



Pharmacology Update

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The New Adult Immunization Schedule

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In February 2002 the Advisory Committee on Immunization Practice approved the first adult immunization schedule. These recommendations have been accepted by the American Academy of Family Physicians and the American College of Obstetricians and Gynecologists and are updated yearly (Advisory Committee on Immunization Practices [ACIP], 2003; Pinkowish, 2002). All healthcare professionals, including neuroscience nurses, should be knowledgeable about current recommendations to answer patient and family questions. In addition, increasing the vaccination rates among adults will decrease the burden of diseases such as tetanus, diphtheria, influenza, pneumonia, hepatitis A and B, measles, mumps, rubella, varicella, and meningitis. In fact all of these are now considered to be vaccine preventable diseases.

Vaccines are tested in the laboratory first, then in animals, and next in phased human clinical trials for safety and efficacy before being licensed (Chen et al., 2001). This process provides data on common acute vaccine reactions but minimal to no data on rare reactions, reactions with delayed onset (30 days or more), or reactions

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in populations excluded from the clinical trials. Therefore, issues and controversies arise after licensure once the vaccines are administered to millions of individuals.

This article provides an overview of each category of the new adult immunization schedule. Several issues and challenges of importance to neuroscience nurses, such as appropriate vaccines for trauma patients and the influenza vaccine and its association with Guillain-Barre syndrome (GBS) and multiple sclerosis (MS), are also discussed.

Overview of the Adult Schedule

The basic recommended adult immunization schedule, United States, 2003–2004 by age group is given in Fig 1 (ACIP, 2003). The full schedule, with footnotes, can be easily accessed online at www.cdc.gov/nip/recs/adult-schedule.pdf.

The schedule contains recommendations for all adults, defined as individuals 19 years of age or older. There are specifics to catch up individuals if they are behind in the recommended childhood vaccinations. The basic age categories are 19–49 years, 50–64 years, and older than 65 years with no specified upper age limit. There are specific recommendations for each of the tetanus and diphtheria (Td); influenza; pneumococcal polysaccharide; hepatitis A and B; measles, mumps, and rubella (MMR); varicella; and meningococcal polysaccharide vaccines.

The recommended immunizations for adults with medical conditions are shown in Fig 2 (ACIP, 2003). While not considered by some to be a medical condition, pregnancy is addressed in the recommended immunization for adults with medical conditions. Other conditions include diabetes, heart disease, chronic pulmonary disease, chronic liver disease (including alcoholism), congenital immunodeficiency, leukemia, lymphoma, generalized malignancy, therapy with alkylating agents, antimetabolites, radiation or large amounts of corticosteroids, renal failure/ end stage renal disease, recipients of hemodialysis or clotting factor concentrates, asplenia including elective splenectomy, terminal complement component deficiencies, and HIV infection. There is also an adult vaccination screening form available at the CDC Web site to assist healthcare professionals in the screening process (ACIP).

Specific Recommendations

Tetanus and Diphtheria (Td)

In the United States, the combined tetanus toxoid (TT) and diphtheria toxoid (Td) vaccine has been used in immunization programs for more than 50 years (Gardner, 2001). TT is a formalin-inactivated tetanus toxin, and current U.S. recommendations are that it should always be administered with diphtheria toxoid in the Td formulation. Td is used almost exclusively in adults, and approximately 16 million doses are distributed annually in the United

Vaccine ▶ Medical Conditions ▼	Tetanus-Diphtheria (Td) ^{*,1}	Influenza ²	Pneumococcal (polysaccharide) ^{3,4}	Hepatitis B ^{*,5}	Hepatitis A ⁶	Measles, Mumps, Rubella (MMR) ^{*,7}	Varicella ^{*,8}
Pregnancy		A					
Diabetes, heart disease, chronic pulmonary disease, chronic liver disease, including chronic alcoholism		B	C		D		
Congenital immunodeficiency, leukemia, lymphoma, generalized malignancy, therapy with alkylating agents, antimetabolites, radiation or large amounts of corticosteroids			E				F
Renal failure / end stage renal disease, recipients of hemodialysis or clotting factor concentrates			E	G			
Asplenia including elective splenectomy and terminal complement component deficiencies		H	E, I, J				
HIV infection			E, K			L	

