

8


[CDC Home](#)
[Search](#)
[Health Topics A-Z](#)

Recommendations and Reports

April 25, 1997 / 46(RR-9);1-25

Prevention and Control of Influenza: Recommendations of the Advisory Committee on Immunization Practices (ACIP)

Summary

These recommendations update information concerning the vaccine and antiviral agents available for controlling influenza during the 1997-98 influenza season (superseding MMWR 1996;45 {No. RR-5}:1-24). The principal changes include information about a) the influenza virus strains included in the trivalent vaccine for 1997-98, b) the vaccination of pregnant and breastfeeding women, and c) side effects and adverse reactions.

INTRODUCTION

Influenza A viruses are classified into subtypes on the basis of two surface antigens: hemagglutinin (H) and neuraminidase (N). Three subtypes of hemagglutinin (H1, H2, and H3) and two subtypes of neuraminidase (N1 and N2) are recognized among influenza A viruses that have caused widespread human disease. Immunity to these antigens -- especially to the hemagglutinin -- reduces the likelihood of infection and lessens the severity of disease if infection occurs. Infection with a virus of one subtype confers little or no protection against viruses of other subtypes. Furthermore, over time, antigenic variation (antigenic drift) within a subtype may be so marked that infection or vaccination with one strain may not induce immunity to distantly related strains of the same subtype. Although influenza B viruses have shown more antigenic stability than influenza A viruses, antigenic variation does occur. For these reasons, major epidemics of respiratory disease caused by new variants of influenza continue to occur. The antigenic characteristics of circulating strains provide the basis for selecting the virus strains included in each year's vaccine.

Typical influenza illness is characterized by abrupt onset of fever, myalgia, sore throat, and nonproductive cough. Unlike other common respiratory illnesses, influenza can cause severe malaise lasting several days. More severe illness can result if either primary influenza pneumonia or secondary bacterial pneumonia occurs. During influenza epidemics, high attack rates of acute illness result in both increased numbers of visits to physicians' offices, walk-in clinics, and emergency rooms and increased hospitalizations for management of lower respiratory tract complications.

Elderly persons and persons with underlying health problems are at increased risk for complications of influenza. If they become ill with influenza, such members of high-risk groups (see Groups at Increased Risk for Influenza-Related Complications) are more likely than the general population to require hospitalization. During major epidemics, hospitalization rates for persons at high risk may increase twofold to fivefold, depending on the age group. Previously healthy children and younger adults also may require hospitalization

for influenza-related complications, but the relative increase in their hospitalization rates is less than for persons who belong to high-risk groups.

An increase in mortality further indicates the impact of influenza epidemics. Increased mortality results not only from influenza and pneumonia but also from cardiopulmonary and other chronic diseases that can be exacerbated by influenza. An estimated greater than 20,000 influenza-associated deaths occurred during each of nine different U.S. epidemics from 1972-73 to 1991-92, and greater than 40,000 influenza-associated deaths occurred during each of four of these epidemics. More than 90% of the deaths attributed to pneumonia and influenza occurred among persons aged greater than or equal to 65 years.

The number of elderly persons in the U.S. population is increasing, as well as the number of persons aged less than 65 years at increased risk for influenza-related complications. Longer life expectancy for a) organ-transplant recipients, b) neonates in intensive-care units, and c) persons who have cystic fibrosis and acquired immunodeficiency syndrome (AIDS) results in a higher survival rate for younger persons at high risk for influenza.

Influenza vaccine campaigns are targeted to approximately 32 million persons aged greater than or equal to 65 years and 27 million to 31 million persons aged less than 65 years who are at high risk for influenza-associated complications. National health objectives for the year 2000 include vaccination of at least 60% of persons at risk for severe influenza-related illness.

Influenza vaccination levels among persons aged greater than or equal to 65 years increased substantially from 1985 (23%) to 1994 (55%), although vaccination levels among persons aged less than 65 years at high risk for influenza are estimated to be less than 30%. Possible reasons for the increase in influenza vaccination levels, especially among persons aged greater than or equal to 65 years, include greater acceptance of preventive medical services by practitioners, increased delivery and administration of vaccine by health-care providers and sources other than physicians, and the initiation of Medicare reimbursement for influenza vaccination in 1993.

OPTIONS FOR THE CONTROL OF INFLUENZA

In the United States, two measures are available that can reduce the impact of influenza: immunoprophylaxis with inactivated (i.e., killed-virus) vaccine and chemoprophylaxis or therapy with an influenza-specific antiviral drug (amantadine or rimantadine). Vaccinating persons at high risk before the influenza season each year is the most effective measure for reducing the impact of influenza. Vaccination can be highly cost effective when it is a) directed at persons who are most likely to experience complications or who are at increased risk for exposure and b) administered to persons at high risk during hospitalizations or routine health-care visits before the influenza season, thus making special visits to physicians' offices or clinics unnecessary. When vaccine and epidemic strains of virus are well matched, achieving high vaccination rates among persons living in closed settings (e.g., nursing homes and other chronic-care facilities) can reduce the risk for outbreaks by inducing herd immunity.

INACTIVATED VACCINE FOR INFLUENZA A AND B

Each year's influenza vaccine contains three virus strains (usually two type A and one type B) representing the influenza viruses that are likely to circulate in the United States in the upcoming winter. The vaccine is made from highly purified, egg-grown viruses that have been made noninfectious (inactivated). Influenza vaccine rarely causes systemic or febrile reactions. Whole-virus, subvirion, and purified-surface-antigen preparations are available.

Most vaccinated children and young adults develop high postvaccination hemagglutination-inhibition antibody titers. These antibody titers are protective against illness caused by strains similar to those in the vaccine or the related variants that may emerge during outbreak periods. Elderly persons and persons with certain chronic diseases may develop lower postvaccination antibody titers than healthy young adults and thus may remain susceptible to influenza-related upper respiratory tract infection. However, even if such persons develop influenza illness despite vaccination, the vaccine can be effective in preventing lower respiratory tract involvement or other secondary complications, thereby reducing the risk for hospitalization and death.

