EDUCATIONAL OBJECTIVES

GOAL: The goal of this program is to educate pharmacists and pharmacy technicians about current vaccine recommendations so that they can identify adolescent and adult patients who may need vaccinations. Readers will also gain knowledge about where to obtain information about current vaccine recommendations.

After participating in this activity, pharmacists will be able to:
> Discuss the human and economic burden of major vaccine-preventable diseases
> Identify recent changes in vaccine recommendations and be able to locate reputable sources for the most current vaccine recommendations
> Outline the pharmacist’s role in identifying patients who are least likely to be vaccinated and identifying high-risk adolescents and adults who require immunizations
> Apply knowledge to determine which vaccines a patient may need

After participating in this activity, pharmacy technicians will be able to:
> Recall the basic principles behind vaccinations
> Locate reputable sources for the most current vaccine recommendations
> Discuss proper storage temperatures for vaccinations
> Recognize when to refer patients to the pharmacist for recommendations on vaccinations

Abstract

As the number of vaccines available for adolescents and adults continues to increase, pharmacists can serve as a useful resource by providing data and administering vaccines to patients. This module discusses the burden of vaccine-preventable diseases in adults and adolescents, summarizes information about vaccine administration, and offers reliable resources for further facts about vaccines. This article specifically addresses vaccines that pharmacists can administer to patients, with a focus on recent changes in recommendations for these vaccines and ways in which pharmacists can identify patients who may be eligible for vaccination.

Faculty: Jennifer E. Girotto, PharmD
Dr. Girotto is an associate clinical professor of Pharmacy Practice, University of Connecticut, Storrs, Conn., and antimicrobial stewardship co-director, Connecticut Children’s Medical Center, Hartford, Conn.

Disclosure of Discussions of Off-Label and Investigational Uses of Drugs: This activity may contain discussion of unlabeled/unapproved use of drugs in the United States. When unlabeled discussion occurs, it will be based upon the Centers for Disease Control and Prevention recommendations. The content and views presented in this educational program are those of the faculty and do not necessarily represent those of Drug Topics or University of Connecticut School of Pharmacy. Please refer to the official information for each product for discussion of approved indications, contraindications, and warnings.
**Introduction**

In the United States, great strides have been made in improving vaccination efforts, resulting in significant reductions in the occurrence of vaccine-preventable diseases (VPD). Many of these improvements have been the result of very successful pediatric vaccination efforts. The area that pharmacists have made substantial improvements in vaccination of adolescents and adults have been with influenza vaccines. Unfortunately, more work is needed, especially in the vaccination of adolescents and adults for vaccinations other than just influenza. Therefore, this review will not address influenza vaccination in this population; instead, it will review other vaccines that should become a priority for pharmacist vaccination programs aimed at adolescents and adults.

In 2013, there were 26,639 cases of pertussis, 17,193 cases of pneumococcal disease, 3050 cases of hepatitis B, and 241 cases of meningococcal disease (strains ACYW or B) in the United States that could potentially have been prevented by vaccination. These diseases are associated not only with significant morbidity and mortality but also with significant costs. In one study that evaluated the cost of major VPD in adults aged 50 years and older, the annual expenses, including medical and indirect costs, were estimated to be $5.1 billion for pneumococcal diseases, $5 billion for herpes zoster (HZ), and $397.7 million for pertussis.

The percentage of adults receiving recommended vaccinations is generally low. For example, less than one-quarter of those indicated to receive hepatitis B or HZ vaccines do so. Further, few patients receive the full schedule of human papillomavirus (HPV) vaccine with only 5.9% to 37% of men and women aged 19 to 26 years receiving even a single dose. Although overall tetanus vaccine rates in adults over the past 10 years have been slightly higher (ranging from 56%-63% depending on age), less than 20% of patients aged 19 years and older have ever received a dose of the tetanus-containing pertussis vaccine (Tdap) as recommended. The uptake of pneumococcal vaccine among adults is slightly better; however, goal rates have still not been achieved, with only 60% of patients aged 65 years and older having received any pneumococcal vaccine despite recommendations.

Although overall vaccination rates are higher for adolescents than for adults, they are still lower than recommended, with rates of only 29% for completion of meningococcal (MenACWY) vaccination, 40% for completion of HPV vaccination, and 88% for a single dose of Tdap.

