



Immunizations Guideline Team

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Adult Immunizations

Population: Adults, ≥18 years old

Objectives: Implement an evidence-based strategy for routine adult immunizations.

Key Points

Routine immunizations for adults are: hepatitis A, hepatitis B, herpes zoster, human papilloma virus, influenza, measles, mumps, rubella, meningococcal, pneumococcal, tetanus, diphtheria, pertussis and varicella. Below is a summary on priority populations, initial vaccination, and revaccination.

- Use combination vaccines whenever possible to increase the coverage rates for vaccine-preventable diseases: Tetanus-diphtheria (Td), Tetanus-diphtheria-acellular pertussis (Tdap), Measles-Mumps-Rubella (MMR), hepatitis A-hepatitis B (Twinrix). Single antigen vaccines have no safety advantage.
Live virus vaccines (Herpes Zoster, Measles-Mumps-Rubella, and Varicella) are contraindicated in persons who are pregnant or may become pregnant in the next four weeks, or who have immunocompromising conditions. If administering multiple live vaccines, give simultaneously or separate them by 4 weeks.

This guideline follows recommendations of the federal Advisory Committee on Immunization Practices:

- These vaccinations should be performed for general populations at risk as indicated [I*].
Evidence for each vaccine is based on randomized controlled trials [A*].

Table with 2 columns: Vaccine/ Doses and Priority Populations. Rows include Hepatitis A vaccine, Hepatitis B vaccine, and No routine booster.

1 Accelerated dosing schedule: Hepatitis A/ Hepatitis B Vaccine (Twinrix Adult) Three doses in 3 weeks (0, 7days, 21-30 days); booster at 12 months. Consider for: emergency first-care responders, individuals preparing to travel to high-risk areas on short notice, those with risk factors for hepatitis such as HIV and sexually transmitted diseases

* Strength of recommendation:

I = generally should be performed; II = may be reasonable to perform; III = generally should not be performed.

** Levels of evidence reflect the best available literature in support of an intervention or test:

A = randomized controlled trials; B = controlled trials, no randomization; C = observational trials; D = opinion of expert panel

Vaccine/ Doses	Priority Populations
Herpes zoster vaccine	Note: Live virus vaccine. [This vaccine may not be covered by all payers or all Medicare Part D policies. Patients should confirm coverage.]
One dose	Adults, ≥ 60 years old, whether or not they report a prior episode of herpes zoster. Persons with chronic medical conditions may be vaccinated, unless a contraindication precaution exists.
Human papilloma virus (HPV) vaccine, Quadrivalent	Note: In women of child bearing age, avoid pregnancy for at least 4 weeks after immunization
Three doses at 0, 2 and 6 months. Minimum interval of 24 weeks between doses 1 and 3	Females ≤ 26 years old who have not received the vaccine or completed the series. If a woman turns 27 years old after the first dose is administered but before the third dose is given, complete the series using the recommended intervals between doses
Booster uncertain	Efficacy beyond 5 years is presently unknown.
Influenza vaccines	
Initial dose: Inactivated (injectable)	<ul style="list-style-type: none"> • adults ≥ 50 years old [B*] • persons with chronic illnesses (e.g., cardiovascular, pulmonary, renal, metabolic, sickle cell disease, immunosuppression/ HIV, disorders increasing risk of aspiration), asplenia • residents of long-term care facilities [B*] • women who are pregnant • health care workers, including home care and long-term care workers [A*] • household contacts and out-of-house caregivers of children less than 6 years old or adults ≥ 65 years old • others who can transmit influenza to a high risk population
Live attenuated (intranasal)	<ul style="list-style-type: none"> • for non-pregnant healthy persons <50 years old in priority populations, live attenuated vaccine may be used as an alternative to inactivated vaccine. (Non-priority healthy persons <50 years old may receive either vaccine if supply allows.)
Revaccinate annually	<ul style="list-style-type: none"> • persons eligible under criteria for initial immunization vaccine
Measles, mumps, rubella vaccine (use MMR vaccine) Note: Live virus vaccine	
Initial dose	<ul style="list-style-type: none"> • no evidence of immunity* to measles, to mumps, and (if woman of childbearing age) to rubella • consider giving initial dose to unvaccinated health-care workers born before 1957 who do not have other evidence of mumps immunity*
Second dose at ≥ 1 month	<ul style="list-style-type: none"> • health care workers (for measles, mumps). • college students (for measles, mumps; first dose may be required before start of classes) • travelers to foreign countries (for measles, mumps) • recently exposed to measles or are in an outbreak setting • previously vaccinated with killed measles vaccine, or between 1963-1967 with an unknown measles vaccine • in age group affected during a mumps outbreak
* Evidence of immunity: (a) documentation of MMR vaccination requires 2 doses for measles, 1 dose for rubella or mumps (b) laboratory evidence of immunity, (c) documentation of physician diagnosis or (d) born before 1957 (age exceptions: rubella immunity not assumed for women of child-bearing age who could become pregnant; measles and mumps immunity possibly not assumed for health care workers).	
Meningococcal vaccine Use meningococcal conjugate (Menactra™) for adults < 55 years old and meningococcal polysaccharide (Menomune®) for those >55 years old	
Initial - one dose	<ul style="list-style-type: none"> • college freshman living in dormitories • persons who have functional or anatomic asplenia and terminal complement component deficiencies • travelers to sub-Saharan Africa from Senegal in the west to Ethiopia in the east, especially from December to June. • Microbiologists routinely exposed to isolates of Neisseria meningitidis
Revaccinate: once every 3-5 years	<ul style="list-style-type: none"> • The above persons if indications still exist for vaccination and the last vaccination was given with meningococcal polysaccharide. • No need to revaccinate if previously vaccinated with meningococcal conjugate (Menactra™)