The effectiveness of influenza vaccine in preventing or attenuating illness varies, depending primarily on the age and immunocompetence of the vaccine recipient and the degree of similarity between the virus strains included in the vaccine and those that circulate during the influenza season. When a good match exists between vaccine and circulating viruses, influenza vaccine has been shown to prevent illness in approximately 70%-90% of healthy persons aged less than 65 years. In these circumstances, studies also have indicated that the effectiveness of influenza vaccine in preventing hospitalization for pneumonia and influenza among elderly persons living in settings other than nursing homes or similar chronic-care facilities ranges from 30% to 70%.

Among elderly persons residing in nursing homes, influenza vaccine is most effective in preventing severe illness, secondary complications, and death. Studies of this population have indicated that the vaccine can be 50%-60% effective in preventing hospitalization and pneumonia and 80% effective in preventing death, even though efficacy in preventing influenza illness may often be in the range of 30%-40% among the frail elderly. Achieving a high rate of vaccination among nursing home residents can reduce the spread of infection in a facility, thus preventing disease through herd immunity.

RECOMMENDATIONS FOR THE USE OF INFLUENZA VACCINE

Influenza vaccine is strongly recommended for any person aged greater than or equal to 6 months who -- because of age or underlying medical condition -- is at increased risk for complications of influenza. Health-care workers and others (including household members) in close contact with persons in high-risk groups also should be vaccinated. In addition, influenza vaccine may be administered to any person who wishes to reduce the chance of becoming infected with influenza. The trivalent influenza vaccine prepared for the 1997-98 season will include A/Bayern/07/95-like (H1N1), A/Wuhan/359/95-like (H3N2), and B/Beijing/184/93-like hemagglutinin antigens. For the A/Bayern/07/95-like, A/Wuhan/359/95-like, and B/Beijing/184/93-like antigens, U.S. manufacturers will use the antigenically equivalent strains A/Johannesburg/82/96(H1N1), A/Nanchang/933/95 (H3N2), and B/Harbin/07/94 because of their growth properties. Guidelines for the use of vaccine among certain patient populations follow; dosage recommendations vary according to age group (Table_1).

Although the current influenza vaccine can contain one or more of the antigens administered in previous years, annual vaccination with the current vaccine is necessary because immunity declines in the year following vaccination. Because the 1997-98 vaccine differs from the 1996-97 vaccine, supplies of 1996-97 vaccine should not be administered to provide protection for the 1997-98 influenza season.

Two doses administered at least 1 month apart may be required for satisfactory antibody responses among previously unvaccinated children aged less than 9 years; however, studies of vaccines similar to those being used currently have indicated little or no improvement in antibody response when a second dose is administered to adults during the same season.

During recent decades, data on influenza vaccine immunogenicity and side effects have been obtained for intramuscularly administered vaccine. Because recent influenza vaccines have not been adequately evaluated

when administered by other routes, the intramuscular route is recommended. Adults and older children should be vaccinated in the deltoid muscle and infants and young children in the anterolateral aspect of the thigh.

TARGET GROUPS FOR SPECIAL VACCINATION PROGRAMS Groups at Increased Risk for Influenza-Related Complications:

- Persons aged greater than or equal to 65 years
- Residents of nursing homes and other chronic-care facilities that house persons of any age who have chronic medical conditions
- Adults and children who have chronic disorders of the pulmonary or cardiovascular systems, including children with asthma
- Adults and children who have required regular medical follow-up or hospitalization during the preceding year because of chronic metabolic diseases (including diabetes mellitus), renal dysfunction, hemoglobinopathies, or immunosuppression (including immunosuppression caused by medications)
- Children and teenagers (aged 6 months-18 years) who are receiving long-term aspirin therapy and therefore might be at risk for developing Reye syndrome after influenza
- Women who will be in the second or third trimester of pregnancy during the influenza season

Influenza-associated excess mortality among pregnant women has not been documented except during the pandemics of 1918-19 and 1957-58. However, because death-certificate data often do not indicate whether a woman was pregnant at the time of death, studies conducted during interpandemic periods may underestimate the impact of influenza in this population. Case reports and limited studies suggest that pregnancy may increase the risk for serious medical complications of influenza as a result of increases in heart rate, stroke volume and oxygen consumption, decreases in lung capacity, and changes in immunologic function. A recent study of the impact of influenza during 17 interpandemic influenza seasons documented that the relative risk of hospitalization for selected cardiorespiratory conditions among pregnant women increased from 1.4 during weeks 14-20 of gestation to 4.7 during weeks 37-42 compared with rates among women who were 1-6 months postpartum. Women in their third trimester of pregnancy were hospitalized at a rate comparable to that of nonpregnant women who have high-risk medical conditions for whom influenza vaccine has traditionally been recommended. Using data from this study, it was estimated that an average of 1 to 2 hospitalizations among pregnant women could be prevented for every 1,000 pregnant women immunized. On the basis of these and other data that suggest that influenza infection may cause increased morbidity in women during the second and third trimesters of pregnancy, the Advisory Committee on Immunization Practices (ACIP) recommends that women who will be beyond the first trimester of pregnancy (14 weeks' gestation) during the influenza season be vaccinated. Pregnant women who have medical conditions that increase their risk for complications from influenza should be vaccinated before the influenza season -- regardless of the stage of pregnancy. Studies of influenza immunization of more than 2,000 pregnant women have demonstrated no adverse fetal effects associated with influenza vaccine; however, more data are needed. Because influenza vaccine is not a live virus vaccine and major systemic reactions to it are rare, many experts consider influenza vaccination safe during any stage of pregnancy. However, because spontaneous abortion is common in the first trimester and unnecessary exposures have traditionally been avoided during this time, some experts prefer influenza vaccination during the second trimester to avoid coincidental association of the vaccine with early pregnancy loss.

