Update on Immunizations in Children and Adolescents

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Over the past few years, there have been many changes to the recommendations for children and adolescents by the Advisory Committee on Immunization Practices. These include dividing the immunization schedule into two parts (i.e., ages birth to six years and seven to 18 years, with catch-up schedules for each group); expanding the recommendations for influenza vaccine to children ages six months to 18 years without risk factors; expanding coverage for hepatitis A vaccine to include all children at one year of age; initiating routine immunization with oral rotavirus vaccine given at ages two, four, and six months; and adding a booster dose of varicella vaccine at four to six years of age. The tetanus and diphtheria toxoids and acellular pertussis vaccine (Tdap), quadrivalent meningococcal conjugate vaccine (MCV4), and quadrivalent human papillomavirus (HPV) vaccine are routinely recommended for adolescents 11 to 12 years of age. Tdap provides pertussis immunity in addition to the tetanus and diphtheria immunity provided by the tetanus and diphtheria toxoids vaccine (Td). MCV4 has improved immunogenicity compared with the older meningococcal vaccine. HPV vaccine protects against serotypes 6, 11, 16, and 18, and is given in three doses, ideally at 11 to 12 years of age; the effectiveness increases when the vaccine is given before the onset of sexual activity. Family physicians play an integral role in implementing new immunization recommendations and properly educating patients and families in the increasingly complex armamentarium of prevention. (*Am Fam Physician.* 2008;77(11):1561-1568, 1571-1572. Copyright © 2008 American Academy of Family Physicians.)

▶ **Patient information:** A handout on childhood immunizations, written by the author of this article, is provided on page 1571.

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In a recent evaluation of clinical preventive services, childhood immunizations ranked first in cost-effectiveness and clinical impact.[1] The 2004 National Immunization Survey Data showed encouraging results that exceeded the Healthy People 2010 goals: 85.5 percent of preschool children received four or more doses of diphtheria and tetanus toxoids and whole-cell pertussis vaccine (DTP)/diphtheria and tetanus toxoids and acellular pertussis vaccine (DTaP); 91.6 percent received three or more doses of inactivated poliovirus vaccine (IPV); 90.3 percent received one dose of measles, mumps, and rubella vaccine (MMR); 93.5 percent received three or more doses of *Haemophilus influenzae* type b conjugate vaccine (Hib); 92.4 percent received three doses of hepatitis B vaccine (HepB); and 87.4 percent received one dose of varicella vaccine.[2]

Despite these encouraging results, significant gaps remain, especially in certain communities and practices.[2] The use of patient reminder and recall systems has been effective in increasing immunization rates in developed countries, as have food-voucher programs and other novel approaches.[3-5]

The Advisory Committee on Immunization Practices (ACIP), American Academy of Family Physicians, and American Academy of Pediatrics use a single vaccination schedule. Additional information, including updates on changes, recommendations, and vaccine supply, is available at the Centers for Disease Control and Prevention (CDC) Web site (http://cdc.gov/vaccines/).

Existing Vaccines with No Changes

Recommendations for several vaccines have not changed from 2007. These include MMR, Hib, pneumococcal vaccine (PCV), DTaP, and IPV *(Table 1)*.[6-15] *Table 2* provides a comparison of the pneumococcal vaccines.[6,12-15]

Recent Changes in Existing Vaccines

INFLUENZA

In the United States, influenza epidemics caused approximately 36,000 deaths per year from 1990 to 1999, and 226,000 hospitalizations annually from 1979 to 2001; more than 90 percent of those deaths were among patients older than 65 years. Children are most commonly infected, but children younger than two years and persons older than 65 years, as well as persons of any age

SORT: KEY RECOMMENDATIONS FOR PRACTICE

Clinical recommendation	*Evidence rating*	*References*
Immunization of children and adolescents is highly cost-effective and clinically effective.	A	1
DTaP, IPV, MMR, Hib, HepB, and varicella vaccine should be given as recommended.	A	31
Pneumococcal vaccine has been shown to significantly decrease the number of cases of invasive pneumococcal disease in children as well as increase herd immunity in the population.	A	12, 14, 15
Tdap (Adacel, Boostrix) has a safety profile comparable to Td and has an excellent immunologic response in adolescents.	A	42-44
Use of HepB and immune globulin effectively prevents transfer of hepatitis B from mother to infant.	A	39
Rotavirus vaccine has been shown to significantly decrease the severity and number of hospitalizations for acute gastroenteritis in young infants.	A	40, 41
Use of a patient reminder and recall system is helpful in increasing immunization rates in developed countries.	A	4