See Special Notes for Medical Conditions below—also see Footnotes for Recommended Adult Immunization Schedule, by Age Group and Medical Conditions, United States, 2003–2004 on back cover

- For all persons in this group
- Catch-up on childhood vaccinations
- For persons with medical / exposure indications
- Contraindicated

Special Notes for Medical Conditions

- A. For women without chronic diseases/conditions, vaccinate if pregnancy will be at 2nd or 3rd trimester during influenza season. For women with chronic diseases/conditions, vaccinate at any time during the pregnancy.
- B. Although chronic liver disease and alcoholism are not indicator conditions for influenza vaccination, give 1 dose annually if the patient is ≥ 50 years, has other indications for influenza vaccine, or if the patient requests vaccination.
- C. Asthma is an indicator condition for influenza but not for pneumococcal vaccination.
- D. For all persons with chronic liver disease.
- E. For persons < 65 years, revaccinate once after 5 years or more have elapsed since initial vaccination.
- F. Persons with impaired humoral immunity but intact cellular immunity may be vaccinated. *MMWR* 1999; 48 (RR-06): 1–5.
- G. Hemodialysis patients: Use special formulation of vaccine (40 ug/mL) or two 1.0 mL 20 ug doses given at one site. Vaccinate early in the course of renal disease. Assess antibody titers to hep B surface antigen (anti-HBs) levels annually. Administer additional doses if anti-HBs levels decline to < 10 millinternational units (mIU)/mL.
- H. There are no data specifically on risk of severe or complicated influenza infections among persons with asplenia. However, influenza is a risk factor for secondary bacterial infections that may cause severe disease in asplenic.
- I. Administer meningococcal vaccine and consider Hib vaccine.
- J. Elective splenectomy: vaccinate at least 2 weeks before surgery.
- K. Vaccinate as close to diagnosis as possible when CD4 cell counts are highest.
- L. Withhold MMR or other measles containing vaccines from HIV-infected persons with evidence of severe immunosuppression. *MMWR* 1998; 47 (RR-8): 21–22; *MMWR* 2002; 51 (RR-02): 22–24.

Fig 1. Recommended adult immunization schedule, United States, 2003–2004, by age group

States (Gardner). Immunization against tetanus and diphtheria in the United States has been very successful in decreasing the burden of both these diseases. Reported cases of tetanus in the past decade have been between 35 and 59 cases per year, and diphtheria cases have been between 1 and 5 cases per year in the United States (Gardner). The new adult immunization schedule contains a straight forward recommendation for Td. The recommendation is for all adults to have 1 booster dose every 10 years (ACIP, 2003).

Influenza

Each year in the United States, influenza, an acute upper respiratory infection, is responsible for 36,000 deaths and approximately 200,000 hospitalizations (Bridges et al., 2003; Neuzil, Griffin, & Schaffner, 2002). Annual influenza vaccination campaigns, while not perfect, are highly effective in preventing this annual viral onslaught (Neuzil et al.). The formulation for the influenza vaccine changes each year as vaccine manufacturers and public health officials try to anticipate the most common strains each upcoming season. Adults develop peak antibody protection against influenza approximately 2 weeks after vaccination (Bridges et al.). It is for this reason that while the flu season lasts from November to March, vaccination campaigns begin in October.

The recommendation for influenza, more commonly referred to as "the flu shot" is that persons between the ages of 19 and 49 years receive an inactivated influenza vaccine (containing inactivated virus) if there are medical or occupational indications or if there are household contacts with persons with medical indications (Bridges et al., 2003).

One dose annually of the inactivated influenza vaccine is recommended for persons 50 years of age or older (Bridges et al., 2003). Any individual working in the healthcare field should get an influenza shot each year, regardless of age.

