

CENTER STAGE: Adolescent Immunizations

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Nurses and nurse practitioners (NPs) have contributed to the advances in immunization coverage for infants and preschoolers, decreasing the incidence of common vaccine-preventable childhood diseases by almost 100%.¹ In a similar fashion, the rate of influenza coverage for older adults has doubled, from 33% in 1989 to 66% in 2003.^{2,3} Now NPs have an opportunity to focus on immunizations for adolescents. In recent years, new vaccines have been added to the adolescent immunization schedule,⁴ and more adolescent immunization vaccines are in development.⁵

The 11/12-year-old visit is an opportune time to administer vaccines recommended for children this age and to assess other immunization needs.⁴ The Society for Adolescent Medicine recommends three distinct adolescent vaccination visits, at ages 11/12, 14/15, and 17/18.⁵ Adolescent immunizations should include the meningococcal vaccine and a booster for tetanus/diphtheria combined with an adolescent formulation for pertussis (Tdap). The need for hepatitis A, influenza, and pneumococcal immunizations should be assessed, along with the need for any vaccines that may have been missed in earlier years. These include immunizations against hepatitis B, measles–mumps–rubella (MMR), varicella, and polio. In addition, a human papillomavirus (HPV) vaccine has been approved for use in female adolescents, and clinical recommendations are forthcoming.

This article reviews the epidemiology, disease characteristics, and indications for each adolescent immunization.

Vaccines for All Adolescents

Meningococcal Vaccine—Meningococcal infections, spread by contact with large-droplet respiratory secretions, typically present as meningitis or sepsis, with sudden onset of symptoms. Even with rapid antibiotic therapy, meningococcal infections have a case-fatality rate of 10% to 14%.⁶ In other words, at least 1 of every 10 persons infected by the *Neisseria meningitidis* bacterium dies. Among meningococcal disease survivors, 11% to 19% have severe sequelae such as limb loss, hearing deficits, stroke, seizures, or other neurologic disabilities.⁶ Adolescents rank second only to infants in terms of their rate of meningococcal disease.⁷ However, meningococcal disease-related mortality is higher among adolescents and young adults than among infected infants.⁸

The most common serotypes of meningococcal meningitis are C, Y, and W-135. Serotype A is not common in the United States but is prevalent in sub-Saharan Africa.¹ The quadrivalent meningococcal vaccine (A, C, Y, W-135) can prevent more than 80%

of meningococcal infections among adolescents and young adults.⁸ For now at least, we lack a vaccine against meningococcal serogroup B, which primarily affects younger children and infants.

Two forms of meningococcal vaccine for adolescents are available: a polysaccharide vaccine (Menomune®) and a newer conjugate vaccine (Menactra™). Both vaccines protect against meningococcal serogroups A, C, Y and W-135. The polysaccharide vaccine, Menomune, has a shorter duration—it offers 3 to 5 years of protection and should be given as temporally close as possible to the highest risk period (eg, just before teens begin dormitory life). The conjugate vaccine, Menactra, appears to provide longer-lasting protection at least 8 years. It can be given at the 11/12-year-old visit or later to protect patients through the adolescent years and into the college years. Need for revaccination has not yet been determined.

The Advisory Committee for Immunization Practices (ACIP) of the Centers for Disease Control and Prevention (CDC) recommends universal use of the conjugate vaccine for 11/12-year-olds. ACIP has also issued an interim recommendation for immunizing persons entering high school and those who will be college freshman living in a dormitory.⁶ In a few years, the cohort of immunized 11/12-year-olds will enter high school and the interim recommendations can evolve to catch-up immunizations. Because the incidence of meningococcal disease is relatively higher among college students living in a dorm, it is important to protect them before they leave for school. Several states and colleges require entering students to be vaccinated with, or at least educated about, the meningococcal vaccine.⁹ With Menactra, NPs do not need to wait until just before their patients move into a dorm. In fact, to avoid peak demand in the summer and potential spot shortages of vaccine, NPs can immunize these patients at any time during the year.