DTaP = diphtheria and tetanus toxoids and acellular pertussis vaccine; HepB = hepatitis B vaccine; Hib = Haemophilus influenzae *type b conjugate vaccine; IPV = inactivated poliovirus vaccine; MMR = measles, mumps, and rubella vaccine; Td = tetanus and diphtheria toxoids vaccine; Tdap = tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccine.*

A = consistent, good-quality patient-oriented evidence; B = inconsistent or limited-quality patient-oriented evidence; C = consensus, disease-oriented evidence, usual practice, expert opinion, or case series. For information about the SORT evidence rating system, see http://www.aafp.org/afpsort.xml.

Table 1. Summary of Established Vaccines with No Changes in Recommendations from 2007

Vaccine	*Progress in disease elimination*
DTaP	Adherence to current vaccine schedule results in antibodies to tetanus and diphtheria in more than 95 percent of patients, but immunity wanes in adulthood; only 534 cases of tetanus were reported from 1990 to 2000, and the last reported case of diphtheria was in 2000[6]
Hib	Vaccine provides protection against *Haemophilus influenzae* type B, the main cause of invasive disease; incidence has fallen 99 percent since vaccination began; in all reported cases since 1999, patients were not immunized or were incompletely immunized; children 59 months or younger whose vaccination is delayed should receive one dose; children older than 59 months with asplenia, human immunodeficiency virus infection, or immunosuppression may receive one dose[7]
IPV	The last case in the United States was in 1979; global eradication is a goal; if third dose is given after 4 years of age, no fourth dose is necessary; only IPV is available in the United States; Pediarix (DTaP/HepB/IPV) may be given as first three doses[8]
MMR	Decrease in cases of measles, mumps, and rubella by more than 99 percent since vaccination began; booster recommended in 1989 because of waning immunity; rubella received elimination status, and sustained transmission of measles within the United States is no longer possible; live, attenuated vaccine[9-11]
Pneumococcal	Since vaccination began in 2000, there has been a dramatic decrease in invasive pneumococcal disease in children and improved herd immunity, but only a small decrease in pneumococcal otitis media; vaccine is effective against antibiotic-resistant strains, which are increasing[7,12-14]; pneumococcal pneumonia is still the most common cause of vaccine-preventable death in the United States
	Children at greatest risk for invasive disease include those with sickle cell anemia, immunosuppression, and cochlear implants; and American Indians and Alaskan natives[12-15]

DTaP = diphtheria and tetanus toxoids and acellular pertussis vaccine; HepB = hepatitis B vaccine; Hib = H. influenzae *type b conjugate vaccine; IPV = inactivated poliovirus vaccine; MMR = measles, mumps, and rubella vaccine.*

Information from references 6 through 15.

with medical conditions that increase the likelihood of complications, are at greatest risk of influenza-related hospitalization and death.

Public health officials view children not only as persons at risk for the disease, but also as a reservoir for the infection of older adults.[16-18] Although very young children and older adults have a higher case-fatality rate, 57 percent of hospitalizations occur in persons younger than 65 years, and most deaths among children occur in those who have no known risk factors.[17] According to CDC reports, the number of influenza-related deaths among children in the United States in the previous three influenza seasons ranged from 46 to 74; only nine deaths among children were reported as of February 2008 for the 2007-2008 season.[18]

Table 3 outlines recommendations for the use of influenza vaccines in children.[16-32] Two vaccines are currently available: trivalent (inactivated) influenza vaccine (TIV; Fluzone) and live, attenuated influenza vaccine (LAIV; Flumist). Use of the LAIV was recently expanded to