On June 18, 2003 the U.S. Food and Drug Administration (FDA) gave approval for FluMist manufactured by the company MedImmune (Barbaro, 2003). This is the first influenza vaccine intended to be sprayed into the nose instead of injected into the arm. The major difference in this intranasal formulation is that it contains live attenuated influenza virus (Bridges et al., 2003). The FDA gave approval only for healthy individuals between the ages of 5–49 years, not for those with medical conditions (Barbaro).

Pneumococcal Polysaccharide

Community-acquired pneumonia is responsible for approximately 350,000 to 620,000 hospitalizations each year in the United States among persons 65 years of age or older (Jackson et al., 2003). In addition, with approximately 500,000 cases in the United States each year, it is the most common cause of community acquired pneumonia, causing about 39% of adult pneumonias (Poland, 2001). In addition to pneumonias, pneumococcal infection is also responsible for about 50,000 cases of sepsis and 3,000 cases of meningitis each year (Poland).

In a large cohort study of 47,365 Group Health Cooperative members 65 years of age or older, receipt of the pneumococcal vaccine was associated with a significant reduction in the risk of pneumococcal bacteremia (Jackson et al., 2003). Despite research findings of the positive benefits of the pneumococcal vaccine, it is estimated that only one quarter of this high risk elderly group receives the vaccine (Institute of Medicine [IOM], 2000).

The new adult recommendation for those in the age group 19–64 years is one dose of the pneumococcal vaccine for persons with medical or other indications (ACIP, 2003). One dose revaccination 5 years after the first dose is recommended for adults with immunosuppressive conditions (ACIP).

The new adult recommendation is for persons who are 65 years or

older to receive one dose of the pneumococcal polysaccharide vaccine. Revaccination with pneumococcal polysaccharide vaccine is indicated after 5 years for certain medical conditions (ACIP, 2003).

Hepatitis B

It is estimated that hepatitis B has infected between 150,000 to 450,000 individuals in the United States each year during the past two decades (Goldstein et al., 2002). Comprehensive immunization programs for children and adolescents have been effective in preventing hepatitis B. One survey reported a 76.1% decrease in acute hepatitis B infection, from 13.8 cases per 100,000 in 1987 to 3.3 cases per 100,000 in 1998 (Goldstein et al.).

Three doses of the hepatitis B vaccine are recommended in the new adult schedule at 0, 1–2, and 4–6 month intervals for all individuals with medical, behavioral, occupational or other indications. The numerous indications are spelled out in the footnotes for the adult immunization schedule and can be found on the CDC Web site (ACIP, 2003).

Hepatitis A

Approximately one third of Americans have evidence of past infection of hepatitis A. Currently, the number of cases is decreasing, but during epidemic years, the number of reported cases reached 35,000 (Centers for Disease Control and Prevention [CDC], 2003).

The recommendation for hepatitis A is 2 doses at 0 and 6–12 month intervals for individuals with medical, behavioral, occupational, or other indications. These numerous indications are also spelled out in the footnotes for the adult immunization schedule and can be found on the CDC Web site (ACIP, 2003).

Measles Mumps Rubella (MMR)

The MMR vaccine efforts in children have effectively reduced rates of these three diseases. The combination vaccine has been licensed since 1971. In the last decade, only small

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Diabetes, heart disease, chronic pulmonary disease, chronic liver disease, including chronic alcoholism		B	C		D		
Congenital immunodeficiency, leukemia, lymphoma, generalized malignancy, therapy with alkylating agents, antimetabolites, radiation or large amounts of corticosteroids			E				F
Renal failure / end stage renal disease, recipients of hemodialysis or clotting factor concentrates			E	G			
Asplenia including elective splenectomy and terminal complement component deficiencies		H	E, I, J				
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See Special Notes for Medical Conditions below—also see Footnotes for Recommended Adult Immunization Schedule, by Age Group and Medical Conditions, United States, 2003–2004 on back cover

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Special Notes for Medical Conditions

A. For women without chronic diseases/conditions, vaccinate if pregnancy will be at 2nd or 3rd trimester during influenza season. For women with chronic diseases/conditions, vaccinate at any time during the pregnancy.