Vaccine/ Doses	Priority Populations
Pneumococcal polysaccharide vaccine	
Initial dose	<ul style="list-style-type: none"> • all adults > 65 years old [B] • persons 19 through 64 years old who smoke cigarettes or have asthma • residents of nursing home and long-term care facilities • persons with chronic illness (e.g., cardiovascular, pulmonary), diabetes, kidney or liver disease, alcoholism, cerebrospinal fluid leak, cochlear implants, sickle cell disease, asplenia and other immunosuppressive conditions, chemotherapy, steroid use – see text) • Native Americans and Native Alaskans who are living in areas where there is an increased risk of invasive pneumococcal disease
Revaccinate once ≥ 5 years after initial dose only for the following high risk patients. Note: Maximum of 2 doses PPSV23 in a lifetime.	<ul style="list-style-type: none"> • age: persons ≥ 65 years old, if initial vaccine was given ≥ 5 years previously at <65 years old [A*]. • chronic disease: highest risk for pneumococcal infection or rapid decline in antibody (e.g., functional or anatomic asplenia, sickle cell disease, transplant recipient, HIV, nephrotic syndrome, chronic renal failure, immunosuppressed).
Tetanus, diphtheria, pertussis vaccines (Td/Tdap) (primary series assumed)²	
Revaccinate every 10 years	<ul style="list-style-type: none"> • all patients [A*]. • a one-time dose of Tdap should be given to: <ul style="list-style-type: none"> – postpartum women, close contacts of infants <12months old, and health care workers with at least a 2 year interval from previous Td vaccine – adults <65 years old who have not previously received a dose of Tdap and are due for a tetanus vaccine (for booster or wound management)
Revaccinate in ≥ 5 years	<ul style="list-style-type: none"> • patients with wounds (other than clean or minor wounds)
² If primary series not given: 3 doses Td at 0, 4 wks, and 7 - 12 months.	
Varicella vaccine Note: Live virus vaccine	
Two doses at 0 and ≥ 4 weeks	<ul style="list-style-type: none"> • all non-pregnant adults without evidence of immunity to varicella³. Give special consideration to those who have close contact with persons at high risk for severe disease (e.g., healthcare workers and family contacts of immunocompromised persons) or are at high risk for exposure or transmission (e.g., teachers of young children; child care workers; college students; residents and staff of institutional settings, including correctional facilities; military personnel; international travelers; and non-pregnant women of childbearing age).
³ Evidence of immunity to varicella: (a) documentation of 2 doses of varicella vaccine; (b) U.S. -- born before 1980 (except for immunocompromised, health-care workers and pregnant women); (c) history of diagnosis of varicella by a health-care provider; (d) history of herpes zoster based on health-care provider diagnosis; or (e) laboratory evidence of immunity or laboratory confirmation of disease (see text for further details).	

Clinical Background

Hepatitis A

Burden of Suffering

Hepatitis A is one of the most frequently reported vaccine-preventable diseases in the United States. During 1995-2006, hepatitis A incidence declined 90% to the lowest rate ever recorded (1.2 cases per 100,000 population). Declines were greatest among children and in those states where routine vaccination of children was recommended beginning in 1999. An increasing proportion of cases occurred in adults. In 2006, a total of 3,579 acute

symptomatic cases of hepatitis A were reported. Adjusting data for underreporting and asymptomatic infections, the National Notifiable Diseases Surveillance System estimated that there were 32,000 new infections that occurred in 2006. People with chronic liver disease (including hepatitis C) are at increased risk for fulminant hepatitis A. Most U.S. cases of hepatitis A result from person-to-person transmission by fecal-oral route or by ingestion of contaminated food or water. Rarely, it has been transmitted through blood or blood product transfusions. Because most children have asymptomatic or unrecognized infections, they serve as a source for transmitting infection to others.

