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THE IMPORTANCE OF IMMUNIZATIONS IN SCHOOL-AGED CHILDREN

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Abstract

This paper identifies in detail the importance of vaccinations, focusing primarily on the category of school-aged children. All 12 vaccines are discussed individually, recognizing the disease/diseases they are protecting against, benefits of the vaccine, how and to whom the vaccine is administered, contraindications for the immunization, and risks associated with each vaccination. The information used in this project is from a combination of scholarly peer-reviewed journal articles, medical texts, and information from the Centers for Disease Control and Prevention (CDC). It addresses all regulated childhood vaccinations including hepatitis B (Hep B); haemophilus influenzae type b (Hib); diphtheria, tetanus, and pertussis (DTaP/Tdap); inactivated polio vaccine (IPV); pneumococcal conjugate vaccine (PCV13); rotavirus; measles, mumps, and rubella (MMR); varicella; hepatitis A (Hep A); meningococcal (MenACWY); influenza (Flu); and the human papillomavirus vaccine (HPV).
The Importance of Immunizations in School-Aged Children

To vaccinate, or not to vaccinate... that is the question. In regards to vaccinations, there is a variety of opinionated information circulating in the media nowadays. While some parents and caregivers opt-in for their children to receive vaccines without question, there are still those who are anti-immunizations. Regardless of stance on the matter, it is important that parents and caregivers of school-aged children are informed and understand how critical vaccinations can be to not only their children, but to others around them as well.

Immunizations protect people from a variety of devastating and sometimes even deadly disease processes. They are typically administered intramuscularly, orally, and/or intranasally. The Center for Disease Control and Prevention (CDC) states “vaccines help develop immunity by imitating an infection, but this ‘imitation’ infection does not cause illness. Instead it causes the immune system to develop the same response as it does to a real infection so the body can recognize and fight the vaccine-preventable disease in the future” (para. 4). Vaccines not only protect the individual receiving the immunization, but since vaccinated people will be less likely to contract the disease, those around them that are too young to receive the vaccines will be at a decreased chance of falling ill from that disease as well.

According to Stern and Markel (2005), the first vaccine was developed in the 1790s, dating the history of immunizations back approximately two centuries. Since the discovery of the first vaccine, several others have been developed and implemented as routine health practices for people of all ages. When focusing on school-aged children, the CDC (2018) states “Vaccination is one of the best ways parents can protect infants, children, and teens from 16
potentially harmful diseases that can be very serious, may require hospitalization, or even be deadly” (para. 1). The 16 diseases that the CDC is referring to are hepatitis B, haemophilus influenzae type b, diphtheria, tetanus, pertussis, polio, pneumococcal disease, rotavirus, measles, mumps, rubella, varicella (chickenpox), hepatitis A, meningococcal disease, influenza, and the human papillomavirus. The vaccinations for these 16 diseases are most commonly divided into twelve individual immunizations, sometimes combining more than one vaccination into one injection. It is imperative for parents and caregivers to know the disease which the vaccine is protecting against, benefits of the vaccine, how and to whom the vaccine is administered, contraindications for the immunization, and risks associated.

**Hepatitis B Vaccine**

**The Disease**

Hepatitis B is an infection of the liver that is directly related to the inflammation of the hepatocytes, also known as the liver cells (Branco, Oliveira, Silva, Santos, & Guimarães, 2017). A diagnosis of hepatitis B can be described as acute (lasting less than 6 months) or chronic in nature (lasting greater than 6 months). The CDC (2015) describes the diagnosis of hepatitis B as the following:

Hepatitis B is a liver infection caused by the Hepatitis B virus (HBV). Hepatitis B is transmitted when blood, semen, or another body fluid from a person infected with the Hepatitis B virus enters the body of someone who is not infected. This can happen through sexual contact; sharing needles, syringes, or other drug-injection equipment; or from mother to baby at birth. For some people, hepatitis B is an acute, or short-term, illness but for others, it can become a long-term, chronic infection. Risk for chronic
infection is related to age at infection: approximately 90% of infected infants become chronically infected, compared with 2%–6% of adults. Chronic Hepatitis B can lead to serious health issues, like cirrhosis or liver cancer. The best way to prevent Hepatitis B is by getting vaccinated. (para. 1)

Other modes of transmission of hepatitis B that are not listed above include sharing items such as toothbrushes or razors, and even contact with the blood or open sores of an infected person (CDC, 2018).

Common signs and symptoms of hepatitis B include but are not limited to “fever, fatigue, loss of appetite, nausea, and/or vomiting, jaundice (yellow skin or eyes, dark urine, clay-colored bowel movements), pain in muscles, joint pain, and stomach pain” (CDC, p. 1). When it comes to clinical findings, elevated liver enzymes are indicative of a liver inflammatory response or infectious disease. Liver enzymes typically tested to confirm diagnosis include Alanine transaminase (ALT), Aspartate transaminase (AST), Gamma-glutamyl transpeptidase (GGT), and Alkaline phosphatase (ALP). Further imaging such as a liver ultrasound is a usual diagnostic tool used in confirming a hepatitis B infection as well.

**Benefits of the Vaccine**

According to the CDC (2018) approximately 2,000 people in the United States die from hepatitis B-related liver disease every year. To lessen the chances of infection by hepatitis B and its complications such as liver cancer and cirrhosis, one should receive the hepatitis B vaccination at the given times set by the CDC (CDC, 2018). The CDC (2018) reports that the hepatitis B vaccination is “made from parts of the hepatitis B virus” (p. 1). However, hepatitis B
cannot be contracted from receiving the vaccine. “Safe and effective vaccines against hepatitis B have been available since 1982” (World Health Organization [WHO], 2017).

Administration of the Vaccine

Currently in the United States, the hepatitis B vaccine is the only vaccine received at birth. This immunization is administered via the intramuscular route, typically in the lateral thigh or deltoid muscle. According to the CDC recommended schedule, it is then administered again at one to two months of age and between six to eighteen months of age for the third and final dose (CDC, 2018).

The CDC (2018) states that “all children and adolescents younger than 19 years of age who have not yet gotten the vaccine should also be vaccinated” (p. 1). The CDC (2018) clarifies that individuals who should also receive the hepatitis B vaccine include but are not limited to:

- People whose sex partners have hepatitis B
- Sexually active persons who are not in a long-term monogamous relationship
- Persons seeking evaluation or treatment for a sexually transmitted disease
- Men who have sexual contact with other men
- People who share needles, syringes, or other drug-injection equipment
- People who have household contact with someone infected with the hepatitis B virus
- Health care and public safety workers at risk for exposure to blood or body fluids
- Residents and staff of facilities for developmentally disabled persons
- Persons in correctional facilities
- Victims of sexual assault or abuse
- Travelers to regions with increased rates of hepatitis B
• People with chronic liver disease, kidney disease, HIV infection, or diabetes
• Anyone who wants to be protected from hepatitis B (p. 1)

Risks of the Vaccine

In regards to the hepatitis B vaccine, there are a few contraindications for receiving this immunization. It is appropriate for people who are acutely ill, with something such as a cold, to still receive the vaccine. However, if a person has a more serious ailment such as the flu or a stomach virus, the hepatitis B vaccine is not recommended as the vaccine may worsen symptoms (i.e. fever, diarrhea, etc.). The CDC (2018) also states that if a patient has any severe allergies to any part of the hepatitis B vaccination such as hives, swelling of the face, or difficulty breathing or swallowing, it is contraindicated for that person.

Risks for receiving the hepatitis B vaccine include both minor and more serious reactions. Minor reactions include fever and localized soreness where the injection was administered. More severe reactions include fainting after the injection is given, long-lasting pain at the injection site, and allergic reactions such as hives, difficulty breathing, swelling of the face and throat, tachycardia, weakness and dizziness. Typically, these reactions will appear within a few minutes to a few hours after the vaccine is administered (CDC, 2018).

Furthermore, it is important to report that there have been no correlations between the hepatitis B vaccine and any chronic illnesses. WHO (2017) states:

Numerous long-term studies have found no evidence of serious adverse events causally linked to hepatitis B vaccination. Data do not indicate a causal association between hepatitis B vaccine and neurological disease (including Guillain-Barré syndrome and multiple sclerosis), diabetes mellitus, demyelinating disorders, chronic fatigue syndrome,
arthritis, autoimmune disorders, asthma, hair loss, or sudden infant death syndrome. (p. 382-383)

In conclusion, the hepatitis B vaccine is important for school-aged children to aid in preventing debilitating diseases such as cirrhosis and liver cancer which can be directly associated with the hepatitis B disease. By adhering to the CDC guidelines for administration of the vaccine, chances of contracting the hepatitis B disease can be decreased drastically. Although some people may still opt out of vaccinations, benefits of the hepatitis B vaccine greatly outweigh the risks.

**Hib Vaccine**

**The Disease**

Haemophilus influenzae type b (Hib) is a type of bacteria that is known to cause a variety of different infections. These infections can range from a mild ear infection to something as serious as a deadly infection of the bloodstream. The CDC (2018) reports the following:

Doctors consider some of these infections “invasive.” Invasive disease happens when the bacteria invade parts of the body that are normally free from germs. The most common types of invasive disease caused by *H. influenzae* are:

- Pneumonia (lung infection)
- Bacteremia (bloodstream infection)
- Meningitis (infection of the tissue covering of the brain and spinal cord)
- Epiglotittis (swelling in the throat)
- Cellulitis (skin infection)
- Infectious arthritis (inflammation of the joint) (p. 1)
Hib infection is best identified by signs and symptoms of each of the individual disease processes. According to the CDC (2018), pneumonia is characterized by fever, chills, headaches, cough, shortness of breath, chest pain, excessive sweating (perfusion), fatigue, and muscle pain or aches. Bacteremia signs and symptoms include fatigue, fever and chills, abdominal pain, nausea (with or without vomiting), diarrhea, altered mental status, anxiety, shortness of breath and/or difficulty breathing. Characteristics of meningitis can include a severe headache, stiffness of the neck, fever, nausea (with or without vomiting), photophobia (light sensitivity related to the eyes), and confusion. Diagnosis of Hib infection is obtained by laboratory confirmation of the *H. influenzae* bacteria via blood or spinal fluid specimens.

Hib infection is transmitted via person to person contact. This means that a person can contract this infection simply by being around someone who has the Hib bacteria. The CDC (2015) states that the Hib disease typically affects children under the age of 5. They state that before the Hib vaccine, “Hib was the leading cause of bacterial meningitis among children under 5 years old in the United States” (p. 1). Meningitis, as stated previously, is an infection of the tissue lining the brain and spinal cord and can lead to serious problems such as deafness and brain damage (CDC, 2015). Furthermore, the CDC (2015) states that approximately “20,000 children in the United States under 5 years old got Hib disease each year, and about 3% - 6% of them died” (p. 1).

**Benefits of the Vaccine**

When it comes to the effectiveness of the Hib vaccine, it is best to look at the statistics. WHO (2006) reports:
Vaccines are the only public health tool capable of preventing the majority of cases of serious Hib disease. The vaccines are formulated either as single antigens or as part of combination vaccines. Hib vaccines are safe and efficacious even when administered in early infancy; they are included in routine childhood vaccination programmes in more than 90 countries in all regions of the world. As a consequence, invasive Hib disease has been practically eliminated in many industrialized countries, and its incidence has been dramatically reduced in some parts of the developing world. (p. 446)

In addition, the CDC (2015) reiterates the importance of the Hib vaccine stating that since implementing the immunization, there has been a 99% decrease in cases of invasive Hib disease. Without vaccinating against Hib, numerous children would be infected by this potentially deadly disease.

