Abstract

Objectives: To describe recent changes in recommended immunization practices, including the introduction of new vaccines, and to explore other immunization issues of interest to pharmacists.

Data sources: CDC’s Advisory Committee on Immunization Practices, the Infectious Diseases Society of America, product labeling, and supplemental information identified through PubMed and by the advisory board.

Study selection: At the author’s discretion based on clinical relevance of the information presented to the immunization issues discussed.

Summary: Several recent changes have occurred in immunization practices in the United States, including approval of a 9-valent human papilloma virus vaccine and a meningococcal B vaccine; changes to recommendations for pneumococcal vaccinations and the use of influenza vaccine in patients with egg allergy; and new recommendations for the use of vaccines by patients taking immunosuppressive medications. In addition, pharmacists should be familiar with recommendations for pertussis vaccination to combat the ongoing pertussis epidemic.

Conclusion: Pharmacists who are familiar with the most recent data and recommendations on immunizations will be better prepared to provide their patients with care that aligns with best practices.


Learning objectives
At the completion of this activity, pharmacists will be able to

■ Provide recommendations on the use of vaccines to prevent human papilloma virus.

■ Determine when patients should be vaccinated against tetanus, diphtheria, and/or pertussis, and select an appropriate vaccine.

■ Provide recommendations on the use of pneumococcal vaccines, and determine the appropriate vaccines and timing for individual patients.

■ Describe the appropriate use of meningococcal B vaccine.

■ Discuss recommendations on the use of influenza vaccine in patients with a history of egg allergy.

■ Use recommendations from the Infectious Diseases Society of America to determine which vaccinations are appropriate for patients with medication-induced immunosuppression.
Preassessment questions
Before participating in this activity, test your knowledge by answering the following questions. These questions will also be part of the CPE assessment.

1. Bryce is a 16-year-old female who has previously completed a three-dose series with quadrivalent human papillomavirus (HPV) vaccine. Her mother heard that a new HPV vaccine is available and wants to know if Bryce should receive this vaccine as well. What should you tell her?
   a. Bryce should not receive the new vaccine because there is no additional theoretical benefit.
   b. Bryce should not receive the vaccine because of the risk of serious safety concerns.
   c. There is no recommendation to receive the vaccine, but there are also no serious safety concerns with this practice if it is chosen.
   d. Bryce should receive the vaccine only if she is sexually active.

2. Sarah is 68 years old, is immunocompetent, and has hypertension but no other chronic conditions. She received pneumococcal polysaccharide vaccine (PPSV23; Pneumovax—Merck) after turning age 65. Should she receive any pneumococcal vaccinations at this time?
   a. No additional pneumococcal vaccines should be administered at this time.
   b. Yes, she should receive pneumococcal conjugate vaccine (PCV13; Prevnar 13—Pfizer) because at least 1 year has passed since she received a dose of PPSV23.
   c. She should receive PCV13 but should wait until she turns age 70 so that at least 5 years have passed since she received a dose of PPSV23.
   d. Yes. Because she has a high-risk condition, she should receive PCV13 now (at least 1 year after PPSV23), followed by another dose of PPSV23 when she turns age 70 (at least 5 years after the last dose of PPSV23).

3. According to recommendations released in 2016 by CDC’s Advisory Committee on Immunization Practices, a patient who experiences allergic symptoms such as angioedema and respiratory distress following exposure to egg should receive which of the following?
   a. No influenza vaccines; they are all contraindicated in patients with this medical history
   b. Recombinant influenza vaccine only
   c. Live attenuated influenza vaccine
   d. Any licensed influenza vaccine that is otherwise appropriate for the patient

4. Which of the following vaccines is contraindicated in a patient with low-level immunosuppression?
   a. Tetanus—diphtheria—acellular pertussis
   b. PPSV23
   c. Live attenuated influenza vaccine
   d. Herpes zoster

Objectives
Although significant progress has been made in preventing life-threatening diseases with the use of vaccines, the uptake of several vaccines remains suboptimal. Pharmacists play an integral role in improving vaccination rates by administering vaccines themselves and by supporting the provision of appropriate vaccines by other health care providers. In addition, pharmacists must remain current with updated vaccination recommendations and newly approved vaccines.

Every year, CDC’s Advisory Committee on Immunization Practices (ACIP) releases updated recommendations for childhood and adult immunization schedules. The 2016 Immunization Schedules, available at www.cdc.gov/vaccines/schedules/hcp/index.html, include several updates that revise the recommended use of existing vaccines and disseminate recommendations for newly approved vaccines. In this article, we review those updates and explore other immunization issues of interest to pharmacists.