Table 2. Comparison of Pneumococcal Vaccines

Comparison points	*PPV (Pneumovax 23)*	*PCV (Prevnar)*
Ages	Not effective in children younger than 2 years	Routine vaccination of children at 2, 4, 6, and 12 to 15 months of age
Dosing	Recommended as a single dose in patients 2 years and older with chronic illness, functional or anatomic asplenia, immunocompromise, or other risk factors (i.e., functional or anatomic asplenia, transplant, nephrotic syndrome, renal failure, or immunosuppression)	Children not vaccinated and those older than 12 months need two doses, given at least eight weeks apart Healthy children not vaccinated at 24 to 59 months of age need one dose
Effectiveness	60 to 70 percent effective in preventing invasive disease; less effective in preventing pneumonia	More than 90 percent effective against invasive disease in children; less effective against pneumonia and otitis media
Special considerations	May revaccinate once if it has been five years or more since previous vaccination in child or adolescent at high risk	Administer one dose of PCV to all healthy children 24 to 59 months of age who have an incomplete schedule Vaccine generally not recommended for children 5 years and older
Vaccine components	Purified capsular polysaccharide antigens from 23 serotypes causing 88 percent of invasive disease	Pneumococcal polysaccharide conjugated to nontoxic diphtheria toxin (7 serotypes) causing 86 percent of bacteremia and 83 percent of meningitis among children younger than 6 years

PCV = 7-valent pneumococcal conjugate vaccine; PPV = 23-valent pneumococcal polysaccharide vaccine.

Information from references 6, and 12 through 15.

include children two to five years of age, with precautions for the following: concomitant aspirin therapy, history of recurrent wheezing, altered immunocompetency status, and medical conditions that would predispose a patient to influenza complications. In addition, the vaccine dose is 0.2 mL, rather than 0.5 mL, and the minimum interval from first to second dose in children requiring two doses is reduced from six weeks to four weeks, as with TIV.

Annual influenza vaccination is recommended for children with asthma, diabetes, cardiac disease, sickle cell anemia, human immunodeficiency virus infection, or any condition compromising respiratory function, and as of February 2008, for all children ages six months through 18 years. All persons who take care of infants and children five years and younger, and family members of at-risk adults should be immunized as well.[17,18,22,23] Unique characteristics of the influenza virus make development of an effective vaccine difficult. The effectiveness of influenza vaccines varies from 30 to 95 percent, depending on the antigenic drift, similarity of the vaccine strain to the circulating strain, and the health and age of the recipient.

Current recommendations, based on ongoing surveillance, are the following: all children ages six months to eight years who were not previously vaccinated, or who were vaccinated with only one dose their first year of vaccination, should initially receive two doses of vaccine separated by at least four weeks and followed by annual vaccination with a single dose. LAIV is approved only for healthy persons two to 49 years of age.[16-18,20-30]

VARICELLA (CHICKENPOX)

Varicella is a highly contagious disease caused by varicella-zoster virus; it usually results in lifetime immunity. Complications include congenital varicella infection, shingles, severe illness, and death.[33] The three currently available varicella vaccines are: single-antigen varicella (Varivax; approved for children 12 months and older), quadrivalent combination vaccine (Proquad), and herpes zoster virus vaccine (Zostavax; approved for persons 60 years and older). All three vaccines contain the same Oka/Merck varicella vaccine virus, but in increasing concentrations. After one dose, children ages 12 months to 12 years have a 97 percent rate of detectable antibody; after two doses, 99 percent of patients 13 years and older test seropositive.[33-35]

In June 2006, after continued surveillance and an increased number of breakthrough cases, ACIP recommended that all children receive two doses of varicella vaccine, routinely given with MMR at 12 months and at four to six years of age. A combination of varicella vaccine and MMR (i.e., Proquad) is recommended for children who need both components and may be given for both doses in children 12 months to 12 years of age.[36] For children younger than 13 years who need only varicella vaccine, the booster dose should be given three months or more after the initial dose. All adolescents 13 years and older without evidence of varicella infection should receive two doses, as recommended previously, at an interval of at least 28 days.

Varicella vaccine contains a live virus, as does MMR, and is contraindicated during pregnancy and in persons

Table 3. Recommendations for Childhood Influenza Vaccines as of January 2008

Comparison points	*TIV (Fluzone)*	*LAIV (Flumist)*
Ages	All children older than 6 months	Children 2 to 18 years of age
Contraindications/precautions	Allergy to vaccine components, including anaphylactic reaction to eggs[19] Moderate illness with or without fever History of Guillain-Barré syndrome	Same as TIV Pregnancy Medical conditions predisposing to influenza complications, concomitant aspirin therapy, history of recurrent wheezing, altered immunocompetency status
Decrease in asthma or otitis	No statistical difference[20,21]	No statistical difference
Dosing	0.25 mL (6 to 35 months) and 0.5 mL (3 years and older)	One vial intranasal—one half vial in each nostril (remove divider after first half administered)
Effectiveness against influenza A and B	30 to 95 percent immune response, depending on the health of the recipient and antigenic drift of the virus[16,22]	May be more effective than TIV in children younger than two years, but still not approved because of increased wheezing[20,23-27,32]
Thimerosal	None	None
Timing of vaccine	Give between October and March; if two doses are needed, may give first dose in September Effectiveness peaks two weeks after vaccination	Same as TIV, but may be given as early as July
Two doses indicated[28,29]	6 months to 8 years of age if first year of vaccination or if child did not receive two doses previously At least 28 days between doses	2 to 8 years of age if first year of vaccination or if child did not receive two doses previously At least 28 days between doses

LAIV = live, attenuated influenza vaccine; TIV = trivalent (inactivated) influenza vaccine.