Rationale for Recommendation

Protective antibody levels develop in 94%-100% of adults one month after the first dose is given in a two-dose series. All persons studied had protective levels of antibody after the second dose, given 6-12 months after the first. Surveillance data and population-based studies are being conducted to monitor the long-term protective efficacy and to determine the possible need for a booster dose. Persons considered to be at increased risk for hepatitis A or its adverse outcomes who should be routinely vaccinated include all persons with chronic liver disease, persons with clotting-factor disorders, travelers to countries where there is high or intermediate hepatitis A virus (HAV) endemicity, men who have sex with men, illicit drug-users (both users of injecting and non-injecting drugs), and persons who work with HAV-infected primates or with the virus in research laboratories. Health care workers and food handlers are not recommended for routine immunization.

The combination hepatitis A (inactivated) and hepatitis B (recombinant) vaccine (Twinrix) is available and should be used for persons aged ≥ 18 years old, having an indication for both hepatitis A and B vaccination. Primary vaccination consists of three doses, given on a 0-, 1-, and 6-month schedule, the same schedule as that used for single antigen hepatitis B vaccine. Note: Administering two doses of Twinrix and one dose of hepatitis B vaccine is not sufficient and will not complete a series for both hepatitis A and hepatitis B vaccination. Twinrix contains less hepatitis A antigen than a single antigen hepatitis A vaccine, therefore three doses of hepatitis A are needed when using this product.

Hepatitis B

Burden of Suffering

During 1990-2006, acute hepatitis B incidence declined 81% to the lowest rate ever recorded (1.6 cases per 100,000 population). Declines occurred among all age groups but were greatest among children aged < 15 years old. Universal vaccination of children against hepatitis B has reduced disease incidence substantially among younger age groups. Higher rates of hepatitis B virus (HBV) infection continue among adults, particularly males 25 - 44 years old, reflecting the need to vaccinate adults at risk for HBV infection. In 2006, a total of 4,713 acute, symptomatic cases of hepatitis B were reported nationwide. After asymptomatic infection and underreporting were taken into account, the estimate of new cases for that year reached 46,000. Six to ten percent of infected individuals become a chronic carrier. Twenty five percent of chronic carriers develop chronic active hepatitis, which can progress to cirrhosis or hepatocellular carcinoma resulting in death. Prevention of hepatitis B also prevents infection of hepatitis delta virus, which can also lead to cirrhosis or hepatocellular carcinoma.

Rationale for Recommendation

Controlled trials of the plasma derived vaccine indicate 95% (range 80 – 100%) effectiveness against clinical HBV infection and chronic carriage for at least 15 years after a series of three intramuscular injections in immunocompetent individuals at 0, 1 and 6 months. Immunocompromised patients and hemodialysis patients ≥ 20 years old should get an increased vaccine dose (40 micrograms).

Hepatitis B vaccination is recommended for adults in high-risk groups including:

- Health care workers, public safety workers and others with occupational risk of exposure to blood or other infectious materials
- Clients and staff of institutions and non-residential facilities for the developmentally disabled
- Clients and staff members of correctional facilities
- Household and sexual contacts of those with chronic HBV infection
- Individuals with multiple sex partners (e.g., homosexual men, prostitutes)
- Men who have sex with men
- Patients with end stage renal disease, including but not limited to patients on hemodialysis
- IV drug users and their sexual partners
- Persons seeking evaluation or treatment for a sexually transmitted disease
- Those with HIV infection
- Persons with chronic liver disease
- Travelers to countries with increased prevalence of chronic HBV infection

In addition, anyone who is seeking protection from HBV infection should receive the vaccine.

Routine post-immunization testing is not necessary but is recommended one to two months after the third vaccine dose for the following specific groups:

- hemodialysis patients
- health care workers with occupational risk
- immunocompromised patients and those with HIV infections who are at risk for HBV exposure
- persons with HBsAg-positive sexual partners.

Vaccine recipients who do not seroconvert after a primary vaccine series should be re-immunized with an additional 3-dose series.

Hepatitis B vaccination is currently recommended for all newborns and adolescents not previously immunized. Over time this current practice for children and adolescents will increase the likelihood that adults have been previously vaccinated.

Information of long term efficacy of the vaccine is not currently available but immunity is felt to be long-lived. Routine booster doses are not recommended except in the following:

For hemodialysis patients, need for booster doses should be assessed by annual antibody to Hepatitis B surface antigen (HBsAb) testing. A booster dose should be administered when antibody levels decline to less than 10 IU/ml. For other immunocompromised persons, the need for booster doses has not been determined.