Groups that Can Transmit Influenza to Persons at High Risk

Persons who are clinically or subclinically infected can transmit influenza virus to persons at high risk that they care for or live with. Some persons at high risk (e.g., the elderly, transplant recipients, and persons with AIDS) can have a low antibody response to influenza vaccine. Efforts to protect these members of high-risk groups against influenza might be improved by reducing the likelihood of influenza exposure from their caregivers. Therefore, the following groups should be vaccinated:

- physicians, nurses, and other personnel in both hospital and outpatient-care settings;
- employees of nursing homes and chronic-care facilities who have contact with patients or residents;
- providers of home care to persons at high risk (e.g., visiting nurses and volunteer workers); and
- household members (including children) of persons in high-risk groups.

VACCINATION OF OTHER GROUPS Persons Infected with Human Immunodeficiency Virus

Limited information exists regarding the frequency and severity of influenza illness among human immunodeficiency virus (HIV)-infected persons, but reports suggest that symptoms might be prolonged and the risk for complications increased for some HIV-infected persons. Influenza vaccine has produced protective antibody titers against influenza in vaccinated HIV-infected persons who have minimal AIDS-related symptoms and high CD4+ T-lymphocyte cell counts. In patients who have advanced HIV disease and low CD4+ T-lymphocyte cell counts, however, influenza vaccine may not induce protective antibody titers; a second dose of vaccine does not improve the immune response for these persons.

Recent studies have examined the effect of influenza vaccination on replication of HIV type 1 (HIV-1). Although some studies have demonstrated a transient (i.e., 2- to 4-week) increase in replication of HIV-1 in the plasma or peripheral blood mononuclear cells of HIV-infected persons after vaccine administration, other studies using similar laboratory techniques have not indicated any substantial increase in replication. Deterioration of CD4+ T-lymphocyte cell counts and progression of clinical HIV disease have not been demonstrated among HIV-infected persons who receive vaccine. Because influenza can result in serious illness and complications and because influenza vaccination may result in protective antibody titers, vaccination will benefit many HIV-infected patients.

Breastfeeding Mothers

Influenza vaccine does not affect the safety of breastfeeding for mothers or infants. Breastfeeding does not adversely affect immune response and is not a contraindication for vaccination.

Persons Traveling to Foreign Countries

The risk for exposure to influenza during travel to foreign countries varies, depending on season and destination. In the tropics, influenza can occur throughout the year; in the Southern Hemisphere, most activity occurs from April through September. Because of the short incubation period for influenza, exposure to the virus during travel can result in clinical illness that begins while traveling, which is an inconvenience or potential danger, especially for persons at increased risk for complications. Persons preparing to travel to the tropics at any time of year or to the Southern Hemisphere from April through September should review their influenza vaccination histories. If they were not vaccinated the previous fall or winter, they should consider influenza vaccination before travel. Persons in high-risk groups should be especially encouraged to receive the most current vaccine. Persons at high risk who received the previous season's vaccine before travel should be revaccinated in the fall or winter with the current vaccine.

General Population

Physicians should administer influenza vaccine to any person who wishes to reduce the likelihood of becoming ill with influenza. Persons who provide essential community services should be considered for vaccination to minimize disruption of essential activities during influenza outbreaks. Students or other persons in institutional settings (e.g., those who reside in dormitories) should be encouraged to receive vaccine to minimize the disruption of routine activities during epidemics.

PERSONS WHO SHOULD NOT BE VACCINATED

Inactivated influenza vaccine should not be administered to persons known to have anaphylactic hypersensitivity to eggs or to other components of the influenza vaccine without first consulting a physician (see Side Effects and Adverse Reactions). Use of an antiviral agent (i.e., amantadine or rimantadine) is an option for prevention of influenza A in such persons. However, persons who have a history of anaphylactic hypersensitivity to vaccine components but who are also at high risk for complications of influenza can benefit from vaccine after appropriate allergy evaluation and desensitization. Specific information about vaccine components can be found in package inserts for each manufacturer.

Adults with acute febrile illness usually should not be vaccinated until their symptoms have abated. However, minor illnesses with or without fever should not contraindicate the use of influenza vaccine, particularly among children with mild upper respiratory tract infection or allergic rhinitis.

SIDE EFFECTS AND ADVERSE REACTIONS

Because influenza vaccine contains only noninfectious viruses, it cannot cause influenza. Respiratory disease after vaccination represents coincidental illness unrelated to influenza vaccination. The most frequent side effect of vaccination is soreness at the vaccination site that lasts up to 2 days. These local reactions generally are mild and rarely interfere with the ability to conduct usual daily activities. In addition, two types of systemic reactions have occurred:

- Fever, malaise, myalgia, and other systemic symptoms can occur following vaccination and most often affect persons who have had no exposure to the influenza virus antigens in the vaccine (e.g., young children). These reactions begin 6-12 hours after vaccination and can persist for 1 or 2 days. Recent placebo-controlled trials suggest that in elderly persons and healthy young adults, split-virus influenza vaccine is not associated with higher rates of systemic symptoms (e.g., fever, malaise, myalgia, and headache) when compared with placebo injections.
- Immediate -- presumably allergic -- reactions (e.g., hives, angioedema, allergic asthma, and systemic anaphylaxis) rarely occur after influenza vaccination. These reactions probably result from hypersensitivity to some vaccine component; most reactions likely are caused by residual egg protein. Although current influenza vaccines contain only a small quantity of egg protein, this protein can induce immediate hypersensitivity reactions among persons who have severe egg allergy. Persons who have developed hives, have had swelling of the lips or tongue, or have experienced acute respiratory distress or collapse after eating eggs should consult a physician for appropriate evaluation to help determine if vaccine should be administered. Persons who have documented immunoglobulin E (IgE)-mediated hypersensitivity to eggs -- including those who have had occupational asthma or other allergic responses due to exposure to egg protein -- might also be at increased risk for reactions from influenza vaccine, and similar consultation should be considered. The protocol for influenza vaccination developed by Murphy and Strunk may be considered for patients who have egg allergies and medical conditions that place them at increased risk for influenza-associated complications.

Hypersensitivity reactions to any vaccine component can occur. Although exposure to vaccines containing thimerosal can lead to induction of hypersensitivity, most patients do not develop reactions to thimerosal when administered as a component of vaccines -- even when patch or intradermal tests for thimerosal indicate hypersensitivity. When reported, hypersensitivity to thimerosal usually has consisted of local, delayed-type hypersensitivity reactions.