**Basic vaccine principles**

There are two general classes of vaccines: inactivated and live. Inactivated vaccines cannot cause disease, even if administered to patients with significant immunodeficiency, because they contain either an inactivated whole virus or bacterium or contain only protein, polysaccharide, or toxoid components of the pathogen. Most vaccines routinely given to adults are inactivated. The only live vaccines recommended for adolescents and adults are the measles, mumps, and rubella (MMR) vaccine; varicella (chickenpox or HZ) vaccines; and intranasal influenza vaccine. Live vaccines contain a live virus or bacteria; however, they contain not the wild strain but a weakened, or attenuated, strain of the pathogen. Attenuated strains do not cause disease in healthy individuals but should not be administered to immunosuppressed individuals, as these attenuated strains can still cause significant disease in these patients.

**Vaccine recommendations**

The CDC routinely provides recommendations for vaccination. The CDC’s advisory committee (the Advisory Committee on Immunization Practices [ACIP]) meets quarterly to discuss updated vaccine information and to vote on changes to existing recommendations. Information about these meetings, including agendas, minutes, presentations, and full YouTube recordings, is available at www.cdc.gov/vaccines/acip/meetings/meetings-info.html. The CDC’s recommendations are considered enacted when they are formally published in the Morbidity and Mortality Weekly Report (MMWR). Pharmacists may wish to subscribe to a listserv (http://www.cdc.gov/Other/emailupdates/) that provides updates on immunizations (ACIP official recommendations) and/or MMWR subscription to ensure that they are always following current recommendations. To summarize the changes that occur over the year, the CDC also provides an annual update, usually in February, to the vaccine schedules (both pediatric and adult). In the vaccine schedules, the CDC describes what vaccinations should still be “caught-up” or administered if vaccines are missed, minimum and maximum ages, and what the minimum intervals between doses of these vaccinations.

Although the CDC is an excellent resource for vaccine recommendations, additional resources are avail-
able for pharmacists. The Immunization Action Coalition website (www.immunize.org) has a multitude of resources for pharmacists, including vaccine information statements in many different languages, clinic resources, and question-and-answer summaries about common topics related to vaccination.

Vaccine storage and administration
Pharmacists must be aware of key points regarding storage and administration of vaccines. For vaccine storage, it is important to use stand-alone refrigerator and freezer units with a temperature-monitoring device containing an alarm that is activated if the temperature is outside of the required range. The temperature should be recorded at least twice daily. As shown in Table 1, most live vaccines should be stored in the freezer, whereas inactivated vaccines are kept in the refrigerator.

Most live vaccines are administered subcutaneously (SC); inactivated vaccines are generally administered intramuscularly (IM) (Table 1). For administration of an SC vaccine, a 23- to 35-gauge 5/8-inch needle should be inserted at a 45° angle in pinched fatty tissue below the dermis but over the upper outer triceps muscle. For administration of an IM vaccine, a 22- to 25-gauge needle ranging from 5/8 inch to 1.5 inch depending on the patient’s weight is used. The needle is inserted into the lower half of the deltoid muscle at a 90° angle. Choosing the correct needle length based on patient weight and administering the vaccine in the lower half of the deltoid muscle will improve the likelihood that the vaccine reaches the muscle; if the vaccine instead enters the bursa space, acromion, or synovial space (all of which are located behind the upper one-third of the deltoid muscle), this can result in an increased risk of local adverse reactions, some severe enough to require surgery.

Table 1: Vaccine Storage and Administration Routes

<table>
<thead>
<tr>
<th>TYPE OF VACCINE</th>
<th>STORAGE TEMPERATURE</th>
<th>ADMINISTRATION ROUTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live (measles, mumps, and rubella*; varicella; zoster)</td>
<td>Freezer: -58°F to 5°F</td>
<td>Subcutaneous</td>
</tr>
<tr>
<td>Inactivated (hepatitis A, hepatitis B, hepatitis A and B, human papillomavirus, polio, meningococcal, pneumococcal, tetanus, diphtheria, and pertussis)</td>
<td>Refrigerator: 35°F to 46°F</td>
<td>Intramuscular*</td>
</tr>
</tbody>
</table>

*Measles, mumps, and rubella vaccines can be stored in refrigerator or freezer as unconstituted lyophilized vaccine. The polysaccharide meningococcal vaccine (MPSV4) should be administered subcutaneously instead of intramuscularly. Both polio and pneumococcal polysaccharide vaccines can be administered either intramuscularly or subcutaneously.