The combination hepatitis A (inactivated) and hepatitis B (recombinant) vaccine (Twinrix) is available and should be used for persons ≥ 18 years old, having an indication for both hepatitis A and B vaccination. Primary vaccination consists of three doses, given on a 0-, 1-, and 6-month schedule, the same schedule as that used for single antigen hepatitis B vaccine. Note: Administering two doses of Twinrix and one dose of hepatitis B vaccine is not sufficient and will not complete a series for both hepatitis A and hepatitis B vaccination.

Herpes Zoster Vaccine

Burden of Suffering

Herpes zoster, commonly known as “shingles,” is caused by a reactivation of the varicella zoster virus, which may occur decades after illness with chickenpox. It is estimated that 500,000 to 1 million cases of zoster are diagnosed annually in the U.S. Zoster infection usually is associated with a reduced immune response, which may occur with illness, immunosuppressive therapy or normal aging. The unilateral vesicular rash along a dermatome is the most distinctive feature, but the pain during the prodrome, acute eruptive or postherpetic phase of the infection is the most debilitating. Postherpetic neuralgia can persist for weeks or months after the rash. Serious complications may include scarring, pneumonia, encephalitis, visual impairment, hearing loss, bacterial superinfection, allodynia, cranial and motor neuron palsies and death.

Rationale for Recommendation

Herpes Zoster vaccine, licensed in May 2006, contains the same live attenuated virus as varicella vaccine, but at a much higher titer. In clinical studies, the overall incidence of herpes zoster in those vaccinated was 51% less than those who received placebo, with the highest efficacy in the 60 – 69 year old subjects. Among individuals who developed herpes zoster, vaccinated subjects reported fewer complications (e.g. 66% reduction in postherpetic neuralgia) compared to those who had not been vaccinated. The most frequently reported adverse events following vaccination were injection site reactions and rashes. Serious adverse experiences occurred at a similar rate in placebo and vaccine recipients. Post-licensure safety studies are expected to be undertaken.

The ACIP recommends a single dose of the vaccine for adults 60 years old and older, and the potential need for booster doses is unknown.

Contraindications. Because herpes zoster vaccine is a live attenuated virus the following persons should not get herpes zoster vaccine:

- Those with a life-threatening allergic reaction to gelatin, the antibiotic neomycin, or any other component of shingles vaccine.
- Those who have a weakened immune system because of: HIV, AIDS or another disease that affects the immune system, treatment with drugs that affect the immune system, such as steroids, cancer treatment such as radiation or chemotherapy, a history of cancer affecting the bone marrow or lymphatic system, such as leukemia or lymphoma,
- Those with active, untreated tuberculosis,
- Women who are pregnant, or might be pregnant. Women should not become pregnant until at least three months after getting shingles vaccine.

Human Papilloma Virus Vaccine

Burden of Suffering

Human Papilloma Virus (HPV) infections are the most common type of sexually transmitted infection with a lifetime cumulative incidence in the U.S. reaching 80% and prevalence of 15% in people 15-49 years old. Cervical cancer is associated with HPV infection such that the virus is detected in nearly every cervical cancer specimen. Of the ~40 types of HPV that infect the genital tract, 70% of cervical cancers are caused by Types HPV-16 and HPV-18. The quadrivalent HPV vaccine targets HPV-16 and HPV-18 and also targets HPV-6 and HPV-11. HPV-16 and -18 also cause 80% of high- and low-grade cervical dysplasias, are commonly associated with anal cancers, and are detected in ~10% of head and neck cancers. The low-risk Types HPV-6 and HPV-11 also targeted by the vaccine, cause 90% of genital warts and recurrent respiratory papillomatosis, as well as low -grade cervical dysplasias.

Rationale for Recommendation

Controlled trials of the quadrivalent HPV vaccine, which is derived from yeast, indicate that prophylactic administration decreases the risk HPV-16 and -18 related cervical, vulvar, and vaginal cancer, as well as dysplastic lesions that are precursors to cervical, vulvar and vaginal cancer. Efficacy was demonstrated for all four HPV types for infection, low-grade dysplastic lesions, and genital warts in 16-26-year old women. The quadrivalent HPV vaccine is indicated for girls and women to prevent the following diseases caused by HPV types 6, 11, 16, and 18:

1. Cervical cancer
2. Genital warts (condyloma acuminata).
3. Cervical intraepithelial neoplasia (CIN) grade 1, grade 2 and grade 3.
4. Cervical adenocarcinoma in situ.