Human papillomavirus vaccines
Human papillomavirus (HPV) is the most common sexually transmitted infection in the United States. Each year, approximately 14 million new infections occur, one-half of which are among individuals aged 15 to 24 years. More than 120 types of HPV have been identified. Of these, about 40 can infect the mucosal epithelium, and 13 or 14 are considered high-risk.

The two most common types of cervical cancer are squamous cell carcinoma and adenocarcinoma, which affect more than 12,500 patients and cause nearly 4,000 deaths annually in the United States. Nearly all of these cases of cancer are associated with HPV, and two types of HPV—16 and 18—are associated with 70% of these cancers. In addition, HPV is responsible for 90% of anal cancers; 71% of vulvar, vaginal, or penile cancers; and 72% of oropharyngeal cancers.

Three vaccines are available for the prevention of HPV: a bivalent vaccine (Cervarix—GlaxoSmithKline), licensed for use in females; a quadrivalent vaccine (Gardasil—Merck), approved for use in both males and females; and the newest, a 9-valent vaccine (Gardasil 9—Merck), approved in December 2014 for use in males and females. In February 2015, ACIP recommended the 9-valent vaccine as one of three vaccines that can be used for routine vaccination of females aged 9 years to 26 years and one of two that can be used for routine vaccination of males aged 9 years to 26 years.

Patient case: Susan
Question: Susan is a 13-year-old patient who has currently received two doses of quadrivalent HPV vaccine. She arrives at the pharmacy with her mother for her third dose. Her mother wants to know if she should get the new HPV vaccine. What do you tell her?

The bivalent vaccine targets HPV types 16 and 18, which account for the majority of HPV-related cancers. The quadrivalent vaccine includes types 6 and 11, which cause anogenital warts. The 9-valent vaccine covers types 6, 11, 16, and...
Since 2007, in 2005, ACIP recommended vaccination for adolescents and adults to improve immunity against pertussis.4,5 Over the past 10 years, there were 13,004 reported cases, the lowest incidence since 1957.6

The 9-valent vaccine may be used to continue or complete a series started with a different HPV vaccine. There is no recommendation to provide the 9-valent vaccine to individuals who have already completed a series with a different HPV vaccine. Available data indicate that no serious safety concerns exist with this practice. However, compared with individuals who had never received any HPV vaccine, those who had already completed a three-dose series with the quadrivalent vaccine had higher rates of injection-site swelling and redness after administration of the 9-valent vaccine.3

### Patient case: Susan

**Answer:** Susan may receive the 9-valent HPV vaccine if her mother chooses, but there is no specific recommendation from ACIP regarding which vaccine Susan should receive. However, remind her that if she starts with HPV4 and does not switch to HPV9, it is important to finish the HPV4 series.

#### Tetanus–diphtheria–acellular pertussis (Tdap) vaccines for pertussis

Pertussis incidence has increased since the early 1980s, when there were fewer than 2,500 cases annually.1 A total of 32,971 cases were reported to CDC in 2014, including 13 deaths.4 In 2015, there were 13,004 reported cases, the lowest incidence since 2007.5 In 2005, ACIP recommended vaccination for adolescents and adults to improve immunity against pertussis.6,7

Several vaccine products are recommended for protection against tetanus, diphtheria, and/or pertussis (Table 1).4,6,7 These vaccines include DTaP (Daptacel—Sanofi Pasteur; Infanrix—GlaxoSmithKline), Td (Decavac—Sanofi Pasteur and generic), and Tdap (Adacel—Sanofi Pasteur; Boostrix—GlaxoSmithKline), where “D” or “d” refers to diphtheria, “T” refers to tetanus, and “aP” or “ap” refers to acellular pertussis; capital letters indicate a higher dosage.

In addition, DTaP is available in combination with other vaccines often used in childhood, including polio vaccine (DTaP–inactivated polio vaccine [IPV]; Kinrix—GlaxoSmithKline), hepatitis B (HepB) and polio vaccine (DTaP–HepB–IPV; Pediarix—GlaxoSmithKline), and polio and Haemophilus influenzae type b (Hib) vaccine (DTaP–IPV–Hib; Pentacel—Sanofi Pasteur). Children aged 2 months to 6 years should receive five doses of DTaP at ages 2 months, 4 months, 6 months, 15 to 18 months, and 4 to 6 years.8

Children who received four doses before their fourth birthday should receive a fifth dose of DTaP before entering school. This booster dose is not necessary (but may be given) if the fourth dose in the series was given on or after the fourth birthday. The fifth dose increases antibody levels and may decrease the risk of school-age children transmitting the disease to younger siblings who are not fully vaccinated.1

Td is a vaccine that provides protection against tetanus and diphtheria only. It is given to adolescents and adults as a booster shot every 10 years or after an exposure to tetanus under some circumstances. Tdap is similar to Td but also provides protection against pertussis. The following individuals should be vaccinated with a single dose of Tdap:3,9

- Adolescents aged 11 to 18 (preferably at age 11–12 y)
- Adults aged 19 and older who did not previously receive Tdap (in place of Td vaccine)
- Children aged 7 years to 10 years who are not fully immunized against pertussis
- Health care personnel who have not previously received Tdap

Tdap can be given no matter when Td was last received. After an individual has received Tdap, Td should be given every 10 years.