Source: Ref 1,8

Key VPD and vaccination recommendations for adolescents and adults
As discussed earlier, adolescent and adult vaccination rates are often suboptimal, providing an opportunity for pharmacists to work with patients to improve their protection against multiple pathogens. In this section, vaccines with recent changes or those that offer a significant opportunity for pharmacist vaccination programs are highlighted.

Pneumococcus
Pneumococcal disease, or disease caused by the bacteria Streptococcus pneumoniae, has been reported to be associated with four million infections annually in the United States, half of which occur in adults. It is also associated with approximately 22,000 deaths annually from pneumonia, acute exacerbation of chronic bronchitis, bacteremia/sepsis, and meningitis. Importantly, 60% of hospitalizations associated with pneumococcal disease occur in adults, and 95% of deaths occur in patients aged 65 years and older, mostly from pneumococcal pneumonia.

Adolescent and adult patients at increased risk for serious pneumococcal disease include those who are immunocompromised (eg, those with cancer, transplant, chronic renal failure, HIV); those with anatomical or functional asplenia (eg, sickle cell disease); and those who are immunocompetent but have other risk factors such as chronic heart disease (eg, congestive heart failure, cardiomyopathies), chronic lung disease (eg, chronic obstructive pulmonary disease, emphysema, or asthma), diabetes mellitus, chronic liver disease, cerebral spinal fluid leak, cochlear implant, alcoholism, or a history of smoking. Additionally, all patients aged 65 years and older are at increased risk for severe pneumococcal disease.

Two vaccines are currently available to provide protection against pneumococcal disease. The 23-valent pneumococcal polysaccharide vaccine (Pneumovax; PPSV23) has been available since the 1980s and provides protection against 23 strains of S pneumoniae.

However, PPSV23 has demonstrated efficacy results ranging from just 10% to 74% against various invasive pneumococcal diseases. This vaccine is still recommended despite its lack of robust effect because of the significance of invasive pneumococcal disease and the number of strains it provides protection against.

In 2010, a 13-valent pneumococcal conjugate vaccine (Prevnar13; PCV13) was approved by the FDA for patients aged 50 years and older. This vaccine has demonstrated the abil-
It is also important to provide immunologic responses that are at least as strong as those seen with PPSV23. Furthermore, in a study evaluating pneumococcal pneumonia in patients aged 65 years and older, PCV13 demonstrated efficacy against first episode of community-acquired pneumonia (45%) and invasive pneumococcal disease (75%) that was identified to be caused by a vaccine strain.16

Current recommendations for pneumococcal vaccination for adolescents and adults include both of these vaccines (Table 2).12-14,17 Because many patients are recommended to receive both vaccines, the CDC has recently clarified the spacing between vaccine doses.12-14,17 When neither vaccine has yet been given, PCV13 should be administered first. Timing between the administration of PCV13 and PPSV23 then depends on whether the patient has risk factors (other than being aged >65 years). If the patient has specific risk factors (eg, immunocompromise, asplenia, cochlear implants, cerebrospinal fluid leak) and both vaccines are recommended, PPSV23 can be administered eight weeks after PCV13. In adults who were administered PPSV23 first or in those without these risk factors, the spacing between the vaccines should be one year. In adolescents with risk factors, PCV13 can be given as soon as eight weeks after PPSV23.17 It is also important to remember that any time more than one dose of PPSV23 is indicated, the doses should be separated by a minimum of five years.

Zoster
Varicella zoster virus is responsible for both chickenpox and HZ diseases. The virus initially causes chickenpox and then hides in the dorsal root ganglia, where it remains latent for a period of time.18 It is believed that factors such as increasing age cause a loss of cellular-mediated immunity, which allows for the latent virus to become active and spread along the nerve cells to the skin, resulting in HZ infection.18 Before routine vaccination was recommended, patients with these infections were older than 50 years in 49% of cases and older than 60 years in 68% of cases; a total of 60% of affected patients were women.19

“Administering the vaccine in the lower half of the deltoid muscle will improve the likelihood that the vaccine reaches the muscle.”

