JENNIFER LONG, PharmD
Dr. Long is a pharmacy practice resident at Veterans Administration Hospital in Cleveland, Ohio.

KAY KYLLONEN, PharmD
Dr. Kyllonen is a clinical pharmacist in pediatrics at the Cleveland Clinic Children's Hospital.

Adult vaccinations: a short review

KEY POINTS:

The adult groups targeted for vaccination with the varicella vaccine are susceptible health care workers, household contacts of immunocompromised persons, day care and school workers, nonpregnant women of childbearing years, and persons living or working in high-risk environments.

All persons should complete a primary tetanus-diphtheria series; afterward they need a booster dose every 10 years.

Persons older than 65 years and others at risk should receive the influenza vaccine every fall and a single dose of the pneumococcal vaccine.

Hepatitis B vaccine is indicated for health care workers, homosexual men, persons with multiple sexual partners, and abusers of intravenous drugs.

ABSTRACT: Rates of vaccination in adults fall far short of recommendations. We review the epidemiology, efficacy, safety, and recommended use of vaccines against pneumococcal pneumonia, influenza, hepatitis A and B, varicella, measles, mumps, rubella, tetanus, and diphtheria.

Immunizations are underused in adults, even though they could prevent many cases of infectious disease and death. Each year 50,000 to 70,000 adult Americans die of diseases that vaccines can prevent, primarily pneumococcal infection, influenza, and hepatitis B; by comparison, 1000 children die of diseases that are targeted by childhood immunizations.[1–3]

Possible reasons for the less-than-satisfactory rates of immunization among adults include poor documentation of vaccination records, doubts about the efficacy and safety of vaccines, uncertainty about specific recommendations for different vaccines, inadequate reimbursement, and poorly developed and insufficiently promoted programs for immunizing adults.[1,2]

The Centers for Disease Control and Prevention (CDC) and other organizations have set goals for increasing the rate of adult immunization for specific diseases such as influenza, pneumococcal pneumonia, hepatitis B, and measles.[4,5] In the following pages we review the efficacy, safety, and use of the major vaccines indicated for adults; the TABLE summarizes the vaccinations indicated for various patient groups.

PNEUMOCOCCAL VACCINE

Pneumococcal pneumonia causes an estimated 40,000 deaths per year in the United States.[2] The mortality rate is highest among the elderly, persons with bacteremia or meningitis, and persons with underlying chronic conditions.

Yet, only about 14% of persons older than 65 years and 5% to 7% of those from 18 to 64 years who have conditions that predispose them to pneumonia have received the pneumococcal vaccine.[2,6,7] The Public Health Service would like these numbers to increase to 60% by the year 2000 for pneumococcal vaccine and influenza vaccine as well.[8]

Efficacy

The current polysaccharide vaccine protects against the 23 strains that cause 88% of pneumococcal infections in the United States. In early studies, it conferred protection in 85% to 95% of young adults who received it. However, recent studies show an overall protective efficacy rate of only 56%, as it is less effective in older patients.[6,8,9]

Adverse effects

Common: Mild erythema and pain at the site of injection.

Less common: Systemic adverse reactions such as fever and myalgia and severe local reactions (less than 1% of injections).

Rare: Anaphylaxis (5 per million doses).[2,6,8]

Recommendations

All persons should receive 0.5 mL intramuscularly or subcutaneously at 65 years of age, or earlier if they are at risk (TABLE). Persons without a spleen, persons with renal failure or nephrotic syndrome, and transplant recipients should also receive a booster shot 6 years later, because they tend to have declining antibody levels that put them at greater risk of fatal pneumonia.[4] Some experts advocate giving the vaccine as early as 55 years of age, when the response may be better.