Unlike the 1976 swine influenza vaccine, subsequent vaccines prepared from other virus strains have not been clearly associated with an increased frequency of Guillain-Barre syndrome (GBS). However, obtaining a precise estimate of a small increase in risk is difficult for a rare condition such as GBS, which has an annual background incidence of only one to two cases per 100,000 adult population. During five of six seasons studied since 1976, the point estimates of the relative risks of GBS after influenza vaccination were slightly elevated; however, in none of these studies was the overall elevation in relative risk statistically significant. In the two most recently studied seasons, the combined number of GBS cases peaked 2 weeks after vaccination. Data from all of these studies suggest that if an increased relative risk does exist, it is lower for persons aged greater than or equal to 65 years than for those 18-64 years of age. The slight increase in the point estimates of the relative risks and the increased number of cases in the second week after vaccination may be the result of vaccination but also could be due to other factors (e.g., confounding or diagnostic bias) rather than a true vaccine-related risk.

Among persons who received the swine influenza vaccine in 1976, the rate of GBS that exceeded the background rate was slightly less than one case per 100,000 vaccinations. Even if GBS were a true side effect in subsequent years, the estimated risk for GBS was much lower than 1:100,000 and substantially less than that for severe influenza, which could be prevented by vaccination, especially for persons aged greater than or equal to 65 years and those who have medical indications for influenza vaccination.

Whereas the incidence of GBS in the general population is very low, persons with a history of GBS have a substantially greater likelihood of subsequently developing GBS than persons without such a history. Thus, the likelihood of coincidentally developing GBS after influenza vaccination is expected to be greater among persons with a history of GBS than among persons with no history of this syndrome. Whether influenza vaccination might be causally associated with this risk for recurrence is not known. Although avoiding a subsequent influenza vaccination in persons known to have developed GBS within 6 weeks of a previous influenza vaccination seems prudent, for most persons with a history of GBS who are at high risk for severe complications from influenza the established benefits of influenza vaccination justify yearly vaccination.

SIMULTANEOUS ADMINISTRATION OF OTHER VACCINES, INCLUDING CHILDHOOD VACCINES

The target groups for influenza and pneumococcal vaccination overlap considerably. For persons at high risk who have not previously been vaccinated with pneumococcal vaccine, health-care providers should strongly consider administering pneumococcal and influenza vaccines concurrently. Both vaccines can be administered at the same time at different sites without increasing side effects. However, influenza vaccine is administered each year, whereas pneumococcal vaccine is not. Children at high risk for influenza-related complications can receive influenza vaccine at the same time they receive other routine vaccinations, including pertussis vaccine (DTaP or DTP). Because influenza vaccine can cause fever when administered to young children, DTaP (which is less frequently associated with fever and other adverse events) is preferable.

TIMING OF INFLUENZA VACCINATION ACTIVITIES

Beginning each September (when vaccine for the upcoming influenza season becomes available) persons at high risk who are seen by health-care providers for routine care or as a result of hospitalization should be

offered influenza vaccine. Opportunities to vaccinate persons at high risk for complications of influenza should not be missed.

The optimal time for organized vaccination campaigns for persons in high-risk groups is usually the period from October through mid-November. In the United States, influenza activity generally peaks between late December and early March. High levels of influenza activity infrequently occur in the contiguous 48 states before December. Administering vaccine too far in advance of the influenza season should be avoided in facilities such as nursing homes, because antibody levels might begin to decline within a few months of vaccination. Vaccination programs can be undertaken as soon as current vaccine is available if regional influenza activity is expected to begin earlier than December.

Children aged less than 9 years who have not been vaccinated previously should receive two doses of vaccine at least 1 month apart to maximize the likelihood of a satisfactory antibody response to all three vaccine antigens. The second dose should be administered before December, if possible. Vaccine should be offered to both children and adults up to and even after influenza virus activity is documented in a community.

STRATEGIES FOR IMPLEMENTING INFLUENZA VACCINE RECOMMENDATIONS

Successful vaccination programs have combined education for health-care workers, publicity and education targeted toward potential recipients, a plan for identifying persons at high risk (usually by medical-record review), and efforts to remove administrative and financial barriers that prevent persons from receiving the vaccine. Persons for whom influenza vaccine is recommended can be identified and vaccinated in the settings described in the following paragraphs.

Outpatient Clinics and Physicians' Offices

Staff in physicians' offices, clinics, health-maintenance organizations, and employee health clinics should be instructed to identify and label the medical records of patients who should receive vaccine. Vaccine should be offered during visits beginning in September and throughout the influenza season. The offer of vaccine and its receipt or refusal should be documented in the medical record. Patients in high-risk groups who do not have regularly scheduled visits during the fall should be reminded by mail or telephone of the need for vaccine. If possible, arrangements should be made to provide vaccine with minimal waiting time and at the lowest possible cost.

Facilities Providing Episodic or Acute Care

Health-care providers in these settings (e.g., emergency rooms and walk-in clinics) should be familiar with influenza vaccine recommendations. They should offer vaccine to persons in high-risk groups or should provide written information on why, where, and how to obtain the vaccine. Written information should be available in language(s) appropriate for the population served by the facility.

Nursing Homes and Other Residential Long-Term-Care Facilities

Vaccination should be routinely provided to all residents of chronic-care facilities with the concurrence of attending physicians rather than by obtaining individual vaccination orders for each patient. Consent for vaccination should be obtained from the resident or a family member at the time of admission to the facility, and all residents should be vaccinated at one time, immediately preceding the influenza season. Residents admitted during the winter months after completion of the vaccination program should be vaccinated when they are admitted.

Acute-Care Hospitals

All persons aged greater than or equal to 65 years and younger persons (including children) with high-risk conditions who are hospitalized at any time from September through March should be offered and strongly encouraged to receive influenza vaccine before they are discharged. Household members and others with whom they will have contact should receive written information about why and where to obtain influenza vaccine.

