CME CREDIT ***EDUCATIONAL OBJECTIVE:*** Readers will vaccinate their patients according to guidelines from the US Centers for Disease Control and Prevention

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Keeping up with immunizations for adults

ABSTRACT

This paper discusses recommendations from the US Centers for Disease Control and Prevention's Advisory Committee on Immunization Practices for vaccinating adults against influenza, tetanus, measles, mumps, rubella, varicella, hepatitis A and B, human papillomavirus, shingles (zoster), pneumonia, and meningitis.

KEY POINTS

Information on immunization schedules, including an app for mobile devices, is available at www.cdc.gov/vaccines/schedules/hcp/adult.html.

Vaccination rates in adults are low, and appropriate vaccinations should be encouraged. The electronic medical record can help remind us when vaccinations are due.

The live-attenuated vaccines, ie, zoster, varicella, and combined measles, mumps, and rubella, are contraindicated during pregnancy and in immunocompromised patients.

A 58-YEAR-OLD MAN with a history of irritable bowel syndrome and diabetes presents for an evaluation in early November. He is taking metformin and insulin glargine 10 units. He smokes 1 pack per day. He believes that his childhood immunizations were completed, but he has no records. He thinks his last "shot" was 15 years ago when he cut his hand on some wood.

Which immunizations, if any, would be most appropriate for this patient?

The explosion of new vaccines, new formulations, and new combinations made available in recent years makes managing immunizations a challenge. This article reviews common immunizations and current recommendations for their appropriate use.

Immunization recommendations (**TABLE 1**) are made predominantly by the Advisory Committee on Immunization Practices (ACIP) of the US Centers for Disease Control and Prevention (CDC). The last 15 years have seen the arrival of new vaccines (eg, varicella, hepatitis A, pneumococcal, and human papillomavirus), new formulations (eg, intranasal influenza), and new combinations.

To keep clinicians abreast of new indications, the ACIP issues immunization schedules annually for children and adults, available online and downloadable for easy reference.[1] For adults, the ACIP provides schedules based on age and medical condition. The schedule for medical conditions offers specific information regarding immunization and pregnancy, human immunodeficiency virus (HIV) infection, kidney failure, heart disease, asplenia, and other conditions. The ACIP also provides guidance on contraindications; for example, pregnant and immunocompromised patients should not receive the live-attenuated vaccines, ie, zoster, varicella, and combined measles, mumps, and rubella [MMR]).

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Adult awareness of vaccines is low, as are vaccination rates: in people older than 60, the vaccination rate is about 70% for influenza, 60% for pneumococcus, 50% for tetanus, and 15% for zoster. The lack of vaccine awareness and the availability of new vaccines and indications have made it difficult to manage immunizations in the primary care setting. The electronic medical record is useful for tracking patient vaccine needs. Ideally, keeping up with immunizations should be a routine part of visits provided by a physician's care team and does not always require direct physician coordination.

TETANUS, DIPHTHERIA, PERTUSSIS EVERY 10 YEARS

Tetanus (also called "lockjaw") is a nervous system disorder characterized by muscle spasms. Caused by infection with *Clostridium tetani*, it is a rare disease in the United States thanks to widespread immunization, and it causes fewer than 50 cases annually. Worldwide, the incidence is about 1 million cases a year with 200,000 to 300,000 deaths.

Diphtheria (formerly sometimes called "throat distemper") is caused by the gram-positive bacillus *Corynebacterium diphtheriae* and can occur as a respiratory illness or as a milder cutaneous form. The last outbreak in the United States was in Seattle in the 1970s, with the last reported case in 2003. The ACIP recommends booster shots for tetanus and diphtheria every 10 years following completion of the primary series.

Pertussis or whooping cough, caused by *Bordetella pertussis* infection, is a highly contagious disease increasingly seen in adults in the United States. It causes few deaths but high morbidity, with coughing that can persist up to 3 months. Coughing can be severe enough to cause vomiting, a characteristic sign.

In July 2012, the CDC reported that the United States was at a 50-year high for pertussis, with 18,000 cases reported and 8 deaths.[2] In Washington State alone, more than 2,520 cases had been seen through June 16 of that year, a 1,300% increase over the previous year. Rates were high in older children and adolescents despite previous vaccination, suggesting an early waning of immunity.