Hepatitis B is the only disease in which the incidence has risen since a vaccine was introduced

■ INFLUENZA VACCINE

Since 1957 there have been 19 severe influenza epidemics, and more than 10,000 persons died in each of them—the two most severe epidemics had more than 40,000 deaths each—even though the inactivated-virus vaccine was available. Patients older than 65 years accounted for 80% to 90% of the deaths; the mortality rate was highest in persons with underlying cardiac or pulmonary disease.[2,6]

Only 30% of persons older than 65 years receive the influenza vaccine each year, and only 9% to 13% of 18-to-64-year-olds at high risk.[2,5]

Efficacy

Precise efficacy data for the influenza vaccine are not available, as the CDC formulates a new influenza vaccine every year on the basis of information from a worldwide surveillance system that identifies the current strains responsible for epidemics. The vaccine is available starting in mid-September. The viruses are grouped by subtypes on the basis of the hemagglutinin antigen and the neuraminidase antigen. Acquired immunity to these antigens protects against influenza or lessens its severity in persons who do contract it.

Adverse effects

Common: Mild local reactions.

Less common: Systemic reactions (malaise, myalgia), appearing 6 to 12 hours after vaccination and lasting 1 to 2 days.

Rare: Severe allergic reaction (the influenza vaccine is contraindicated in persons with a history of anaphylaxis in response to eggs).[2,6,8]

Recommendations

Because of antigen variation and the short duration of induced immunity, the influenza vaccine should be given every year to:

- Persons 65 years or older.
- Other persons at risk (TABLE).
- Health care workers.
- Persons who, if infected, may transmit the virus to a person at high risk.[2,6,8]

Ideally, the vaccine should be given in mid-September; however, any time before mid-December is acceptable. The antibody takes 2 to 4 weeks to reach sufficient protective levels.

Universal influenza vaccination is controversial. Both health and economic benefits have been attributed to influenza vaccinations in healthy working adults and the noninstitutionalized elderly: reduced rates of illness, absenteeism, physician visits, and hospital admissions.[10–12] However, some argue that giving the vaccine to healthy persons every year may diminish its effectiveness.[13,14] On the other hand, a study that addressed this concern in healthy 30-to-60-year-old volunteers found that the influenza vaccine was as effective in subjects who had received a previous vaccination within 3 years of the study as it was in those receiving their first vaccina-

TABLE

ADULT VACCINATIONS: A QUICK REFERENCE

Age	Vaccinations recommended (if no history of disease or not up to date)
18–64 years	Varicella, measles-mumps-rubella, tetanus-diphtheria toxoid
≥ 65 years	Pneumococcal, influenza, tetanus-diphtheria toxoid
Other considerations	**Additional vaccines recommended**
Condition	
Homeless persons, immigrants	Review all immunization records
Institutionalized mentally dysfunctional persons	Hepatitis B
Nursing home residents	Pneumococcal, influenza
Pregnant women	Both varicella and measles-mumps-rubella vaccine are contraindicated
Prisoners	Hepatitis B
Occupation	
Military recruits	Pneumococcal, influenza, hepatitis A, others to bring patient up to date
Health care workers	Influenza, hepatitis B
Day care center workers	Influenza
Lifestyles	
Travelers	Review all vaccinations; consider influenza, pneumococcal, hepatitis A and B, and others according to area of visit
Homosexual men	Hepatitis B, hepatitis A
Persons with multiple sexual partners	Hepatitis B
Intravenous drug abusers	Hepatitis B, hepatitis A
Diseases	
Accidents (bites, wounds)	Tetanus-diphtheria toxoid (if no booster given in past 5 years); if needed, give rabies vaccine, rabies immune globulin, tetanus immune globulin, antivenin
Alcoholism	Pneumococcal, influenza
Cancer	Pneumococcal, influenza
Chronic liver disease	Influenza, hepatitis A
Diabetes mellitus	Pneumococcal, influenza
HIV, AIDS, immunocompromise	Pneumococcal, influenza, hepatitis B
Organ transplant recipients	Pneumococcal, influenza
Renal dysfunction, hemodialysis	Pneumococcal, influenza
Splenic dysfunction or absence	Pneumococcal, *Haemophilus influenzae* B

tion.[15] Efficacy was determined by postvaccination antibody titers and the incidence of influenza infection-related illness. Thus, the decision is one of personal choice, since yearly vaccination seems to do no harm.

