



CENTERS FOR DISEASE CONTROL AND PREVENTION 2009 Immunization Update

Learning Objectives

After completing this activity, participants should be better able to:

- Utilize reliable science-based information when addressing patient concerns or questions about immunization
- Identify common errors and misunderstandings often seen in immunization practice in the United States
- Explain recent changes to immunization recommendations coming from the Advisory Committee on Immunization Practices
- Locate essential immunization resources such as immunization recommendations and Vaccine Information Statements

Adolescent and Adult Immunizations: A Clinical Challenge

Immunization significantly reduces the risk of contracting a vaccine-preventable disease. While many parents are vigilant about ensuring that their young children receive their childhood vaccines on time, adults generally don't think about immunizations for themselves beyond their annual flu shot (if even then). And, unless teenagers need a physical examination or vaccination for school or sports, chances are you will not see them in the office for preventive care. Data from 2007 indicate that only 2% of adults ≥ 60 years received the new herpes zoster vaccine, and just 10% of 18- to 26-year-old women were immunized against human papillomavirus (HPV).¹ While 69% of those ≥ 65 years received the annual influenza immunization in 2006, only 42% of healthcare workers received a flu shot.²

Nurse practitioners and physician assistants can help their adult and adolescent patients reduce the risk of contracting infectious diseases by educating them on the importance of

Nurse practitioners and physician assistants are in a position to prevent disease, foster public health, and educate the public about vaccine-preventable diseases.

Two situations warrant a second dose of pneumococcal vaccine.

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immunizations. Every office visit is an opportunity to teach patients about the role of immunizations in maintaining their own health as well as protecting their family and community from disease transmission.

Use of “standing orders” is an effective strategy for increasing immunization rates. These written policies, used in office, hospital, and residential care facilities, permit nonphysicians to offer and administer vaccines without direct physician involvement. Standing orders for immunizations can be downloaded from the Immunization Action Coalition (<http://www.immunize.org/standingorders>).

Each year, the Centers for Disease Control and Prevention (CDC) Advisory Committee on Immunization Practices (ACIP) re-evaluates and updates the immunization schedules for children, adolescents, and adults in the United States. This chapter summarizes 7 immunizations for adolescents and adults recommended by the ACIP in 2009, based on age or risk group.³⁻⁵

Pneumococcal Polysaccharide Vaccine

Pneumococcal disease is the second most common cause, after influenza, of vaccine-preventable death in the United States.³ The causative organism is a gram-positive bacterium, *Streptococcus pneumoniae*, which frequently colonizes the human respiratory tract and is transmitted via respiratory droplets. The major clinical manifestations of pneumococcal disease are pneumonia, bacteremia, and meningitis. Table 1 shows the annual estimates and case mortality rates for these serious diseases.

Table 1. Estimated Annual Pneumococcal Disease Burden in the United States

Major Clinical Syndrome	Approximate No. of US Cases/Year	Case Mortality Rate
Pneumonia	175,000 hospitalizations	5%-7% Higher in older adults
Bacteremia	>50,000	20% Up to 60% in older adults
Meningitis	3000-6000	30% Up to 80% in older adults

- *Streptococcus pneumoniae* causes up to 36% of adult community-acquired pneumonia and 50% of hospital-acquired pneumonia.
- Bacteremia occurs in approximately 25%-30% of patients with pneumococcal pneumonia.
- About 25% of patients with pneumococcal meningitis also have pneumonia.

Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. 11th ed. Atlanta, GA: CDC; 2009.

While invasive pneumococcal disease affects individuals of all ages, disease incidence peaks in the youngest (<1 year) and oldest (>64 years) age groups (Figure 1).⁶ Two vaccines are available for these populations. Pneumococcal conjugate vaccine, licensed in 2000, is routinely administered as a series to infants and toddlers 2 to 15 months of age. Pneumococcal polysaccharide vaccine (PPSV) (formerly PPV) is indicated for older adults and younger people who have certain medical conditions that place them at high risk. Licensed in 1983, PPSV covers 23 pneumococcal serotypes replacing the 14-valent PPSV first marketed in 1977. More than 80% of healthy adults immunized with PPSV develop antibodies within 2 to 3 weeks. Vaccine efficacy studies have estimated that PPSV is 60% to 70% effective in preventing invasive pneumococcal disease, but less effective in preventing pneumococcal pneumonia.

Who Should Receive PPSV?

The following groups should be given a 1-time dose of PPSV, administered intramuscularly (IM) or subcutaneously (preferably in the deltoid muscle or lateral mid-thigh):

- All adults ≥65 years of age
- People 2 through 64 years who:
 - Have ≥1 high-risk condition, including chronic pulmonary disease (chronic obstructive pulmonary disease, emphysema), chronic cardiovascular disease (congestive heart failure, cardiomyopathy), diabetes, alcoholism, chronic liver disease (including cirrhosis), cerebrospinal fluid leaks, cochlear implants, or functional or anatomic asplenia (including sickle cell disease and splenectomy)
 - Have an immunocompromising condition, such as human immunodeficiency virus

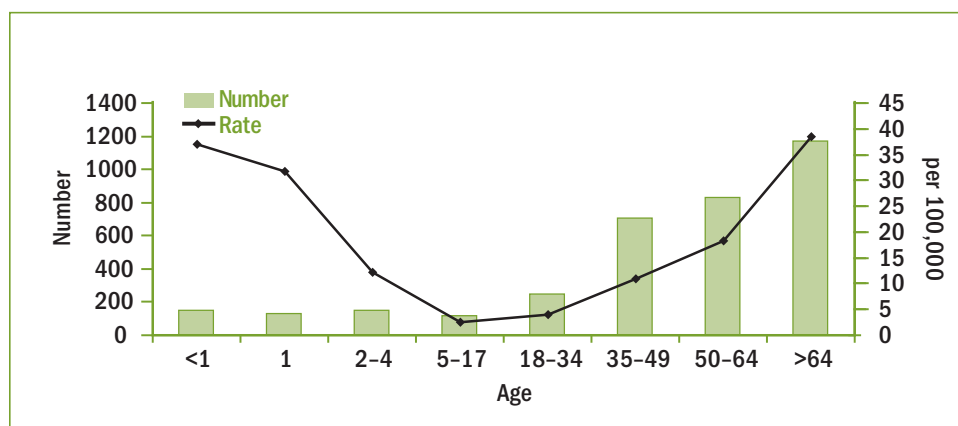


Figure 1. Incidence of invasive pneumococcal disease, active bacterial core surveillance, 2004. The incidence of pneumococcal disease has a bimodal distribution pattern, with peaks in the youngest and oldest age-groups. Per 100,000 population, 153 (37.0%) cases in babies <1 year old and 1173 (38.4%) cases in people >64 years old were reported for 2004. Active Bacterial Core Surveillance (ABCs) Report. <http://www.cdc.gov/ncidod/dbmd/abcs/survreports/spneu04.pdf>. Accessed June 15, 2009.