TABLE 1

Immunizations recommended by the Advisory Committee on Immunization Practices

Tetanus and diphtheria booster every 10 years after the primary series is completed

Pertussis once for all adults and pregnant women at 27–36 weeks gestation

Measles-mumps-rubella (MMR) for all immunocompetent adults born in 1957 or after; women of childbearing age should be screened for immunity and receive the vaccine if needed, although not during pregnancy or within 4 weeks before pregnancy

Hepatitis A and B for at-risk groups, including men who have sex with men, intravenous drug users, and those with chronic liver disease

Influenza annually for everyone age 6 months and older

Pneumococcal vaccine for people age 65 and older, and high-risk patients over age 19 (eg, those who are immunocompromised, have chronic disease, or are smokers)

Varicella (against chickenpox): for all adults born in 1980 or after, except for pregnant women or those who may become pregnant within 4 weeks

Zoster (against shingles) for everyone age 60 and older, except those with severe immunodeficiency

Meningococcal immunization for college students in dormitories, adults with asplenia, complement deficiency, or human immunodeficiency virus (HIV) infection, and travelers to Africa

The ACIP recommends a single dose of the combination of high-dose tetanus and low-dose diphtheria and pertussis vaccines (Tdap) for all adults regardless of age and for all pregnant women with each pregnancy between 27 and 36 weeks of gestation. A dose of Tdap counts as the tetanus-diphtheria booster shot that is recommended every 10 years.

The patient described above is due for his tetanus-diphtheria booster and so should be given Tdap.

MEASLES, MUMPS, RUBELLA FOR THOSE BORN AFTER 1957

Measles remains a problem in the developing world, with an estimated average of 330 deaths daily. The number of cases fell 99% in the United States following the vaccination program that started in the early 1960s. Before the measles vaccine was available, an estimated 90% of children acquired measles by age 15.

The clinical syndrome consists of fever, conjunctivitis, cough, rash, and the characteristic Koplik spots—small white spots occurring on the inside of cheeks early in the disease course.

During the first 5 months of 2014, the CDC reported 334 cases of measles in the United States in 18 states, with most people affected being unvaccinated.[3] In comparison, from 2001 to 2008, the number of cases averaged 56 annually.

Many of the recent cases were associated with infections brought from the Philippines. The increased number of measles cases underscores the need for vaccination to prevent measles and its complications.

Mumps is an acute, self-limited viral syndrome, and parotitis is the hallmark. Vaccination led to a 99% decline in cases in the United States. Although complications are rare, they can be serious and include orchitis (with risk of sterility), meningoencephalitis, and deafness.

Mumps outbreaks still occur, especially in close-contact settings such as schools, colleges, and camps. During the first half of 2014, central Ohio had more than 400 cases linked to The Ohio State University.

Since the 1990s, there has been an explosion of new vaccines

Rubella, also known as German measles, is a generally mild infection but is associated with congenital rubella syndrome. If a woman is infected with rubella in the first trimester of pregnancy, the risk of miscarriage is greater than 80%, as is the risk of birth defects, including hearing loss, developmental delay, growth retardation, and cardiac and eye defects.

Recommendations for MMR vaccination. People born before 1957 are considered immune to measles and usually to mumps. Health care workers should document immunity before assuming no vaccination is needed.

People born in 1957 or after should have one dose of MMR vaccine unless immunity is documented or unless there is a contraindication such as immunosuppression. A second dose is recommended for those born in or after 1957 who are considered to be at high risk: eg, health care workers, students entering college, and international travelers. The second dose should be given 4 weeks after the first.

Women of childbearing age should be screened for immunity to rubella. Susceptible women should receive MMR, although not during pregnancy and not if they may get pregnant within 4 weeks.

The patient described above was born before 1957, and so he is probably immune to measles and mumps.

HEPATITIS B FOR THOSE AT RISK

Hepatitis B vaccination is recommended for all adolescents and adults at increased risk: eg, men who have sex with men, intravenous drug users, people with multiple sexual partners, health care workers, patients with end-stage renal disease on hemodialysis, patients with chronic liver disease, and those with diabetes (age < 60).

Immunization consists of a series of three shots (at 0, 1–2, and 4–6 months). Booster doses are not recommended. Postvaccination testing for immunity is available and is recommended for health care workers, patients on hemodialysis, patients with HIV infection or who are otherwise immunocompromised, and sexual partners of people who are positive for hepatitis B surface antigen. Nonresponders should be revaccinated with the entire three-shot schedule. Hepatitis B vaccination is safe in pregnancy.

The patient described above has diabetes and so is a candidate for vaccination.

HEPATITIS A: A SLIGHTLY DIFFERENT RISK GROUP

Hepatitis A vaccination is recommended only for at-risk populations: international travelers; intravenous drug users; men who have sex with men; patients with clotting disorders, chronic liver disease, or hepatitis C infection; international adoptees; and laboratory personnel working with hepatitis A virus. The vaccination is given in two doses with a minimum interval of 6 months between doses.

A hepatitis A and hepatitis B combination vaccine (Twinrix) is also available. It is given in three doses, at 0, 1, and 6 months.

ANNUAL INFLUENZA VACCINE FOR ALL

In 2010, the ACIP recommended a policy of universal annual vaccination for everyone age 6 months and older. Some patients are at especially high risk themselves or are at high risk of

exposing others and so are given higher priority during vaccine shortages—ie, patients who are immunosuppressed or have other medical risk factors, health care workers, household members of at-risk patients, and pregnant women after 13 weeks of gestation.