5. Vulvar intraepithelial neoplasia (VIN) grade 2 and grade 3.
6. Vaginal intraepithelial neoplasia (VaIN) grade 2 and grade 3.

Special situations

The quadrivalent HPV vaccine can be administered at the same visit when other vaccines are provided, such as Tdap, Td and MCV4.

Cervical cancer screening recommendations are not changed for females who receive the quadrivalent HPV vaccine.

HPV vaccine can be given to females who have an equivocal or abnormal Pap test, a positive HPV test, or genital warts. Data from clinical trials indicate the vaccine will **not** have any therapeutic effect on existing Pap test abnormalities, HPV infection or genital warts. Vaccination of these females may provide protection against infection with vaccine HPV types not already acquired.

Lactating women can receive the quadrivalent HPV vaccine.

Females who are immuno-compromised, either from disease or medication, can receive the HPV vaccine, however, vaccine effectiveness might be less than in females who are immuno-competent.

Contraindications. The quadrivalent HPV vaccine is contraindicated for people with a history of immediate hypersensitivity to yeast or to any vaccine component.

Vaccination of people with moderate or severe acute illnesses should be deferred until after the illness improves.

The quadrivalent HPV vaccine is not recommended for use in pregnancy, although in limited data, vaccination during pregnancy has not been causally associated with adverse outcomes of pregnancy or adverse events to the developing fetus. Any exposure to vaccine during pregnancy should be reported to the vaccine pregnancy registry (1-800-986-8999).

Influenza

Burden of Suffering

Influenza has been estimated to cause over 4 million respiratory illnesses per year and 16-18 million bed or restricted activity days among adults. Elderly persons and those with chronic medical illnesses are at increased risk for complications such as pneumonia. Influenza is estimated to cause approximately 36,000 deaths per year in the United States and more than 90% are age 65 years and older. Rates of serious illness and death attributable to influenza are highest among persons aged 65 years and older. Influenza vaccines (both inactivated and live

attenuated) contain antigens identified by global surveillance to match circulating influenza A and B viruses. Due to antigen shift the vaccine must be manufactured and administered annually.

Rationale for Recommendation

Beginning with the 2000-2001 influenza season, the Advisory Committee on Immunization Practices (ACIP) added persons 50-64 years old to the primary target group for annual influenza vaccine because a substantial proportion of this group (24-32 percent) have one or more chronic medical conditions placing them at high risk for influenza-related hospitalization and death. "Over the lifetime of a birth cohort of 4 million, it is estimated that about 275,000 quality-adjusted life years (QALYs) would be saved if vaccination were offered annually to all people after age 50" (Maciosek, et al, 2006, p 76). Randomized controlled trials demonstrate fewer days of illness for vaccinated hospital workers (6 vs. 8, p=0.07); 25% fewer episodes of URI in the vaccinated general population (105 vs. 140 per 100 persons) and 43% fewer days of sick leave (70 vs. 122 per 100 persons) in vaccinated working adults.

Adult priority groups for vaccination include the following:

- Persons aged 50 years and older
- Adults with chronic disorder of the pulmonary and cardiac systems, including asthma
- Adults who require regular medical follow up for chronic metabolic diseases, renal dysfunction, asplenia, hemoglobinopathies, or immunosuppression from medication or dysfunction
- Women who will be pregnant during the influenza season
- Residents of nursing homes and long term care facilities
- Health care workers involved in direct patient care
- Household contacts and out of home caregivers of people at high risk including children < 6 years old.

Healthy adults who do not fall within a priority group may want to reduce their risk for influenza. These individuals may be vaccinated if the supply allows.

- Whenever possible, vaccination programs should begin by October. Immunity begins approximately 2 weeks after vaccination.
- Patients with severe egg allergy or previous allergy/anaphylaxis to influenza vaccine should not receive the flu vaccine.
- Caution should be taken in those with a previous history of Guillian –Barre syndrome.

Influenza vaccine is available as an inactivated vaccine administered intramuscularly and as a live, attenuated vaccine administered as a nasal spray. The live, attenuated vaccine is currently approved for use only in healthy individuals 2 – 49 years old.

Measles, Mumps, Rubella

Burden of Suffering

Measles, mumps, and rubella are considered to be viral illnesses of childhood. These diseases are no longer considered to be indigenous diseases in the United States, however, globally represent a significant health risk. In 2006, 51 cases of measles were reported to the CDC. Most of these cases are associated with importation from other countries or in areas of inadequate vaccination coverage. Between January and October, 2006, 5,723 cases of mumps were reported across 45 states in the US. In response to this widespread mumps outbreak, ACIP recommendations for prevention and control of mumps were updated. Rubella presents the greatest risk to the fetus if contracted by a pregnant woman. Infection within the first 16 weeks of pregnancy may result in miscarriage, stillbirth, or congenital rubella syndrome (CRS): hearing loss, growth retardation, developmental delay and cardiac and ocular defects.