- (HIV) infection or AIDS, leukemia, lymphoma, Hodgkin's disease, multiple myeloma, generalized malignancy, chronic renal failure, nephrotic syndrome, or organ or bone marrow transplant
- Are receiving immunosuppressive chemotherapy, long-term corticosteroids, or radiation therapy
- Live in nursing homes or long-term care facilities
- Adults ≥ 19 years who have asthma or smoke cigarettes (The ACIP added these 2 indications in 2008 based on evidence of increased risk of invasive pneumococcal disease in these groups.)

Candidates for Revaccination

Although routine revaccination is not recommended, 2 circumstances warrant a second dose. First, 1-time revaccination after 5 years is recommended for persons at highest risk for serious pneumococcal infection, including those with chronic renal failure or nephrotic syndrome; those with functional or anatomic asplenia; and those with immunosuppression. Second, people ≥ 65 years of age should be given a second PPSV if they were vaccinated ≥ 5 years previously and were < 65 years at the time of the first PPSV. Typically, these are people in a high-risk category, which is why they received their first dose at a younger age. No more than 2 lifetime doses of PPSV should be given, and the minimum interval between doses is 5 years.

Contraindications, Precautions, and Adverse Reactions

Hypersensitivity to any PPSV component is a contraindication to immunization. People with moderate or severe acute illness should wait until their condition improves before being vaccinated. Those with minor illness, however, such as an upper respiratory infection, usually can be vaccinated. PPSV is not recommended during pregnancy. Ideally, women with underlying medical conditions that place them at high risk for pneumococcal disease should be vaccinated before becoming pregnant. Local and generally mild side effects lasting for up to 48 hours, such as pain, swelling, and erythema at the injection site, occur in about 30% to 50% of patients.

PPSV and the Novel Influenza A Outbreak

Secondary bacterial pneumonia was a significant cause of illness and death in 20th century influenza pandemics, and *S pneumoniae* was the most frequent etiologic agent. The association between pneumococcal infections and the 2009 novel influenza A (H1N1) pandemic is uncertain. The CDC recommends that healthcare practitioners continue to immunize patients with PPSV according to the current ACIP recommendations. Clinicians should be vigilant about vaccinating younger persons with underlying high-risk conditions, as this population seems to be overrepresented among severe cases of H1N1 flu, and PPSV coverage among this group is low.⁷

Influenza Vaccine

A highly infectious viral illness, influenza is responsible for an average of 226,000 hospitalizations and approximately 36,000 influenza-associated deaths each year in the United States. People ≥ 65 years of age account for more than 90% of deaths related to influenza and pneumonia, but rates of infection are highest among children.⁸ During the past 2 centuries, there have been 4 worldwide epidemics (pandemics) of influenza that killed millions of people (Table 2).

Because new influenza virus variants resulting from frequent, minor changes or “antigenic drift” in surface antigens occur during viral replication, influenza vaccine formulations need to be reassessed and updated annually. In contrast, more dramatic changes, or antigenic shifts, occur less frequently, but these can result in the emergence of a novel subtype of the H1N1 virus. If the new variant can be transmitted efficiently from person to person, it has the potential to cause a pandemic.^{3,8} With the recent emergence of the H1N1 infection, we may be witnessing a new manifestation of antigenic shift.

Influenza activity follows a temporal pattern. Typically, in temperate climates “flu season” peaks from December to March, but cases can occur earlier or later, even well into spring (Figure 2). Annual influenza vaccination is the most effective way to prevent influenza virus infection and its complications.⁹ The ideal time to start vaccinating patients is September, continuing through October and November. However, vaccination in December and January can provide protection, and clinicians should continue vaccinating through this period.³ After vaccination, it takes about 2 weeks for a person to develop antibodies against influenza. Vaccination effectively protects up to 90% of healthy people ≤ 65 years of age from influenza when the vaccine viral strain is similar to the circulating strain. While vaccination is less effective in preventing flu in older people, it is effective in preventing complications and death in this population.³

Table 2. Known Influenza Pandemics, 19th and 20th Centuries

Pandemic	Date	No. of Deaths	Serotype Involved	Pandemic Severity Index ^a
Asiatic (Russian) flu	1889-1890	1 million	Possibly H2N2	?
Spanish flu	1918-1920	20-100 million	H1N1	5
Asian flu	1957-1958	1-1.5 million	H2N2	2
Hong Kong flu	1968-1969	0.75-1 million	H3N2	2

^aDeveloped by the CDC in 2007, the pandemic severity index ranks the severity of a pandemic (worldwide epidemic) by the number of fatalities it causes, ranging from a category 1 pandemic (90,000 deaths) to a category 5 pandemic (1.8 million deaths).

Who Should Receive Influenza Vaccination?

The ACIP recommends that healthy adults ≥ 50 years of age receive an annual flu immunization. In 2008 to 2009, recommendations for immunizing children and teenagers were expanded to include all those 6 months to 18 years of age.⁹ Women who will be pregnant during influenza season also should be vaccinated to lower the risk of complications, hospitalizations, and preterm labor.