**Administration of the Vaccine**

There are several different brands of the Hib vaccine available including ones that only cover Hib and also combination vaccines that include multiple immunizations into one single injection. Regardless of the brand, all are administered via the intramuscular route. Depending on whether a single or combination vaccine is used, the CDC (2015) recommends that the vaccine be given in either 3 or 4 doses following this schedule:

- **Initial dose:** 2 months old
- **2\textsuperscript{nd} dose:** 4 months old
- **3\textsuperscript{rd} dose:** 6 months old (depending on the brand of the vaccine)
- **4\textsuperscript{th} dose/ booster:** 12-15 months of age
The Hib vaccine is safe to administer with other vaccines and is most commonly paired with the polio vaccine, tetanus diphtheria and pertussis vaccine, rotavirus immunization, hepatitis B vaccine and the pneumonia vaccine since these have a similar schedule for administration.

Apart from the scheduled recommendations by the CDC, the Hib vaccine is also indicated for children and adults over the age of 5 with asplenia or sickle cell disease, pre-operation for a splenectomy, or after a bone marrow transplant (CDC, 2015). It may also be given to patients with human immunodeficiency virus (HIV) between the ages of 5-18. Otherwise, people over the age of 5 do not need the Hib vaccine (CDC, 2015).

**Risks of the Vaccine**

In contrast, the Hib vaccine is not suitable for some populations. The CDC states that the “Hib vaccine should not be given to infants younger than 6 weeks of age” (p. 2). As with the hepatitis B vaccine, the Hib immunization can be given during acute illnesses, but should be avoided during serious ones. The CDC (2015) also reports that people who are allergic to any portion of the Hib vaccine or if they have had a serious reaction to a previous dose of the immunization should avoid it.

In conclusion, the Hib vaccination can protect people from contracting the *H. influenzae* bacteria, thus protecting them from various disease processes such as pneumonia, meningitis, and bacteremia, just to name a few. As it relates to administration, healthcare providers should adhere to the CDC guidelines using a 3 or 4 step vaccination schedule depending on the brand of the vaccine. Benefits, yet again, outweigh the risks of not receiving the Hib vaccine, especially for children under the age of 5 years old since the *H. influenzae* bacteria can cause severe and sometimes deadly illnesses.
Diphtheria, Tetanus, and Pertussis Vaccine

The Diseases

According to the CDC (2015), diphtheria is a disease caused by the bacteria Corynebacterium diphtheriae and is transmitted via person to person contact by secretions such as sneezing or coughing. The CDC describes diphtheria as causing “a thick covering in the back of the throat. It can lead to breathing problems, paralysis, heart failure, and even death” (CDC, 2015). Once the bacteria adheres to the throat, it can form a toxin (poison) causing symptoms such as weakness, fever, sore throat, and swollen glands in the neck (CDC, 2018).

Tetanus, on the other hand, causes a painful tightening of the muscles. The CDC (2017) describes tetanus as:

Tetanus is an infection caused by bacteria called Clostridium tetani. When the bacteria invade the body, they produce a poison (toxin) that causes painful muscle contractions. Another name for tetanus is “lockjaw”. It often causes a person’s neck and jaw muscles to lock, making it hard to open the mouth or swallow. (para. 1)

Tetanus is transmitted by the C. tetani bacteria entering the body through a break in the skin via contaminated soil or dust (CDC, 2017). Common signs and symptoms of tetanus are:

- Cramping of the jaw
- Muscle spasms (most commonly in the abdomen)
- All over muscle stiffness
- Difficulty swallowing
- Seizures
• Headache

• Sweating and fever

• Changes in blood pressure and an elevated heart rate

Pertussis, also known as Whooping Cough, is a highly contagious respiratory disease cause by the bacterium *Bordetella pertussis* (CDC, 2017). The CDC (2017) reports:

Pertussis is known for uncontrollable, violent coughing which often makes it hard to breathe. After cough fits, someone with pertussis often needs to take deep breaths, which result in a “whooping” sound. Pertussis can affect people of all ages, but can be very serious, even deadly, for babies less than a year old. (para. 1)

Like diphtheria, pertussis is transmitted from person-to-person contact by either coughing or sneezing. Signs that someone may have pertussis include both early and late symptoms. According to the CDC (2017):

Early symptoms can last for 1 to 2 weeks and usually include:

• Runny nose

• Low-grade fever (generally minimal throughout the course of the disease)

• Mild, occasional cough

• Apnea- a pause in breathing (in babies)

After 1 to 2 weeks and as the disease progresses, the traditional symptoms of pertussis may appear and include:
- Paroxysms (fits) of many, rapid coughs followed by a high-pitched “whoop” sound
- Vomiting (throwing up) during or after coughing fits
- Exhaustion (very tired) after coughing fits (para. 3)

Benefits of the Vaccine

Before vaccinations against diphtheria, tetanus, and pertussis were available, many people suffered from these illnesses. Immunizations are beneficial in protecting against these serious and even deadly disease processes. The CDC (2015) reports that tetanus kills approximately “1 out of 10 people who are infected even after receiving the best medical care” (p. 1). Prior to immunizations, diphtheria was the cause of death for tens of thousands of children in the United States every year (CDC, 2018). Furthermore, the CDC (2015) reports:

Before vaccines, as many as 200,000 cases of diphtheria, 200,000 cases of pertussis, and hundreds of cases of tetanus, were reported in the United States each year. Since vaccination began, reports of cases for tetanus and diphtheria have dropped by about 99% and for pertussis by about 80%. (p. 1)

Administration of the Vaccine

Vaccinations against diphtheria, tetanus, and pertussis are available in four different combinations: DTaP, DT, Tdap, and Td. DTaP has an elevated level of diphtheria and pertussis versus the Tdap vaccine, while the DT includes more diphtheria immunization than that of the Td vaccine. All variations of the vaccine are given intramuscularly in either the upper thigh or upper arm.
According to CDC guidelines, DTaP (diphtheria, tetanus, and pertussis) is given in five doses. CDC (2018) states that children receive this vaccine at the following ages:

- 2 months
- 4 months
- 6 months
- 15-18 months
- 4-6 years

DT (diphtheria and tetanus without the pertussis vaccine) can be given in place of the DTaP vaccine if someone is unable to receive the pertussis part of the immunization. It is safe to administer the DTaP vaccine with other immunizations. Often, the DTaP vaccine is part of combination vaccinations such as with Pentacel (combining DTaP, Hib, and IPV in one injection) (CDC, 2018).

Tdap (tetanus, diphtheria, and pertussis) is routinely given at either 11 or 12 years old (CDC, 2015). Apart from school-aged children, is also important for healthcare workers, pregnant women (during specific trimesters), and individuals who are in close contact with babies younger than 12 months old to receive this vaccine as it protects the infant from pertussis (CDC, 2015). Tdap or Td (tetanus and diphtheria without pertussis vaccine) are given as boosters every ten years.

**Risks of the Vaccine**

It is contraindicated for individuals who are allergic to any part of the DTaP, DT, Tdap, and Td vaccine to receive these immunizations. The CDC reports that only children under the age of 7 should receive the DTaP vaccine and children over 7 should receive Tdap due to the
dosing of the vaccinations (CDC, 2018). People who should not get the diphtheria, tetanus, and pertussis vaccines are the following:

- Have had a coma or experienced seizures within 7 days after being administered any variation of the diphtheria, tetanus, and pertussis vaccine
- Have a history of nervous system issues or seizure disorder
- Have Guillain-Barré Syndrome (GBS)
- Have had severe pain and edema (swelling) after a previous dose of DTaP or DT (CDC, 2018)

As with any medication or vaccination, receiving these immunizations can cause adverse reactions. The CDC (2018) lists common side effects of the DTaP vaccine as the following:

- Redness, soreness, swelling, and tenderness where the shot is given are common after DTaP.
- Fever, fussiness, tiredness, poor appetite, and vomiting sometimes happen 1 to 3 days after DTaP vaccination.
- More serious reactions, such as seizures, non-stop crying for 3 hours or more, or high fever (over 105°F) after DTaP vaccination happen much less often. Rarely, the vaccine is followed by swelling of the entire arm or leg, especially in older children when they receive their fourth or fifth dose.
- Long-term seizures, coma, lowered consciousness, or permanent brain damage happen extremely rarely after DTaP vaccination. (p. 2)
Side effects from the Tdap vaccine are similar in nature to that of those from the DTaP immunization. The CDC (2015) categorizes the side effects of the Tdap vaccine as mild, moderate, and severe reactions. Mild problems include pain, redness, or swelling at the injection site; mild fever (approximately 100.4°F); headache; fatigue (tiredness); stomach ache with or without nausea, vomiting, and diarrhea; chills; body aches; rash; swollen glands (CDC, 2015). Moderate reactions include fever greater than 102°F and swelling of the entire arm where the injection was given. Severe side effects of the Tdap vaccine are severe pain, swelling, redness, and bleeding of the arm where the vaccine was administered; and severe allergic reactions such as hives, difficulty breathing (dyspnea), swelling of the face and throat, weakness, elevated heart rate, and dizziness (CDC, 2015).

In summary, the vaccinations against diphtheria, tetanus, and pertussis are combined in four different variations including DTaP, DT, Tdap, and Td. DTaP and DT are intended for children under the age of seven years old while Tdap and Td are recommended for those over the age of seven. These vaccinations protect against ailments associated with these diseases such as lockjaw, severe muscle tightening, dyspnea, thick coatings in the throat, paralysis, severe coughing spells, pneumonia, and sometimes even death just to name a few. It is imperative for school-aged children to receive the immunizations (if able) as numbers have dropped drastically in cases of diphtheria, tetanus, and pertussis since vaccinations have been available (CDC, 2015).

**Polio Vaccine**

**The Disease**

Polio is a disease caused by a virus that is spread primarily by person-to-person contact (CDC, 2016). The CDC (2016) states that polio can also be spread via the fecal-oral-route. The
fecal-oral-route is when food or drinks are contaminated by feces of an infected individual and then consumed by an uninfected person. The CDC (2016) reports:

Most people infected with polio have no symptoms, and many recover without complications. But sometimes people who get polio develop paralysis (cannot move their arms or legs). Polio can result in permanent disability. Polio can also cause death, usually by paralyzing the muscles used for breathing. (p. 1)

The WHO (2016) states that before the vaccination was available, polio was the leading cause for permanent disability in children. The CDC states that there is no cure for polio, but that immunization is best for prevention of this disease (CDC, 2016).

**Benefits of the Vaccine**

According to the CDC, polio was once very prevalent in the United States. The CDC (2016) states that “it paralyzed and killed thousands of people every year before polio vaccine was introduced in 1955” (p. 1). Since implementing the polio vaccine, polio has been eradicated from the United States. However, some cases of polio are still active in other parts of the world (CDC, 2016). The WHO (2016) reports that “all children worldwide should be fully vaccinated against polio, and every country should seek to achieve and maintain high levels of coverage with polio vaccine in support of the global commitment to eradicate polio” (p. 164). The CDC (2016) adds to this statement by saying that if all countries are successful at ending polio worldwide, the polio vaccination will no longer be needed.