Increased age and immunocompromised state increase the likelihood of complications from zoster infections. The most common complication is postherpetic neuralgia (PHN), which is the prolonged duration of persistent pain. This complication increases in incidence as patient age increases, with an incidence ranging from 5% in patients aged 50 to 59 years to 20% in patients aged at least 80 years.19 The duration of PHN varies but can be very prolonged, with 6% of those aged at least 50 years having pain for one year or more.19 Other complications of zoster disease include HZ oticus, Bell-like palsy, motor nerve palsies, and skin superinfections.19

Zoster infections are not isolated to a single episode; recurrence is possible. Follow-up from a zoster epidemiology study showed that at eight years, the estimated recurrence rate was 6.2%.20 Factors associated with increased risk of recurrence include female sex (7.2% vs 4.5% male), immunocompromised status at initial episode (12% vs 5.7% immunocompetent), and the occurrence of PHN for at least 30 days with the first episode (hazard ratio, 2.8; 95% confidence interval [CI], 1.8-4.3).20

One live attenuated vaccine is currently approved for the prevention of zoster (Zostavax). This vaccine is approved for patients aged 50 years and older, but the CDC recommends vaccination only for patients aged at least 60 years.21 The CDC evaluated the limited follow-up data available from the original efficacy trials (in patients aged ≥60 years) and found that estimated vaccine efficacy for preventing zoster infection was reduced to 43.1% at five years and 21.1% at seven to 10 years.21 Additionally, vaccine efficacy for preventing PHN was reduced to 60.1% at years four to seven and to 35.4% at years seven to 10.21 These data demonstrate that the vaccine loses its effectiveness over time and does not provide lifelong immunity. This is important as the ACIP and additional studies have not shown that administering it at age 50 years is generally cost-effective.21 Therefore, most patients should wait to be vaccinated until age 60 years to ensure protection when they are at highest risk for complications.21 Because many patients who have had an episode of zoster will have a recurrence, the CDC also recommends that the vaccine should be administered even in patients who have experienced a previous episode.21

The current zoster vaccine is a live vaccine; as such, it should not be administered to patients who are immunocompromised (eg, malignant...
disease or taking medications such as biological modifiers), those who are pregnant, or those receiving antiviral treatments with activity against herpesviruses (eg, famciclovir, valacyclovir). That being said, patients with many chronic conditions such as chronic renal failure, diabetes, rheumatoid arthritis, and chronic pulmonary disease can receive the zoster vaccine. Additionally, patients who receive nonimmunosuppressant dosing of corticosteroids (<20 mg/day or ≥20 mg/day for <2 weeks), low-dose methotrexate (≤0.4 mg/kg/week), or low-dose azathioprine (≤1.5 mg/kg/day) are not considered to be significantly immunosuppressed and can so receive the zoster vaccine. An inactivated zoster vaccine, HZ/su, is currently in phase III trials. This vaccine, which is a two-dose series given at zero and two months, had an efficacy of 97.2% (95% CI, 93.7-99.0) in a placebo-controlled study that included 15,411 patients aged 50 years and older. Differences in vaccine efficacy did not appear to be related to age, so this vaccine may be promising for patients of all ages, and those who cannot receive the currently approved live vaccine because of an immunocompromised status.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Pneumococcal Vaccination Overview for Adolescents and Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indication</strong></td>
<td><strong>Vaccine(s) Indicated</strong></td>
</tr>
<tr>
<td>Immunocompromised patients; patients with asplenia (aged ≥65 years)</td>
<td>PCV13 and PPSV23 (1 additional PPSV23 dose in patients aged &lt;65 years; follow appropriate spacing)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Patients with cerebrospinal fluid leaks or cochlear implants (aged &lt;65 years)</td>
<td>PCV13 and PPSV23 only 1 time in patients aged &lt;65 years</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Immunocompetent patients with disease risk factors (aged &lt;65 years)</td>
<td>PPSV23 only 1 time in patients aged &lt;65 years</td>
</tr>
<tr>
<td>Immunocompetent patients without risk factors (aged ≥65 years)</td>
<td>None</td>
</tr>
<tr>
<td>Immunocompetent patients aged ≥65 years</td>
<td>PCV13 and PPSV23 (1 time each)</td>
</tr>
</tbody>
</table>

*Note that adolescent and adult patients can receive 1 PCV13 vaccine, whereas patients can receive up to 3 lifetime doses (2 before age 65 years and 1 after) of PPSV23 depending on risk factors. Appropriate spacing must be followed throughout. Abbreviations: N/A, not applicable.*