All individuals ≥ 6 months of age who are at increased risk of influenza complications because of a chronic illness, such as pulmonary, cardiovascular, renal, hepatic, or metabolic disease or immunosuppression, should be immunized. Residents of nursing homes and other long-term care facilities should be vaccinated, as should youngsters 6 months to 18 years of age who receive long-term aspirin therapy.⁹ It is estimated that $<20\%$ of people in high-risk groups receive influenza vaccine each year. Therefore, clinicians need to increase efforts to identify and immunize these vulnerable patients.³

All healthcare professionals and staff, including home care workers and employees of long-term care and assisted-living facilities should receive an annual flu vaccination to reduce the chance of transmitting influenza to high-risk individuals. Survey data from 2006 indicate that only 42% of healthcare workers reported receiving influenza vaccine in the previous 12 months.² Healthcare providers should be encouraged to get the annual influenza vaccine to protect themselves ($>25\%$ less respiratory illness and $>43\%$ fewer days

of sick leave), their families and close contacts, and their patients.⁸

Household contacts and caregivers should be vaccinated if they care for children <5 years of age, with particular focus on contacts of babies <6 months (for whom there is no licensed vaccine); adults >50 ; and persons with medical conditions that put them at high risk for severe complications from influenza.

Any person who wishes to reduce the chance of becoming ill with flu or transmitting the disease to others may be vaccinated.³

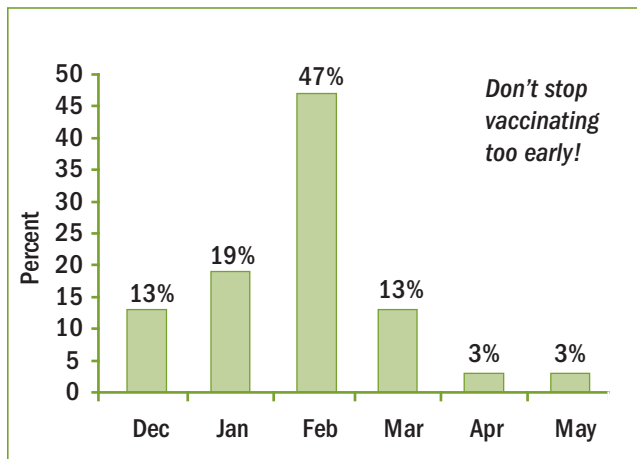


Figure 2. Months of peak influenza activity in the United States, 1976-2008.

In the United States, influenza cases generally peak between December and March, but cases may continue to occur as late as April or May. Clinicians should start vaccinating in September, particularly patients at increased risk for influenza complications, and ideally immunize the majority of patients through November. Continue vaccinating through December and beyond if vaccine supplies are available. CDC. *MMWR. Morb Mortal Wkly Rep.* 2006;55(50):1359-1362. Data from 2 recent seasons (unpublished data).

Two Influenza Vaccines Are Available

Trivalent inactivated influenza vaccine (TIV) administered by IM injection has been used in the general population since the 1950s.¹⁰ In 2003, live attenuated influenza vaccine (LAIV), administered by intranasal spray, was approved for use. Both vaccines contain 3 virus types, as well as egg protein.³

LAIV is approved for use in healthy, nonpregnant persons aged 2 to 49 years. This includes healthcare personnel and people in contact with high-risk groups. Close contacts of severely immunosuppressed individuals (ie, those requiring care in a protective environment), however, should receive a TIV injection instead of LAIV. Although people who receive LAIV should refrain from contact with severely immunosuppressed individuals for 7 days after vaccination, they may have contact with people who are not severely immunosuppressed.⁹ People immunized with TIV cannot “catch” the flu from the vaccine, because the virus in this vaccine is killed. The virus used in LAIV is weakened and does not cause influenza, although some patients may experience runny nose, nasal congestion, and cough after receiving LAIV.

Contraindications, Precautions, and Adverse Reactions

TIV and LAIV are contraindicated in people who have a severe (anaphylactic) allergy to a vaccine component, including eggs, or following a prior dose of vaccine. Vaccination should be postponed if a patient has moderate or severe acute illness. As a precaution, people with a history of Guillain-Barré syndrome should not be vaccinated within 6 weeks following a previous dose of influenza vaccine. Additional contraindications to LAIV (but not TIV) include pregnancy, age (<2 or ≥50 years), and certain health conditions (eg, underlying medical conditions, immunosuppression, children <18 years receiving long-term aspirin therapy).

Healthcare providers who are severely immunosuppressed should not administer LAIV. However, other persons at increased risk for influenza complications may administer LAIV, including pregnant women, people with asthma, and those ≥50 years of age. While gloves and masks are not required, they can be used.

Adverse reactions occur in about 15% to 20% of individuals who are vaccinated. The most common adverse reactions to TIV are local reactions, such as soreness, erythema, and induration at the injection site, lasting 1 to 2 days. Among healthy adults vaccinated with LAIV, 10% to 40% have reported cough, runny nose, nasal congestion, sore throat, and chills.

Novel H1N1 Vaccine

The CDC continues to track cases and gather data on the pandemic novel H1N1 virus and its characteristics. Steps have been taken to develop and test a vaccine for safety and efficacy, and industry is gearing up to produce an H1N1 vaccine. Clinicians should consult the CDC Web site (<http://www.cdc.gov>) for updates on H1N1 and vaccine efforts, as well as any amended recommendations for seasonal flu vaccine.

Tdap Vaccine

Td vaccine has provided booster immunization for adolescents and adults for many years. In 2005, a new tetanus and diphtheria vaccine containing an acellular pertussis component (Tdap) was licensed for use in these age groups.

Pertussis is an acute bacterial infection caused by *Bordetella pertussis* that is transmitted by the respiratory route. The illness is prolonged and is characterized by insidious onset of runny nose, sneezing, low-grade fever, and mild, occasional cough that progresses to frequent paroxysmal coughing episodes. These may conclude with a long inspiratory effort and a high-pitched “whoop” followed by vomiting and exhaustion. However, very young infants as well as adolescents and adults often do not exhibit the classic whoop of “whooping cough” (Table 3). Recovery is gradual. Complications of pertussis include secondary bacterial pneumonia, neurologic sequelae, otitis media, anorexia, and dehydration.³ Pertussis can be life threatening; infants too young to be completely immunized with diphtheria and tetanus toxoids and acellular pertussis (DTaP) childhood vaccine series are particularly vulnerable. According to the CDC, of 82 deaths from pertussis reported in 2004 through 2006, 69 (84%) occurred in children ≤3 months of age.³

Table 3. Selected Clinical Characteristics and Complications Among Adults Aged >19 Years With Reported Pertussis

Clinical Characteristic	Frequency (% reported)
Paroxysmal cough	84-86
Difficulty breathing	86
Cough duration >9 weeks	55
Post-tussive vomiting	45-54
Whoop	37-41
Weight loss	33
Pneumonia on chest x-ray	2-5
Rib fracture	4
Hospitalization	3

Lee GM, et al. *Clin Infect Dis*. 2004;39:1572-1580; National Notifiable Diseases Surveillance System and Supplemental Reported Pertussis Surveillance System, 1996-2004.