Outpatient Facilities Providing Continuing Care to Patients at High Risk

All patients should be offered vaccine before the beginning of the influenza season. Patients admitted to such programs (e.g., hemodialysis centers, hospital specialty-care clinics, and outpatient rehabilitation programs) during the winter months after the earlier vaccination program has been conducted should be vaccinated at the time of admission. Household members should receive written information regarding the need for vaccination and the places to obtain influenza vaccine.

Visiting Nurses and Others Providing Home Care to Persons at High Risk

Nursing-care plans should identify patients in high-risk groups, and vaccine should be provided in the home if necessary. Caregivers and other persons in the household (including children) should be referred for vaccination.

Facilities Providing Services to Persons Aged greater than or equal to 65 Years

In these facilities (e.g., retirement communities and recreation centers), all unvaccinated residents/attendees should be offered vaccine on site before the influenza season. Education/publicity programs also should be provided; these programs should emphasize the need for influenza vaccine and provide specific information concerning how, where, and when to obtain it.

Clinics and Others Providing Health Care for Travelers

Indications for influenza vaccination should be reviewed before travel. Vaccine should be offered, if appropriate (see Travelers to Foreign Countries).

Health-Care Workers

Administrators of all health-care facilities should arrange for influenza vaccine to be offered to all personnel before the influenza season. Personnel should be provided with appropriate educational materials and strongly encouraged to receive vaccine. Particular emphasis should be placed on vaccination of persons who care for members of high-risk groups (e.g., staff of intensive-care units {including newborn intensive-care units}, staff of medical/surgical units, and employees of nursing homes and chronic-care facilities). Using a mobile cart to take vaccine to hospital wards or other work sites and making vaccine available during night and weekend work shifts can enhance compliance, as can a follow-up campaign early in the course of a community outbreak.

ANTIVIRAL AGENTS FOR INFLUENZA A

The two antiviral agents with specific activity against influenza A viruses are amantadine hydrochloride and rimantadine hydrochloride. These chemically related drugs interfere with the replication cycle of type A (but not type B) influenza viruses. When administered prophylactically to healthy adults or children before and

throughout the epidemic period, both drugs are approximately 70%-90% effective in preventing illness caused by naturally occurring strains of type A influenza viruses. Because antiviral agents taken prophylactically can prevent illness but not subclinical infection, some persons who take these drugs can still develop immune responses that will protect them when they are exposed to antigenically related viruses in later years.

In otherwise healthy adults, amantadine and rimantadine can reduce the severity and duration of signs and symptoms of influenza A illness when administered within 48 hours of illness onset. Studies evaluating the efficacy of treatment for children with either amantadine or rimantadine are limited. Amantadine was approved for treatment and prophylaxis of all influenza type A virus infections in 1976. Although few placebo-controlled studies were conducted to determine the efficacy of amantadine treatment among children before approval, amantadine is indicated for treatment and prophylaxis of adults and children aged greater than or equal to 1 year. Rimantadine was approved in 1993 for treatment and prophylaxis in adults but was approved only for prophylaxis in children. Further studies might provide the data needed to support future approval of rimantadine treatment in this age group.

As with all drugs, amantadine and rimantadine can cause adverse reactions in some persons. Such adverse reactions rarely are severe; however, for some categories of patients, severe adverse reactions are more likely to occur. Amantadine has been associated with a higher incidence of adverse central nervous system (CNS) reactions than rimantadine (see Considerations for Selecting Amantadine or Rimantadine for Chemoprophylaxis or Treatment).

RECOMMENDATIONS FOR THE USE OF AMANTADINE AND RIMANTADINE Use as Prophylaxis

Chemoprophylaxis is not a substitute for vaccination. Recommendations for chemoprophylaxis are provided primarily to help health-care providers make decisions regarding persons who are at greatest risk for severe illness and complications if infected with influenza A virus.

When amantadine or rimantadine is administered as prophylaxis, factors such as cost, compliance, and potential side effects should be considered when determining the period of prophylaxis. To be maximally effective as prophylaxis, the drug must be taken each day for the duration of influenza activity in the community. However, to be most cost effective, amantadine or rimantadine prophylaxis should be taken only during the period of peak influenza activity in a community.

Persons at High Risk Vaccinated After Influenza A Activity Has Begun

Persons at high risk still can be vaccinated after an outbreak of influenza A has begun in a community. However, the development of antibodies in adults after vaccination can take as long as 2 weeks, during which time chemoprophylaxis should be considered. Children who receive influenza vaccine for the first time can require as long as 6 weeks of prophylaxis (i.e., prophylaxis for 2 weeks after the second dose of vaccine has been received). Amantadine and rimantadine do not interfere with the antibody response to the vaccine.

Persons Providing Care to Those at High Risk

To reduce the spread of virus to persons at high risk, chemoprophylaxis may be considered during community outbreaks for

- a. unvaccinated persons who have frequent contact with persons at high risk (e.g., household members, visiting nurses, and volunteer workers) and b) unvaccinated employees of hospitals, clinics, and chronic-care facilities. For those persons who cannot be vaccinated, chemoprophylaxis during the period of peak influenza activity may be considered. For those persons who receive vaccine at a time

when influenza A is present in the community, chemoprophylaxis can be administered for 2 weeks after vaccination. Prophylaxis should be considered for all employees, regardless of their vaccination status, if the outbreak is caused by a variant strain of influenza A that might not be controlled by the vaccine.

Persons Who Have Immune Deficiency

Chemoprophylaxis might be indicated for persons at high risk who are expected to have an inadequate antibody response to influenza vaccine. This category includes persons who have HIV infection, especially those who have advanced HIV disease. No data are available concerning possible interactions with other drugs used in the management of patients who have HIV infection. Such patients should be monitored closely if amantadine or rimantadine chemoprophylaxis is administered.

Persons for Whom Influenza Vaccine Is Contraindicated

Chemoprophylaxis throughout the influenza season or during peak influenza activity might be appropriate for persons at high risk who should not be vaccinated. Influenza vaccine may be contraindicated in persons who have severe anaphylactic hypersensitivity to egg protein or other vaccine components.