HEPATITIS B VACCINE

Approximately 300,000 new cases of hepatitis B are diagnosed each year in the United States; of these, an estimated 12,000 are related to occupational exposure. Hepatitis B is the only disease in which the incidence has actually risen since a vaccine for it was introduced.[2,6] Each year hepatitis B causes 250 deaths from fulminant hepatitis, 4000 from cirrhosis, and 800 from liver cancer.[2,4,5]

Efficacy

The antibody levels produced by the hepatitis B vaccine decline with age: 70% of persons 50 to 59 years old achieve a protective response, but only 50% of older persons do.[16] The antibody response is also diminished in patients with chronic conditions such as diabetes, liver disease, obesity, and cigarette smoking.[17] Men seem to have a poorer response than women.

Use hepatitis A immune globulin for immediate protection

It is uncertain how long the vaccine confers protection, but it is believed to last approximately 7 to 9 years.[2,6] The higher the antibody response, the longer that antibodies persist.

Adverse effects

Common: Mild local reactions occur in 10% to 20% of persons.

Less common: Systemic symptoms (fever, headache, fatigue, nausea).[2,6]

The product is a recombinant vaccine grown on yeast and lacks the viral contamination associated with the earlier plasma-derived vaccine.

Recommendations

Hepatitis B vaccine should be given to:

- All health care workers.
- Homosexual men.
- Persons with multiple sexual partners.
- Intravenous drug abusers.
- Hemodialysis patients.
- Immunocompromised patients.[1,2,6]

The high cost of the vaccine remains a deterrent to its use, even in persons at high risk.

Dosage: Two doses of 10 µg (1 mL), 1 month apart, and a third 10-µg dose 5 months later.[6,12] Since hepatitis B vaccine is less effective when injected into the gluteal area, it should be given in the deltoid muscle.[6,18]

HEPATITIS A VACCINE

Hepatitis A causes approximately 75,000 to 100,000 cases of acute hepatitis and 100 deaths each year.[8,19] The main route of infection is fecal-oral, primarily through contaminated food or water. Unlike hepatitis B, hepatitis A does not induce a chronic carrier state. However, young children can be a reservoir and transmit the virus to adults.

Risk factors include employment or attendance at a day care center, intravenous drug abuse, international travel, and exposure to contaminated food or water.[8,20] Approximately 42% of persons who acquire the infection have no identifiable risk factor.

The hepatitis A vaccine consists of killed virus.

Efficacy

Protective antibody levels are detectable in 80% to 98% of patients 15 days after a single dose; most of the remaining patients attain protective levels within 1 month. Because a booster dose increases antibody titers 40 to 80 times above the protective concentration, we expect the vaccine to be effective 10 years or more.[20] Immunocompromised patients may need additional doses to achieve a protective level.

Adverse effects

Common: Mild injection-site reactions are reported in about 50% of adults who receive it.

Rare: Systemic adverse reactions and anaphylaxis are rare.[8,20]

Recommendations

Immunization is recommended for:

- Military personnel.

- Travelers to countries in which hepatitis A is endemic.
- Homosexual men.
- Intravenous drug users.
- Patients with chronic liver disease.

There are no current recommendations for routine use in day care or food preparation workers.[8,20]

Dosage: Give 1 mL in the deltoid muscle and a 1-mL booster dose 6 to 12 months later.

If an outbreak of hepatitis A occurs and immediate protection is needed, the CDC recommends giving hepatitis A immune globulin, since the effectiveness of the vaccine has not yet been evaluated in this situation.[8,20]

VARICELLA VACCINE

Varicella zoster virus causes both varicella (chicken pox) and herpes zoster (shingles; caused by a reactivation of a latent infection). Approximately 15% of persons with chicken pox later develop shingles, which occurs mostly in elderly or immunocompromised persons. More adults who contract chicken pox develop pulmonary and central nervous system complications than do children. The illness may be more severe in pregnant women and immunocompromised patients.[8]

The varicella vaccine is a live attenuated virus prepared from the Oka strain of varicella zoster virus.

Efficacy

Varicella vaccine induces seroconversion in 82% of adults after one dose and in 94% after two doses. Antibody levels appear to persist for at least 1 year after two doses.[8,21]

Adverse effects

Common: Tenderness and erythema at the injection site.