In 2004 and 2005, about 60% of pertussis cases occurred in people ≥11 years of age.³ Between 2005 and 2008, however, a decline in pertussis incidence in 11- to 18-year-olds occurred, although no change was reported in the rate of infant pertussis (<1 year). Experts note that while it is too early to attribute the decreased incidence to Tdap vaccine, vaccination may be contributing directly and indirectly to the declining rate.¹¹

A highly communicable infection, pertussis has secondary attack rates of 80% among susceptible household contacts.³ A diagnosis of pertussis in adolescents and adults often is missed because symptoms may not include the characteristic whoop and the index of suspicion is low in these age groups. Pertussis in people in these age groups is particularly important because they are a

reservoir of infection for young children. A recent study showed that mothers were the main source of infection in 32% of cases of infant pertussis. Other family members were the source for 43% of infections (father, 15%; siblings, 20%; grandparents, 8%). Individuals outside the family—including healthcare workers and daycare staff—were responsible for 25% of infant pertussis cases.¹²

Pertussis immunity wanes about 5 to 10 years after vaccination or natural immunity from the disease. Now that the Tdap booster vaccine is available, adolescents and adults can be immunized to prevent pertussis and its spread. DTaP (childhood vaccine series) and Tdap (for preteens, adolescents, and adults) are different vaccine formulations and are not interchangeable.

Who Should Receive Tdap Vaccine?

Tdap vaccine is approved as a single (booster) dose for people who have completed the recommended childhood DTP/DTaP vaccination series. It is injected IM into the deltoid muscle of the upper arm. Adolescents 11 or 12 years of age should receive a single dose of Tdap if they have not received a Td booster. Those aged 13 through 18 years should receive a catch-up Tdap booster instead of Td vaccine. Adults 19 through 64 years of age who have not previously received Tdap should receive a single Tdap dose in place of Td; thereafter, a Td booster every 10 years is recommended.

The issue of the interval between Td and Tdap doses can be confusing. In routine circumstances a 5-year interval between Td and Tdap administration is encouraged (and recommended in the manufacturers' prescribing information) to reduce the risk of local adverse reactions. However, the ACIP has not defined any absolute minimum interval. If pertussis immunity is imperative (eg, an infant in the household, pertussis outbreak, healthcare personnel) and the benefit of pertussis immunity outweighs the risk of a local reaction, Tdap should be given regardless of the interval since the last Td.

Adults who have close contact with infants, such as parents, childcare workers, and healthcare personnel, should be vaccinated with Tdap. Women who did not receive Tdap before they became pregnant should receive a Tdap booster in the immediate postpartum period or as soon as possible thereafter. Healthcare workers in hospitals or ambulatory care settings who have direct patient contact, especially those in contact with infants ≤ 12 months, should receive a single Tdap dose as soon as possible.

Contraindications, Precautions, and Adverse Reactions

Contraindications for Tdap vaccination include a history of severe allergic reaction to a vaccine component or after a prior dose and severe encephalopathy not due to another identifiable cause occurring within 7 days of receiving a pertussis-containing vaccine. Caution is advised for individuals who have a history of Guillain-Barré syndrome; progressive, unstable neurologic disorder; severe local reaction (Arthus reaction) following a Td vaccine; and moderate or severe acute illness. A local reaction, such as pain, redness, or swelling at the injection site, is the most common adverse effect of Tdap vaccination.

Varicella and Zoster Vaccines

Varicella (chickenpox) and herpes zoster (shingles) are caused by the same organism, varicella zoster virus (VZV), a DNA virus of the herpesvirus group. While varicella typically is considered a childhood disease and herpes zoster affects mostly older people, both diseases can occur across all age groups. In people who had varicella infection, VZV persists in the body within the sensory nerve ganglia. Latent VZV may reactivate years after the primary varicella infection and manifest as herpes zoster, characterized by neuralgic pain along the area of the affected nerve and vesicular clusters over the corresponding dermatome. It usually is unilateral. A live attenuated varicella vaccine was licensed in the United States in 1995.¹³ A vaccine to reduce the risk of herpes zoster was licensed in 2006.¹⁴

Varicella (Chickenpox)

In the prevaccine era, varicella was endemic in the United States, and approximately 4 million people were infected each year. The majority were children—only 7% of cases were adults ≥ 20 years of age. By adulthood, almost everyone had chickenpox and had developed lifetime immunity.³

Early symptoms of chickenpox in adults are similar to those in children and may include body aches, fever, fatigue, irritability, itching, sore throat, and a generalized rash concentrated on the face, scalp, and trunk. The rash progresses from macules to papules to vesicular lesions before crusting, and successive crops appear over 5 to 7 days. The rash may spread into the mouth or other internal parts of the body. While the illness usually is not severe in adults, the risk of hospitalization, complications, and death is increased among adults and adolescents. Symptoms appear 10 to 21 days after exposure to the VZV. Individuals who received the varicella vaccine may develop a mild presentation, with 50 or fewer red bumps that rarely evolve into blisters.

Complications of varicella include secondary bacterial infection of skin lesions, pneumonia (usually more severe in adults and children < 13 years), encephalitis, aseptic meningitis, and Reye syndrome, among others. The risk of complications varies with age, occurring more often in individuals > 15 years of age. In addition, immunocompromised patients have a high risk of disseminated varicella infection and often develop pneumonia and encephalitis. Varicella in pregnant women can produce complications for the mother and infant. The varicella fatality rate varies according to age: among adolescents aged 15 to 19 years, the fatality rate is approximately 2.7 per 100,000 cases; and among adults 20 to 49 years, 25.2 per 100,000 cases.³

Varicella is a highly communicable disease. Secondary attack rates among susceptible household contacts of people with varicella are as high as 90%. The virus is transmitted from person to person via infected respiratory tract secretions or airborne virus-containing droplets, as well as by direct contact or inhalation of aerosols from vesicular fluid of skin lesions. Varicella is contagious from 1 to 2 days before the appearance of rash until all the blisters have formed scabs or lesions fade away (in the absence of blisters).