Other Persons

Amantadine or rimantadine also can be administered prophylactically to anyone who wishes to avoid influenza A illness. The health-care provider and patient should make this decision on an individual basis.

Use of Antivirals as Therapy

Amantadine and rimantadine can reduce the severity and shorten the duration of influenza A illness among healthy adults when administered within 48 hours of illness onset. Whether antiviral therapy will prevent complications of influenza type A among persons at high risk is unknown. Insufficient data exist to determine the efficacy of rimantadine treatment in children. Thus, rimantadine is currently approved only for prophylaxis in children, but it is not approved for treatment in this age group.

Amantadine- and rimantadine-resistant influenza A viruses can emerge when either of these drugs is administered for treatment; amantadine-resistant strains are cross-resistant to rimantadine and vice versa. Both the frequency with which resistant viruses emerge and the extent of their transmission are unknown, but data indicate that amantadine- and rimantadine-resistant viruses are no more virulent or transmissible than amantadine- and rimantadine-sensitive viruses.

The screening of naturally occurring epidemic strains of influenza type A has rarely detected amantadine- and rimantadine-resistant viruses. Resistant viruses have most frequently been isolated from persons taking one of these drugs as therapy for influenza A infection. Resistant viruses have been isolated from persons who live at home or in an institution where other residents are taking or have recently taken amantadine or rimantadine as therapy. Persons who have influenza-like illness should avoid contact with uninfected persons as much as possible, regardless of whether they are being treated with amantadine or rimantadine. Persons who have influenza type A infection and who are treated with either drug can shed amantadine- or rimantadine-sensitive viruses early in the course of treatment, but can later shed drug-resistant viruses, especially after 5-7 days of therapy. Such persons can benefit from therapy even when resistant viruses emerge; however, they also can transmit infection to other persons with whom they come in contact. Because of possible induction of amantadine or rimantadine resistance, treatment of persons who have influenza-like illness should be discontinued as soon as clinically warranted, generally after 3-5 days of treatment or within 24-48 hours after the disappearance of signs and symptoms. Laboratory isolation of influenza viruses obtained from persons

who are receiving amantadine or rimantadine should be reported to CDC through state health departments, and the isolates should be sent to CDC for antiviral sensitivity testing.

Outbreak Control in Institutions

When confirmed or suspected outbreaks of influenza A occur in institutions that house persons at high risk, chemoprophylaxis should be started as early as possible to reduce the spread of the virus. Contingency planning is needed to ensure rapid administration of amantadine or rimantadine to residents. This planning should include preapproved medication orders or plans to obtain physicians' orders on short notice. When amantadine or rimantadine is used for outbreak control, the drug should be administered to all residents of the institution -- regardless of whether they received influenza vaccine the previous fall. The drug should be continued for at least 2 weeks or until approximately 1 week after the end of the outbreak. The dose for each resident should be determined after consulting the dosage recommendations and precautions (see Considerations for Selecting Amantadine or Rimantadine for Chemoprophylaxis or Treatment) and the manufacturer's package insert. To reduce the spread of virus and to minimize disruption of patient care, chemoprophylaxis also can be offered to unvaccinated staff who provide care to persons at high risk. Prophylaxis should be considered for all employees, regardless of their vaccination status, if the outbreak is caused by a variant strain of influenza A that is not controlled by the vaccine.

Chemoprophylaxis also may be considered for controlling influenza A outbreaks in other closed or semi-closed settings (e.g., dormitories or other settings where persons live in close proximity). To reduce the spread of infection and the chances of prophylaxis failure resulting from transmission of drug-resistant virus, measures should be taken to reduce contact as much as possible between persons on chemoprophylaxis and those taking drug for treatment.

CONSIDERATIONS FOR SELECTING AMANTADINE OR RIMANTADINE FOR CHEMOPROPHYLAXIS OR TREATMENT Side Effects/Toxicity

Despite the similarities between the two drugs, amantadine and rimantadine differ in their pharmacokinetic properties. More than 90% of amantadine is excreted unchanged, whereas approximately 75% of rimantadine is metabolized by the liver. However, both drugs and their metabolites are excreted by the kidneys.

The pharmacokinetic differences between amantadine and rimantadine might explain differences in side effects. Although both drugs can cause CNS and gastrointestinal side effects when administered to young, healthy adults at equivalent dosages of 200 mg/day, the incidence of CNS side effects (e.g., nervousness, anxiety, difficulty concentrating, and lightheadedness) is higher among persons taking amantadine compared with those taking rimantadine. In a 6-week study of prophylaxis in healthy adults, approximately 6% of participants taking rimantadine at a dose of 200 mg/day experienced at least one CNS symptom, compared with approximately 14% of those taking the same dose of amantadine and 4% of those taking placebo. The incidence of gastrointestinal side effects (e.g., nausea and anorexia) is approximately 3% among persons taking either drug, compared with 1%-2% among persons receiving the placebo. Side effects associated with both drugs are usually mild and cease soon after discontinuing the drug. Side effects can diminish or disappear after the first week despite continued drug ingestion. However, serious side effects have been observed (e.g., marked behavioral changes, delirium, hallucinations, agitation, and seizures). These more severe side effects have been associated with high plasma drug concentrations and have been observed most often among persons who have renal insufficiency, seizure disorders, or certain psychiatric disorders and among elderly persons who have been taking amantadine as prophylaxis at a dose of 200 mg/day. Clinical observations and studies have indicated that lowering the dosage of amantadine among these persons reduces the incidence and severity of such side effects, and recommendations for reduced dosages for these groups of patients have been made. Because rimantadine has been marketed for a shorter period of time than amantadine, its safety in certain patient populations (e.g., chronically ill and elderly persons) has been evaluated less frequently.

Clinical trials of rimantadine have more commonly involved young, healthy persons.

Providers should review the package insert before using amantadine or rimantadine for any patient. The patient's age, weight, and renal function; the presence of other medical conditions; the indications for use of amantadine or rimantadine (i.e., prophylaxis or therapy); and the potential for interaction with other medications must be considered, and the dosage and duration of treatment must be adjusted appropriately. Modifications in dosage might be required for persons who have impaired renal or hepatic function, the elderly, children, and persons with a history of seizures (Table_2). The following are guidelines for the use of amantadine and rimantadine in certain patient populations.