Information from references 16 through 32.

with severe immunosuppression. Proper storage of the fragile varicella vaccine in a separate freezer unit, as well as daily temperature monitoring, is essential; improper storage and handling may be a reason for breakthrough disease in vaccinated persons.[35,36]

HEPATITIS A AND B

After the licensure of the hepatitis A vaccine in 1996, U.S. disease rates have declined to the lowest level ever recorded. Initially, only children living in communities with high rates of hepatitis A were immunized. In May 2006, ACIP issued a new recommendation, based on new epidemiologic data and economic analyses, for universal immunization of children.[37] All children should receive hepatitis A vaccine at one year of age (i.e., 12 to 23 months), with the first dose at the 12- to 15-month visit and the second dose six to 12 months later. Children not vaccinated by two years of age can be vaccinated at later visits. Existing programs to immunize high-risk groups such as homosexuals, injection drug users, persons with liver disease, and those with clotting disorders will continue. The hepatitis A vaccine is available as a single-antigen vaccine (Vaqta, Havrix) for children 12 months and older, and in combination with HepB (Twinrix) for those older than 18 years.[37]

Before routine immunization programs were established in the United States, an estimated 30 to 40 percent of all hepatitis B infections resulted from perinatal or childhood transmission. These children have the greatest risk of developing cirrhosis and hepatocellular carcinoma, and they serve as a reservoir of infection for the population as a whole. In 2004, more than 92 percent of young children were fully immunized against hepatitis B,[38] compared with only 50 to 60 percent of adolescents. Currently, the CDC and ACIP emphasize vaccination before hospital discharge for infants of both HBsAg-negative and -positive mothers. Emphasis is also placed on vaccinating nonimmune adolescents, immigrants, and high-risk children.[31]

Recommendations for HepB dosing is unchanged: 0.5 mL given as a three-dose series at birth, two months, and six to 12 months of age. An extra dose may be given at four months when combination vaccinations are used, but it cannot replace the six-month dose.[38] Infants of HBsAg-positive mothers receive immune globulin and vaccination within 12 hours of birth, as previously recommended.[39] The third dose must be given at least four months after the first dose, and the second and third doses should be given at least eight weeks apart.

Recently Developed Childhood Vaccines

ROTAVIRUS

Rotavirus is a common cause of gastrointestinal disease worldwide. In the United States, it is the most common

cause of gastroenteritis-related hospitalization, with direct and indirect costs of infection approaching $1 billion per year.[40] Rotavirus causes the most severe symptoms in children three to 35 months of age and peaks in the winter months. In the first five years of life, four out of five children in the United States have symptoms, one in seven requires an emergency department visit, and one in 70 requires hospitalization.[40]

Initial enthusiasm for vaccination against this virus waned when the first vaccine, Rotashield, was withdrawn from the market because of its association with intussusception. In 2006, a new live, oral rotavirus vaccine with five reassortant viruses from human and bovine strains was approved as a three-dose vaccine in the United States after trials involving more than 70,000 infants in 11 countries were conducted.[41] Randomized controlled trials have shown that vaccination dramatically decreases the all-cause rate of severe gastroenteritis and hospitalization rates from diarrhea. If a child is older than 12 weeks, the vaccine series cannot be started because of a lack of studies on vaccine safety in older children.[40] A summary of the rotavirus vaccine is provided in *Table 4*.[40,41]

Table 4. Key Points About the Rotavirus Vaccine

Key point	*Comments*
Age	Routinely given at 2, 4, and 6 months of age; first dose no earlier than 6 weeks and no later than 12 weeks of age
	All doses must be completed no later than 32 weeks of age because of lack of safety data in older infants
Breastfed infants	Same indications and same effectiveness in breastfed and bottle-fed infants
Contraindications	Severe illness with or without fever, allergy to vaccine components, previous intussusception, current acute gastroenteritis
Dosing	Oral dose is complete contents of vial; unnecessary to repeat if infant spits some out
Inadequate data	Immunosuppression, underlying gastrointestinal disease
Minimum interval between doses	Four weeks

Information from references 40 and 41.