Who Should Receive Varicella Vaccine?

Since the introduction of varicella vaccine in 1995, varicella epidemiology has changed.

Breakthrough outbreaks in vaccinated children and other factors led the ACIP to revise and extend varicella immunization recommendations in 2005 and 2006. Preteenagers and teenagers 7 to 18 years of age without evidence of immunity (see sidebar) should complete a 2-dose series. That is, those who are unvaccinated should receive 2 doses and those who received only a single dose should receive a second dose. In this age group, the minimal interval between doses is 3 months, but a second dose administered at least 28 days after the first dose can be accepted as valid.

ACIP recommends that all adults (≥ 19 years) without evidence of immunity routinely receive 2 doses of single-antigen varicella vaccine unless medically contraindicated. Adults who received only 1 dose should receive a second dose; doses should be separated by at least 28 days. It is important to ensure that certain populations are vaccinated, including anyone who has close contact with individuals at high risk for severe disease, such as health-care personnel and family, or close contacts of people with immunocompromising conditions. For example, a parent who has a child with leukemia should be immunized if he or she does not have evidence of immunity. In addition, people who are at high risk of exposure or transmission warrant special consideration. This includes teachers, childcare workers, residents and staff of institutional settings, college students, military personnel, adolescents and adults living in households with children, nonpregnant women of childbearing age, and international travelers. Women who are pregnant should be assessed for evidence of immunity. Those

What Constitutes “Evidence of Immunity” to Varicella for Adolescents and Adults?

Evidence of immunity to varicella includes any of the following:

- **Vaccination:** written documentation of complete vaccination (2 doses)
- **Serology:** laboratory confirmation of immunity or disease^a
- **Diagnosis:** healthcare provider verification of a history or diagnosis of varicella disease^b
- **Age:** birth in the United States before 1980
—For healthcare personnel, pregnant women, and immunocompromised persons, birth before 1980 should *not* be considered evidence of immunity

^aCommercial assays can be used to assess disease-induced immunity, but they lack sensitivity to always detect vaccine-induced immunity (ie, they might yield false-negative results).

^bVerification of history or diagnosis of typical disease can be provided by any healthcare provider (eg, school or occupational clinic nurse, nurse practitioner, physician assistant, or physician). For persons reporting a history of, or reporting with, atypical or mild cases, assessment by a physician or their designee is recommended, and one of the following: 1) an epidemiologic link to a typical varicella case to a laboratory-confirmed case or 2) evidence of laboratory confirmation, if it was performed at the time of acute disease. When such documentation is lacking, persons should not be considered as having a valid history of disease because other diseases might mimic mild atypical varicella.

Marin M, et al. Prevention of varicella: recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Recomm Rep.* 2007;56(RR-4):1-40.

without evidence of immunity should receive the first dose of varicella vaccine in the immediate postpartum period and the second dose 4 to 8 weeks after the first dose.¹³

The efficacy of varicella vaccine is high. Among healthy adolescents and adults (≥ 13 years of age), an average of 78% develop antibody after 1 dose and 99% develop antibody after a second dose. After the second valid dose, antibody persists for at least 1 year in 97% of vaccinated persons.³

Varicella vaccine should be administered subcutaneously, preferably in the deltoid muscle of the upper arm.

Contraindications, Precautions, and Adverse Reactions

Varicella vaccination is contraindicated in persons who are pregnant; have immunocompromising conditions such as leukemia, lymphoma, generalized malignancy, or immune deficiency disease; or who are receiving immunosuppressive therapy. It is also contraindicated in people with HIV infection if they have a CD4+ T-lymphocyte count of <200 cells/ μL . However, adults with HIV infection who have a CD4+ T-lymphocyte count of ≥ 200 cells/ μL may be considered for vaccination with single-antigen varicella vaccine. In addition, people with severe allergic reaction to a vaccine component or following a prior dose of vaccine should not receive varicella vaccine. The vaccine contains small amounts of neomycin and hydrolyzed gelatin but no egg protein or preservative. Vaccination should be postponed in individuals who have moderate or severe acute illness until their condition improves. Minor illness is not a contraindication. Because passively transferred antibodies may inhibit varicella vaccination response, varicella vaccine should not be administered for 3 to 11 months after receipt of antibody-containing blood products.

The most common adverse reactions are generally local and include pain, soreness, erythema, and swelling. Systemic reactions are uncommon. Small local and generalized varicella-like rashes have been reported in a low percentage (1% following the second dose) of adolescent and adult vaccine recipients.³

Herpes Zoster (shingles)

Herpes zoster occurs when latent VZV reactivates and causes recurrent disease. Anyone who has recovered from varicella can develop zoster. The typical presentation is a painful rash, usually in a single dermatome, most often in the thoracic, cervical, or ophthalmic areas. Pain, itching, or tingling may precede the rash for 1 to 5 days, and headache, photophobia, and malaise also may occur in this phase. The rash begins as an erythematous maculopapular eruption that develops into clusters of clear vesicles. Vesicles continue to form over 3 to 5 days and then crust (Figure 3). Herpes zoster is uncomfortable and can be debilitating. Healing may take 2 to 4 weeks, with residual scarring and pigmentation changes. Rarely, and usually among immunocompromised patients, the rash may become generalized and look similar to the rash of varicella. A painful, distressing complication of zoster is postherpetic neuralgia, characterized by pain in the area of the rash that persists up to a year or longer after the lesions have resolved. The risk for postherpetic neuralgia after zoster infection is approximately 10% to 18%. Further, ocular involvement

occurs in 20% to 24% of zoster episodes and is associated with prolonged pain, facial scarring, and vision loss.^{3,14}

Approximately 500,000 to 1 million episodes of zoster occur each year in the United States. The lifetime risk of developing zoster is about 32%. The most prominent risk factors are increasing age and cellular immunosuppression. About half of all people who live to age 85 will develop zoster.³ Approximately 3% of patients with zoster need to be hospitalized; many of these patients have 1 or more immunocompromising conditions.¹⁴

Who Should Receive Herpes Zoster Vaccine?