**Administration of the Vaccine**

The polio vaccine is better known as Inactivated Polio Vaccine (IPV). IPV is typically administered via the intramuscular route in either the thigh or deltoid muscles. CDC guidelines
recommend that most people receive the polio vaccine at 2, 4, 6 to 18 months, and 4 to 6 years old (CDC, 2016). Most adults do not need the vaccination since they are typically immunized as children, but the CDC (2016) states that some adults are at a higher risk of contracting the polio virus such as:

- people traveling to certain parts of the world,
- laboratory workers who might handle polio virus, and
- health care workers treating patients who could have polio.

These higher-risk adults may need 1 to 3 doses of IPV, depending on how many doses they have had in the past. There are no known risks to getting IPV at the same time as other vaccines. (p. 1)

IPV is given as both a solitary immunization and as a combination vaccine. It is commonly paired with Hib and DTaP such as with Pentacel.

**Risks of the Vaccine**

As with all medications, there are risks with the polio vaccination. However, according to the CDC (2016), “IPV has not been known to cause serious problems, and most people do not have any problems with it” (p. 1). Potential risks of the polio vaccination include:

- Possible fainting or dizziness after the injection is given
- Pain at the injection site
- Fever
- Severe allergic reaction such as difficulty breathing or swallowing, hives, swelling of the face or throat
People who should not receive the polio vaccine include those who are allergic to the immunization and those who are not feeling well. The CDC (2016) states that anyone who has had a previous allergic reaction to any part of the polio vaccine should not receive it. The CDC goes on to say that if a person is ill with a minor ailment such as a cold, it is permissible for them to receive the polio vaccination. Contrarily, if a person has a severe illness such as the flu or a stomach virus, it is not recommended for that person to receive the vaccine that day (CDC, 2016).

In conclusion, the polio vaccine protects against the once most common form of childhood paralysis. It is administered primarily to children, but can be given to adults under certain circumstances. The most important benefit of the polio vaccine is that it has completely eliminated the polio virus in the United States and in other parts of the world, as well. Risks of the vaccination are minimal, and efforts to eradicate this disease worldwide are made possible by vaccination.

**Pneumococcal Conjugate Vaccine**

**The Disease**

Pneumococcal disease is caused by the bacteria *Streptococcus pneumoniae* and is spread by close contact with an infected person (CDC, 2017). According to the CDC, it can lead to simple ailments such as ear infections and can also cause severe complications such as pneumonia (infection of the lungs), bacteremia (infection of the blood), and meningitis (infection covering the brain and spinal cord) (CDC, 2015).

Anyone is susceptible to contracting the pneumococcal disease, but it is most prevalent in children less than the age of 2 and adults over the age of 65 (CDC, 2015). The CDC (2015) goes
on to say that “people with certain medical conditions, and cigarette smokers” are also at a
higher risk for pneumococcal disease (p. 1). The CDC (2015) reports that “pneumococcal
pneumonia is most common among adults. Pneumococcal meningitis can cause deafness and
brain damage, and it kills about 1 child in 10 who get it” (p. 1).

Clinical diagnosis of pneumococcal disease can vary. It is typically verified via
laboratory findings. Meningitis is confirmed via cerebrospinal fluid while bacteremia is
confirmed by blood specimens (CDC, 2017). These tests are crucial in determining what type of
antibiotic treatment is appropriate as some pneumococcal diseases are resistant to certain
antibiotics (CDC, 2017).

Benefits of the Vaccine

The Pneumococcal Conjugate Vaccine (also known as PCV13 and Prevnar13®) protects
against 13 different pneumococcal bacteria (CDC, 2017). The CDC (2015) reports:

Before there was a vaccine, the United States saw:

- more than 700 cases of meningitis,
- about 13,000 blood infections,
- about 5 million ear infections, and
- about 200 deaths

in children under five each year from pneumococcal disease. Since the vaccine became
available, severe pneumococcal disease in these children has fallen by 88%. (p. 1)

Administration of the Vaccine
The pneumococcal vaccine is administered via the intramuscular route in either the upper thigh or deltoid muscle. The CDC (2015) recommends that children receive this vaccine at two, four, six, and 12-15 months of age. The CDC (2015) also states that the immunization should be given to “children and adults two to 64 years of age with certain health conditions, and for all adults 65 years of age and older” (p. 1).

**Risks of the Vaccine**

Risks related to the pneumococcal vaccine include both mild and serious reactions. According to the CDC (2015) reactions to this immunization may vary by age and with the dose in the series. In relations to school-aged children, the most common problems reported by the CDC (2015) were the following:

- About half became drowsy after the shot, had a temporary loss of appetite, or had redness or tenderness where the shot was given.
- About 1 out of 3 had swelling where the shot was given.
- About 1 out of 3 had a mild fever, and about 1 in 20 had a fever over 102.2°F.
- Up to about 8 out of 10 became fussy or irritable. (p. 1)

Other common reactions to the vaccine include pain, swelling, and redness at the injection site; along with muscle pain, mild fever, headache, chills, and fatigue (CDC, 2015). More serious reactions include difficulty breathing, swelling of the face or throat, elevated heart rate, and hives. These symptoms indicate a possible severe allergic reaction.

The pneumococcal vaccination is contraindicated for several people. Those who have had a serious allergic reaction to the pneumococcal vaccine should not receive it (CDC, 2015).
Furthermore, anyone that has had a life-threatening reaction to any vaccine containing diphtheria toxoid (such as DTaP) should also avoid the pneumococcal immunization as it contains a variant of the diphtheria toxin (CDC, 2015). It is also reported that if the person receiving the vaccination is ill, the provider may decide to give the shot on a different day since the immunization could potentially worsen their symptoms (CDC, 2015).

All in all, the pneumococcal vaccination is effective at helping prevent infections such as ear infections, pneumonia, bacteremia, and meningitis. It is most commonly administered to infants between the ages of two months and 15 months, but is also given to persons between the ages of two and 65 years old. Benefits of the vaccine are greater than the mild side effects that one may receive, but the immunization should be avoided if there is a history of reaction to previous doses or if a person is allergic to any component of the pneumococcal vaccine.

**Rotavirus**

**The Disease**

According to the CDC (2018) the rotavirus is a viral infection which causes diarrhea, vomiting, and fever mostly in babies and young children. The WHO (2013) reports that the rotavirus typically has an incubation period of one to three days and is followed by an abrupt onset of vomiting, fever, and explosive watery diarrhea. “Transmission occurs primarily by the [fecal]-oral route directly from person to person, or indirectly via contaminated fomites” (WHO, 2013, p. 51). A fomite is defined as “objects such as clothing, towels, and utensils that may harbor a disease agent and are capable of transmitting it” (Lippincott, Williams, and Wilkins, 2005, p. 560).
The rotavirus is positively diagnosed in a laboratory setting via stool specimens (CDC, 2018). Currently, there is no cure against the rotavirus (WHO, 2013). Treatment commonly focuses on preventing dehydration by use of fluid replacement either orally or intravenously.

**Benefits of the Vaccine**

The CDC (2018) states that before the rotavirus vaccine was available, “almost all children in the United States had at least one rotavirus infection before their fifth birthday” (p. 1). The CDC (2018) also reports the following:

Every year before the vaccine was available:

- more than 400,000 young children had to see a doctor for illness caused by rotavirus,
- more than 200,000 had to go to the emergency room,
- 55,000 to 70,000 had to be hospitalized, and
- 20 to 60 died.

Since the introduction of the rotavirus vaccine, hospitalizations and emergency visits for rotavirus have dropped dramatically. (p. 1)

In addition to those statistics, the rotavirus vaccine protects almost all babies from severe rotavirus diarrhea. This does not mean that children are safe from all diarrhea. They are only protected against diarrhea caused by the rotavirus.

**Administration of the Vaccine**

The rotavirus vaccine is one of the only vaccines administered via the oral route. It is a liquid vaccine that is routinely given in either two or three doses depending on which brand of
vaccine is used. The CDC recommends that the immunization be given at the following intervals:

- First Dose: two months old
- Second Dose: 4 months old
- Third Dose: 6 months old (if needed)

The CDC (2018) goes on to say that the first dose must be given “before 15 weeks of age, and the last by age eight months. Rotavirus vaccine may safely be given at the same time as other vaccines” (p. 1).

**Risks of the Vaccine**

Even though the rotavirus vaccination is administered differently than those vaccines aforementioned, some side effects are still possible when receiving this immunization. Most reactions to the rotavirus are mild and go away on their own. Serious reactions are possible, but rare (CDC, 2018). According to the CDC (2018) mild side effects include irritability, or mild, temporary diarrhea or vomiting in babies. More serious side effects include intussusception and severe allergic reactions. Intussusception is a bowel blockage and is defined in Stedman’s Medical Dictionary as “the taking up or receiving of one part within another, especially the enfold ing of one segment of the intestine within another” (Lippincott et al., 2005, p. 769).

Furthermore, some children should avoid the rotavirus vaccination completely. These children include the following:

- Those with life-threatening allergic reactions to any part of the rotavirus vaccine or to a previous dose of the rotavirus immunization
- Those who have a severe latex allergy
• Children with severe combined immunodeficiency (SCID)
• Babies who have intussusception
• Babies who are moderately or severely ill (including those with diarrhea and/or vomiting)
• Those with a weakened immune system (for example- HIV/AIDS, cancer, treatment with steroids) (CDC, 2018)

In conclusion, the rotavirus vaccine aids in protecting against one of the most common causes of gastrointestinal upset in babies, the rotavirus. Benefits of the vaccine include decreased severity of diarrhea if a vaccinated individual were to contract the rotavirus or complete immunity against the virus. Receiving the rotavirus vaccination can ultimately protect against dehydration most commonly caused by the rotavirus. This liquid oral immunization is recommended for babies in two to three doses between the ages of two months and 6 months of age. Benefits of the vaccine typically outweigh the risks as side effects are typically mild and serious reactions are rare in nature.

Measles, Mumps, and Rubella (MMR) Vaccine

The Diseases

Measles is a viral infection that is characterized by fever, nasal drainage, cough, red, watery eyes, and is most commonly followed by a systemic rash (a rash covering the entire body). The CDC (2018) states that measles “can lead to ear infections, diarrhea, and infection of the lungs (pneumonia). Rarely, measles can cause brain damage or death” (p. 1). It is reported that the measles rash consists of multiple flat red bumps that typically start on the head and face and spread downward toward the trunk and lower limbs (CDC, 2018). Tiny white lesions called
Koplik spots can also appear in the mouth of an infected person as an early sign of the measles virus (CDC, 2018).

In regards to transmission, the measles virus is spread by airborne particles. On their website, the CDC (2018) reports:

Measles is a highly contagious virus that lives in the nose and throat mucus of an infected person. It can spread to others through coughing and sneezing. Also, measles virus can live for up to two hours in an airspace where the infected person coughed or sneezed. If other people breathe the contaminated air or touch the infected surface, then touch their eyes, noses, or mouths, they can become infected. Measles is so contagious that if one person has it, 90% of the people close to that person who are not immune will also become infected. (para. 1)

Mumps is a virus that symptoms include headaches, fever, body aches, decreased appetite, fatigue, and swollen and tender salivary glands including one or both sides (CDC, 2018). In relation to the mumps virus, the CDC (2017) states:

It spreads through saliva or mucus from the mouth, nose, or throat. An infected person can spread the virus by

- coughing, sneezing, or talking,
- sharing items, such as cups or eating utensils, with others, and
- touching objects or surfaces with unwashed hands that are then touched by others.