Recently Developed Adolescent Vaccines

Three recently developed vaccines are recommended during adolescence, ideally at the 11- to 12-year visit: tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccine (Tdap; Adacel, Boostrix), quadrivalent meningococcal conjugate vaccine (MCV4; Menactra), and the quadrivalent human papillomavirus (HPV) vaccine (Gardasil). All three vaccines may be given together.

TETANUS, DIPHTHERIA, AND PERTUSSIS

The current childhood immunization series against tetanus, diphtheria, and pertussis induces antibodies that are highly protective (i.e., greater than 95 percent) against diphtheria and tetanus, although immunity wanes with time. Primary vaccination against pertussis, however, is less effective (i.e., 50 to 90 percent), and passive and active immunity wanes after five to 10 years, leaving many adults and adolescents susceptible. Pertussis, consequently, is the least well controlled of the vaccine-preventable diseases of childhood.

In the 1980s, the incidence of pertussis began to rise; in 2005 there were 25,616 reported cases, more than 60 percent among persons 11 to 64 years of age.[42] Pertussis, caused by the gram-negative coccobacillus *Bordetella pertussis*, is a highly infectious acute respiratory illness characterized by severe cough (classically the staccato, whooping cough). Adolescents with pertussis have paroxysmal cough and often have post-tussive emesis; one third still cough more than three months after the onset of illness. Adolescents and adults are a reservoir of infection for unimmunized infants, who account for 92 percent of all deaths from pertussis in the United States, and who have the highest rates of death and complications.[42-44]

The first acellular pertussis vaccine for adults and adolescents (i.e., Tdap) was licensed in 2005 to reduce the morbidity of pertussis in adolescents and adults, to decrease transmission to infants, and to maintain the standard of care for tetanus and diphtheria prevention.[41] Both Adacel (for ages 11 to 64 years) and Boostrix (for ages 10 to 18 years) contain the same tetanus toxoid, diphtheria toxoid, and three of the five pertussis antigens as those in pediatric DTaP, but with decreased quantities of the diphtheria and pertussis components. Adacel also contains two different fimbriae antigens. The vaccines have demonstrated excellent immunogenicity against tetanus, diphtheria, and pertussis after one dose in adolescents and adults who have received a previous immunization series with DTaP or DTP.[42,43]

ACIP has recommended that adolescents (ages 11 to 18 years) and adults who have completed the DTaP or DTP series receive a dose of Tdap in place of their regular tetanus and diphtheria toxoids vaccine (Td) booster. This should be given at the 11- to 12-year visit, or five years after receiving the previous tetanus-containing vaccine, although they may be given Tdap as soon as two years after a Td booster if immunity to pertussis is desired. Those patients with anaphylactic latex allergy should not be given the prefilled syringe with a latex plunger. There is no thimerosal in either vaccine; local reactions are similar to those with Td booster.

Table 5. Comparison of Meningococcal Vaccines

Comparison points	*MPSV4 (Menomune)*	*MCV4 (Menactra)*
Age	Recommended for children 2 to 10 years who have a history of Guillain-Barré syndrome and who desire immunization	Recommended for all children 11 to 12 years of age, unvaccinated children entering high school, college freshmen living in dormitories, and military recruits Recommended for children 2 to 10 years of age who need to be vaccinated because of risk factors or travel May be given three years after MPSV4 is administered
Preservative	Thimerosal	None
Revaccination	If at risk, revaccinate five years after the first dose, but use MCV4	Revaccination not recommended
Route of administration	Subcutaneously	Intramuscularly
Side effects	Mild adverse reactions, including fever, occur in up to 3 percent of children[45]	Mild adverse reactions, including fever, occur in up to 3 percent of children
Special considerations	May be used in persons 11 to 55 years if MCV4 is not available	May be used in persons 11 to 55 years who are at risk of invasive meningococcal disease
Vaccine components	Quadrivalent polysaccharide vaccine (serotypes A, C, Y, W-135)	Quadrivalent polysaccharide vaccine (serotypes A, C, Y, W-135) conjugated to diphtheria toxin

MCV4 = quadrivalent meningococcal conjugate vaccine; MPSV4 = quadrivalent meningococcal polysaccharide vaccine.