The herpes zoster vaccine was approved in 2006 for use in people ≥ 60 years of age who have no contraindications to the vaccine and want to reduce the likelihood of developing shingles. People who have already experienced an episode of zoster as well as those with chronic medical conditions may be vaccinated. The vaccine is administered subcutaneously in the deltoid region of the arm as a single dose. It contains the same live attenuated varicella zoster virus strain used in the varicella vaccine, but the zoster vaccine is 14 times stronger than the single-antigen varicella vaccine. It is not necessary to ask patients for their history of varicella or to have serologic testing done to determine immunity before administering the vaccine.¹⁴ Zoster vaccine is available through Part D of Medicare.

In a randomized, double-blind, placebo-controlled preapproval vaccine trial, investigators studied 36,716 adults ≥ 60 years of age for an average of 3 years after zoster vaccination. Compared with the placebo group, the vaccinated group experienced 51% fewer episodes of zoster, less severe zoster illness, and 66% less postherpetic neuralgia. No significant vaccine safety issues were identified.¹⁵ Although zoster vaccine cannot completely prevent zoster due to the latent nature of the virus in the ganglia, it effectively reduces the risk and severity of zoster episodes and associated postherpetic neuralgia.

Contraindications, Precautions, and Adverse Reactions

Contraindications to zoster vaccination include severe allergic reaction to a vaccine component or following a prior dose, moderate or severe acute illness, immunosuppression from any cause, and pregnancy or planned pregnancy within 4 weeks. Current therapy with an antiviral drug is a precaution to zoster vaccination, because these drugs can interfere with replication of the vaccine virus. Recent receipt of a blood product is not a precaution for zoster vaccine as it is for most

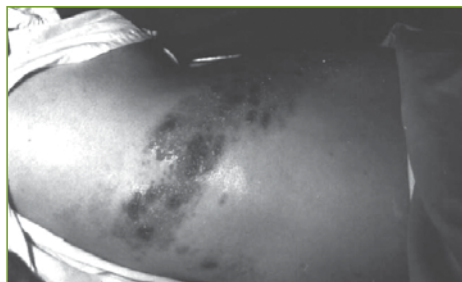


Figure 3. Herpes zoster rash. The rash of herpes zoster infection most often involves the thoracic dermatomes, seen here, but facial and ocular distribution is also common. Zoster is very painful and can be debilitating. Postherpetic neuralgia may persist up to a year or longer after lesions have resolved. Centers for Disease Control and Prevention Public Health Image Library (PHIL). <http://phil.cdc.gov>. Accessed August 3, 2009.

other live virus vaccines. The most common adverse reactions are local pain, erythema, tenderness, and swelling. These are reported in about 34% of zoster vaccine recipients. Less than 1% of vaccine recipients report a fever 101°F or higher, a rate similar to placebo recipients.³

HPV Vaccine

HPV vaccine is the first vaccine developed to prevent viral infections known to be associated with cervical cancer, low-grade cervical abnormalities, precancerous lesions, and genital warts.

HPVs are a large family of DNA viruses that infect the epithelium—more than 100 HPV types have been identified. In simplified terms, HPV can be thought of as 2 main groups: the cutaneous (nonmucosal) or skin group, which includes about 60 HPV types that commonly cause skin warts on the hands and feet; and the mucosal or genital group, which includes approximately 40 HPV types, that have a predilection for nonkeratinized squamous epithelium and the anogenital region (Figure 4).^{3,16}

The mucosal HPV types are categorized based on their epidemiologic association with cervical cancer. Infection with low-risk, or nononcogenic, HPV types, such as types 6, 11, and others, can cause low-grade cervical cell abnormalities, genital warts, and laryngeal papillomas. The high-risk or so-called oncogenic HPV types act as carcinogens in the development of cervical and other anogenital cancers. These types include HPV 16, 18, 31, 45, and many others,

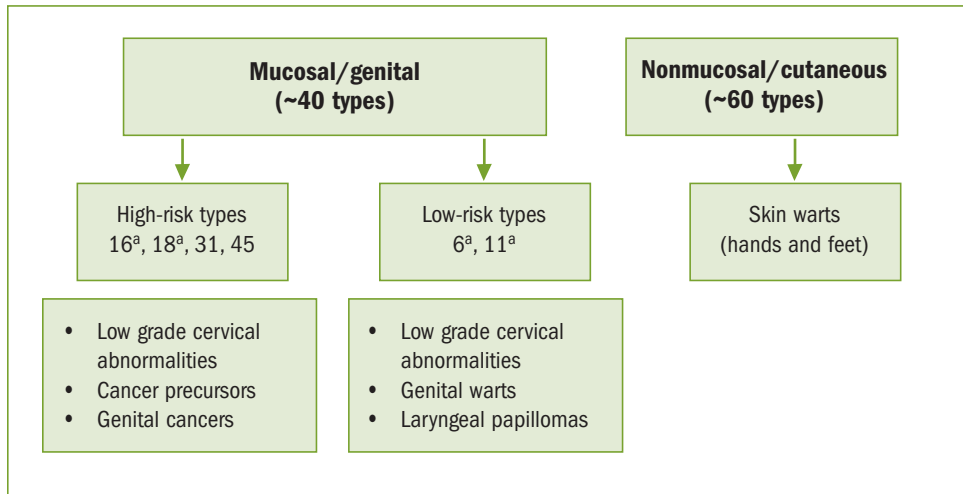


Figure 4. Human papillomavirus (HPV) types and disease association. The more than 100 HPV types are grouped as cutaneous (nonmucosal) or mucosal (genital), based on the type of epithelium they preferentially infect. The cutaneous group includes about 60 types that are associated with common hand and foot warts as well as other lesions of keratinized epithelium such as skin. The mucosal or genital types commonly infect nonkeratinized squamous epithelium and the anogenital region. This group includes about 40 types that are further divided into so-called “high-” and “low-” risk types. The designation of high risk is based on the frequency of detection in malignancies. The absolute risk of malignancy is low for all infections, so the “high-risk” designation can be confusing. ^aHPV types included in the quadrivalent vaccine. Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. 11th ed. Atlanta, GA: CDC; 2009.

which can cause low-grade cervical cell abnormalities, high-grade cervical cell abnormalities that are precursors to cancer, and anogenital cancers. Approximately 99% of cervical cancers contain HPV high-risk types. HPV types 16 and 18 account for about 70% of cervical cancers worldwide.³

HPV infection is transmitted mainly by genital contact with an infected person, usually through sexual intercourse. The virus can also be transmitted from an infected woman to her baby during birth. Infants born to women with genital warts develop warts in their throats (respiratory papillomatosis), a potentially life-threatening condition for the child that requires frequent laser surgery to prevent blockage of the breathing passages.