Mumps likely spreads before the salivary glands begin to swell and up to five days after the swelling begins. (para. 1)
Mumps can ultimately be a very debilitating disease. It can lead to deafness, encephalitis or meningitis (swelling of the brain and/or spinal cord covering). Mumps can also result in “painful swelling of the testicles or ovaries and, very rarely, death” (CDC, 2018, p. 1).

Rubella is viral infection that is also known as German Measles. Rubella is spread from person to person by contact with nasal or throat secretions or by contact with droplets in the air from an infected person sneezing or coughing (CDC, 2018). Common signs and symptoms of rubella include:

- fever, sore throat, eye irritations, headaches, and rash
- arthritis in teenagers and adult women
- possible miscarriage or serious birth defects if a pregnant woman is infected (CDC, 2018)

The CDC (2018) reports that since the introduction of the MMR vaccination, these diseases are much less common in the United States.

**Benefits of the Vaccine**

The MMR vaccination has many benefits, one of which is that after receiving the recommended dosages of the vaccine, individuals are protected against three different life-altering and life-threatening diseases. Statistics show that the MMR has proven to be effective in preventing these illnesses. The CDC (2018) reports:

- One dose
  - One dose of MMR vaccine is—
    - 93% effective for measles (range: 39%–100%)
    - 78% effective for mumps (range: 49%–92%)
o 97% effective for rubella (range: 94%–100%)

Two doses

- Two doses of MMR are—
  o 97% effective for measles (range: 67%–100%)
  o 88% effective for mumps (range: 31%–95%) (para. 3)

Equally as important, the CDC (2018) states that “people who receive MMR vaccination according to the U.S. vaccination schedule are considered protected for life” (para. 4).

**Administration of the Vaccine**

The MMR vaccine is an injectable immunization that is most commonly administered via the intramuscular route in either the upper thigh or deltoid muscle. The CDC (2018) recommends that this immunization be given in two doses.

- First dose between 12 to 15 months old
- Second dose between the ages of four and six years old

It is also recommended that any infant between the ages of six and 11 months old should receive a dose of the MMR vaccine if they will be traveling outside of the United States as it can provide temporary protection against a measles infection (CDC, 2018).

Furthermore, the MMR vaccine can be administered as a third dose during certain situations such as a mumps outbreak (CDC, 2018). The CDC (2018) also states that there are no known risks to receiving the MMR vaccine at the same time as other immunizations. The MMR vaccine is sometimes given as a combination vaccine known as the MMRV. This vaccination
includes not only immunity from measles, mumps, and rubella, but also varicella (also known as chickenpox).

**Risks of the Vaccine**

In comparison to other immunizations, the MMR vaccine can be more risky to certain populations. The CDC states the MMR vaccine should be avoided by:

- Anyone with a severe or life-threatening allergy to any part of the MMR vaccine
- Any woman who is pregnant or plans to be pregnant within a month from receiving the MMR vaccine
- Any person with a weakened immune system related to a disease process such as HIV/AIDS, or is receiving medical treatments such as chemotherapy or radiation
- Anyone with a parent or sibling with a history of being immunocompromised
- Anyone with a history of bruising or bleeding conditions
- Anyone who has received blood products or has undergone a recent blood transfusion
- Any person with active tuberculosis
- Any individual that has received any live vaccinations within the past four weeks
- Anyone who is suffering from a moderate or severe illness (CDC, 2018)

As with other vaccinations and medications, certain side effects can be associated with the MMR vaccine. Minor reactions to the immunization can include fever, pain or redness at the injection site, or swelling of the gland in the cheeks or neck (CDC, 2018). Moderate side effects can include a systemic rash, temporary low platelet count (which can cause easy bruising or bleeding), seizures, and temporary joint pain and stiffness (CDC, 2018). More serious reactions to the MMR vaccine include potential brain damage, deafness, long-term seizures, or a coma.
(CDC, 2018). The CDC (2018) states that “most people who get MMR vaccine do not have any problems with it” (p. 2).

In summary, the MMR vaccine protects against three different, harmful viruses: measles, mumps, and rubella. These diseases can lead to a plethora of symptoms that range in seriousness from fevers and rashes all the way to brain damage or even death. Life-time immunization can be provided by receiving the MMR vaccine in the two doses recommended by the CDC. When comparing the pros and cons of the MMR immunization, the CDC (2018) states that “getting the MMR vaccine is much safer than getting measles, mumps, or rubella disease” (p. 2).

**Varicella Vaccine**

**The Disease**

Varicella (also known as chickenpox) is caused by the varicella zoster virus (CDC, 2018). According to the CDC (2018), the varicella virus is “usually mild, but it can be serious in infants under 12 months of age, adolescents, adults, pregnant women, and people with weakened immune systems” (p. 1). Chickenpox is spread via close contact with an infected person (CDC, 2018). Chickenpox can also be contracted from an individual with shingles - a rash caused by the same varicella zoster virus (CDC, 2018).

Varicella causes an itchy rash all over the body that typically last around one week (CDC, 2018). The CDC (2018) also states that the chickenpox virus can also cause:

- fever
- tiredness
- loss of appetite
• headache

More serious complications can include:

• skin infections

• infection of the lungs (pneumonia)

• inflammation of blood vessels

• swelling of the brain and/or spinal cord coverings (encephalitis or meningitis)

• blood stream, bone, or joint infections

Some people get so sick that they need to be hospitalized. It doesn’t happen often, but people can die from chickenpox (p. 1)

**Benefits of the Vaccine**

“Chickenpox vaccine became available in the United States in 1995” (CDC, 2018, para. 3). Before the vaccine was readily available, an average of four million people each year in the United States got chickenpox, 10,500 to 13,000 were hospitalized, and approximately 100 to 150 died each year (CDC, 2018). The CDC (2018) states that “each year, more than 3.5 million cases of chickenpox, 9,000 hospitalizations, and 100 deaths are prevented by chickenpox vaccination in the United States” (para. 3).

Some vaccinated people can still contract chickenpox. However, for these people, symptoms are usually milder with fewer or no blisters at all (CDC, 2018). The CDC goes on to say the following:
Two doses of the chickenpox vaccine is more than 90% effective at preventing chickenpox. When [a person] get[s] vaccinated, [that individual] protect[s] [themselves] and others in [their] family and community. This protection is especially important for people who cannot get vaccinated, such as those with weakened immune systems, or pregnant women. (para. 2)

**Administration of the Vaccine**

Varicella vaccine is an injectable vaccine that is administered via the subcutaneous route typically in the upper arm or upper thigh. The chickenpox vaccine is recommended for children between the ages of 12 months and 12 years old (CDC, 2018). The CDC recommends that the vaccine be given in two doses as follows:

- First dose: between 12 and 15 months old
- Second dose: between the ages of four to six years old

In addition, it is safe to receive the varicella vaccine at the same time as other vaccinations. It is most commonly paired with the MMR vaccine (also known as the MMRV). Furthermore, the CDC (2018) states the following:

People 13 years of age or older who didn’t get the vaccine when they were younger, and have never had chickenpox, should get two doses at least 28 days apart. A person who previously received only one dose of chickenpox vaccine should receive a second dose to complete the series. The second dose should be given at least 3 months after the first dose for those younger than 13 years, and at least 28 days after the first dose for those 13 years of age or older. (p. 1)

**Risks of the Vaccine**
Risks of the varicella vaccine include both minor and more serious side effects. However, “most people who get chickenpox vaccine do not have any problems with it” (CDC, 2018). Minor events include:

- Redness or soreness at the injection site
- Fever

More serious events include:

- Rash all over body
- Seizures
- Pneumonia
- Meningitis

The CDC (2018) reports that sometimes a rash can develop following varicella vaccination. Individuals that develop this rash are capable of spreading the varicella vaccine virus to unprotected people. The CDC (2018) states that “even though this happens very rarely, anyone who gets a rash should stay away from people with weakened immune systems and unvaccinated infants until the rash goes away” (p. 2).

People with known allergies to any part of the varicella vaccine or those who have had a serious life-threatening reaction to any previous dose should avoid this vaccine. The CDC (2018) reports that other individuals who should refrain from getting the varicella vaccine include the following:

- Pregnant women, or those that may be pregnant
- Individuals with weakened immune systems
• People with a parent or sibling with a history of immune system issues
• Those taking salicylates (for example: aspirin)
• Individuals who have received blood or blood product transfusions
• Those with active tuberculosis
• People that have received other live vaccinations within the past four weeks
• Individuals who are not feeling well (CDC, 2018)

The CDC (2018) states that it is permissible for someone with an acute illness such as a common cold to receive the varicella vaccine, but those with more serious ailments should avoid the vaccine until advised by their medical provider.

In conclusion, varicella is a contagious disease caused by the varicella zoster virus and is most commonly referred to as the chickenpox virus. Benefits of the vaccine greatly outweigh the risks of the vaccine with statistical data showing that since the introduction of the vaccine in 1995, the number of cases of chickenpox has decreased by millions. Although there are some potential side effects of the vaccine, reactions are “usually mild and go away on their own” (CDC, 2018, p. 2).

**Hepatitis A Vaccine**

**The Disease**

According to the CDC (2016), “Hepatitis A is a serious liver disease. It is caused by the hepatitis A virus (HAV)” (p. 1). Hepatitis A is spread via the fecal-oral route either by person to person contact or via a fomite contaminated with infected feces such as food or water (CDC, 2017). Typically, contamination is a result of poor hand hygiene. The CDC (2017) states that hepatitis A “is a self-limited disease that does not result in chronic infection” (para. 1).
According to the CDC (2016), most children do not experience symptoms of hepatitis A, however, majority of adults do. The CDC reports that the hepatitis A virus can still be spread even with the absence of symptoms. Typical signs and symptoms of hepatitis A infection include:

- Jaundice (yellowing of the eyes or skin, dark urine, clay-colored feces)
- Fever, fatigue, nausea, vomiting, joint pain, decreased appetite
- Diarrhea and severe stomach pains (CDC, 2016)

WHO (2012) states that diagnosis of hepatitis A is confirmed in the lab via serological testing. The CDC (2016) reports that symptoms of hepatitis A typically appear between two and six weeks after exposure to the virus and “usually last less than two months, although some people can be ill for as long as six months” (p. 1). The CDC (2016) goes on to say that “hepatitis A can cause liver failure and death, although this is rare and occurs more commonly in persons 50 years of age or older and persons with other liver diseases, such as hepatitis B or C” (p. 1).

**Benefits of the Vaccine**

Although the exact length of protection is unknown, the CDC (2019) states that the hepatitis A vaccine lasts for at least 20 years in both children and adults. The CDC (2019) goes on to say that “hepatitis A rates in the United States have declined by more than 95% since hepatitis A vaccine first became available in 1995” (para. 1). Furthermore, the hepatitis A vaccine is safe to administer with other vaccinations with no complications (CDC, 2019). The CDC (2019) reports that “hepatitis B, diphtheria, poliovirus (oral and inactivated), tetanus, typhoid (oral and intramuscular), cholera, Japanese encephalitis, rabies, and yellow fever
vaccines can be given at the same time that hepatitis A vaccine is given, but at a different injection site” (para. 32).

**Administration of the Vaccine**

The hepatitis A vaccination is an injectable, inactivated vaccine that is administered via the intramuscular route in either the deltoid or upper thigh. For long-lasting protection, it is recommended that everyone receive two doses of the hepatitis immunization at least 6 months apart (CDC, 2016). It is most common for children to receive their first dose of the hepatitis vaccine “between their first and second birthdays (12-23 months of age)” (CDC, 2016, p. 1).