Rationale for Recommendation

Efficacy: A single dose of measles vaccine is 95% effective in producing long term immunity. The Advisory Committee on Immunization Practices (ACIP) recommends that two doses of live measles vaccine be given to children; one dose at 12 to 15 months old, and a second dose when entering school at 4-5 years old. Most persons born before 1957 are likely to have natural immunity.

Mumps vaccine was introduced in 1967 with a 99% reduction in the incidence of mumps demonstrated in the U.S.

Rubella immunity should be documented in women of child bearing age by vaccination history or serologic test. Susceptible non-pregnant women should be offered the vaccine. Pregnancy should be avoided for 4 weeks following immunization as this is a live vaccine. Susceptible pregnant women should be vaccinated after delivery. No documented cases of CRS have resulted from vaccination in early pregnancy, but this practice is not recommended.

The combination vaccine, MMR, should be used unless a patient has a contraindication to an individual component.

Do not give immune globulin products and MMR simultaneously. If unavoidable, give at different sites and revaccinate or test for seroconversion in 3 months. If MMR is given first, do not give IG for 2 weeks. If IG is given first, the interval between IG and measles vaccination depends on the product, the dose, and the indication.

Measles vaccination may temporarily suppress tuberculin reactivity. MMR vaccine may be given after, or on the same day as TB testing. If MMR has been given recently,

postpone the TB test until 4-6 weeks after administration of MMR.

Meningococcal Vaccine

Burden of Suffering

Each year in the United States, 1,400-2,800 cases of meningococcal disease occur with a case-fatality rate of 10-14 percent. Moreover, 11-19% of survivors have sequelae (e.g., neurologic disability, limb loss, hearing loss). The highest rate of disease occurs among infants, with a second peak occurring in adolescents and young adults 14 -24 years old.

Rationale for Recommendation

Tetavalent meningococcal conjugated vaccine, MCV4 (Menactra™) provides similar efficacy against the same 4 serogroups as the previously licensed polysaccharide meningococcal vaccine, MPSV4 (Menomune™) but is expected to provide a longer duration of protection. Meningococcal conjugate vaccine is the preferred vaccine for persons at high risk in the <55 year age range. Menomune™ can be given to all others at increased risk.

Routine single-dose vaccination is recommended for certain high-risk groups: persons with terminal complement component deficiencies and those with functional or anatomic asplenia. College freshman who live in dormitories or residence halls are at modestly increased risk for meningococcal disease compared to others in the general population, and should be vaccinated. Microbiologists who are routinely exposed to *Neisseria meningitidis*, which may be in aerosolized solutions, should be considered for vaccination. Also, persons who travel to that part of sub-Saharan Africa extending from Senegal in the West to Ethiopia in the East, especially between the months of December to June should be considered for vaccination.

Revaccination may be indicated after 3 years for high risk persons if indications still exist for vaccination and the last meningococcal vaccine given was meningococcal polysaccharide vaccine. Revaccination of individuals who have received meningococcal conjugate vaccine is not currently recommended.

Pneumococcal Disease

Burden of Suffering

Population based surveillance studies have reported annual pneumococcal disease rates of 15-19/100,000. Higher rates are found among those <5 years old, >65 years old, alcoholics, smokers, Native Americans (e.g., Alaskan natives, Apaches and Navajos), African Americans, nursing home residents, and those with chronic underlying medical conditions. Pneumococcal disease accounts for

15% of severe community-acquired pneumonia (case fatality rate 9-26%). Highest fatality rates occur in elderly persons (30-43%) and those with co-morbid diseases (25-27%). Resistant strains of *Streptococcus pneumoniae* have emerged, emphasizing the importance of vaccination.

Rationale for Recommendation

The current 23-valent vaccine was introduced in 1983. Duration of antibody protection is unknown but elevated titers persist for at least 5 years. Cohort studies suggest that clinical efficacy persists at least 7-10 years.

Pneumococcal vaccine's primary benefit is in preventing invasive disease (bacteremia, meningitis) and death, but does not appear to reduce the incidence of pneumonia. A meta-analysis of nine randomized trials demonstrated significant reductions in definitive and presumptive pneumococcal disease among low risk individuals, including older individuals. Antibody response has been demonstrated to be satisfactory in older subjects (e.g., age >85 years old). Although, this same reduction was not demonstrated in high risk populations, the Advisory Committee on Immunization Practices (ACIP) recommended that pneumococcal vaccination be given to individuals with chronic underlying diseases (i.e., cardiac disease, diabetes, pulmonary diseases, liver disease and those who are immunocompromised). In October, 2008, the ACIP published provisional recommendations for the use of 23-valent pneumococcal polysaccharide vaccine to include smokers 19 through 64 years old, and asthmatics. Asthma is an independent risk factor for invasive pneumococcal disease and should be included among the chronic pulmonary diseases (such as COPD and emphysema). Persons 19 through 64 years old who have asthma or who smoke cigarettes should receive a single dose of PPSV23. Smokers should also receive smoking cessation counseling.