**Hepatitis B**

Hepatitis B virus is a double-stranded DNA virus that is usually acquired via blood or mucosal routes, with most infections occurring through blood (eg, needles or lancets), perinatal, or sexual exposure. Men who have sex with men, patients who use intravenous drugs, and those who have multiple sexual partners continue to be the largest identified populations with hepatitis B. Patients with diabetes who use assisted blood glucose monitoring are also at increased risk of infection. Hepatitis B infection can cause acute hepatitis or chronic infection. Older patients are more likely to have acute hepatitis. Acute disease presents similarly to other forms of hepatitis, with fever, jaundice, nausea, vomiting, right upper quadrant pain, and a serum alanine aminotransferase level higher than 100 IU/L. Those who are infected at younger ages, are immunocompromised, have diabetes, or require hemodialysis are more likely to have chronic infection. Patients with chronic disease are able to transmit the infection, which is associated with cirrhosis, liver failure, and hepatocellular carcinoma. Although there have been significant reductions since the early 2000s in hepatitis B rates in the United States, most recent estimates suggest that nearly 20,000 acute cases still occur annually. Patients aged 30 to 39 years followed by those aged 40 to 49 years have the highest reported incidence of acute hepatitis, and this incidence increased from the previous year in both groups. Among patients whose data was submitted to the CDC, only 37% had an identified risk factor for hepatitis B acquisition.

Multiple vaccines are approved to provide protection against hepatitis B infection in adolescents and adults. Two general single-antigen hepatitis B vaccines (Recombivax HB and Engerix-B) are available, as well as a combination hepatitis A and B vaccine (Twinrix) and a formulation specifically for patients currently undergoing or about to undergo hemodialysis (Recombivax HB Dialysis formulation). The routine vaccination schedule for hepatitis B protection is one dose (0.5 mL of single-antigen vaccine for patients aged <20 years; 1.0 mL of single-antigen vaccine for patients aged ≥20 years; 40 mcg of dialysis formulation for dialysis patients; 1 mL of combination vaccine in adults) administered at zero, one, and six months. Alternative schedules include three-dose sched-
ules with doses administered at zero, one to two, and four months (adolescents and adults) or at zero, 12, and 24 months (adolescents) and a two-dose schedule (for patients aged 11-15 years) with a dose of 10 mcg of the dialysis formulation administered at zero and four to six months.26 The combination vaccine can also be administered on a four-dose schedule, with doses administered at zero days, seven days, 21 to 30 days, and 12 months.27

Most patients will respond to the full vaccine series. Approximately 90% of adults aged younger than 40 years who receive the full three-dose series attain protection against hepatitis B. This protection is reduced with increasing age at vaccination, history of smoking, history of obesity, and immunosupression.25 Because most patients will respond to the vaccine series, testing for vaccine response is recommended in only a small number of patient populations. Healthcare and public safety workers who are at risk for exposure, patients undergoing chronic hemodialysis, patients with HIV, and immunocompromised patients should be assessed for vaccination response through evaluation of surface antibody (anti-HBs) levels one to two months after completing the vaccine series. Seroprotection is defined as ≥10 mIU/mL anti-HBs.26 When patients do not demonstrate evidence of seroprotection (ie, anti-HBs levels <10 mIU/mL), they should receive another three-dose series of the vaccine.25 If patients fail to respond one to two months after the second vaccine series, they should be assessed for the presence of the disease with HBsAg testing; if the results are positive, patients are considered infected, but if the results are negative, they are considered nonresponders who are not protected.25

Most patients can be considered to have long-term (>20 years) immunity after demonstrating adequate immune response to vaccination. Patients who undergo hemodialysis or are immunocompromised (including those with HIV, those with hematopoietic stem cell transplant, and those receiving chemotherapy) may have waning responses; as such, anti-HBs levels may need to be assessed annually in these patients.25

Recently, questions have arisen regarding patients who were vaccinated previously (eg, as infants or children) but did not have their vaccine response evaluated and are now part of a group (eg, healthcare providers) who should have evidence of protection established. These patients should undergo response testing. If their anti-HBs level is <10 mIU/mL, they should receive a single dose of hepatitis B vaccine as a challenge dose followed by anti-HBs testing one to two months later. If patients still do not demonstrate an adequate vaccine response, they should receive two additional hepatitis B vaccine doses followed by additional anti-HBs testing one to two months after the final dose.28

**HPV**

There are approximately 150 identified strains of HPV.29 Approximately one-quarter of these strains are associated with causing genital warts (low-risk strains 6 and 11) or genital cancers (oncogenic strains 16, 18, 31, 33, 45, 52, and 58) at the mucosal epithelia.1,29,30 Although most cases of HPV infection are spontaneously cleared, HPV can cause cancers when the infection persists over a period of many years. In cervical cancer, the type of cancer most commonly associated with HPV infection, cervical intraepithelial neoplasia (CIN) that progresses from stages 1 to 3 is indicative of persistent and progressing infection.1 In addition to genital warts and cervical cancer, HPV is also associated with anal, vulvar, vaginal, penile, and oropharyngeal cancers, as well as recurrent respiratory papillomatosis (recurrent warts often on the larynx).29 The 2vHPV (Cervarix) and 4vHPV (Gardasil) vaccines covering HPV 16 and 18 are estimated to provide protection against 64% of HPV-associated invasive cancers; the use of 9vHPV (Gardasil9) adds an additional 10% of protection.30