Aside from the recommended doses for children, other populations should consider receiving the hepatitis A vaccine. According to the CDC (2016), people that should receive the hepatitis A vaccine also include those who:

- are traveling to countries where hepatitis A is common,
- are a man who has sex with other men,
- use illegal drugs,
- have a chronic liver disease such as hepatitis B or hepatitis C,
- are being treated with clotting-factor concentrates,
- work with hepatitis A-infected animals or in a hepatitis A research laboratory, or
- expect to have close personal contact with an international adoptee from a country where hepatitis A is common (p. 1)

The CDC (2019) reports the following:
The hepatitis A vaccine also comes in a combination form, containing both hepatitis A and B vaccine, that can be given to anyone 18 years of age and older. This combination vaccine is given as three shots, over six months. All three shots are needed for long-term protection for both hepatitis A and B. (para. 22)

**Risks of the Vaccination**

As with any medication or vaccination, there are risks to receiving the hepatitis A vaccine. Minor side effects include but are not limited to:

- redness or soreness at the injection site
- low grade fever
- tiredness
- headache

More serious reactions can include allergic reactions involving “hives, swelling of the face and throat, difficulty breathing, a fast heartbeat, dizziness, and weakness. These would usually start a few minutes to a few hours after the vaccination” (CDC, 2016, p. 2).

The CDC (2016) states that if there is a known allergic reaction to any part of the hepatitis A vaccine, it should be avoided. Furthermore, individuals who are ill should not receive the hepatitis A immunization. However, if the illness is only a minor cold, it is most likely safe to receive the vaccine with no issues (CDC, 2016).

In conclusion, the hepatitis A vaccine protects against the viral liver disease known as hepatitis A. Hepatitis A can result in fever, jaundice, joint pain, nausea, vomiting, diarrhea, clay-colored stools, dark urine, and yellowing of the skin and eyes. In severe cases, hepatitis A can cause liver failure and death. Immunization is recommended for children between the ages of
one and two but can also be administered to adults in certain situations. Vaccination of hepatitis A have proven to be beneficial as numbers of confirmed cases have decreased drastically since the vaccine was introduced in 1995. Benefits of the hepatitis A vaccine greatly outweigh the minimal risks associated with the immunization.

**Meningococcal ACWY Vaccine**

**The Disease**

Meningococcal disease is a bacterial infection caused by the bacteria called *Neisseria meningitidis* (CDC, 2018). The CDC (2018) reports that this bacteria “can lead to meningitis (infection of the lining of the brain and spinal cord) and infections of the blood. Meningococcal disease often occurs without warning – even among people who are otherwise healthy” (p. 1). “There are at least 12 types of *N. meningitidis*, called ‘serogroups.’ Serogroups A, B, C, W, and Y cause most meningococcal disease” (CDC, 2018, p. 1).

Meningococcal disease is spread via person-to-person contact through close or lengthy contact. Close contact refers to kissing or coughing while lengthy contact is associated with long exposure to an infected person such as living in the same household (CDC, 2018). The CDC (2017) reports that “people do not catch *N. meningitidis* through casual contact or by breathing air where someone with meningococcal disease has been” (para. 3). It is possible for an individual to be a carrier of the *N. meningitidis* bacteria but not become infected with it (CDC, 2017). “About 1 in 10 people have these bacteria in the back of their nose and throat with no signs or symptoms of disease” (CDC, 2017, para. 1).

In regard to susceptibility to contracting the meningococcal disease, the CDC (2018) reports the following:
Anyone can get meningococcal disease but certain people are at increased risk, including:

- Infants younger than one year old
- Adolescents and young adults 16 through 23 years old
- People with certain medical conditions that affect the immune system
- Microbiologists who routinely work with isolates of *N. meningitidis*
- People at risk because of an outbreak in their community (p. 1)

According to the CDC (2018), the meningococcal disease kills 10-15 out of 100 infected people even after treatment. Those who survive meningococcal disease can suffer debilitating complications. These issues can include brain damage, kidney damage, hearing loss, amputations, nervous system issues, and scars related to skin grafts (CDC, 2018).

**Benefits of the Vaccine**

The CDC (2018) reports that the “Meningococcal ACWY vaccine can help prevent meningococcal disease caused by serogroups A, C, W, and Y. A different meningococcal vaccine is available to help protect against serogroup B” (p. 1). The CDC (2019) goes on to say that “teens and young adults are at increased risk for meningococcal disease. Meningococcal disease is a very serious illness where death can occur in as little as a few hours” (para. 1). The meningococcal ACWY vaccine can help protect children and also adults against this potentially deadly disease.

**Administration of the Vaccine**

The meningococcal ACWY vaccine is an injectable vaccine that is typically administered intramuscularly in the deltoid muscle. School-aged children between the ages of 11 through 18
are recommended to receive two doses of the meningococcal ACWY vaccine. The doses should be administered as follows:

- First dose: at 11 or 12 years old
- Second dose: at age 16

“Some adolescents including those with HIV, should get additional doses” (CDC, 2018, p. 1). The CDC (2018) also states the following:

In addition to routine vaccination for adolescents, MenACWY vaccine is also recommended for certain groups of people:

- People at risk because of a serogroup A, C, W, or Y meningococcal disease outbreak
- People with HIV
- Anyone whose spleen is damaged or has been removed, including people with sickle cell disease
- Anyone with a rare immune system condition called “persistent complement component deficiency”
- Anyone taking a drug called eculizumab (also called Soliris®)
- Microbiologists who routinely work with isolates of *N. meningitidis*
- Anyone traveling to, or living in, a part of the world where meningococcal disease is common, such as parts of Africa
- College freshmen living in dormitories
- U.S. military recruits
Some people need multiple doses for adequate protection. (p. 1)

The meningococcal ACWY vaccine is safe to administer at the same time as other immunizations.

**Risks of the Vaccination**

Most all medications and vaccines come with risks, and the meningococcal ACWY vaccine is no different. The majority of side effects associated with the meningococcal ACWY vaccine are “mild and go away on their own within a few days, but serious reactions are also possible” (CDC, 2018, p. 1). The CDC (2018) states that minor reactions can include the following:

- Redness or pain at the injection site
- Fever

More severe reactions may include allergic reactions to any part of the meningococcal vaccine, or severe pain in the arm that the injection was given (CDC, 2018).

The CDC (2018) reports that people who should avoid the meningococcal ACWY vaccine are those who:

- Have had a severe or life-threatening allergic reaction to a previous dose of the meningococcal ACWY vaccine or a severe reaction to any component of the vaccine
- Are moderately or severely ill

Not much is known about the risks of this vaccine for a pregnant woman or breastfeeding mother. However, pregnancy or breastfeeding are not reasons to avoid MenACWY
vaccination. A pregnant or breastfeeding woman should be vaccinated if she is at increased risk of meningococcal disease. (CDC, 2018, p. 2)

In summary, the meningococcal ACWY vaccination protects against a bacteria called *Neisseria meningitidis*. This bacteria can lead to the serious, and sometimes fatal, illness meningitis. It is spread by person-to-person contact but can potentially be prevented by receiving the recommended two doses of the meningococcal ACWY vaccine between the ages of 11 to 18. Benefits outweigh the minimal risks associated with the meningococcal vaccine and therefore is a vaccine recommended for all school-aged children (CDC, 2018).

**Influenza Vaccine**

**The Disease**

Influenza, also known as the “flu” is a “contagious disease that spreads around the United States every year, usually between October and May” (CDC, 2015, p. 1). The flu is caused by the influenza virus and is spread via droplets. The CDC (2018) reports the following:

People with flu can spread it to others up to about six feet away. Most experts think that flu viruses spread mainly by droplets made when people with flu cough, sneeze or talk. These droplets can land in the mouths or noses of people who are nearby or possibly be inhaled into the lungs. Less often, a person might get flu by touching a surface or object that has flu virus on it and then touching their own mouth, nose, or possibly their eyes.

(para. 1)

According to the CDC (2015), anyone is susceptible to catching the influenza virus. Symptoms, however, can vary by age and can last for several days. Some of these symptoms include:
• Headaches
• Fever/chills
• Myalgias (muscle aches)
• Sore throat
• Nasal congestion or drainage
• Fatigue

Influenza is more dangerous for “infants and young children, people 65 years of age and older, pregnant women, and people with certain health conditions or a weakened immune system” (CDC, 2015, p. 1). Aside from the symptoms experienced during an active case of the influenza virus, the flu can also lead to complications such as pneumonia, blood infections, seizures, and diarrhea (CDC, 2015). The CDC (2015) states that if a person suffers from “a medical condition, such as heart or lung disease, flu can make it worse” (p. 1). Symptoms of the flu can be treated with anti-viral medications, but the best way to prevent influenza is by immunization.

**Benefits of the Vaccine**

The influenza virus causes thousands of fatalities in the United States each year and even more hospitalizations (CDC, 2015). The CDC (2015) reports that the “flu vaccine can:

• keep you from getting flu,
• make flu less severe if you do get it, and
• keep you from spreading flu to your family and other people” (p. 1).
The flu immunization has also been reported to help protect women during pregnancy and postpartum as well as “significantly reduce a child’s risk of dying from influenza” (CDC, 2019, para. 6).

In addition, the CDC (2019) also reports the following beneficial statistics regarding the flu vaccine:

- Flu vaccination can reduce the risk of flu-associated hospitalization for children, working age adults, and older adults.
- Flu vaccine prevents tens of thousands of hospitalizations each year. For example, during 2016-2017, flu vaccination prevented an estimated 85,000 flu-related hospitalizations.
- A 2014 study showed that flu vaccine reduced children’s risk of flu-related pediatric intensive care unit (PICU) admission by 74% during flu seasons from 2010-2012.
- In recent years, flu vaccines have reduced the risk of flu-associated hospitalizations among adults on average by about 40%.
- A 2018 study showed that from 2012 to 2015, flu vaccination among adults reduced the risk of being admitted to an intensive care unit (ICU) with flu by 82 percent (para. 3)

**Administration of the Vaccine**

The influenza vaccine is recommended every year to people six months old and above prior to “flu season” (approximately between the months of October and May). The flu vaccine is administered intramuscularly in either the deltoid muscle or the upper thigh, depending on age. Most people are only recommended to receive one dose of the vaccine, however, children
between the ages of six months to eight years old by need two doses during the same flu season (CDC, 2015).

One common misconception regarding the influenza vaccine is that “it causes the flu”. Contrarily, the CDC (2015) reports “there is no live flu virus in the flu shots. They cannot cause the flu” (p. 1).

**Risks of the Vaccine**

Since there are numerous influenza viruses that are ever-changing, the flu vaccine is also changing yearly to protect against the most likely strands of the flu to cause disease that upcoming season (CDC, 2015). With that being said, the flu vaccine can only protect against three or four different influenza viruses each year. There is no guarantee that the vaccine will protect against the strand of flu that is most prevalent that flu season.

Moreover, the CDC (2015) states that the influenza vaccine cannot protect against illnesses that look like the flu. Minor side effects of the influenza vaccine can include the following:

- “soreness, redness, or swelling where the shot was given
- hoarseness
- sore, red or itchy eyes
- cough
- fever
- aches
- headache
- itching
fatigue” (p. 2).