### Table 1. Recommendations for vaccination with tetanus-, diphtheria-, and pertussis-containing vaccines

<table>
<thead>
<tr>
<th>Patient age</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 mo–6 y</td>
<td>Use DTaP to complete the primary five-dose series at ages 2 mo, 4 mo, 6 mo, 15–18 mo, and 4–6 y.</td>
</tr>
<tr>
<td>7–10 y (for patients who are not fully vaccinated against pertussis)</td>
<td>Give single dose of Tdap. If additional doses of tetanus- and diphtheria-containing vaccines are needed, refer to the catch-up schedule to complete the primary series.</td>
</tr>
<tr>
<td>≥11 y</td>
<td>If there is no record of a Tdap dose, give a single dose of Tdap; follow with one dose of Td every 10 y. Give one dose of Tdap during each pregnancy, preferably during the third trimester, regardless of time since prior Td or Tdap vaccination.</td>
</tr>
<tr>
<td>Pregnant women</td>
<td>If there is no record of a Tdap dose, give one dose of Tdap; follow with one dose of Td every 10 y.</td>
</tr>
<tr>
<td>Individuals who have close contact with infants aged &lt;12 mo</td>
<td>If there is no record of a Tdap dose, give one dose of Tdap; follow with one dose of Td every 10 y.</td>
</tr>
</tbody>
</table>


Sources: References 4, 6, and 7.

### Coconning

The risk of pertussis and associated complications in infants who are too young to be fully vaccinated is a growing concern. Of the pertussis cases in 2014, 3,330 (10.1%) occurred in infants younger than 6 months of age, and eight deaths occurred in those younger than 3 months of age.10

Because the risk of complications from pertussis is increased in infants, current vaccination efforts focus on provid-
ing protection to close contacts of infants, a strategy known as cocooning. People (e.g., grandparents, child care providers, health care providers) who have close contact with young children younger than 12 months of age should be targeted to receive Tdap if they have not previously received a dose.

In addition, pregnant women should receive Tdap during each pregnancy, preferably at 27 through 36 weeks, as it supports transfer of the mother’s antibodies to the fetus.11 Women who have just given birth should receive a single dose of Tdap immediately if they have not received a dose previously during the pregnancy.

### Patient case: Melissa
**Question:** Melissa is 28 weeks pregnant with her first child. She received a dose of Tdap 14 months ago as prophylaxis following a wound on her leg from a biking accident. Since she received a dose of Tdap within the past 2 years, should she receive another dose?

**Answer:** Yes, Melissa should receive Tdap between 27 and 36 weeks of gestation regardless of the timing of the last Tdap dose.

### Timing of Tdap following Td. If a patient who should receive pertussis vaccination recently received a Td booster dose, ACIP recommends that Tdap vaccination should not be delayed. Tdap vaccine should be administered regardless of the interval since the last Td vaccine. Although longer intervals between Td and Tdap vaccination could decrease the potential occurrence of local reactions, the benefits of protection against pertussis outweigh the potential risk for adverse events.

### Patient case: Melissa
**Answer:** Yes, Melissa should receive Tdap between 27 and 36 weeks of gestation regardless of the timing of the last Tdap dose.

### Pneumococcal vaccines
Currently, two vaccines are available for the prevention of pneumococcal disease in adults and children:

- **Pneumococcal conjugate vaccine (PCV13; Prevnar 13—Pfizer),** which targets 13 serotypes of *Streptococcus pneumoniae,* is recommended for children, certain high-risk adults, and adults aged 65 and older. This vaccine replaced the previously available PCV7 vaccine and provides more comprehensive coverage.

- **Pneumococcal polysaccharide vaccine (PPSV23; Pneumovax 23—Merck),** which targets 23 serotypes of *S. pneumoniae,* is recommended for certain high-risk children, certain high-risk adults, and adults aged 65 and older.