Persons Who Have Impaired Renal Function Amantadine

Amantadine is excreted unchanged in the urine by glomerular filtration and tubular secretion. Thus, renal clearance of amantadine is reduced substantially in persons with renal insufficiency. A reduction in dosage is recommended for patients with creatinine clearance less than or equal to 50 mL/min/1.73m². Guidelines for amantadine dosage based on creatinine clearance are found in the packet insert. However, because recommended dosages based on creatinine clearance might provide only an approximation of the optimal dose for a given patient, such persons should be observed carefully so that adverse reactions can be recognized promptly and either the dose can be further reduced or the drug can be discontinued, if necessary. Hemodialysis contributes minimally to drug clearance.

Rimantadine

The safety and pharmacokinetics of rimantadine among patients with renal insufficiency have been evaluated only after single-dose administration. Further studies are needed to determine the multiple-dose pharmacokinetics and the most appropriate dosages for these patients.

In a single-dose study of patients with anuric renal failure, the apparent clearance of rimantadine was approximately 40% lower, and the elimination half-life was approximately 1.6-fold greater than that in healthy controls of the same age. Hemodialysis did not contribute to drug clearance. In studies among persons with less severe renal disease, drug clearance was also reduced, and plasma concentrations were higher compared with control patients without renal disease who were the same weight, age, and sex.

A reduction in dosage to 100 mg/day is recommended for persons with creatinine clearance less than or equal to 10 mL/min. Because of the potential for accumulation of rimantadine and its metabolites, patients with any degree of renal insufficiency, including elderly persons, should be monitored for adverse effects, and either the dosage should be reduced or the drug should be discontinued, if necessary.

Persons Aged greater than or equal to 65 Years Amantadine

Because renal function declines with increasing age, the daily dose for persons aged greater than or equal to 65 years should not exceed 100 mg for prophylaxis or treatment. For some elderly persons, the dose should be further reduced. Studies suggest that because of their smaller average body size, elderly women are more likely than elderly men to experience side effects at a daily dose of 100 mg.

Rimantadine

The incidence and severity of CNS side effects among elderly persons appear to be substantially lower among those taking rimantadine at a dose of 200 mg/day compared with elderly persons taking the same dose of amantadine. However, when rimantadine has been administered at a dosage of 200 mg/day to chronically ill

elderly persons, they have had a higher incidence of CNS and gastrointestinal symptoms than healthy, younger persons taking rimantadine at the same dosage. After long-term administration of rimantadine at a dosage of 200 mg/day, serum rimantadine concentrations among elderly nursing-home residents have been twofold to fourfold greater than those reported in younger adults.

The dosage of rimantadine should be reduced to 100 mg/day for treatment or prophylaxis of elderly nursing-home residents. Although further studies are needed to determine the optimal dose for other elderly persons, a reduction in dosage to 100 mg/day should be considered for all persons aged greater than or equal to 65 years if they experience signs and symptoms that might represent side effects when taking a dosage of 200 mg/day.

Persons Who Have Liver Disease Amantadine

No increase in adverse reactions to amantadine has been observed among persons who have liver disease. Rare instances of reversible elevation of liver enzymes have been reported in patients receiving amantadine, although a specific relationship between the drug and such changes has not been established.

Rimantadine

The safety and pharmacokinetics of rimantadine only have been evaluated after single-dose administration. In a study of persons with chronic liver disease (most with stabilized cirrhosis), no alterations were observed after a single dose. However, in persons with severe liver dysfunction, the apparent clearance of rimantadine was 50% lower than that reported for persons without liver disease. A dose reduction to 100 mg/day is recommended for persons with severe hepatic dysfunction.

Persons Who Have Seizure Disorders Amantadine

An increased incidence of seizures has been reported in patients with a history of seizure disorders who have received amantadine. Patients with seizure disorders should be observed closely for possible increased seizure activity when taking amantadine.

Rimantadine

In clinical trials, seizures (or seizure-like activity) have been observed in a few persons with a history of seizures who were not receiving anticonvulsant medication while taking rimantadine. The extent to which rimantadine might increase the incidence of seizures among persons with seizure disorders has not been adequately evaluated, because such persons usually have been excluded from participating in clinical trials of rimantadine.

Children Amantadine

The use of amantadine in children aged less than 1 year has not been adequately evaluated. The FDA-approved dosage for children aged 1-9 years is 4.4-8.8 mg/kg/day, not to exceed 150 mg/day. Although further studies to determine the optimal dosage for children are needed, physicians should consider prescribing only 5 mg/kg/day (not to exceed 150 mg/day) to reduce the risk for toxicity. The approved dosage for children aged greater than or equal to 10 years is 200 mg/day; however, for children weighing less than 40 kg, prescribing 5 mg/kg/day, regardless of age, is advisable.

Rimantadine

The use of rimantadine in children aged less than 1 year has not been adequately evaluated. In children aged

1-9 years, rimantadine should be administered in one or two divided doses at a dosage of 5 mg/kg/day, not to exceed 150 mg/day. The approved dosage for children aged greater than or equal to 10 years is 200 mg/day (100 mg twice a day); however, for children weighing less than 40 kg, prescribing 5 mg/kg/day, regardless of age, also is recommended.

Drug Interactions Amantadine

Careful observation is advised when amantadine is administered concurrently with drugs that affect the CNS, especially CNS stimulants. Concomitant administration of antihistamines or anticholinergic drugs may increase the incidence of adverse CNS reactions.

Rimantadine

No clinically significant interactions between rimantadine and other drugs have been identified. For more detailed information concerning potential drug interactions for either drug, the package insert should be consulted.