The CDC (2015) reports that more severe reactions to the influenza vaccine are possible and can potentially include:

- There may be a small increased risk of Guillain-Barré Syndrome (GBS) after inactivated flu vaccine. This risk has been estimated at 1 or 2 additional cases per million people vaccinated. This is much lower than the risk of severe complications from flu, which can be prevented by flu vaccine.
- Young children who get the flu shot along with pneumococcal vaccine (PCV13), and/or DTaP vaccine at the same time might be slightly more likely to have a seizure caused by fever. Ask your doctor for more information. Tell your doctor if a child who is getting flu vaccine has ever had a seizure. (p. 2)

In addition, a few certain populations should avoid the influenza vaccine altogether. These people include those who:

- have an egg allergy
- have any severe or life-threatening reaction to any part of the flu vaccine
- have ever had Guillain-Barré syndrome
- have a moderate to severe illness at the time of vaccination (CDC, 2015)

In conclusion, the influenza vaccine protects against the influenza virus. This virus can lead to several complications including but not limited to pneumonia, blood infections, seizures, and even death. Although controversial, the benefits of the flu vaccine outweigh the risks of the vaccine in that even if a person contracts the virus following immunization, symptoms can be greatly reduced in severity by receiving the vaccine (CDC, 2015).
Human Papillomavirus Vaccine (HPV Vaccine)

The Disease

The human papillomavirus is a viral disease associated with many types of cancers including:

- “cervical cancer in females
- vaginal and vulvar cancers in females
- anal cancer in females and males
- throat cancer in females and males, and
- penile cancer in males” (CDC, 2016, p. 1).

The CDC (2016) goes on to say the following:

HPV infection usually comes from sexual contact, and most people will become infected at some point in their life. About 14 million Americans, including teens, get infected every year. Most infections will go away on their own and not cause serious problems. But thousands of women and men get cancer and other diseases from HPV. (CDC, 2016, p. 1)

Benefits of the Vaccine

In addition to protecting against the aforementioned type of cancers, the HPV vaccine also aids in preventing infection with HPV types that cause genital warts in both males and females (CDC, 2016). The CDC (2016) states that “in the U.S., about 12,000 women get cervical cancer every year, and about 4,000 women die from it. HPV vaccine can prevent most of these cases of cervical cancer” (p. 1).
**Administration of the Vaccine**

The HPV vaccine is an injectable immunization typically administered in the deltoid muscle. It is recommended by the CDC that both males and females receive this vaccine (CDC, 2016). The HPV vaccine can be given to people between the ages of nine and 26 years old. The CDC (2016) states that children between nine and 14 years old should receive the vaccine in a two-dose series with six to 12 months between the two doses. However, if the vaccine is not initiated until age 15, the vaccine should be administered “as a three-dose series with the second dose given 1-2 months after the first dose and the third dose given 6 months after the first dose” (CDC, 2016, p. 1).

**Risks of the Vaccine**

According to the CDC (2016), “most people who receive the HPV vaccine do not have any serious problems with it” (p. 1). Side effects are typically mild and subside on their own (CDC, 2016). The most common side effects of the HPV vaccine are minor and can include the following:

- redness and/or pain at the injection site
- fever
- headache

Furthermore, the CDC (2016) reports that certain people should avoid receiving the HPV vaccine altogether. These people include:

- Anyone who has had a reaction to any component of the HPV vaccine
- Any woman who is pregnant
- Anyone who is suffering from a mild or moderate illness
In conclusion, the HPV vaccine aids in preventing infection with the human papillomavirus related to several (but not all) types of cancers. The HPV vaccine is injectable and is administered to school-aged children and adults in either a two or a three dose series, depending on the age of the recipient. Benefits of the HPV vaccine outweigh the risks of the immunization as side effects are minimal.

Conclusion

In summary, when contemplating whether parents/caregivers wish to immunize their children or not, it is imperative that they utilize all of the information that is available to them. Vaccines are important for all individuals, but are especially critical to the school-aged population. Since so many of the aforementioned 16 diseases require immunization either as an infant or during childhood, decisions to vaccinate must be made in a timely manner. As stated previously, the choice to vaccinate not only affects the person receiving (or not receiving) the vaccines, but also everyone around them. Considering each individual vaccine, the disease/diseases they are protecting against, benefits of the vaccine, how and to whom the vaccine is administered, contraindications for the immunization, and risks associated with each vaccination, parents and caregivers can make well-informed decisions related to immunizing their children. For additional information, parents and caregivers can also refer to Appendix A to see the CDC’s recommended immunization schedule and catch up vaccination schedule.
References


# IMMUNIZATIONS IN SCHOOL-AGED CHILDREN

**Appendix A**

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

### Vaccines in the Child and Adolescent Immunization Schedule*<sup>†</sup>

<table>
<thead>
<tr>
<th>Vaccines</th>
<th>Abbreviations</th>
<th>Trade names</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diphtheria, tetanus, and acellular pertussis vaccine</td>
<td>DTaP</td>
<td>Daptacel Infranrix</td>
</tr>
<tr>
<td>Diphtheria, tetanus vaccine</td>
<td>DT</td>
<td>No Trade Name</td>
</tr>
<tr>
<td>Haemophilus influenza type b vaccine</td>
<td>HIB (PRP-T)</td>
<td>ActHIB Hiberix PedvaxHIB</td>
</tr>
<tr>
<td>Haemophilus influenza type b vaccine</td>
<td>HIB (PRP-DMP)</td>
<td>Hiberix PedvaxHIB</td>
</tr>
<tr>
<td>Hepatitis A vaccine</td>
<td>HAVAX</td>
<td>Havrix</td>
</tr>
<tr>
<td>Hepatitis B vaccine</td>
<td>HepB</td>
<td>Engerix-B Recombivax HB</td>
</tr>
<tr>
<td>Human papillomavirus vaccine</td>
<td>HPV</td>
<td>Gardasil 9</td>
</tr>
<tr>
<td>Influenza vaccine (inactivated)</td>
<td>IV</td>
<td>Multiple</td>
</tr>
<tr>
<td>Influenza vaccine (live, attenuated)</td>
<td>LAIV</td>
<td>FluMist</td>
</tr>
<tr>
<td>Measles, mumps, and rubella vaccine</td>
<td>MMR</td>
<td>M-M-R II</td>
</tr>
<tr>
<td>Meningococcal serogroups A, C, W, Y vaccine</td>
<td>MenACWY-D</td>
<td>Menactra</td>
</tr>
<tr>
<td>Meningococcal serogroup B vaccine</td>
<td>MenACWY-CRM</td>
<td>Menveo</td>
</tr>
<tr>
<td>Meningococcal serogroup B vaccine</td>
<td>MenB-4C</td>
<td>Bexsero</td>
</tr>
<tr>
<td>Meningococcal serogroup B vaccine</td>
<td>MenB-HbBp</td>
<td>Trumenba</td>
</tr>
<tr>
<td>Pneumococcal 13-valent conjugate vaccine</td>
<td>PCV13</td>
<td>Prevnar 13</td>
</tr>
<tr>
<td>Pneumococcal 23-valent polysaccharide vaccine</td>
<td>PPV23</td>
<td>Pneumovax</td>
</tr>
<tr>
<td>Poliovirus vaccine (inactivated)</td>
<td>IPV</td>
<td>IPV</td>
</tr>
<tr>
<td>Rotavirus vaccine</td>
<td>RV</td>
<td>Rotarix</td>
</tr>
<tr>
<td>Rotavirus vaccine</td>
<td>RV5</td>
<td>Rotarix</td>
</tr>
<tr>
<td>Tetanus, diphtheria, and acellular pertussis vaccine</td>
<td>Tdap</td>
<td>Adacel Boostrix</td>
</tr>
<tr>
<td>Tetanus and diphtheria vaccine</td>
<td>Td</td>
<td>Tenivac Td vaccine</td>
</tr>
<tr>
<td>Varicella vaccine</td>
<td>VAR</td>
<td>Varivax</td>
</tr>
</tbody>
</table>

### Combination Vaccines (Use combination vaccines instead of separate injections when appropriate)

<table>
<thead>
<tr>
<th>Vaccines</th>
<th>Abbreviations</th>
<th>Trade names</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTaP, hepatitis B, and inactivated poliovirus vaccine</td>
<td>DTP-HepB-IPV</td>
<td>Pediatrix</td>
</tr>
<tr>
<td>DTP, inactivated poliovirus, and Haemophilus influenza type b vaccine</td>
<td>DTP-IPV-Hib</td>
<td>Pentacel</td>
</tr>
<tr>
<td>DTP and inactivated poliovirus vaccine</td>
<td>DTP-IPV</td>
<td>Kinevax Quadracel</td>
</tr>
<tr>
<td>Measles, mumps, rubella, and varicella vaccines</td>
<td>MMRIV</td>
<td>ProQuad</td>
</tr>
</tbody>
</table>

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*Administer recommended vaccines if immunization history is incomplete or unknown. Do not restart or add doses to vaccine series for extended intervals between doses. When a vaccine is not administered at the recommended age, administer at a subsequent visit. The use of trade names is for identification purposes only and does not imply endorsement by the ACIP or CDC.
### Table 1

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

**United States, 2019**

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 in Table 1. To determine minimum intervals between doses, see the catch-up schedule (Table 2). School entry and adolescent vaccine age groups are shaded in gray.

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Birth</th>
<th>1 mo</th>
<th>2 mos</th>
<th>4 mos</th>
<th>6 mos</th>
<th>9 mos</th>
<th>12 mos</th>
<th>15 mos</th>
<th>18 mos</th>
<th>19-23 mos</th>
<th>2-3 yrs</th>
<th>4-6 yrs</th>
<th>7-10 yrs</th>
<th>11-12 yrs</th>
<th>13-15 yrs</th>
<th>16 yrs</th>
<th>17-18 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hepatitis B (HepB)</td>
<td>1st</td>
<td>2nd</td>
<td></td>
<td></td>
<td>3rd</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Rotavirus (RV) RV1 (2-dose series); RV5 (3-dose series)</td>
<td>1st</td>
<td>2nd</td>
<td></td>
<td></td>
<td></td>
<td>See Notes</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Diphtheria, tetanus, &amp; acellular pertussis (DTap; &lt;7 yrs)</td>
<td>1st</td>
<td>2nd</td>
<td>3rd</td>
<td></td>
<td>4th</td>
<td></td>
<td></td>
<td>5th</td>
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<td></td>
</tr>
<tr>
<td><em>Hemophilus influenzae</em> type b (Hib)</td>
<td>1st</td>
<td>2nd</td>
<td></td>
<td></td>
<td>3rd</td>
<td>or 4th dose</td>
<td></td>
<td></td>
<td>5th</td>
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<tr>
<td>Pneumococcal conjugate (PCV13)</td>
<td>1st</td>
<td>2nd</td>
<td>3rd</td>
<td></td>
<td></td>
<td>4th</td>
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</tr>
<tr>
<td>Inactivated poliovirus (IPV; &lt;18 yrs)</td>
<td>1st</td>
<td>2nd</td>
<td></td>
<td>3rd</td>
<td>4th</td>
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</tr>
<tr>
<td>Influenza (IV)</td>
<td>1st</td>
<td>2nd</td>
<td>3rd</td>
<td>4th</td>
<td>Annual vaccination 1 or 2 doses</td>
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<tr>
<td>Influenza (LAIV)</td>
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</tr>
<tr>
<td>Measles, mumps, rubella (MMR)</td>
<td>See Notes</td>
<td>1st</td>
<td>2nd</td>
<td></td>
<td></td>
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<tr>
<td>Varicella (VAR)</td>
<td>1st</td>
<td>2nd</td>
<td></td>
<td></td>
<td>2nd</td>
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<tr>
<td>Hepatitis A (HepA)</td>
<td>See Notes</td>
<td>2-dose</td>
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<tr>
<td>Meningococcal (MenACWY-D ≥9 mos; MenACWY-CRM ≥2 mos)</td>
<td>See Notes</td>
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<tr>
<td>Tetanus, diphtheria, &amp; acellular pertussis (Tdap; ≥7 yrs)</td>
<td>See Notes</td>
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</tr>
<tr>
<td>Human papillomavirus (HPV)</td>
<td>See Notes</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Meningococcal B</td>
<td>See Notes</td>
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<tr>
<td>Pneumococcal polysaccharide (PPSV23)</td>
<td>See Notes</td>
<td></td>
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</tbody>
</table>

**Legend**

- Orange: Range of recommended ages for all children
- Green: Range of recommended ages for catch-up immunization
- Purple: Range of recommended ages for certain high-risk groups
- Blue: Range of recommended ages for non-high-risk groups that may receive vaccine, subject to individual clinical decision-making
- Gray: No recommendation
## Table 2: Catch-up immunization schedule for persons aged 4 months—18 years who start late or who are more than 1 month behind, United States, 2019

The figure 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.