The recommended schedules for use of these vaccines have undergone several changes in recent years. Unless there is a contraindication, PCV13 is recommended for use in all children as a four-dose series at ages 2 months, 4 months, 6 months, and 12 months to 15 months. Both vaccines are recommended for use in adults with select conditions and those who are aged 65 and older. Recommendations for vaccine use in adults are complex and have undergone recent changes. In 2016, ACIP revised the schedule to change the interval between PCV13 and PPSV23 to at least 1 year.9

General rules about use of these vaccines include the following:9

- When both PCV13 and PPSV23 are indicated, PCV13 should be administered first.

- PPSV23 should be administered at least 1 year after PCV13, except among adults with immunocompromising conditions, anatomical or functional asplenia, cerebrospinal fluid leak, or cochlear implant, for whom the interval should be at least 8 weeks.

- The interval between two PPSV23 doses should be at least 5 years.

- All adults should receive one dose of PCV13 and one, two, or three doses of PPSV23.

- The two vaccines should not be coadministered.

### Patient case: Alan
**Question:** Alan is a new resident at a skilled nursing facility. He is 74 years old, is immunocompetent, and has never received either pneumococcal vaccine. Which vaccine(s) should he receive, and when?

Immune competent adults aged 65 and older should receive both vaccines, as follows (Figure 1):3, 12

- Patients who have never received either vaccine should receive one dose of PCV13 and one dose of PPSV23 at least 1 year later. If PPSV23 happens to be administered first (at age ≥65 y), PCV13 should be administered at least 1 year later.

- Patients who received PPSV23 before they turned age 65 should have both vaccines administered. The patient should first receive PCV13 at least 1 year after the most recent dose of PPSV23, then a dose of PPSV23 at least 1 year after PCV13 and at least 5 years after the last dose of PPSV23.

- Patients who received PCV13 (but not PPSV23) before they turned age 65 should receive one dose of PPSV23 at least 1 year after receiving PCV13.

- Patients who received both PPSV23 and PCV13 before they turned age 65 should receive one dose of PPSV23 at least 1 year after PCV13 and at least 5 years after the last dose of PPSV23.

### Patient case: Alan
**Answer:** Alan should receive both vaccines. He should first receive one dose of PCV13 and then receive one dose of PPSV23 at least 1 year later.

**Question:** How would your answer differ if Alan had received a dose of PPSV23 at age 65?

**Answer:** Patients who received PPSV23 after turning age 65 should have PCV13 administered at least 1 year later. Because it is now about 9 years later, Alan should receive PCV13.

Adults aged 19 and older with immunocompromising conditions or anatomical or functional asplenia should receive both vaccines, as follows (Figure 2):9

- Patients who have never received either vaccine should receive PCV13 followed by PPSV23 at least 8 weeks later.
Figure 1. Use of pneumococcal vaccine in adults aged 65 and older

- If PCV13 was given before age 65 years, no additional PCV13 is needed.
- No history of pneumococcal vaccine
- PCV 13
- 1 year (8 weeks for groups B & C as defined below)
- PPSV 23
- Pneumovax® 23

- Received PPSV23 before age 65
- 1 year
- PCV 13

- Received PPSV23 at age 65 or older
- 1 year
- PCV 13

B. Immunocompromised (including HIV infection),
- Chronic renal failure,
- Nephrotic syndrome, or
- Asplenia

C. CSF leaks or Cochlear implants

Figure 2. Use of pneumococcal vaccine in adults aged 19 to 64 with underlying conditions

- Prior doses count towards doses recommended below and do not need to be repeated.
- If PPSV23 given previously – wait one year before giving PCV13;
  - for group B, wait at least five years before giving a second dose of PPSV23.
- No more than two doses of PPSV23 recommended before 65th birthday and one dose thereafter.

A. Smoker,
- Long-term facility resident, or
- Chronic conditions:
  - heart disease (excluding hypertension)
  - lung disease (including asthma)
  - liver disease (including cirrhosis)

B. Immunocompromised (including HIV infection),
- Chronic renal failure,
- Nephrotic syndrome, or
- Asplenia

C. CSF leaks or Cochlear implants
A second dose of PPSV23 should be administered at least 5 years after the first dose of PPSV23.