Less common: A generalized maculopapular or vesicular rash develops within 1 month in 5% of patients. The number of vaccine-associated rashes tends to decrease with the second dose of the vaccine.[8,21] It is uncommon for vaccinated persons with rash to transmit the virus to susceptible contacts. Children with leukemia have an increased risk of developing this rash, but it is generally subclinical or mild.

Rare: One case of shingles has been reported in a person who received the vaccine (an apparent incidence of 13 per 100,000 person-years).[8]

Recommendations

Varicella vaccine is primarily indicated for infants and children, but it is approved for adults because of the severity of illness in this age group. The targeted adult groups are:

- Health care workers who have not had chicken pox.
- Susceptible household contacts of immunocompromised persons.
- Susceptible day care and school workers.
- Nonpregnant women of childbearing years.
- Persons living or working in high risk environments (college students, military recruits, and possibly travlers).[8,21]

Dosage. Two 0.5-mL subcutaneous doses, 4 to 8 weeks apart. Since this is a live vaccine it is contraindicated in immunocompromised persons and pregnant women.[21] Recipients can transmit varicella zoster virus to close contacts and therefore should take care not to expose susceptible persons.

MEASLES, MUMPS, RUBELLA (MMR) VACCINE

Attenuated viral vaccines have significantly decreased the incidence of measles, mumps, and rubella. However, these diseases have undergone a resurgence in recent years, as more children either received inadequate immunization or none at all. The problem is not one of diminishing immunity but rather a lack of primary response to the vaccine.[21,22] Young adults can acquire these viruses in close living quarters on college campuses or through travel to endemic areas.[2,22,23]

Varicella vaccine recipients can transmit the virus to close contacts

Adverse effects

Common: The measles component of the MMR vaccine can produce a rash and a temperature of more than 39.4°C within 5 to 21 days of immunization; local reactions occur in a small percentage of patients.

The rubella portion causes joint symptoms in approximately 40% of persons, beginning 3 to 25 days after vaccination and lasting up to 11 days, most often in nonimmune women who receive the vaccine.

Recommendations

The following persons should receive two doses of the MMR vaccine:

- All persons born after 1956. No adverse reactions have been reported when

the MMR was given to a person who was already immune to one or more of the components. Therefore, if a question arises about a person's immunization history, it is safe to give the vaccine again.[2]

- Any person who received the early measles vaccines (killed, live attenuated with gamma globulin, or live attenuated given before 12 months of age) between 1957 and 1971.
- Any person who received a live attenuated measles vaccine between 1971 and 1980.
- Persons with symptomatic or asymptomatic HIV infection who have not been adequately immunized.
- The MMR vaccine is not recommended for use in other immunocompromised patients.
- Persons entering college.
- Persons with tuberculosis.[21]

In case of an epidemic, the CDC recommends that any unimmunized child between the ages of 6 and 12 months be immunized with the monovalent measles vaccine. For unimmunized children 12 months and older, the MMR vaccine is recommended.

The MMR vaccine is contraindicated in pregnancy and in those with a history of anaphylaxis in response to eggs or neomycin.[2,21]

Do not give Td toxoid if the patient has received a booster in the past 5 years

TETANUS-DIPHTHERIA (Td) TOXOID

In the United States, tetanus is primarily a disease of older adults—the incidence increases with age, as does the mortality rate. Most of these cases occur because the patient failed to complete a primary immunization series. The incidence of respiratory diphtheria has decreased, but 40% to 85% of adults older than 60 years still lack protective antibody titers.

Adverse

Common: Most patients develop a local reaction, but this does not contraindicate further use.

Recommendations

Every adult, regardless of age or lifestyle, should receive a full 3-dose primary Td series if he or she never received one. The first two doses should be given intramuscularly at least 4 weeks apart and the third dose 6 to 12 months after the second. Thereafter, patients should receive a booster dose every 10 years. Persons who fail to complete a primary series need only to finish the series—it is not necessary to begin again.