Information from references 6, 31, 38, and 45 through 48.

Contraindications and relative contraindications for Tdap are: encephalopathy within seven days of receiving a pertussis-containing vaccine, allergic reaction to any of the vaccine components, an unstable neurologic condition, or a history of Guillain-Barré syndrome within six weeks of receiving a tetanus-containing vaccine. Patients who have a history of an Arthus-type reaction to a tetanus vaccine should wait 10 years after a tetanus vaccine before receiving Tdap. The dose for all ages is 0.5 mL given intramuscularly, preferably in the deltoid.[42-44]

MENINGOCOCCAL DISEASE

Meningococcal disease, caused by the gram-negative diplococcus *Neisseria meningitidis,* is a leading cause of bacteremia and meningitis. It affects 1,400 to 2,800 persons per year in the United States.[6] Meningococci are classified by serology based on the polysaccharide capsule that helps the bacteria resist phagocytosis and complement-mediated lysis. Almost all invasive disease is caused by serotypes A, B, C, Y, and W-135. Even with appropriate antibiotic therapy, the case-fatality rate is 9 to 12 percent, with 11 to 19 percent of survivors having serious sequelae.[6,45]

Infants and teenagers have the highest risk of contracting meningitis. Persons considered at higher risk for meningococcal disease include those with functional or anatomic asplenia, those with terminal complement compound deficiencies, military recruits, those who travel to or live in endemic areas (particularly sub-Saharan Africa), and microbiologists exposed to isolates.[6,45]

Until recently, the standard quadrivalent meningococcal polysaccharide vaccine (MPSV4; Menomune) was still recommended for children two to 11 years of age with terminal complement deficiency or anatomic or functional asplenia, as well as children traveling to endemic areas. MCV4, previously approved for persons 11 to 55 years of age, was recommended for routine use in adolescents in 2005. As of October 2007, however, ACIP has advised the use of MCV4 in at-risk children two to 10 years of age as well. For those children who were previously vaccinated and are at continued risk for meningococcal disease, ACIP recommends they be vaccinated three years after receiving MPSV4.[46,47]

The main advantages of the newer vaccine include: a booster response after the second dose, longer duration of immunity, and effectiveness against most of the common strains.[45] As of September 2006, investigators had identified 17 confirmed cases of Guillain-Barré syndrome following immunization with MCV4. For children with a history of Guillain-Barré syndrome, the CDC recommends temporary use of MPSV4. Because of the sporadic nature of Guillain-Barré syndrome, a causal relationship has not been determined.[48] Because of the inherent limitations of the Vaccine Adverse Event Reporting System (VAERS) and uncertain data concerning the background rate of Guillain-Barré syndrome, the CDC recommends that physicians continue to immunize adolescents, military recruits, college freshmen living in dormitories, and other at-risk persons.[48] *Table 5* compares the available meningococcal vaccines.[6,31,38,45-48]

HUMAN PAPILLOMAVIRUS

A new quadrivalent recombinant HPV vaccine, made from noninfectious HPV-like particles, is now recommended for females 11 to 12 years of age, but it may be administered in females nine to 26 years of age. The

vaccine protects against HPV types 6, 11, 16, and 18, which cause 70 percent of cervical cancers and 90 percent of genital warts.[49] It is most effective when administered before initiation of sexual activity and may be given from nine to 26 years of age. HPV vaccine is given in a three-dose schedule, preferably at 11 to 12 years of age with booster doses two and six months later; and it may be given with other vaccines. Although it does not affect existing HPV infections, it may be given to females with an abnormal Papanicolaou test result because it may provide protection against infection with HPV types not yet acquired. The vaccine has been tested in more than 11,000 women and is nearly 100 percent effective in protecting patients from HPV types 6, 11, 16, and 18 and the diseases caused by them. Contraindications to the vaccine include pregnancy, severe acute illness, or hypersensitivity to the vaccine components or to yeast.[49]

Safety Issues

Some parents, having never seen a case of vaccine-preventable disease, may be reluctant to immunize their child. Family physicians can play an integral role in educating parents on the safety of vaccination. Monitoring of adverse events after vaccines are licensed is provided through the CDC's Immunization Safety Office *(online Table A)*. This office conducts studies to determine if a particular adverse event is caused by a specific vaccine *(online Table B)*. Adverse reactions may be reported to VAERS at 800-822-7967.[50,51]

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