Considered the most common sexually transmitted infection in the United States, about 20 million people currently are infected with HPV, and an estimated 6.2 million new infections occur each year.¹⁶ Among adolescent girls, prevalence is as high as 64%. Men also are commonly infected; clinic-based studies in heterosexual men estimate the prevalence of genital HPV infection to be 20% or higher.³ HPV infection has no specific treatment. Rather, the particular clinical manifestations of the infection, such as genital warts or abnormal cervical cell cytology, determine treatment.

Risk factors for acquiring HPV infection are related to sexual behavior. The number of sex partners, lifetime history of sex partners, and partners' sexual history are the most strongly identified risk factors. Young age (<25 years) is a possible risk factor, as are inconsistent condom use, number of pregnancies, and genetic factors, among others.

Although most HPV infections are transient and resolve spontaneously, a small percentage of infected people become persistently infected. Persistent infection is the most important factor associated with the development of cervical cancer precursor lesions. It is estimated that more than 11,000 cases of cervical cancer are diagnosed in the United States each year, and more than 3700 women die from the disease annually. HPV is thought to be responsible for almost all these cases.¹⁶ Further, about 90% of anogenital warts are associated with the low-risk HPV types 6 and 11. Population-based estimates reveal that approximately 1% of sexually active adolescents and adults have clinically apparent genital warts.³

In 2006, a quadrivalent subunit vaccine produced using recombinant DNA technology was licensed in the United States to protect against infection with HPV types 6, 11, 16, and 18 in girls and women 9 to 26 years of age. Among women who have not been infected with vaccine-containing HPV types, the vaccine is highly effective in preventing those types of HPV and related diseases. It is less effective in preventing HPV-related disease in women who have been exposed to ≥ 1 HPV types. However, prior infection with 1 HPV type covered by the vaccine (eg, HPV type 16) does not diminish the efficacy of the vaccine against the other vaccine-containing HPV types (ie, types 6, 11, and 18).³

Who Should Receive HPV Vaccine?

The ACIP recommends that girls receive routine immunization with HPV vaccine at 11 to 12 years of age. Girls as young as 9 years may be given the vaccine at the clinician's discretion.

The vaccine is administered as a 3-dose series of IM injections in the deltoid muscle, with the first dose given at month 0, the second dose 2 months after the first dose, and the third dose given 6 months after the first dose (at least 24 weeks after the first dose). Catch-up immunization is recommended for girls aged 13 to 18 who have not been vaccinated or who have not completed the full series. The vaccine also is licensed for adult women 19 to 26 years of age who have not been vaccinated or did not complete the series. Note that there is no maximum interval between doses. If a vaccine schedule is interrupted by a long delay, the series does not need to be restarted; administer the next required dose and observe the minimal interval required if the third dose is also necessary. However, doses administered at a shorter-than-recommended dosing interval are considered invalid and should be readministered.¹⁶ Although it is optimal to complete the HPV vaccine before potential exposure to HPV through sexual contact, young women who may have been exposed should still be vaccinated.³

Clinical studies are underway to assess whether women >26 years of age would benefit from HPV vaccination. One double-blind placebo-controlled study recently demonstrated that in women aged 24 to 45 years who were not infected with the relevant HPV types at study enrollment, the vaccine was more than 90% efficacious.¹⁷ Studies also have been conducted to determine whether the vaccine prevents HPV infection in boys and men. Investigators studied the quadrivalent HPV vaccine in 9- to 26-year-old males who were naïve to vaccine-containing HPV types at study onset. They found that HPV vaccine effectively reduced the burden of external genital lesions and infection associated with HPV types 6, 11, 16, and 18. In addition, the immunogenicity of the vaccine in men was similar to that seen in women in previous studies.¹⁸ A medical advisory panel has concluded that the vaccine is safe and effective in males aged 9 to 26, but at the time of press it had not been approved for use.

Women immunized with HPV vaccine must continue to receive Papanicolaou test screening at the recommended intervals because 30% of cervical cancers are caused by HPV types that are not included in the vaccine.

Contraindications, Precautions, and Adverse Reactions

As with other vaccines, contraindications to HPV vaccination include severe allergic reaction to a vaccine component (including yeast) or following a prior dose and moderate or severe acute illness. HPV vaccine is not recommended during pregnancy, as safety data are limited. However, the vaccine is not contraindicated in immunosuppressed patients or those with such chronic medical conditions as diabetes or chronic liver disease.

Most adverse reactions are local and mild to moderate in intensity. Common reactions include pain (84%), swelling (25%), erythema (25%), and fever within 15 days of vaccination (10%). Since 2005, reports to the Vaccine Adverse Event Reporting System (VAERS) regarding postvaccination syncope have increased, primarily among females aged 11 to 18 years.¹⁹ Subsequent serious injuries are rare and usually the result of traumatic falls. Healthcare providers should be aware of the potential for syncope after vaccination and take appropriate measures to

prevent injuries. Tonic-clonic (jerking) movements and seizurelike activity during postvaccination syncope also have been reported. The ACIP recommends that clinicians strongly consider observing patients for 15 minutes after vaccination because most syncope episodes occur within this period. In addition, clinicians should discuss presyncopal symptoms (weakness, dizziness, pallor) and their management (ie, remain seated or lying down) with patients and their parents. As of June 2009, the US Food and Drug Administration (FDA) approved a revised label for HPV vaccine to include syncope in the warnings and precautions section. The FDA and the CDC are also revising the Vaccine Information Statements to include syncope.