Pertussis Vaccine—Pertussis is the only vaccine-preventable disease on the rise in the United States; the highest increase in incidence is among 10- to 19-year-olds.¹⁰ Bordetella pertussis is spread person to person, mostly through respiratory droplets created by coughs and sneezes. In a typical case, pertussis infection initially presents as a common cold; this phase is the most contagious. The disease is highly communicable, with attack rates as high as 80% to 90% among non-immune household contacts.¹¹ Infants infected with pertussis prior to completing the infant immunization series are especially vulnerable, accounting for 90% of pertussis-related deaths.¹¹ Although most teenagers do not get the classic “whoop” from which pertussis gets its “whooping cough” moniker, they do experience prolonged cough, and remain infectious for an extended period of time. Among persons diagnosed with pertussis, 97% have a cough lasting more than 3 weeks.¹² Additional signs and symptoms (S&S) of pertussis include difficulty breathing, sleep disruptions, and vomiting related to excessive coughing.¹¹

The Tdap vaccine for adolescents and adults contains a smaller amount of pertussis than does the pediatric formulation, combined with tetanus and diphtheria antigens. One Tdap formulation, Daptacel®, is approved for persons aged 11 to 64 years. Another formulation, Boostrix®, is approved for use among 10- to 18-year-olds. Current US Food and Drug Administration licensure is for onetime use of Tdap only.

Because the Menactra vaccine also contains a diphtheria toxoid component, ACIP recommends that it and Tdap be given simultaneously (as opposed to being spaced less than a month apart).¹¹ If these two vaccines are not given on the same day, ACIP suggests an interval of at least 1 month between them. In addition, ACIP recommends a 10-year interval between a previous tetanus–diphtheria (Td) booster and a Tdap, and a minimum 5-year interval between a pediatric DTaP and a Tdap.¹¹ Some adolescents experience syncope after receiving a Tdap vaccine (this reaction is more common in this age group than in younger children); therefore, they should be seated while the vaccine is being administered and should remain so for 20 minutes afterward.¹

Vaccines for Selected Adolescents

Influenza Vaccine—Influenza, more common in winter than in other seasons, causes 36,000 deaths each year in the United States.³ Flu virus particles are transmitted through coughs and sneezes of infected persons, but infectivity can precede S&S onset. Disease incidence is highest among children, who can be a major source of influenza transmission to others.³ Complications and mortality are highest among seniors, infants, and persons with medical conditions such as asthma and diabetes. Not only are adolescents potential sources of infection to vulnerable infants and seniors, but many of them also have medical conditions placing them at risk for influenza complications.

Current influenza vaccine recommendations call for universal immunization of seniors aged 65 years or older and children aged 6 to 23 months. Immunization is recommended for all adolescents with a chronic condition that may increase their risk of flu complications. The list of chronic conditions includes respiratory disorders (eg, asthma), metabolic disorders (eg, diabetes mellitus), cardiovascular conditions, renal dysfunction, and any neurologic disorder that can compromise the handling of respiratory secretions. In addition, children and adolescents aged 6 months to 18 years who are receiving long-term aspirin therapy should be immunized against influenza because aspirin use in a patient with flu can increase the risk of developing Reye syndrome. Adolescents who reside with persons in high-risk groups for influenza should also be immunized because they can transmit flu in the household. Pregnancy is an indication for influenza immunization; therefore, all pregnant adolescents should be immunized.³

Influenza vaccine is available in two forms. The trivalent inactivated vaccine (TIV) is injected intramuscularly. ACIP recommends that TIV be used in adolescents who have a chronic condition because they are more vulnerable to flu complications. TIV can also be given to healthy adolescents. The live attenuated influenza vaccine (LAIV; FluMist®), an intranasal spray, can be used only in healthy adolescents, including those who are close contacts of high-risk and immunosuppressed persons.

Pneumococcal Vaccine—*Streptococcus pneumoniae* can cause pneumonia, bacteremia, and meningitis. Pneumococcal disease is most likely to occur in persons with a predisposing chronic condition. The 23-valent pneumococcal polysaccharide vaccine is

recommended for adolescents with a chronic illness, including cardiovascular disease, pulmonary disease, diabetes, or liver problems, as well as in those who are immunocompromised. The 23-valent vaccine can be given after age 2 years. (The pneumococcal 7-valent conjugate vaccine, Prevnar®, is given to young children.)