- Patients who have received one dose of PPSV23 should receive PCV13 at least 1 year after the PPSV23. A second dose of PPSV23 should be administered at least 8 weeks after PCV13 and at least 5 years after the first dose of PPSV23.
- Patients who have received two doses of PPSV23 should receive PCV13 at least 1 year after the most recent dose of PPSV23.
- Patients who have received PCV13 should receive PPSV23 at least 8 weeks after PCV13 and at least 5 years after the first dose of PPSV23.
- If a patient received the most recent dose of PPSV23 before age 65, then at age 65 or older, the patient should receive a dose of PPSV23 at least 8 weeks after PCV13 and at least 5 years after the last dose of PPSV23.
- Adults aged 19 and older with cerebrospinal fluid leaks or cochlear implants (Figure 2) should receive the PCV13 followed by PPSV23 at least 8 weeks after PCV13. If PPSV23 was administered before age 65, then at age 65 or older, another dose of PPSV23 should be administered at least 5 years after the last dose of PPSV23. The PCV13 is not repeated at age 65.

**Patient case: Michael**

**Question:** Michael is 56 years old, has type 2 diabetes, and smokes one pack of cigarettes per day. Should he receive any pneumococcal vaccines at this time?

**Answer:** Yes. Because he has certain high-risk conditions, Michael should receive PCV23 at this time. When he turns age 65, he should receive PCV13, followed by another dose of PPSV23 at least 1 year after PCV13 and at least 5 years after the last dose of PPSV23.

**Meningitis vaccines**

Several vaccines are available for the prevention of meningitis. Three vaccines protect against *Neisseria meningitidis* serogroups A, C, Y, and W: a quadrivalent meningococcal polysaccharide vaccine (PPSV4; Menomune—Sanofi Pasteur) and two meningococcal polysaccharide–protein conjugate vaccines (MenACWY; Menactra—Sanofi Pasteur and Menveo—Novartis). In addition, a bivalent meningococcal vaccine (Hib-MenCY; MenHibrix—GlaxoSmithKline), protects against *N. meningitidis* serogroups C and Y in combination with providing protection against Hib.

Two vaccines have been approved to provide protection against *N. meningitidis* serogroup B (MenB): MenB-FHbp (Trumenba—Pfizer), approved in 2014, and MenB-4C (Bexsero—Novartis), approved in 2015. The recommended use of these vaccines is shown in Table 2.

### Table 2. ACIP recommendations for use of meningitis vaccines

<table>
<thead>
<tr>
<th>Patient characteristic</th>
<th>Meningitis vaccine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults with anatomical or functional asplenia or persistent complement component deficiencies</td>
<td>Two doses of MenACWY at least 2 mo apart; revaccinate every 5 y; MenB series&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Microbiologists who are routinely exposed to isolates of <em>N. meningitidis</em></td>
<td>Single dose of MenACWY; revaccinate every 5 y if still at high risk; MenB series&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Persons at risk because of a meningococcal disease outbreak</td>
<td>If outbreak is due to serogroups A, C, Y, or W, a single dose of MenACWY; if outbreak is due to serogroup B, MenB series&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Military recruits</td>
<td>Single dose of MenACWY</td>
</tr>
<tr>
<td>First-year college students aged ≤21 y who live in residence halls</td>
<td>Single dose of MenACWY if students have not received a dose on or after their 16th birthday</td>
</tr>
<tr>
<td>Young adults aged 16–23 y (preferred age range, 16–18 y)</td>
<td>MenB series to provide short-term protection against most strains of disease&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Persons who travel to or live in countries in which meningococcal disease is hyperendemic or epidemic</td>
<td>Single dose of MenACWY; revaccinate every 5 y if still at high risk; MenB not recommended</td>
</tr>
</tbody>
</table>

<sup>a</sup>ABBREVIATIONS USED: MenACWY, meningococcal polysaccharide–protein conjugate vaccine; MenB, serogroup B meningococcal vaccine.

Both MenB vaccines are FDA approved for use in patients aged 10 years to 25 years; however, because there is no theoretical difference in safety for those older than 25 years, ACIP recommends MenB for routine use in all individuals aged 10 years and older who are at increased risk. MenB-4C should be administered as two doses given at least 1 month apart;
MenB vaccine series may be administered to adolescents and young adults aged 16 through 23 years (preferred age is 16–18 y) to provide short-term protection against most strains of serogroup B meningococcal disease.23 Of note, the 2016 child and adolescent schedule added a blue bar for the use of MenB vaccine in adolescents aged 16 to 18. The blue bar indicates “clinical discretion,” which means that the vaccine may be recommended subject to individual clinical decision making.

Patient case: Janice

Question: Janice is 17 years old, heading to college in 2 months, and planning to live in a dormitory. She has never been vaccinated against meningococcal disease, and her mother wants to know if she should receive meningococcal vaccine. What do you tell her?

Answer: Tell Janice and her mother that two types of meningococcal vaccines are available. Janice should receive a single dose of MenACWY at this time. For MenB, Janice may receive the vaccine subject to individual clinical decision making. A discussion of the likelihood of infection, as well as risks and benefits of vaccination, is appropriate to help guide this decision.