Certain populations are at higher risk for HPV infection or at higher risk for increased disease severity. Immunocompromised patients (those with transplant, those with HIV, those taking immunosuppressant medications) are at higher risk for both disease occurrence and increased disease severity. Men who have sex with men are at increased risk for HPV disease and the cancers associated with this infection. Patients with a history of sexual abuse or assault are at an increased risk of exposure to HPV because of the potential for future abuse and risky sexual behaviors.29,30

Three vaccines are currently approved for the prevention of HPV infection in adolescents and adults: 2vHPV, 4vHPV, and 9vHPV. 2vHPV is approved for female patients aged nine through 25 years, whereas 4vHPV is approved for both male and female patients aged nine through 26 years.
female patients aged nine through 26 years. 9vHPV is approved for female patients aged nine through 26 years and male patients aged nine through 15 years. 2vHPV and 4vHPV have shown not only initial efficacy but also significant persistence of protection. Recent data show that both of these vaccines have sustained protection for more than eight years with almost 100% efficacy at protection against CIN 2 or 3 caused by included strains. Additionally, the 27th birthday as long as the series was initiated at the appropriate age.29

All HPV vaccines have the same administration schedule: a three-dose series administered at zero months, one to two months, and six months. HPV vaccination is recommended routinely for patients aged 11 or 12 years.29,30 The HPV vaccines can be administered in patients as young as nine years, especially in those with a history of sexual assault or other risk factors. Catch-up vaccinations should be continued through age 21 years for women and for men who are immunocompromised, have sex with other men, or want to be vaccinated. If the patient began with 2vHPV or 4vHPV, he or she can finish out the series with 9vHPV. Additionally, the vaccine series can be finished after the 27th birthday as long as the series was initiated at the appropriate age.29

**Meningococcal Vaccine Indications**

<table>
<thead>
<tr>
<th>VACCINE COVERAGE</th>
<th>SPECIFIC VACCINES</th>
<th>INDICATIONS FOR VACCINATION</th>
<th>BOOSTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strains A, C, Y, and W</td>
<td>MenACWY-D</td>
<td>Routine adolescent vaccination; vaccination for high-risk adolescents and adults</td>
<td>Adolescents, 1 time; high-risk patients, every 5 years</td>
</tr>
<tr>
<td></td>
<td>MenACWY-CRM</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MPSV4</td>
<td>Indicated based on risk in patients aged &gt;55 years who have never received a MenACWY vaccine</td>
<td>No</td>
</tr>
<tr>
<td>Strain B</td>
<td>MenB-4C</td>
<td>Routine recommendation for high-risk adolescents and adults; permissive recommendation for patients aged 16-23 years (preference, patients aged 16-18 years)</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>MenB-FHbp</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*If still at high risk* Source: Refs 33-33

Meningococcal vaccines can be confusing, as different vaccines cover different strains and have different indications. Three vaccines are approved to cover strains A, C, Y, and W in adolescents and adults. The two conjugate vaccines (MenACWY) are MenACWY-D (Menactra) and MenACWY-CRM (Meneo). MenACWY-D is approved for patients aged nine months to 55 years, whereas MenACWY-CRM is approved for patients aged two to 55 years. Both of these vaccines are recommended for both primary (one- or two-dose series, depending on the patient) and booster dosing. The other vaccine is a polysaccharide vaccine (MPSV4; Menomune). MPSV4 is approved for patients aged at least two years but is recommended only for some patients aged more than 55 years.32

Another two vaccines provide protection against the B strain of meningococcus: MenB-4C (Bexsero; two-dose series) and MenB-FHbp (Trumenba; three-dose series). Both of these vaccines are approved for patients aged 10 to 25 years; however, the CDC recommendation is for patients aged at least 10 years old with no maximum age.33