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Minimum Age for Dose 1</th>
<th>Dose 1 to Dose 2</th>
<th>Minimum Interval Between Doses</th>
<th>Dose 3 to Dose 4</th>
<th>Dose 4 to Dose 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hepatitis B</td>
<td>Birth</td>
<td>4 weeks</td>
<td>8 weeks and at least 16 weeks after first dose. Minimum age for the final dose is 24 weeks.</td>
<td>No further doses needed if previous dose was administered at age 15 months or older.</td>
<td>6 months</td>
</tr>
<tr>
<td>Rotavirus</td>
<td>6 weeks</td>
<td>4 weeks</td>
<td>4 weeks</td>
<td>4 weeks</td>
<td>6 months</td>
</tr>
<tr>
<td>Maximum age for first dose is 14 weeks, 6 days</td>
<td>8 weeks (as final dose) if first dose was administered at age 12 through 14 months.</td>
<td></td>
<td>No further doses needed if previous dose was administered at age 15 months or older.</td>
<td>8 weeks (as final dose) if first dose was administered at age 12 through 14 months.</td>
<td></td>
</tr>
<tr>
<td>Diphtheria, tetanus, and acellular pertussis</td>
<td>6 weeks</td>
<td>4 weeks</td>
<td>4 weeks</td>
<td>No further doses needed if previous dose was administered at age 15 months or older.</td>
<td>8 weeks (as final dose) if first dose was administered at age 12 through 14 months.</td>
</tr>
<tr>
<td>Haemophilus influenzae type b</td>
<td>6 weeks</td>
<td>4 weeks</td>
<td>4 weeks</td>
<td>4 weeks</td>
<td>6 months</td>
</tr>
<tr>
<td>Pneumococcal conjugate</td>
<td>6 weeks</td>
<td>4 weeks</td>
<td>4 weeks</td>
<td>No further doses needed if previous dose was administered at age 24 months or older.</td>
<td>8 weeks (as final dose) if first dose was administered at age 12 through 14 months.</td>
</tr>
<tr>
<td>Inactivated poliovirus</td>
<td>6 weeks</td>
<td>4 weeks</td>
<td>4 weeks</td>
<td>4 weeks</td>
<td>8 weeks (as final dose) if first dose was administered at age 24 months or older.</td>
</tr>
<tr>
<td>Measles, mumps, rubella</td>
<td>12 months</td>
<td>4 weeks</td>
<td>4 weeks</td>
<td>No further doses needed for healthy children if previous dose was administered at age 24 months or older.</td>
<td>6 months (minimum age 4 years for final dose).</td>
</tr>
<tr>
<td>Varicella</td>
<td>12 months</td>
<td>3 months</td>
<td>4 weeks</td>
<td>4 weeks</td>
<td>6 months (minimum age 4 years for final dose).</td>
</tr>
<tr>
<td>Hepatitis A</td>
<td>12 months</td>
<td>6 months</td>
<td>4 weeks</td>
<td>4 weeks</td>
<td>6 months (minimum age 4 years for final dose).</td>
</tr>
<tr>
<td>Meningococcal</td>
<td>2 months MenACWY-CRM</td>
<td>8 weeks</td>
<td>4 weeks</td>
<td>8 weeks (as final dose) if first dose was administered at age 24 months or older.</td>
<td>6 months (minimum age 4 years for final dose).</td>
</tr>
<tr>
<td>9 months MenACWY-D</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meningococcal</td>
<td>Not Applicable (N/A)</td>
<td>8 weeks</td>
<td>4 weeks</td>
<td>8 weeks (as final dose) if first dose was administered at age 24 months or older.</td>
<td>6 months if first dose of DTaP/DT was administered before 1st birthday.</td>
</tr>
<tr>
<td>Tetanus, diphtheria, and acellular pertussis</td>
<td>7 years</td>
<td>4 weeks</td>
<td>4 weeks</td>
<td>4 weeks</td>
<td>6 months if first dose of DTaP/DT was administered before 1st birthday.</td>
</tr>
<tr>
<td>Human papillomavirus</td>
<td>9 years</td>
<td>Routine dosing intervals are recommended.</td>
<td>6 months (as final dose) if DTap/DT was administered at or after the 1st birthday.</td>
<td>Routine dosing intervals are recommended.</td>
<td>6 months if first dose of DTaP/DT was administered before the 1st birthday.</td>
</tr>
<tr>
<td>Hepatitis A</td>
<td>N/A</td>
<td>6 months</td>
<td>8 weeks (as final dose)</td>
<td>8 weeks and at least 16 weeks after first dose.</td>
<td>6 months if first dose of DTaP/DT was administered before the 1st birthday.</td>
</tr>
<tr>
<td>Hepatitis B</td>
<td>N/A</td>
<td>4 weeks</td>
<td>6 months</td>
<td>6 months (as final dose)</td>
<td>6 months if first dose of DTaP/DT was administered at or after the 1st birthday.</td>
</tr>
<tr>
<td>Inactivated poliovirus</td>
<td>N/A</td>
<td>4 weeks</td>
<td>8 weeks and at least 16 weeks after first dose.</td>
<td>6 months (as final dose)</td>
<td>6 months if first dose of DTaP/DT was administered at or after the 1st birthday.</td>
</tr>
<tr>
<td>Measles, mumps, rubella</td>
<td>N/A</td>
<td>3 months if younger than age 13 years.</td>
<td>8 weeks and at least 16 weeks after first dose.</td>
<td>8 weeks and at least 16 weeks after first dose.</td>
<td>6 months if first dose of DTaP/DT was administered at or after the 1st birthday.</td>
</tr>
<tr>
<td>Varicella</td>
<td>N/A</td>
<td>4 weeks</td>
<td>4 weeks if age 13 years or older.</td>
<td>4 weeks if age 13 years or older.</td>
<td>4 weeks if age 13 years or older.</td>
</tr>
</tbody>
</table>
### Table 3
Recommended Child and Adolescent Immunization Schedule by Medical Indication
United States, 2019

<table>
<thead>
<tr>
<th>VACCINE</th>
<th>Pregnancy</th>
<th>Immunocompromised status (excluding HIV infection)</th>
<th>HIV infection CD4+ count&lt;15% and total CD4 cell count of &lt;200/mm³</th>
<th>≥15% and total CD4 cell count of ≥200/mm³</th>
<th>Kidney failure, end-stage renal disease, on hemodialysis</th>
<th>Heart disease, chronic lung disease</th>
<th>CSF leaks/ cochlear implants</th>
<th>Asplenia and persistent complement component deficiencies</th>
<th>Chronic liver disease</th>
<th>Diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hepatitis B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Rotavirus</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diphtheria, tetanus, &amp; acellular pertussis (DTaP)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Haemophilus influenza type b</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Pneumococcal conjugate</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Inactivated poliovirus</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Influenza (IV)</td>
<td></td>
<td></td>
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1 For additional information regarding HIV laboratory parameters and use of live vaccines, see the General Best Practice Guidelines for Immunization "Altered Immunocompetence" at www.cdc.gov/vaccines/hcp/acip-recs/general-recs/immunocompetence.html, and Table 4-1 (footnote D) at: www.cdc.gov/vaccines/hcp/acip-recs/general-recs/contraindications.html.

2 Severe Combined Immunodeficiency

3 LAIV contraindicated for children 2–4 years of age with asthma or wheezing during the preceding 12 months.
For vaccine recommendations for persons 19 years of age and older, see the Recommended Adult Immunization Schedule.

Additional information
- Consult relevant ACIP statements for detailed recommendations at www.cdc.gov/vaccines/hcp/acip-recs/index.html.
- For a vaccine, consult the General Best Practice Guidelines for Immunization and relevant ACIP statements at www.cdc.gov/vaccines/hcp/acip-recs/index.html.
- For calculating intervals between doses, 4 weeks = 28 days. Intervals of 2-4 months are determined by calendar months.
- Within a number range (e.g., 12-18), a dash (-) should be read as "through.
- Vaccine doses administered ≥4 days before the minimum age or interval are considered valid. Doses of any vaccine administered ≥5 days earlier than the minimum age or minimum interval should not be counted as valid and should be repeated as age-appropriate. The repeat dose should be spaced after the invalid dose by the recommended minimum interval. For further details, see Table 3-1, Recommended and minimum ages and intervals between vaccine doses, in General Best Practice Guidelines for Immunization at www.cdc.gov/vaccines/hcp/acip-recs/general-recs/timing.html.
- Information on travel vaccine requirements and recommendations is available at wwwnc.cdc.gov/travel/.
- For information regarding vaccination in the setting of a vaccine-preventable disease outbreak, contact your state or local health department.
- The National Vaccine Injury Compensation Program (VICP) is a no-fault alternative to the traditional legal system for resolving vaccine injury claims. All routine child and adolescent vaccines are covered by VICP except for pneumococcal polysaccharide vaccine (PPSV23). For more information, see www.hrsa.gov/vaccinecompensation/index.html.

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

**Routine vaccination**
- 5-dose series at 2, 4, 6, 13-18 months, 4-6 years
- **Prospectively**: Dose 4 may be given as early as age 12 months if at least 6 months have elapsed since dose 3.
- **Retrospectively**: A 4th dose that was inadvertently given as early as 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.
- For other catch-up guidance, see Table 2.

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

**Routine vaccination**
- ActHIB, Hiberix, or Pentacel: 4-dose series at 2, 4, 6, 12-15 months
- PedvaxHIB: 3-dose series at 2, 4, 12-15 months

**Catch-up vaccination**
- **Dose 1 at 7-11 months**: Administer dose 2 at least 4 weeks later and dose 3 (final dose) at 12-15 months or 8 weeks after dose 2 (whichever is later).
- **Dose 1 at 12-14 months**: Administer dose 2 (final dose) at least 8 weeks after dose 1.
- **Dose 1 before 12 months and dose 2 before 15 months**: Administer dose 3 (final dose) 8 weeks after dose 2.
- **2 doses of PedvaxHIB before 12 months**: Administer dose 3 (final dose) at 12-59 months and at least 8 weeks after dose 2.
- **Unvaccinated at 15-59 months**: 1 dose
- For other catch-up guidance, see Table 2.