Influenza vaccine for patients with egg allergy

Recommendations for the use of influenza vaccine for patients with egg allergy were discussed at the February 2016 ACIP meeting. Prior to this meeting, recommendations called for the use of recombinant influenza vaccine (RIV) in patients who have had a severe allergic reaction to eggs (unlike other influenza vaccines, RIV is not grown in eggs). New recommendations for the use of influenza vaccine in patients with egg allergy are as follows:26

■ Regardless of a recipient’s allergy history, all vaccines should be administered in settings in which personnel and equipment for rapid recognition and treatment of anaphylaxis are available.

■ A previous severe allergic reaction to influenza vaccine, regardless of the component suspected of being responsible for the reaction, is a contraindication for future receipt of the vaccine.

■ Persons with a history of egg allergy who have experienced only hives after exposure to egg should receive influenza vaccine. Any licensed vaccine (i.e., any form of inactivated influenza vaccine [IIV], live attenuated influenza vaccine [LAIV], or RIV) that is otherwise appropriate for the recipient’s age and health status may be used.

■ Persons who report having had reactions to egg involving symptoms other than hives (e.g., angioedema, respiratory distress, lightheadedness, or recurrent emesis) or who required epinephrine or another emergency medical intervention, may similarly receive any licensed influenza vaccine (i.e., any form of IIV, LAIV, or RIV) that is appropriate for age and medical conditions. However, the selected vaccine should be administered in a medical setting in which a health care provider with experience in recognizing and managing severe allergic conditions is immediately available.

These recommendations will take effect when they are published. It is anticipated that they will be released with the recommendations for the 2016–17 influenza season.

Vaccines for patients receiving immunosuppressive medications

Live vaccines are produced by taking a “wild” virus or bacteria, modifying it to retain the ability to replicate, and attenuating it so that it generally does not cause clinical disease. Live vaccines must replicate in the body to stimulate an immune response. Live vaccines are usually contraindicated in patients who are immunocompromised because immunosuppression may reduce vaccine efficacy as well as pose a risk for disseminated infection with the pathogens in live vaccines.

Live vaccines available for general use in the United States include the following:

■ Herpes zoster
■ LAIV
■ Measles, mumps, and rubella
■ Measles, mumps, rubella, and varicella
■ Rotavirus
■ Varicella

In 2013, the Infectious Diseases Society of America (IDSA) released a clinical practice guideline for vaccination of immunocompromised patients.27 The guideline provided a new classification for the degree of immunodeficiency (Table 3) and vaccine-specific recommendations for vaccinating patients with immune-suppressing conditions, including the following:

■ HIV infection
■ Cancer
■ Prior to or after allogenic or autologous hematopoietic stem cell transplant
■ Prior to or after solid organ transplant
■ Chronic inflammatory diseases requiring immunosuppressive medications
■ Asplenia, sickle cell disease, cochlear implants, or cerebrospinal leak

In addition, the guideline provides recommendations for administering vaccines to contacts of immunocompromised patients.
Table 3. Guidelines for patients with high- and low-level immunosuppression

<table>
<thead>
<tr>
<th>High level</th>
<th>Low level</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Combined primary immunodeficiency disorder</td>
<td>• Asymptomatic HIV-infected patients with CD4 T-lymphocyte counts 200–499 cells/mm³ for adults and adolescents and a CD4 percentage of 15–24 for infants and children</td>
</tr>
<tr>
<td>• Receiving cancer chemotherapy</td>
<td>• Lower daily dose of systemic corticosteroid therapy than for high-level immunosuppression for ≥14 d or for patients receiving alternate-day corticosteroid therapy</td>
</tr>
<tr>
<td>• Within 2 mo after solid organ transplantation</td>
<td>• Methotrexate ≤0.4 mg/kg/wk, azathioprine ≤3 mg/kg/d, or 6-mercaptopurine ≤1.5 mg/kg/d</td>
</tr>
<tr>
<td>• HIV infection with a CD4 T-lymphocyte count &lt;200 cells/mm³ for adults and adolescents and a CD4 percentage of &lt;15 for infants and children</td>
<td>• Asymptomatic HIV-infected patients with CD4 T-lymphocyte counts 200–499 cells/mm³ for adults and adolescents and a CD4 percentage of 15–24 for infants and children</td>
</tr>
<tr>
<td>• Daily corticosteroid therapy with a dose ≥20 mg (or &gt;2 mg/kg/d for patients who weigh &lt;10 kg) of prednisone or equivalent for ≥14 d</td>
<td>• Lower daily dose of systemic corticosteroid therapy than for high-level immunosuppression for ≥14 d or for patients receiving alternate-day corticosteroid therapy</td>
</tr>
<tr>
<td>• Certain biologic immune modulators (e.g., a tumor necrosis factor-alpha blocker or rituximab)</td>
<td>• Methotrexate ≤0.4 mg/kg/wk, azathioprine ≤3 mg/kg/d, or 6-mercaptopurine ≤1.5 mg/kg/d</td>
</tr>
</tbody>
</table>

Source: Reference 17.