Revaccination is recommended once only for the following situations for adult patients:

- Persons 65 years old or older should be given a second dose of vaccine if they received the vaccine 5 or more years previously and were younger than 65 at the time of primary vaccination.
- Adults who are at high risk for serious pneumococcal infection and those who are likely to have a rapid decline in pneumococcal antibody levels (asplenic or immunosuppressed conditions, renal failure, nephrotic syndrome, organ transplant recipients).

Normal risk persons do not require a 2nd dose, and ACIP does not recommend a 3rd dose for anyone. Routine revaccination of immunocompetent persons previously vaccinated with 23-valent polysaccharide vaccine is not recommended.

Tetanus, Diphtheria and Pertussis

Burden of Suffering

In the mid 1940s, prior to the introduction of routine vaccination in the U.S., approximately 600 cases of tetanus, 9,500 cases of diphtheria, and 175,000 cases of pertussis occurred annually. In 2001, only 27 cases of tetanus were reported in the United States. Respiratory diphtheria has become a rare disease in the U.S. (0-5 cases per year). Pertussis incidence declined with less than 3000 cases reported annually in the 1990s. However, the incidence has been gradually increasing since this time with 25,827 cases of pertussis reported in 2004.

In the United States tetanus is almost exclusively a disease of the elderly or immigrants who either did not complete a primary tetanus/diphtheria (Td) series or did not receive boosters. Serosurveys conducted since 1977 indicate 22 – 62% of adults 18 – 39 years old and 41 – 84% of those 60 years old or older may lack protective antitoxin against diphtheria.

Adolescents and adults are estimated to make up over 60% of the current cases of pertussis. Even though the disease may be mild in adolescents and adults, they are important sources of pertussis for infants and young children for whom the disease can be fatal. This rise in cases prompted the introduction of a one-time addition of pertussis toxoid into the adult vaccination schedule in late 2005. Adding the pertussis component in individuals over 7 years old is new, so data are insufficient to predict waning immunity in vaccinated adults. When data are available, the recommendation regarding pertussis may be modified.

Rationale for Recommendation

Immunity to diphtheria, tetanus and pertussis (DTP) given in childhood wanes in adults. One month after a booster dose, 93% of adults have seroprotective antibody levels to tetanus and diphtheria and 97% to pertussis. The recommendation is for a Td booster every ten years after receiving the full primary series. On October 26, 2005 the ACIP recommended a single dose of Tdap for adults 19-64 years old to replace the next dose of Td. A single dose of Tdap was recommended with a suggested interval of two years since the most recent Td for the following priority groups:

- health care workers with direct patient contact
- adults in close contact with infants < 12 months old
- women in the immediate postpartum period.

Contraindications. Whenever possible Td should be deferred during pregnancy and Tdap substituted in the immediate postpartum period.

Available data do not indicate substantially more adverse reactions to Tdap than to Td vaccine.

Varicella Vaccine

Burden of Suffering

Adults make up only 5% of varicella cases but account for more than a third of the deaths attributable to this infection. Varicella pneumonia is the most common complication in adults, causing 20–30 hospital admissions/10000 adults. Immunocompromised persons are at high risk for complications. Previously, vaccine was only recommended for adults without evidence of immunity who were at high risk of exposure or exposing others who were immunocompromised or otherwise at risk for severe disease. Now, it is recommended that all people ≥ 13 years old without evidence of immunity be vaccinated with two doses to promote individual immunity and for more rapid impact on outbreaks. It is estimated that 70–90% of adults are immune to varicella.

Rational for Recommendation

Patients greater than 13 years old without evidence of immunity should receive two doses of varicella vaccine, 4–8 weeks apart. Criteria for evidence of immunity to varicella were revised in 2006, and include any of the following: 1. documentation of age-appropriate vaccination; 2. laboratory evidence of immunity or laboratory confirmation of disease; 3. birth in U.S. before 1980 (not considered sufficient evidence in immunocompromised, healthcare workers and pregnant women); 4. a healthcare provider diagnosis of varicella or verification of history of varicella disease (special rules apply to diagnosis of atypical disease); and 5. healthcare provider diagnosis or verification of history of herpes zoster.