The CDC routinely recommends vaccination with a MenACWY vaccine for all patients aged 11 to 12 years with a booster at 16 years of age, with catch-up through age 21 years for those who have not received a dose since their 16th birthday. Additionally, the CDC recommends vaccination with ACWY or B in cases of meningococcal outbreaks, with vaccine choice depending on the strain of the current outbreak.32,33 The CDC has also added a permissive recommendation allowing a MenB vaccine series to be administered to patients aged 16 to 23 years (with preference for age 16-18 years) when there is no current outbreak.34

High-risk patients such as those with complement component deficiency, those with asplenia, and microbiologists who work with *N meningitidis* require both an ACWY and B strain vaccine for optimal protection (Table 3).32-34

Currently, all patients (high-risk or permissive) who receive MenB vaccines receive the same recommended series for the vaccine; there is no recommendation for boosting at this time. However, some patients who are indicated to receive MenACWY may need dose modifications. Specifically, patients with immune issues (ie, complement component deficiency, asplenia, or HIV) should receive a two-
dose primary series of MenACWY, separated by eight to 12 weeks. Additionally, booster doses of MenACWY are then needed every five years for those who remain at increased risk. Patients aged greater than 55 years who are indicated to receive meningococcal vaccination and have never received a dose of MenACWY should instead receive MPSV4.

**Tetanus, Diphtheria, and Pertussis**
Tetanus, diphtheria, and pertussis are all toxin-mediated diseases, meaning that although they are caused by bacteria, their specific effects are due to the toxin that these bacteria produce. For this reason, the vaccine is designed to target the toxins, not the bacteria. The incidences of tetanus and diphtheria have significantly decreased because of routine vaccination, making these diseases very uncommon. The incidence of pertussis, however, continues to have periodic outbreaks, partially because of decreased recognition of this condition in adolescents and adults, and partially because of a change in the vaccine in the early 1990s (from a whole-cell vaccine to an acellular vaccine) intended to reduce the occurrence of adverse effects.

There are currently three categories of vaccines that cover these diseases in adults: tetanus toxoid (TT; generic); tetanus and diphtheria (Td; Decavac, Tenivac and generic) and tetanus, diphtheria, and pertussis (Tdap; Adacel and Boostrix). TT is generally not recommended for any patients whereas both Td and Tdap are recommended for routine immunization in adolescents and adults. Specifically, patients should receive a tetanus- and diphtheria-containing vaccine every 10 years (or five years after last tetanus containing vaccine in cases of significant wound infection). Patients who have not yet received a single dose of Tdap should be administered the Tdap vaccine rather than Td. Emphasis should also be placed on ensuring vaccination of patients who plan to have direct contact with infants. In these cases, it is best to provide Tdap two weeks before the patient plans to interact with the infant to allow for full protection. Additionally, Tdap should be administered to every pregnant woman between weeks 27 and 36 of gestation. When Tdap is not administered during pregnancy, it should be administered immediately after the patient gives birth.

Generally, immunizers can administer any brand of vaccine, however, for Tdap administered to patients aged at least 65 years, more evidence exists to support the use of Boostrix, and this agent is therefore preferred over Adacel. However, the CDC clearly states that if Adacel is the only version available to the provider, it would be better to provide Adacel than to miss a vaccination opportunity.

**Strategies to identify patients needing vaccination**
Incorporation of vaccination into the busy pharmacy environment requires various strategies, such as posting current immunization schedules, creation of age-specific targeting (eg, for pneumococcal, zoster, Tdap/Td, meningococcal, HPV vaccines), and disease-state targeting. To incorporate disease-state strategies, pharmacists can target specific medications that would generally only be prescribed for specific indications (eg, metformin for diabetes) to alert for potential vaccination opportunities (eg, pneumococcal and hepatitis B vaccination) and then put an alert on those prescriptions. See http://pharmacy.uconn.edu/academics/ce/immunization/, Medications and Disease Based Immunization Recommendations for Adults, for an example. Technicians can help with this process by tagging prescriptions that they are filling with a note stating that the patient may need vaccination and that the patient should speak with the pharmacist. The technician can then alert the pharmacist when the patient is picking up the prescription so that the pharmacist can discuss whether the vaccine is indicated for that particular patient. Additionally, when time permits, the pharmacist can sit down with the patient to learn more about any additional potential indications for vaccination such as work or sexual exposures.

**Conclusion**
In conclusion, pharmacists are an important provider of vaccines for adolescent and adult patients. Pharmacists must use the resources available to remain updated on information regarding vaccine recommendations and administration, as well as ways to effectively identify patients in need of these vaccines.