Contraindications: The only contraindications are a neurologic reaction or severe hypersensitivity after a previous dose. However, since Arthus-type hypersensitivity reactions often occur after multiple boosters, it is recommended that anyone who has completed a primary series or received a booster dose within the last 5 years should not receive a Td booster even after an injury.[2,6]

ADVICE FOR TRAVELERS

It is important to carefully review the immunization history for persons planning to travel outside the United States. Depending on the area to which they are traveling and the endemic diseases in those regions they may require poliomyelitis, typhoid fever, cholera, Japanese encephalitis, meningococcus, or rabies vaccines.[2,17] ■

REFERENCES

1. The Association for Practitioners in Infection Control. Position paper on immunizations. Am J Infect Control 1992; 20(3):131–132.
2. Gardner P, Schaffner W. Immunizations of adults. N Engl J Med 1993; 328:1252–1258.
3. Williams WW. Hickson MA, Kane MA, Kendal AP, Spika JS, Hinman AR. Immunization policies and vaccine coverage among adults: the risk for missed opportunities. Ann Intern Med 1988; 108:616–625.
4. Update on adult immunization: recommendations of the Immunization Practices Advisory Committee (ACIP). MMWR 1991; 40(RR-12).
5. American College of Physicians Task Force on Adult Immunization, Infectious Diseases Society of America. Guide for adult immunization. 2nd ed. Philadelphia: American College of Physicians, 1990.
6. Stein B. Adult vaccinations: Protecting your patients from avoidable illnesses. Geriatrics 1993; 48(9):46–55.
7. Fedson DS, Harward MP, Reid RA, Kaiser DL. Hospital-based pneumococcal immunization: epidemiologic rationale from the Shenandoah study. JAMA 1990; 264:1117–1122.
8. Gardner P, Eickhoff T, Poland GA, et al. Adult immunizations. Ann Intern Med 1996; 124:35–40.
9. Shapiro ED, Berg AT, Austrian R, et al. The protective efficacy of polyvalent pneumococcal polysaccharide vaccine. N Engl J Med 1991; 325:1453–1460.

10. Nichol KL, Lind A, Margolis KL, et al. The effectiveness of vaccination against influenza in healthy working adults. N Engl J Med 1995; 333:889–893.
11. Nichol KL, Margolis KL, Wuorenma J, et al. The efficacy and cost-effectiveness of vaccination against influenza among elderly persons living in the community. N Engl J Med 1994; 331:778–784.
12. Fedson DS, Wajda A, Nicol JP, et al. Clinical effectiveness of influenza vaccination in Manitoba. JAMA 1993; 270:1956–1961.
13. Hoskins TW. Assessment of inactivated influenza-A vaccine after three outbreaks of influenza A at Christ's Hospital. Lancet 1979; 1:33–35.
14. Small PA, Bender BS. Vaccination against influenza in healthy adults (letter). N Engl J Med 1996; 334:402–403.
15. Keitel WA, Cate TR, Couch RB. Efficacy of sequential annual vaccination with inactivated influenza virus vaccine. Am J Epidemiol 1988; 127:353–363.
16. Denis F, Mounier M, Hessel L, et al. Hepatitis-B vaccination in the elderly. J Infect Dis 1984; 149:1019.
17. Hadler SC, Margolis HS. Hepatitis B immunization: vaccine types, efficacy, and indications for immunization. In: Remington JS, Swartz MN, eds. Current clinical topics in infectious diseases. Vol 12. Boston: Blackwell Scientific 1992:282–308.
18. Advice for travelers. Med Lett Drugs Ther 1996; 38(969):17–20.
19. Kane MA. Perspectives on the control of hepatitis A by vaccination. Vaccine 1992; 10(Suppl 1):S93–96.
20. Hepatitis A vaccine. Med Lett Drugs Ther 1995; 37(950):51–52.
21. Varicella vaccine. Med Lett Drugs Ther 1995; 37(951):55–57.
22. Demmler RW, Bakht FR, DeSilva P. Improving measles vaccination rates in previously vaccinated adults. J Fam Pract Med 1992; 35(2):180–184.
23. Struewing JP, Hyams KC, Tueller JE, et al. The risk of measles, mumps, and varicella among young adults: a serosurvey of US Navy and Marine Corps recruits. Am J Public Health 1993; 83(12): 1717–1720.

ADDRESS: Kay Kyllonen, PharmD, Hospital Pharmacy, S107, The Cleveland Clinic Foundation, 9500 Euclid Avenue, Cleveland, OH 44195.