Hepatitis A Vaccine (HAV)—Hepatitis A usually spreads through the fecal–oral route and may be manifested by sudden onset of malaise, jaundice, fever, anorexia, abdominal discomfort, and dark urine. Although the disease in younger children can be asymptomatic or mild, 70% of older children and adults are symptomatic. Hepatitis A can have substantial impact: 11% to 22% of infected persons are hospitalized, and approximately 100 patients in the United States die from fulminant hepatitis A each year.¹³

HAV is recommended for adolescents at increased risk for hepatitis A, including those who are Native American or Alaskan Native, those with chronic liver disease, males who have sex with males, and illegal drug users (injecting or non-injecting).¹³ HAV is also recommended for adolescents residing in states in which historical hepatitis A rates have been at least twice as high as the national average (>20 cases/100,000); these states include Arizona, Alaska, California, Idaho, Nevada, New Mexico, Oklahoma, Oregon, South Dakota, Utah, and Washington.

The CDC recommends that HAV be considered in adolescents residing in states in which historical hepatitis A rates are between 10 and 20 cases per 100,000; these states include Arkansas, Colorado, Missouri, Montana, Texas, and Wyoming. In addition, HAV should be given to adolescents who plan to travel to countries in which the disease is endemic. For maximum protection, HAV should be given at least 4 weeks before travel.¹ A second dose is given at least 6 months later for lasting protection. Because it is difficult to determine whether today’s adolescent is tomorrow’s “at risk” adult, NPs may consider potential hepatitis A risks when determining immunization needs.

Catch-up Vaccines

NPs should assess adolescents’ immunization history to ensure that they have completed the hepatitis B series and have received the second MMR vaccine and the varicella vaccine.

Hepatitis B Vaccine—In nonimmunized persons, hepatitis B can cause chronic liver disease, which can lead to liver cancer and death.¹ One goal of immunizing adolescents against hepatitis B is to eliminate transmission of the disease to newborns from infected mothers; congenitally-acquired hepatitis can lead to chronic liver disease and death. Perinatal transmission is very efficient: 70% to 90% of infants born to infected mothers, if untreated, develop hepatitis B.¹

Hepatitis B is transmitted primarily via blood and bodily fluids (eg, sexual activity, needle sharing). Risk factors for hepatitis B include multiple partners (³2 partners in 6 months), intravenous drug use, and sex between males. ACIP recommends universal

hepatitis B immunization of children and adolescents.¹ Many adolescents have completed the hepatitis B series before entering school. However, NPs should assess each adolescent's immunization history to ensure that the series has been completed. If the series of three hepatitis B immunizations was previously started but not completed, it is not necessary to repeat any doses. Instead, NPs should continue the series wherever it was interrupted.¹ The usual schedule for adolescents not previously immunized is two doses separated by 4 weeks or longer and a third dose 4 to 6 months after the second dose.¹ An alternative for 11- to 15-year-olds who have not been previously immunized is to give two doses of Recombivax HB® 4 to 6 months apart.

Measles–Mumps–Rubella Vaccine—Widespread use of the MMR vaccine has reduced the incidence of these diseases by more than 99% in the United States.¹ However, measles continues to kill children in underdeveloped countries, especially those who are malnourished.¹ Adolescents should have received two doses, one in the second year of life and a preschool booster. If an adolescent has had neither dose, NPs can give two doses, separated by 4 weeks or longer. If a patient has had one dose after age 1 year, a second dose can be given as long as at least 4 weeks have elapsed since the first dose. An MMR dose given before the first birthday should not be counted as one of the two needed doses.¹ In other words, children need to have two MMR vaccines, separated by at least 4 weeks, after their first birthday.

Varicella Vaccine—Varicella (chickenpox), which is caused by the varicella zoster virus, typically causes clusters of vesicles appearing first on the scalp, then the trunk, and then the extremities. Although generally mild and self-limited, varicella may result in secondary bacterial infections, pneumonia, and central nervous system (CNS) complications. Reye syndrome can occur if aspirin is taken during the varicella illness. The risk of complications increases with age. Compared with young children, adolescents aged 15 to 19 years have a 2.7 times greater case-fatality rate and adults aged 30 to 49 have a 25-fold increased case-fatality rate.¹

Since the vaccine became available in 1995, most adolescents have had the vaccine or the disease previously. A titer can clarify any ambiguity in the history. The varicella vaccine is indicated for adolescents who remain susceptible, having no history of immunization or disease or a low titer. Children aged 12 years or younger need one dose, whereas adolescents aged 13 years or older should have two doses, 4 to 8 weeks apart.¹ Varicella and MMR may be given on the same day. If not given on the same day, these two vaccines should be given at least 28 days apart.¹

Poliomyelitis Vaccine—It is 51 years since the polio vaccine was developed, producing a dramatic decline in this disease. Global eradication of polio within the next 10 years is feasible, but outbreaks in Asia and Africa may make this goal elusive. The polio virus, which has three serotypes, enters the body through the mouth and spreads through the hematologic system to the lymphatic system and CNS. Usually asymptomatic and spreading silently, polio may cause paralysis in some victims by damaging or destroying motor neurons.