**References** are available online at www.drugtopics.com/cpe.

For CPE credit, take the test now online at www.drugtopics.com/cpe ONCE THERE, CLICK ON THE LINK BELOW FREE PEER-REVIEWED CPE ACTIVITIES
TEST QUESTIONS

For Pharmacists

1. A lack of vaccination in adolescents and adults can lead to:
   a. Loss of time at work
   b. Increased medical utilization
   c. Increased direct and indirect costs to patients
   d. All of the above

2. For an otherwise healthy 18-year-old college student who plays competitive softball and does not smoke, which of the following vaccines could be given based on recent changes in vaccine recommendations?
   a. PCV13
   b. IPV
   c. MenB
   d. Zoster

3. Which of the following is a reliable site to confirm current vaccine recommendations?
   a. CDC.org
   b. Immunize.org
   c. MMWR.org
   d. All of the above

4. Which pneumococcal vaccine(s) is/are indicated for a patient who is aged 65 years and has never received a pneumococcal vaccine?
   a. PCV13 only
   b. PPSV23 only
   c. PCV13 and PPSV23, spaced appropriately

5. Which group of adults account for 95% of deaths caused by pneumococcal pneumonia?
   a. 18- to 49-year-old patients
   b. 50- to 64-year-old patients
   c. >65-year-old patients

6. Which of the following 19-year-old patients would be indicated to receive the PCV13 vaccine?
   a. Patient who smokes
   b. Patient with cancer
   c. Patient with diabetes
   d. Patient with hypertension

7. What can be done in the pharmacy to make the pharmacist more effective at identifying patients who may need vaccines?
   a. Tag prescriptions when they are filled based on the likely indication, and talk to these patients when they come in for the prescription.
   b. Target prescriptions based on age, and talk with patients when they come in.
   c. A and B

8. Which of the following represents ACIP’s recommendations on when patients should receive the zoster vaccine?
   a. Age ≥50 years
   b. Age ≥60 years
   c. Age ≥70 years

9. You are working at your pharmacy and are targeting patients to receive HPV9 based on age. Which of the following ages is recommended by ACIP to receive the HPV9 vaccine?
   a. Age 11 to 26 years
   b. Age eight to 15 years
   c. Age 15 to 30 years

10. You have a 30-year-old patient who recently had a car accident that required his spleen to be removed. He was told he would need a meningococcal vaccine. Which meningococcal vaccine(s) should he receive based on CDC recommendations?
    a. MenACWY only
    b. MenB only
    c. Both MenACWY and MenB

For Pharmacy Technicians

1. Can an inactivated vaccine cause disease?
   a. Yes
   b. Yes, only in immunosuppressed patients
   c. No

2. Which organization produces vaccine recommendations?
   a. Medscape
   b. CDC
   c. ASHP

3. Which site has clinic resources on its website that the technician can use to ensure that vaccines are stored appropriately?
   a. ASHP.org
   b. AAP.org
   c. Immunize.org

4. Which of the following vaccines should always be stored in the freezer?
   a. PCV13
   b. MenB
   c. Tdap
   d. Zoster

5. At what temperature should the PCV13 vaccine be stored?
   a. Between 35°F and 46°F
   b. Between -58°F and 5°F
   c. Between 68°F and 78°F

6. What is included in a live virus vaccine such as MMR?
   a. An inactivated virus
   b. Protein fragments of the virus
   c. A weakened strain of the naturally occurring virus

7. A patient comes to the pharmacy, and there is a note on her prescription stating that she may be indicated to receive a particular vaccine. You talk to the patient and learn that she has not received that vaccine in the past. What should be the next step?
   a. Refer the patient to the pharmacist to determine whether she can receive the vaccine.
   b. Ask the patient clinical questions to determine whether she is eligible for vaccination.
   c. Tell the patient to come back another day for the vaccine.

8. In what month are updated immunization schedules usually published by the CDC?
   a. February
   b. April
   c. September

9. The pharmacist has a patient who speaks only Spanish; this patient needs to be given the vaccine information statement in his native language. Where can you go to obtain this for the pharmacist?
   a. CDC Pink Book
   b. Immunization Action Coalition
   c. CDC Morbidity and Mortality Weekly Report

10. How often should the temperature of the refrigerator and freezer that store vaccines be recorded (at a minimum)?
    a. Daily
    b. Twice daily
    c. Hourly
    d. Twice weekly

For CPE credit, take the test now online at www.drugtopics.com/cpe ONCE THERE, CLICK ON THE LINK BELOW FREE CPE PEER-REVIEWED ACTIVITIES
References


