of hepatitis A vaccine at least 2 to 4 weeks before departure if he has not been immunized previously, with completion of the two-dose series 6 to 12 months later.

Although polio exposure may be a concern, if both children are up to date in their vaccination series, no additional polio vaccine is indicated. Finally, typhoid vaccine might be indicated for a trip to India that lasts longer than 2 weeks, but neither of the two licensed vaccines is indicated in children younger than 2 years of age.

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**

The progressive paroxysmal cough progressing over 3 weeks accompanied by posttussive vomiting reported by the girl in the vignette is typical for adolescent pertussis. The duration of disease is 6 to 10 weeks, and complications in adolescents and adults may include sleep disturbances, secondary pneumonia, and vomiting. Immunity to pertussis wanes 6 or more years after vaccination, which makes adolescents and adults susceptible after completing the recommended childhood pertussis vaccine series at 4 to 6 years of age.

In recognition of the increased occurrence of pertussis in this age range and with the demonstrated safety and efficacy of attenuated acellular pertussis booster vaccines (ie, tetanus toxoid, reduced diphtheria toxoid, acellular pertussis [Tdap]), the Advisory Committee on Immunization Practices of the Centers for Disease Control and Prevention recommended in 2005 that a single dose of Tdap be administered at the routine 11- to 12-year-old health supervision visit. A single dose of Tdap also should be administered more than 5 years after the last tetanus toxoid, reduced diphtheria toxoid (Td) dose for individuals up to 64 years of age. In high-risk situations, the dose can be administered as soon as 2 years after the last Td vaccination. Accordingly, determining whether the girl in the vignette has received a dose of Tdap since 11 years of age would help confirm the suspicion of pertussis.

The most common signs and symptoms of gastroesophageal reflux are heartburn, regurgitation, and dysphagia, not primarily coughing spasms. A history of international travel might help support concerns of exposure to tuberculosis. In addition, such travel might increase the individual's exposure to other respiratory agents such as influenza (based on seasonality and hemisphere) and other vaccine-preventable diseases such as pertussis, but supporting the diagnosis of pertussis would be better aided by knowing the history of Tdap immunization. A number of respiratory infections can be transmitted to people from pets or animals (eg, Q fever, Bordetella bronchiseptica), but these infections are much less common than pertussis and are not as consistent with the clinical illness described. Spelunking (or caving) in areas of the eastern and central United States may increase the risk for exposure to histoplasmosis from bird or bat droppings in the caves. Clinically, histoplasmosis in the healthy host usually is asymptomatic. Acute pulmonary histoplasmosis presents with more of an influenza-like illness that resolves over 2 days to 2 weeks.

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*

Children who have not received the *Haemophilus influenzae* type b (Hib) vaccine are at risk for illnesses commonly caused by this organism, including buccal and periorbital cellulitis (as described for the boy in the vignette), pyogenic arthritis, epiglottitis, and bacterial meningitis. *Neisseria meningitidis* usually does not cause a facial cellulitis, and *Staphylococcus aureus* and *Streptococcus pyogenes* are less likely pathogens in the absence of a history of a break in the skin. *S pneumoniae* can be the cause of a nontraumatic facial cellulitis in Hib-vaccinated children, but in an unvaccinated child, Hib would be the most likely pathogen.

Hib disease can be verified by recovery of the organism from a sterile site (eg, blood, cerebrospinal fluid, joint fluid) or by urine antigen testing. Once the organism is isolated, antimicrobial susceptibility testing is important because approximately 30% to 40% of Hib isolates produce beta-lactamase, making these organisms resistant to ampicillin.

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

In the United States, mumps vaccine is administered as part of the measles-mumps-rubella (MMR) vaccine routinely to children at 12 to 15 months of age, with a second dose of MMR typically administered at 4 to 6 years of age. Protective efficacy of the vaccine is estimated to be more than 95%. In cases of exposure, such as described in the vignette, it is important to ensure that the exposed person has received the recommended number of doses of MMR vaccine because mumps outbreaks have occurred in people in highly immunized populations who previously have received only a single dose of mumps-containing vaccine. Therefore, the most appropriate action is to confirm with the mother that her son has received two doses of MMR vaccine.

Mumps vaccine has not been demonstrated to be effective in preventing infection after exposure. However, the vaccine can be administered after exposure to provide protection against subsequent exposures in persons who are not fully vaccinated. Fully immunized persons do not need to be excluded from school after exposure. Students who are not fully immunized are excluded from school until they are immunized, after which they can be readmitted immediately to school. Students who refuse mumps vaccination because of medical, religious, or other reasons should be excluded from school for at least 26 days after the onset of parotitis in the last person who has mumps in the affected school. Persons who have mumps are excluded from school for 9 days from the onset of their parotid swelling.

Immune globulin (IG) and mumps IG are not effective as postexposure prophylaxis measures. In fact, mumps IG no longer is available in the United States. Treatment of the disease is supportive; no effective antiviral agents are available.

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

Health-care personnel are in contact with patients who may have contagious, vaccine-preventable diseases and are at increased risk for contracting such diseases. Further, the employee who becomes infected is at risk for transmitting the disease to other patients who are susceptible to the disease. Therefore, all health-care personnel should protect themselves and susceptible patients by receiving appropriate immunizations. The vaccine-preventable infections that are of special concern to people involved in the health care of children include rubella, measles, mumps, hepatitis B, influenza, varicella, and tuberculosis. The immune status of the health-care worker against these diseases should be documented at the time of employment.

Persons found to be susceptible should receive the appropriate vaccine or vaccine series for the disease to which they are susceptible. Diphtheria, hepatitis A, meningococcal disease, and tetanus are not commonly transmitted by patients in a health-care setting and do not require documentation of immune status.