**Special situations**
- **Chemotherapy or radiation treatment**: 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)**:
  - 12-59 months
    - Unvaccinated or only 1 dose before 12 months: 2 doses, 8 weeks apart
    - 2 or more doses before 12 months: 1 dose at least 8 weeks after previous dose
  - **Unvaccinated**: persons age 5 years or older
    - 1 dose
- **Ectopic splenectomy**:
  - Unvaccinated**: persons age 15 months or older
    - 1 dose (preferably at least 14 days before procedure)
- **HIV infection**:
  - 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**:
  - 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 14 months) OR no doses (14 months or older)
Recommended Child and Adolescent Immunization Schedule for ages 18 years or younger, United States, 2019

**Hepatitis A vaccination** (minimum age: 12 months for routine vaccination)

- **Routine vaccination**
  - 2-dose series (Mavrix 6–12 months apart or Vaqta 6–18 months apart, minimum interval 6 months); a series begun before the 2nd birthday should be completed even if the child turns 2 before the second dose is administered.

- **Catch-up vaccination**
  - Anyone 2 years of age or older may receive HepA vaccine if desired. Minimum interval between doses: 6 months.
  - Adolescents 18 years and older may receive the combined HepA and HepB vaccine, Twinrix, as a 3-dose series (0, 1, and 6 months) or 4-dose series (0, 1, 2, and 21–30 days, followed by a dose at 12 months).

- **International travel**
  - Persons traveling to or working in countries with high or intermediate endemic hepatitis A (wwwnc.cdc.gov/travel/)
    - Infants age 6–11 months: 1 dose before departure; revaccinate with 2 doses, separated by 6–18 months, between 12 to 23 months of age.
    - Unvaccinated age 12 months and older: 1st dose as soon as travel considered.

- **Special situations**
  - At risk for hepatitis A infection: 2-dose series as above
    - Chronic liver disease
    - Clotting factor disorders
    - Men who have sex with men
    - Injection or non-injection drug use
    - Homelessness
    - Work with hepatitis A virus in a research laboratory or nonhuman primates with hepatitis A infection
    - Travel in countries with high or intermediate endemic hepatitis A
  - Close, personal contact with international adoptee (e.g., household or regular babysitting) in first 60 days after arrival from country with high or intermediate endemic hepatitis A
  - Administration of all doses at least 2 weeks before adoptee’s arrival.

**Hepatitis B vaccination** (minimum age: birth)

- **Birth dose (monovalent HepB vaccine only)**
  - Mother is HBsAg-positive: 1 dose within 24 hours of birth for all medically stable infants ≥2,000 grams. Infants <2,000 grams: administer 1 dose at chronological age 1 month or hospital discharge.

- **Mother is HBsAg-negative:**
  - Administer HepB vaccine and 0.5 mL of hepatitis B immune globulin (HBIG) (at separate anatomic sites) within 12 hours of birth, regardless of birth weight. For infants <2,000 grams, administer 3 additional doses of vaccine (total of 4 doses) beginning at age 1 month.
  - For infants ≥2,000 grams, administer 3 additional doses of vaccine (total of 4 doses) beginning at age 1 month.
  - Test for HBsAg and anti-HBs at age 9–12 months. If HepB series is delayed, test 1–2 months after final dose.

  - **Mother’s HBsAg status unknown:**
    - Administer HepB vaccine within 12 hours of birth, regardless of birth weight.
    - For infants <2,000 grams, administer 0.5 mL of HBIG in addition to HepB vaccine within 12 hours of birth. Administer 3 additional doses of vaccine (total of 4 doses) beginning at age 1 month.
    - Determine mother’s HBsAg status as soon as possible. If mother is HBsAg-positive, administer 0.5 mL of HBIG to infants ≥2,000 grams as soon as possible, but no later than 7 days of age.

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

- **Minimum age for the final (3rd or 4th) dose:** 24 weeks

- **Minimum interval:** dose 1 to dose 2: 4 weeks / dose 2 to dose 3: 8 weeks / dose 1 to dose 3: 16 weeks (when 4 doses are administered, substitute “dose 4” for “dose 3” in these calculations).

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

  - For other catch-up guidance, see Table 2.

**Human papillomavirus vaccination** (minimum age: 9 years)

- **Routine and catch-up vaccination**
  - HPV vaccination routinely recommended for all adolescents age 11–12 years (can start at age 9 years) and through age 18 years if not previously adequately vaccinated
  - 2- or 3-dose series depending on age at initial vaccination:
    - Age 9 through 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)

  - If completed valid vaccination series with any HPV vaccine, no additional doses needed

- **Special situations**
  - Immunocompromising conditions, including HIV infection: 3-dose series as above
  - History of sexual abuse or assault: Start at age 9 years
  - Pregnancy: HPV vaccination not recommended until after pregnancy; no intervention needed if vaccinated while pregnant; pregnancy testing not needed before vaccination

**Inactivated 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 the 4th birthday and at least 6 months after the previous dose.

  - 4 or more doses of IPV can be administered before the 4th birthday when a combination vaccine containing IPV is used. However, a dose is still recommended after the 4th birthday and at least 6 months after the previous dose.

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

- **Series containing oral polio vaccine (OPV), either mixed OPV-IPV or OPV-only series**
  - Total number of doses needed to complete the series is the same as that recommended for the U.S. IPV schedule. See www.cdc.gov/mmwr/volumes/66/wr/mm6601a6.htm?cscl=mm6601a6_w.
IMMUNIZATIONS IN SCHOOL-AGED CHILDREN

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Notes

- Only trivalent OPV (tOPV) counts toward the U.S. vaccination requirements. For guidance to assess doses documented as "OPV," see www.cdc.gov/mmwr/volumes/66/wr/mm6606a7.htm?ss_cid=mm6606a7_w.
- For other catch-up guidance, see Table 2.

Influenza vaccination
(minimum age: 6 months [IIV], 2 years [LAIV], 18 years [RIV])

Routine vaccination
1 dose any influenza vaccine appropriate for age and health status annually (2 doses separated by at least 4 weeks for children 6 months–8 years who did not receive at least 2 doses of influenza vaccine before July 1, 2018)

Special situations
- Egg allergy, hives only: Any influenza vaccine appropriate for age and health status annually
- Egg allergy more severe than hives (e.g., angioedema, respiratory distress): Any influenza vaccine appropriate for age and health status annually in medical setting under supervision of health care provider who can recognize and manage severe allergic conditions
- LAIV should not be used for those with a history of severe allergic reaction to any component of the vaccine (excluding egg) or to a previous dose of any influenza vaccine, children and adolescents receiving concomitant aspirin or salicylate-containing medications, children age 2 through 4 years with a history of asthma or wheezing, those who are immunocompromised due to any cause (including immunosuppression caused by medications and HIV infection), anatomic and functional asplenia, cochlear implants, cerebrospinal fluid-orthorhaphyngial communication, close contacts and caregivers of severely immunosuppressed persons who require a protected environment, pregnancy, and persons who have received influenza antiviral medications within the previous 48 hours.

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

Routine vaccination
2-dose series: 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, eczulizumab use:
- Menveo
  - Dose 1 at age 8 weeks: 4-dose series at 2, 4, 6, 12 months
  - Dose 1 at age 7–23 months: 2-dose series (dose 2 at least 12 weeks after dose 1 and after the 1st birthday)
  - Dose 1 at age 24 months or older: 2-dose series at least 8 weeks apart
- Menactra
  - Persistent complement component deficiency:
    - Age 9–23 months: 2 doses at least 12 weeks apart
    - Age 24 months or older: 2 doses at least 8 weeks apart
- Anatomic or functional asplenia, sickle cell disease, or HIV infection:
  - Age 9–23 months: Not recommended
  - 24 months or older: 2 doses at least 8 weeks apart
- Menactra must be administered at least 4 weeks after completion of PCV13 series.

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

Clinical discretion
- MenB vaccine may be administered based on individual clinical decision to adolescents not at increased risk age 16–23 years (preferred age 16–18 years):
  - Bexsero: 2-dose series at least 1 month apart
  - Trumena: 2-dose series at least 6 months apart; if dose 2 is administered earlier than 6 months, administer a 3rd dose at least 4 months after dose 2.

Special situations
Anatomic or functional asplenia (including sickle cell disease), persistent complement component deficiency, eczulizumab use:
- Bexsero: 2-dose series at least 1 month apart
- Trumena: 3-dose series at 0, 1–2, 6 months
- Bexsero and Trumena are not interchangeable; the same product should be used for all doses in a series.

For additional meningococcal vaccination information, see meningococcal MMWR publications at www.cdc.gov/vaccines/hcp/acs-recs/vacc-specific/mening.html.
**IMMUNIZATIONS IN SCHOOL-AGED CHILDREN**

**Notes**

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**Pneumococcal vaccination**

- Minimum age: 6 weeks [PCV13], 2 years [PPSV23]

**Routine vaccination with PCV13**
- 4-dose series at 2, 4, 6, 12–15 months

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

**Special situations**

- High-risk conditions below: When both PCV13 and PPSV23 are indicated, administer PCV13 first. PCV13 and PPSV23 should not be administered during same visit.
- Chronic heart disease (particularly cyanotic congenital heart disease and cardiac failure); chronic lung disease (including asthma treated with high-dose, oral corticosteroids); diabetes mellitus:
  - Age 2–5 years
    - Any incomplete* series with:
      - 3 PCV13 doses: 1 dose PCV13 (at least 8 weeks after any prior PCV13 dose)
      - Less than 3 PCV13 doses: 2 doses PCV13 (8 weeks after the most recent dose and administered 8 weeks apart)
    - No history of PPSV23: 1 dose PPSV23 (at least 8 weeks after any prior PCV13 dose)
  - Age 6–18 years
    - No history of PPSV23: 1 dose PPSV23 (at least 8 weeks after any prior PCV13 dose)

**Cerebrospinal fluid leak, cochlear implant:**

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

**Rotavirus vaccination**

- Minimum age: 6 weeks

**Routine vaccination**

- Rotarix: 2-dose series at 2 and 4 months.
- RotaTeq: 3-dose series at 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 Figure 2.

**Tetanus, diphtheria, and pertussis (Tdap) vaccination**

- Minimum age: 11 years for routine vaccination, 7 years for catch-up vaccination

**Routine vaccination**

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

**Catch-up vaccination**

- Adolescents age 13–18 years who have not received Tdap:
  - 1 dose Tdap, then Td booster every 10 years
- Persons age 7–18 years not fully immunized with DTaP:
  - 1 dose Tdap as part of the catch-up series (preferably the first dose); if additional doses are needed, use Td.
- Children age 7–10 years who receive Tdap inadvertently or as part of the catch-up series should receive the routine Tdap dose at 11–12 years.
- DTaP inadvertently given after the 7th birthday:
  - Child age 7–10 years: DTaP may count as part of catch-up series. Routine Tdap dose at 11–12 should be administered.
- Adolescent age 11–18 years: Count dose of DTaP as the adolescent Tdap booster.
- For other catch-up guidance, see Table 2.
- For information on use of Tdap or Td as tetanus prophylaxis in wound management, see www.cdc.gov/mmwr/volumes/67/rr6702a1.htm.

**Varicella vaccination**

- Minimum age: 12 months

**Routine vaccination**

- 2-dose series: 12–15 months, 4–6 years
- Dose 2 may be administered as early as 3 months after dose 1 (a dose administered after a 4-week interval may be counted).

**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 2-dose series:
  - Ages 7–12 years: routine interval: 3 months (minimum interval: 4 weeks)
  - Ages 13 years and older: routine interval: 4–8 weeks (minimum interval: 4 weeks)
- The maximum age for use of MMRV is 12 years.