There are few contraindications, so almost everyone should be encouraged to receive the influenza vaccine. The flu shot does not cause the flu, but it may cause soreness at the injection site. Those with severe egg allergy should not receive the standard flu shot; a recombinant vaccine that does not use egg culture is available.

The standard flu shot is an inactivated influenza vaccine. In the past, most formulations were trivalent, but quadrivalent formulations are becoming more common. Special high-dose formulations are believed to elicit a better immune response and can be recommended for people over age 65. Intradermal and intramuscular formulations are available.

An intranasal live-attenuated influenza vaccine is also available and may be used for people ages 2 through 49. It should not be given to immunosuppressed people or to pregnant women.

Our patient should get a flu shot.

PNEUMOCOCCAL VACCINE FOR THOSE AGE 65 AND OLDER OR AT RISK

Two formulations are now available for pneumococcal immunization. The standard is a 23-valent polysaccharide vaccine (PPSV23; Pneumovax) indicated for people age 65 and older.

Patients under age 65 can receive PPSV23 if they have chronic lung disease, chronic cardiovascular disease, diabetes, chronic liver disease, or alcoholism or are a resident of a nursing home or an active smoker.

Our patient is a candidate for PPSV23 since he smokes and has diabetes.

The other formulation is a conjugate 13-valent vaccine (PCV13; Prevnar 13). Patients over age 19 at high risk should be given PCV13 plus the PPSV23 8 weeks later. Those who already received PPSV23 should be given PCV13 vaccine more than 1 year later. Candidates for PCV13 are those with immunocompromising conditions (including chronic renal failure and nephrotic syndrome), functional or anatomic asplenia, cerebrospinal fluid leaks, or cochlear implants.

The current revaccination schedule for PPSV23 is as follows:

- One-time revaccination 5 years after the first dose in patients with chronic renal failure, nephrotic syndrome, asplenia, or an immunosuppressive condition
- One-time revaccination for patients age 65 or older if they were younger than 65 when first immunized (with one or two doses of PPSV23) and 5 years have passed
- No revaccination is needed for people vaccinated with PPSV23 after age 65.

HUMAN PAPILLOMAVIRUS VACCINE

Human papillomavirus is the most common sexually transmitted infection in the United States and is strongly associated with cervical cancer. Immunization is now indicated for both sexes, generally between the ages of 9 and 26. Two vaccines are available: the quadrivalent formulation (Gardasil) for males or females and the bivalent formulation (Cervarix) for females only.

Immunization should be given in three doses: at 0, 1 to 2 months, and 6 months. It can be given to patients who are immunocompromised as a result of infection (including HIV infection), disease, or medications, or who have a history of genital warts, an abnormal Papanicolaou test, or a positive human papillomavirus DNA test.

It is hoped that immunization will lead to a significant decrease in cervical cancer rates. Eradication is unlikely because other papillomavirus strains also can lead to cancer, so cancer screening is still warranted. For men who have sex with men, it is hoped that immunization will prevent condyloma and anal cancer.

Live-attenuated vaccines are contraindicated in those with compromised immunity, pregnancy

CHICKENPOX AND SHINGLES VACCINES

Varicella vaccine (Varivax) contains a live-attenuated virus to protect against chickenpox. It is recommended for all adults who have no evidence of immunity. Immunity is assumed with a history of chickenpox, being born before 1980, or having positive titers. Vaccination should be emphasized for those who come in contact with patients at high risk of severe disease (eg, health care workers, fam-

ily contacts of immunocompromised patients) and in individuals with a high risk of personal exposure (eg, teachers, day care workers).

The vaccine is given in two doses, 4 to 8 weeks apart. Women who are pregnant or who may get pregnant within 4 weeks should not be vaccinated.

The shingles vaccine (Zostavax) is a larger dose of the varicella vaccine and reduces the incidence of shingles by 50% and postherpetic neuralgia by 66%.[4] It was approved by the US Food and Drug Administration in May 2006 for people starting at age 50, but was recommended by ACIP in October 2006 for people age 60 and older; as a result, some insurance companies deny coverage for patients ages 50 through 59.

The shingles vaccine can be given to patients who have already had shingles. Pregnancy and severe immunodeficiency are contraindications.

Our patient, 58 years old, could be considered for shingles vaccine if covered by his insurance company or if he wishes to pay for it.

MENINGOCOCCUS VACCINE

Meningococcal immunization is recommended for people at high risk: college students who plan to live in dormitories, adults without a spleen or with complement deficiencies or HIV infection, or travelers to the "meningitis belt" of sub-Saharan Africa.

Two types of meningococcal vaccine are available: the conjugate quadrivalent vaccine (MCV4) for people age 55 and younger, and the polysaccharide quadrivalent vaccine (MPSV4) for people over age 56.

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