Serious adverse reactions have been reported, but most do not appear causally related to the vaccine. Guillain-Barré syndrome, thromboembolic disorders, and deaths have been reported to VAERS. Monitoring and evaluation of reported events are ongoing.²⁰

Meningococcal Vaccine

An acute, potentially severe, life-threatening bacterial illness caused by *Neisseria meningitidis*, meningococcal disease affects approximately 1000 to 3000 people each year in the United States. Meningococcal disease has a case-fatality rate of 10% to 14%, even with appropriate antibiotic therapy. Morbidity is substantial—11% to 19% of survivors experience such serious sequelae as neurologic disability, limb loss, and hearing loss.²¹

The highest rates of disease occur in babies <12 months of age. Incidence of meningococcal disease falls in early childhood, rises again during adolescence and early adulthood, then declines among older adults. The rate of invasive meningococcal disease among 17- to 20-year-olds is approximately double that found in the overall US population.³

The most common clinical presentation (nearly 50%) of invasive meningococcal disease is meningitis. Meningococcal sepsis (bloodstream infection or meningococemia) occurs without meningitis in about 5% to 20% of invasive infections. Meningococcal disease may present less commonly as pneumonia (5% to 15% of cases), arthritis (2%), otitis media (1%), and epiglottitis (<1%). Nearly all invasive disease is caused by 1 of 5 meningococcal serogroups: A, B, C, Y, and W-135.³

N meningitidis is transmitted by aerosolized respiratory droplets or secretions from the nasopharynx of colonized individuals. Family and household members living with an infected person are at higher risk for meningococcal disease. Other risk factors include antecedent upper respiratory infection, household crowding, demographic and socioeconomic factors (including crowding), active and passive smoking, terminal complement component deficiencies, and anatomic or functional asplenia. College freshman living in dormitories are at modestly increased risk of meningococcal disease, and occupational exposure can elevate risk for microbiologists.

The first meningococcal monovalent (group C) polysaccharide vaccine was licensed in 1974, followed by the quadrivalent A, C, Y, W-135 polysaccharide vaccine (MPSV) in 1978. In 2005, a meningococcal conjugate vaccine (MCV) was licensed in the United States. MCV also covers meningococcal serotypes A, C, Y, and W-135. Compared with MPSV, MCV is

expected to provide a longer duration of protection, reduce asymptomatic carriage of *N meningitidis*, and produce herd immunity that extends to individuals who have not been vaccinated. A crucial difference between these 2 vaccines is that MPSV is administered by subcutaneous injection, while MCV is given by IM injection.

Who Should Receive Meningococcal Vaccine?

The ACIP recommends routine meningococcal immunization with MCV for 11- to 12-year-olds and adolescents 13 through 18 years of age if not already vaccinated.^{21,22} Previously unvaccinated college freshman living in a dormitory also should receive the vaccine. Other adults aged 19 to 55 years who may require vaccination with MCV include military recruits, travelers to or residents of countries in which *N meningitidis* meningitis is hyperendemic or epidemic, microbiologists routinely exposed to isolates of *N meningitidis*, people with terminal complement component deficiencies, and individuals with anatomic or functional asplenia. While MCV is preferred for individuals in these situations, MPSV is an acceptable alternative. Revaccination with MCV after 5 years might be indicated for adults previously vaccinated with MPSV who remain at increased risk for infection. Revaccination after receipt of MCV is not recommended.³ MPSV is still recommended for children aged 2 to 10 years and adults >55 years of age who require vaccination.²¹ The ACIP advises that other adolescents, college students, and individuals infected with HIV who wish to lower their risk for meningococcal disease may elect to receive vaccination.²¹

Contraindications, Precautions, and Adverse Reactions

Severe allergic reactions to a vaccine component or following a prior dose is a contraindication to further vaccination. Vaccination should be deferred for moderate or severe acute illness. Immunosuppression and breastfeeding are not contraindications. Pregnancy is not considered a contraindication to vaccination, and no studies of MPSV during pregnancy have documented adverse effects among pregnant women or newborns. No data are available, however, on the safety of the newer MCV during pregnancy.

Adverse reactions usually are local and mild for both vaccines. Pain and redness at the injection site, fever, headache, and malaise have been reported. A growing number of cases of Guillain-Barré syndrome has been associated with MCV immunization. Individuals who have a history of Guillain-Barré syndrome might be at increased risk for postvaccination Guillain-Barré syndrome and, therefore, may have a relative contraindication to vaccination with MCV. Such persons should discuss the decision to be vaccinated with their healthcare provider. MPSV is an acceptable alternative for short-term protection against meningococcal disease (3-5 years).²²

A Word About Vaccine Information Statements

According to federal law, healthcare providers administering certain vaccines must provide the most current version of the Vaccine Information Statement (VIS) to the patient (or to the parent/legal representative if the patient is a minor) before administering the vaccine and allow

the patient time to read the VIS prior to administration. VISs are developed by the CDC and provide information on the risks and benefits of each vaccine. They are not based on the vaccine's prescribing information. Healthcare providers are not permitted to make any changes to the VIS. All available VISs can be downloaded from the Web site of the Immunization Action Coalition (www.immunize.org/vis), which provides VISs in more than 30 languages, or from the CDC Web site (www.cdc.gov/vaccines/pubs/vis/default.htm). VISs for all vaccines routinely recommended for children and adolescents (including influenza vaccine) are mandated by law, even when the vaccine is being given to an adult.

Be a Vaccine Role Model

Adults and adolescents who received their childhood vaccinations still may require additional vaccine doses for any number of reasons—waning immunity, changing disease patterns, behavioral practices, occupational hazards, or life events such as international travel. In addition, many eligible people have not received recently available immunizations, such as the zoster and HPV vaccines, that provide long-term health benefits for adults. By providing immunizations—as well as by example—nurse practitioners and physician assistants are in a position to prevent disease, foster public health, and educate the public about vaccine-preventable diseases. To keep current, consult the CDC vaccine Web site (www.cdc.gov/vaccines/) for the annually updated Recommended Immunization Schedules and late-breaking information. A quick review of ACIP recommendations for the measles, mumps, and rubella (MMR) vaccine, and the hepatitis A (HAV) and hepatitis B (HBV) vaccines, can be found at www.practicingclinicians.com/H2_2009/cdcadd.pdf.

Additional information resources are listed in the PCE/CDC Adult and Adolescent Immunization Resource Center (www.practicingclinicians.com).

Read Q&A from the live symposia at www.practicingclinicians.com/H2_2009/cdcqa.pdf

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