Patient case: Carlos

Question: Carlos has a severe case of poison ivy after camping over the summer and has been taking prednisone 20 mg once daily for the past 2 weeks. It is now early October, and Carlos is interested in receiving influenza vaccine. However, he hates needles and would prefer the intranasal vaccine. What should you tell Carlos?

Answer: Because Carlos has been taking prednisone 20 mg once daily for the past 2 weeks, he has high-level immunosuppression, according to the IDSA guideline. LAIV (the intranasal influenza vaccine) is contraindicated in patients with high-level immunosuppression, as well as those with low-level immunosuppression. Carlos may receive inactivated influenza vaccine at this time; this should be recommended to ensure that he is not lost to follow-up. However, if his needle phobia is severe, he may receive LAIV at a later date instead. According to the 2011 ACIP general recommendations, he should wait at least 1 month following the discontinuation of prednisone. This would allow Carlos to receive LAIV in November, which is still early enough that he will likely be protected during the peak of the influenza season.

The ACIP general recommendations are undergoing revisions, with updated recommendations expected in 2016. It is anticipated that they will address the IDSA immunosuppression guideline.

Table 4. IDSA recommendations for use of live vaccines by patients receiving immunosuppressive medications

<table>
<thead>
<tr>
<th>Live vaccine</th>
<th>Immunosuppression</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Planned</td>
</tr>
<tr>
<td>Herpes zoster</td>
<td>Recommend for patients aged 50–59; provide as usual for patients aged 60 and older ¹</td>
</tr>
<tr>
<td>Live attenuated influenza vaccine</td>
<td>Contraindicated</td>
</tr>
<tr>
<td>Measles–mumps–rubella</td>
<td>Provide as usual ²</td>
</tr>
<tr>
<td>Measles–mumps–rubella–varicella</td>
<td>Provide as usual ²</td>
</tr>
<tr>
<td>Rotavirus</td>
<td>Provide as usual ²</td>
</tr>
<tr>
<td>Varicella</td>
<td>Provide as usual ²</td>
</tr>
</tbody>
</table>

¹This recommendation differs from the 2011 ACIP general recommendations.
²Provide only if patient is not immune, if patient is not severely immunosuppressed, and if the timing is at least 4 weeks prior to initiation of immunosuppressive medications.
³Administration of varicella vaccine can be considered for nonvaricella-immune patients treated for chronic inflammatory disease who are receiving long-term, low-dose immunosuppression.

Source: Reference 17.

IDSA recommendations for the use of live vaccines in patients receiving immunosuppressive medications are shown in Table 4. Refer to the guideline for recommendations on use of vaccines in patients with immunosuppression due to other causes.

It is important to recognize that the IDSA guideline differs from ACIP’s general recommendations for immunization released in 2011. ACIP’s recommendations stated that a dose equivalent to ≥2 mg/kg of body weight or 20 mg/d of prednisone for 14 days or longer is sufficiently immuno-suppressive to raise concern about the safety of vaccination with live vaccines. ACIP recommended that live vaccines be deferred for at least 1 month after discontinuation of high-dose corticosteroid therapy administered for more than 14 days.¹⁶
CPE HOT TOPICS IN IMMUNIZATION

References


CPE assessment
This assessment must be taken online; please see “CPE information” in the sidebar below for further instructions. The online system will present these questions in random order to help reinforce the learning opportunity. There is only one correct answer to each question.

1. Approximately how many types of HPV are considered to be high risk?
   a. Nine
   b. 13 to 14
   c. About 40
   d. More than 120

2. Which HPV vaccine(s) is/are only licensed for use in females?
   a. Bivalent vaccine
   b. Quadrivalent vaccine
   c. 9-valent vaccine
   d. Both the quadrivalent and 9-valent vaccines

3. Bryce is a 16-year-old female who has previously completed a three-dose series with quadrivalent HPV vaccine. Her mother heard that a new HPV vaccine is available and wants to know if Bryce should receive this vaccine as well. What should you tell her?
   a. Bryce should not receive the new vaccine because there is no additional theoretical benefit.
   b. Bryce should not receive the vaccine because of the risk of serious safety concerns.
   c. There is no recommendation to receive the vaccine, but there are also no serious safety concerns with this practice if it is chosen.
   d. Bryce should receive the vaccine only if she is sexually active.