Women should be assessed for immunity to varicella prenatally. Because varicella is a live virus vaccine, women who are pregnant or may become pregnant within 4 weeks should not be vaccinated. Following the pregnancy, women without evidence of immunity should be immunized with the first dose immediately, with a second dose in 4 – 8 weeks.

A second dose of varicella vaccine is recommended for people who have had only one dose of varicella vaccine, both as a catch-up during routine health care visits (at least 3 months following the first dose) and in an outbreak (for adults, at least 4 weeks after the first dose). Following an exposure to varicella, patients without evidence of immunity to varicella who are at high risk of severe disease and complications may be eligible to receive varicella zoster immune globulin under an investigational new drug protocol.

Varicella virus vaccine should not be given for at least 5 months after receipt of blood (except washed red blood cells) or plasma transfusions, immune globulin, or varicella zoster immune globulin. In addition, IG and VZIG should not be administered for 3 weeks after

vaccination unless the benefits exceed those of vaccination.

Contraindications. Vaccine is contraindicated in:

- Pregnant women
- Immunocompromising conditions including HIV with $CD4 \leq 200$, congenital immunodeficiencies, leukemia, lymphoma; generalized malignancies; cerebrospinal fluid leaks; therapy with alkylating agents, antimetabolites, radiation or high dose (> 20 mgs) longterm corticosteroids.

Strategy for Literature Search

The U.S. Department of health and Human Services appoints the Advisory Committee on Immunization Practice (ACIP) to make official U.S. recommendations regarding vaccines and immune globulins. ACIP recommendations are published by the Centers for Disease Control in the Morbidity and Mortality Weekly Report and on the Internet (www.cdc.gov/vaccines/pubs/ACIP-list.htm). This internet site provides the most current recommendations, including detailed recommendations for each of the vaccinations included in this guideline.

The literature search for this update began with the results of a literature search performed in developing the initial version of this guideline. That search on Medline was for literature published from 1/1/95 through 5/1/99. It included the major key words of adults, humans, English; and a number of specific search terms related to immunizations (see specific search terms printed in initial UMHS guideline published March, 2004). Since that search additional literature searches for updates have focused on subsequent ACIP statements regarding immunizations for adults and the supporting literature presented by ACIP. This guideline is based on ACIP statements through January 2009.

Disclosures

The University of Michigan Health System endorses the Guidelines of the Association of American Medical Colleges and the Standards of the Accreditation Council for Continuing Medical Education that the individuals who present educational activities disclose significant relationships with commercial companies whose products or services are discussed. Disclosure of a relationship is not intended to suggest bias in the information presented, but is made to provide readers with information that might be of potential importance to their evaluation of the information.

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Annotated References

Centers for Disease Control and Prevention. Recommended adult immunization schedule-United States, 2009. MMWR 2008;57(53).Centers for Disease Control and Prevention. Recommended adult immunization schedule-United States, 2009. MMWR 2008;57(53).

This nine page document summarizes recommendations for the following vaccines: tetanus/diphtheria, influenza, pneumococcal, hepatitis B, hepatitis A, herpes zoster, human papilloma virus, measles/mumps/ rubella, varicella, and meningococcal. Recommendations are provided by age group and by medical and other indications.

ACIP Provisional Recommendations for use of Pneumococcal Vaccines
<http://www.cdc.gov/vaccines/recs/provisional/downloads/pneumo-oct-2008-508.pdf>

CDC MMWR Surveillance Summaries, March 21, 2008 / 57(SS02);1-24
<http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5702a1.htm#tab2>

[Immunization Update 2007: Zoster Vaccine Segment](#) Aug 9, 2007.

www.cdc.gov/vaccines/ed/imzupdate07/downloads/update07-zoster.ppt

Merck. Highlights of prescribing information Zostavax®
<http://www.fda.gov/cber/label/zosmer052506LB.htm>

Maciosek, M., Solberg, L., Coffield, A., Edwards, N., Goodman, M. Influenza vaccination: health impact and cost-effectiveness among adults aged 50 – 64 and 65 and older. American Journal of Preventive Medicine 2006, 31(1) pg 72-79.

This article addresses the value of influenza vaccination of adults, some not previously considered to be in the target population.

Provisional ACIP Recommendations for Prevention of Varicella, Aug 4, 2006, 2006. from
<http://www.cdc.gov/vaccines/recs/provisional/default.htm>

The Red Book: 2007 Report of the Committee on Infectious Diseases, 27th edition

Note: For the most current federal recommendations of the Advisory Committee on Immunization Practice concerning the vaccinations in this guideline and for other vaccinations, go to the web site of the Centers for Disease Control (www.cdc.gov/vaccines/pubs/ACIP-list.htm).