B. Although chronic liver disease and alcoholism are not indicator conditions for influenza vaccination, give 1 dose annually if the patient is ≥ 50 years, has other indications for influenza vaccine, or if the patient requests vaccination.

C. Asthma is an indicator condition for influenza but not for pneumococcal vaccination.

D. For all persons with chronic liver disease.

E. For persons < 65 years, revaccinate once after 5 years or more have elapsed since initial vaccination.

F. Persons with impaired humoral immunity but intact cellular immunity may be vaccinated. *MMWR* 1999; 48 (RR-06): 1–5.

G. Hemodialysis patients: Use special formulation of vaccine (40 ug/mL) or two 1.0 mL, 20 ug doses given at one site. Vaccinate early in the course of renal disease. Assess antibody titers to hep B surface antigen (anti-HBs) levels annually. Administer additional doses if anti-HBs levels decline to <10 millinternational units (mIU)/ mL.

H. There are no data specifically on risk of severe or complicated influenza infections among persons with asplenia. However, influenza is a risk factor for secondary bacterial infections that may cause severe disease in asplenic.

I. Administer meningococcal vaccine and consider Hib vaccine.

J. Elective splenectomy: vaccinate at least 2 weeks before surgery.

K. Vaccinate as close to diagnosis as possible when CD4 cell counts are highest.

L. Withhold MMR or other measles containing vaccines from HIV-infected persons with evidence of severe immunosuppression. *MMWR* 1998; 47 (RR-8):21–22; *MMWR* 2002; 51 (RR-02): 22–24.

Fig 2. Recommended adult immunization schedule, United States, 2003–2004, by medical conditions

outbreaks of measles, mumps, and rubella have been reported in unvaccinated groups. For example, 20 cases of rubella were reported in 2001 (Bloom & Lambert, 2003).

In the new adult schedule, one dose of the MMR vaccine is recommended for individuals 19–49 years of age if their vaccination history is unreliable. Two doses are recommended for those between the ages of 19 and 49 years if there are occupational or other indications. Occupational indications include those recently exposed to measles (ACIP, 2003). There are no MMR recommendations for adults 50 years of age or older.

Varicella

There are approximately 10,000 hospitalizations for varicella each year in the United States and about 100 deaths (Gershon, 2001). Before the varicella vaccine was introduced for children in 1995, there were an estimated 4 million episodes per year in the United States. Immunity to varicella is already high, at 99% or higher for Americans aged 50 years of older, but high-risk groups still remain (Kilgore et al., 2003). One study found that age, race, and marital characteristics were independently associated with varicella immunity (Kilgore et al.). After the data were adjusted for age, fewer non-Hispanic blacks had varicella antibody (94.5%) compared with non-Hispanic whites (96.8%) or Mexican Americans (97.3%, $p < 0.05$) (Kilgore et al.).

Two doses of the varicella vaccine, at 0 and then 4–8 week intervals, are recommended for all adults 19 years of age or over who are susceptible (ACIP, 2003). Any individual who does not have a reliable clinical history of varicella infection or serological evidence of infection or who is at occupational risk should receive the vaccine.

Meningococcal Polysaccharide

The incidence of meningitis is only 0.5–5/100,000 worldwide, but 10%–15% of cases are fatal. Of patients who recover, 10%–15% have

permanent hearing loss, mental retardation, loss of limbs, or other serious sequelae (CDC, 2002).

One dose of this vaccine should be considered for any individual older than 19 years with medical indications. The numerous medical indications are listed in the footnotes for the adult immunization schedule and can be found on the CDC Web site (ACIP, 2003).

Issues of Concern to Neuroscience Nurses

Trauma

Vaccine-related issues of concern in trauma patients are the presence of tetanus-prone wounds and immunizations for patients who have undergone a splenectomy for trauma (Shatz, 2002).