4. Which of the following vaccines is appropriate for use in children younger than 6 years?
   a. Tdap
   b. DTaP
   c. MenB
   d. HPV

5. Ideally, when should pregnant women receive the Tdap vaccine?
   a. During the second trimester
   b. During the third trimester
   c. During the third trimester, only if the woman has not received Tdap in the past 5 years
   d. Immediately postpartum

6. Which vaccine should be administered to individuals who have close contact with infants younger than 12 months?
   a. DTaP
   b. Tdap
   c. PCV13
   d. PPSV23

7. What is the maximum recommended number of lifetime doses for Tdap?
   a. One
   b. Two
   c. Three
   d. Because Tdap should be administered during every pregnancy, there is no maximum number of recommended lifetime doses.

8. Which of the following statements about the use of pneumococcal vaccine is true?
   a. If both PCV13 and PPSV23 are indicated, PPSV23 should be given first.
   b. The interval between PPSV23 doses should be at least 5 years.
   c. If both PCV13 and PPSV23 are indicated, they may be coadministered.
   d. All adults should receive one, two, or three doses of PCV13.
9. Sarah is 68 years old, is immunocompetent, and has hypertension but no other chronic conditions. She received pneumococcal polysaccharide vaccine (PPSV23; Pneumovax—Merck) after turning age 65. Should she receive any pneumococcal vaccinations at this time?
   a. No additional pneumococcal vaccines should be administered at this time.
   b. Yes, she should receive pneumococcal conjugate vaccine (PCV13; Prevnar 13—Wyeth/Pfizer) because at least 1 year has passed since she received a dose of PPSV23.
   c. She should receive PCV13 but should wait until she turns age 70 so that at least 5 years have passed since she received a dose of PPSV23.
   d. Yes. Because she has a high-risk condition, she should receive PCV13 now (at least 1 year after PPSV23), followed by another dose of PPSV23 when she turns age 70 (at least 5 years after the last dose of PPSV23).

10. Which of the following patients should receive PPSV23?
   a. 30-year-old who smokes cigarettes
   b. 48-year-old with asthma whose last dose of PPSV23 was more than 5 years ago
   c. 74-year-old with no chronic conditions who received PPSV23 at age 65
   d. 19-year-old military recruit with no chronic conditions

11. Patients with immunocompromising conditions who have already received PCV13 (but have not previously received PPSV23) should receive the first dose of PPSV23 after what time interval?
   a. 8 weeks after PCV13
   b. 6 months after PCV13
   c. 1 year after PCV13
   d. 5 years after PCV13

12. The two FDA-approved vaccines that provide protection against N. meningitidis serogroup B (MenB) are indicated for what age range?
   a. 6 months to 65 years
   b. 10 years to 25 years
   c. 18 years to 25 years
   d. 18 years to 65 years

13. ACIP recommends “clinical decision making” regarding the use of MenB vaccine for which patients?
   a. Persons at risk of meningitis infection resulting from an outbreak
   b. Microbiologists who are routinely exposed to isolates of N. meningitidis
   c. Adults with anatomical or functional asplenia or persistent complement component deficiencies
   d. Young adults aged 16 to 18 years

14. According to recommendations voted on by ACIP in 2016, a patient who experiences allergic symptoms such as angioedema and respiratory distress following exposure to egg should receive which of the following?
   a. No influenza vaccines; they are all contraindicated in patients with this medical history
   b. Recombinant influenza vaccine only
   c. LAIV
   d. Any licensed influenza vaccine that is otherwise appropriate for the patient

15. According to ACIP recommendations released in 2016, influenza vaccine is contraindicated in patients who have experienced which of the following?
   a. Any allergic reaction after exposure to egg, including hives only
   b. An allergic reaction to egg involving symptoms such as angioedema, respiratory distress, lightheadedness, or recurrent emesis, and/or emergency medical interventions
   c. An allergic reaction to egg that required emergency medical interventions
   d. A previous severe allergic reaction to the influenza vaccine

16. Which of the following vaccines is contraindicated in a patient who has low-level immunosuppression?
   a. Tdap
   b. PPSV23
   c. Live attenuated influenza vaccine
   d. Herpes zoster

17. Which of the following medications produces low-level immunosuppression?
   a. Tumor necrosis factor-alpha
   b. Rituximab
   c. Daily corticosteroid therapy ≥20 mg for ≥14 days
   d. Methotrexate ≤0.4 mg/kg/wk