Inactivated polio vaccine (IPV) is given in the infant series, with a preschool booster. To prevent vaccine-associated paralytic polio, the live attenuated oral polio vaccine is no longer used in the United States. Non-immunized adolescents should be given two doses of IPV separated by 4 to 8 weeks, and a third dose 6 to 12 months after the second dose. Polio vaccine is not routinely administered to persons aged 18 years or older.¹⁴

TABLE ADOLESCENT IMMUNIZATIONS				
VACCINES FOR ALL ADOLESCENTS				
VACCINE	SC* OR IM†	DOSES	WHICH ADOLESCENTS	CONTRAINDICATIONS
Meningococcal conjugate	SC	1	All	Latex allergy
Tetanus-diphtheria-acellular pertussis (Tdap)	IM	1	All (unless patient had Td in past 2 years)	Severe allergic reaction after previous dose or to a vaccine component; history of encephalopathy within 7 days of previous DTaP or DTwP; progressive neurologic disorders; uncontrolled epilepsy
VACCINES FOR SELECTED ADOLESCENT GROUPS				
Hepatitis A	IM	2	At risk	Severe allergic reaction to previous dose
Influenza	IM (TIV) or intranasal (LAIV)	1 each year	Persons at risk for complications; household contacts of those at risk	TIV: egg or chicken protein allergy, active neurologic disorder, previous severe reaction to flu vaccine LAIV: egg allergy, aspirin therapy, history Guillain-Barré syndrome, pregnancy, chronic cardiovascular or pulmonary disorders, asthma, renal dysfunction, other chronic conditions
Pneumonia	IM	1	At risk	Severe allergic reaction to previous dose or component
CATCH-UP VACCINES				
Hepatitis B	IM	Engerix-B®: 3 doses, over 6 months; Recombivax®: 2 doses, 4-6 months apart	All should complete series	Yeast hypersensitivity or severe allergic reaction to previous dose
Measles-Mumps-Rubella	SC	2 doses, at least 4 weeks apart	All should have had 2 MMR since 1 year of age	Egg, gelatin, or neomycin hypersensitivity; active respiratory or other febrile infection; active untreated tuberculosis; immunosuppression, blood dyscrasias, bone marrow or lymphatic malignancy; pregnancy during and for 3 months after vaccination
Varicella	SC	<12 years: 1 dose; >13 years: 2 doses, 4-8 weeks apart	All, unless had disease	Gelatin or neomycin hypersensitivity; active febrile infection; active untreated tuberculosis; immunosuppression; blood dyscrasias; bone marrow or lymphatic malignancy; pregnancy during and for 3 months after vaccination
Poliomyelitis (IPV)	SC or IM	Series of 3 at 0, 1, and 6-12 months	All <18 years old should complete series	Neomycin, streptomycin, polymyxin b hypersensitivity
<small>SC = subcutaneous; IM = intramuscular; Td = tetanus-diphtheria; DTaP = diphtheria and tetanus toxoids and acellular pertussis; DTwP = diphtheria, tetanus, and whole-cell pertussis; TIV = trivalent inactivated vaccine; LAIV = live attenuated influenza vaccine; IPV = inactivated polio vaccine. *SC: use 5/8-inch, 23- to 25-gauge needle. †IM: select needle for appropriate age: if patient is <12 months old, use 7/8- to 1-inch, 22- to 25-gauge needle; for patients 12 mo-18 yrs, use 7/8- to 1 1/4-inch, 22- to 25-gauge needle; for patients ≥18 years, use 1- to 1 1/2-inch, 22- to 25-gauge needle. Sources: Centers for Disease Control and Prevention. <i>Epidemiology and Prevention of Vaccine-Preventable Diseases</i>. Atkinson W, Hamborsky J, McIntyre L, Wolfe S, eds. 9th ed. Washington DC: Public Health Foundation; 2006. Centers for Disease Control and Prevention. <i>Contraindications to Vaccines Chart</i>. Available at: http://www.cdc.gov/nip/recs/contraindications_vacc.htm. <i>Nurse Practitioners' Prescribing Reference</i>. 2006;13(1).</small>				

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