Any trauma patient with an open wound should be assessed for tetanus-prone wounds. Most commonly, this is done in the emergency department, but in the fast-paced trauma atmosphere it is possible for this to be overlooked. Clostridium tetani can enter the body through a traumatic wound; the organism matures and produces the tetanus toxin. Possible sources are traumatic and suppurative wounds, dental infection, injections of illicit drugs, human and animal bites, frostbite, compound fractures, and gunshot wounds (Warms, 2004). The incubation period is 7–21 days. Neuroscience nurses should review records to determine whether Td was given. If not, they should check whether the wound qualifies as tetanus-prone and if the patient has had \ Td booster in the past 10 years.

The new adult immunization schedule recommends that individuals who have had a splenectomy receive the pneumococcal polysaccharide vaccination (ACIP, 2003). Authors of one survey of 291 trauma surgeons reported that 99.2% of the surgeons surveyed immunized patients following a splenectomy (Shatz, 2002). The vaccine may be administered to the patient

anywhere from immediately postoperative to 6 weeks later (Shatz). The neuroscience nurse should screen individuals post splenectomy and help to maintain this high rate of immunization.

Guillain-Barre Syndrome (GBS)

GBS is an area of high concern to neuroscience patients and their families as the syndrome occurs spontaneously but can also be vaccine related. GBS has been well documented as recurring following repeated injections of tetanus toxoid, although the incidence is reported to be no more than 0.4 cases per million (Gardner, 2001).

Public concern about the risk of developing GBS after influenza vaccination was first raised when an increase in the number of cases was noticed during the 1976–1977 swine influenza vaccination campaign (Chen et al., 2001). Any post-vaccination reaction, such as GBS, should be reported to the Vaccine Adverse Event Reporting System (VAERS). The VAERS has been helpful in tracking and analyzing adverse events. For example, in the 1992–1993 season the number of reports of influenza-associated GBS was 37 and in 1993–1994 increased to 74 (Chen et al.; Lasky et al., 1998). The relative risk of GBS associated with vaccination after the data were adjusted for age, sex, and vaccine season (numbers of persons vaccinated during a season) was 1.7 (95% confidence interval, 1.0 to 2.8; $p = .04$), there was no increased risk when the two seasons were compared (Lasky et al.). A relative risk of 1.7 translates to one additional case of GBS per million persons vaccinated against influenza (Lasky et al.).

Another concern is whether patients who have a history of GBS should receive an influenza vaccine. It is not known whether this vaccine increases the risk of recurrence of GBS among persons with a history of the disease, or whether the risk varies according to the composition (viral strain) of the vaccine (Chen et

al., 2001). The new adult recommendation schedule does not list GBS as a contraindication for receiving an influenza vaccine.

Multiple Sclerosis (MS)

Since MS is thought to have an autoimmune basis, there have been concerns among patients and health-care professionals about the risk of triggering the disease or a relapse in those who already have the disease after immunization (Confavreus & Vukusic, 2002). Few studies have examined the link between immunization and the onset of MS; therefore the evidence is thought to be inadequate to accept or reject a causal relationship between vaccines and the incidence of MS in adults (Confavreus & Vukusic; IOM, 2003). A recent Institute of Medicine committee saw no reason to suspect a relationship might exist (IOM). On the question of an influenza vaccination triggering a relapse in an adult that has MS, the latest evaluation of scientific evidence favored rejection of any causal relationship (IOM).

Summary

Neuroscience nurses, whether they practice in an outpatient or hospital setting, should be aware of the new adult immunization schedule. In particular, they should be prepared to discuss vaccines needed after a traumatic injury and the risk of GBS or MS associated with vaccines. Anytime a vaccine is given, the patient needs to be observed for a reaction. Any post-vaccination reaction should be reported to the VAERS. The VAERS telephone number is 800/822-7967 and the Web site is <http://www.vaers.org> (Pinkowish, 2002).

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