SOURCES OF INFORMATION ON INFLUENZA-CONTROL PROGRAMS

Information regarding influenza surveillance is available through the CDC Voice Information System (influenza update), telephone (404) 332-4551, or through the CDC Information Service on the Public Health Network electronic bulletin board. From October through May, the information is updated at least every other week. In addition, periodic updates about influenza are published in the weekly MMWR. State and local health departments should be consulted regarding availability of influenza vaccine, access to vaccination programs, and information about state or local influenza activity.

Selected Bibliography GENERAL Brown LE, Hampston AW, Webster RG. Options for the control of influenza III. Amsterdam: Excerpta Medica, 1996. Douglas RG. Drug therapy: prophylaxis and treatment of influenza. *N Engl J Med* 1990;322: 443-50. Hannoun C, Kenda AP, Klenk HD, Ruben FL, eds. Options for the control of influenza II. Amsterdam: Excerpta Medica, 1993. Kendal AP, Patriarca PA, eds. Options for the control of influenza. New York: Alan R. Liss, 1986. Kilbourne ED. Influenza. New York: Plenum Publishing, 1987. Noble GR. Epidemiological and clinical aspects of influenza. In: Beare AS, ed. Basic and applied influenza research. Boca Raton, FL: CRC Press, 1982:11-50.

SURVEILLANCE, MORBIDITY, AND MORTALITY Barker WH. Excess pneumonia and influenza associated hospitalization during influenza epidemics in the United States, 1970-78. *Am J Public Health* 1986;76:761-5. Barker WH, Mullooly JP. Impact of epidemic type A influenza in a defined adult population. *Am J Epidemiol* 1980;112:798-813. Barker WH, Mullooly JP. Pneumonia and influenza deaths during epidemics: implications for prevention. *Arch Intern Med* 1982;142:85-9. Baron RC, Dicker RC, Bussell KE, Herndon JL. Assessing trends in mortality in 121 U.S. cities, 1970-79, from all causes and from pneumonia and influenza. *Public Health Rep* 1988;103: 120-8. Couch RB, Kasel WP, Glezen TR, et al. Influenza: its control in persons and populations. *J Infect Dis* 1986;153:431-40. Glezen WP. Serious morbidity and mortality associated with influenza epidemics. *Epidemiol Rev* 1982;4:25-44. Lui KJ, Kendal AP. Impact of influenza epidemics on mortality in the United States from October 1972 to May 1985. *Am J Public Health* 1987;77:712-6. Perrotta DM, Decker M, Glezen WP. Acute respiratory disease hospitalizations as a measure of impact of epidemic influenza. *Am J Epidemiol* 1985;122:468-76. Simonsen L, Clarke MJ, Williamson GD, et al. The impact of influenza epidemics on mortality: introducing a severity index. *Am J Public Health* 1997 (in press). Thacker SB. The persistence of influenza A in human populations. *Epidemiol Rev* 1986;8:129-42.

VACCINES Safety, Immunogenicity, Efficacy ACIP. General recommendations on immunization. MMWR

1994;43(No. RR-1):1-38. Arden NH, Patriarca PA, Kendal AP. Experiences in the use and efficacy of inactivated influenza vaccine in nursing homes. In: Kendal AP, Patriarca PA, eds. Options for the control of influenza. New York: Alan R. Liss, 1986:155-68. Barker WH, Mullooly JP. Effectiveness of inactivated influenza vaccine among non-institutionalized elderly persons. In: Kendal AP, Patriarca PA, eds. Options for the control of influenza. New York: Alan R. Liss, 1986:169-82. Beyer WEP, Palache AM, Baljet M, Masurel N. Antibody induction by influenza vaccines in the elderly: a review of the literature. *Vaccine* 1989;7:385-94. Cate TR, Couch RB, Parker D, Baxter B. Reactogenicity, immunogenicity, and antibody persistence in adults given inactivated influenza virus vaccines -- 1978. *Rev Infect Dis* 1983;5:737-47. Dowdle WR. Influenza immunoprophylaxis after 30 years' experience. In: Nayak DP, ed. Genetic variation among influenza viruses. New York: Academic Press, 1981: 525-34. Fedson DS, Wajda A, Nichol JP, et al. Clinical effectiveness of influenza vaccination in Manitoba. *JAMA* 1993;270:1956-61. Foster DA, Talsma AN, Furumoto-Dawson A, et al. Influenza vaccine effectiveness in preventing hospitalization for pneumonia in the elderly. *Am J Epidemiol* 1992; 136:296-307. Glezen WP, Glezen LS, Alcorn R. Trivalent, inactivated influenza virus vaccine in children with sickle cell disease. *Am J Dis Child* 1983;137:1095-7. Gross PA, Quinnan GV, Rodstein M, et al. Association of influenza immunization with reduction in mortality in an elderly population: a prospective study. *Arch Intern Med* 1988;148:562-5. Gross PA, Weksler ME, Quinnan GV Jr, Douglas RG Jr, Gaerlan PF, Denning CR. Immunization of elderly people with two doses of influenza vaccine. *J Clin Microbiol* 1987;25:1763-5. Helliwell BE, Drummond MF. The costs and benefits of preventing influenza in Ontario's elderly. *Can J Public Health* 1988;79:175-80. La Montagne JR, Noble GR, Quinnan GV, et al. Summary of clinical trials of inactivated influenza vaccine -- 1978. *Rev Infect Dis* 1983;5:723-36. Nichol KL, Margolis KL, Wuorenema J, Sternberg T. The efficacy and cost effectiveness of vaccination against influenza among elderly persons living in the community. *N Engl J Med* 1994; 331:778-84. Nichol KL, Lind A, Margolis KL, et al. The effectiveness of vaccination against influenza in healthy, working adults. *N Engl J Med* 1995;333:889-93. Patriarca PA, Weber JA, Parker RA, et al. Efficacy of influenza vaccine in nursing homes: reduction in illness and complications during an influenza A(H3N2) epidemic. *JAMA* 1985; 253:1136-9. Wright PF, Cherry JD, Foy HM, et al. Antigenicity and reactogenicity of influenza A/USSR/77 virus vaccine in children -- a multicentered evaluation of dosage and safety. *Rev Infect Dis* 1983; 5:758-64.

Vaccination of Pregnant Women Deinhard AS, Ogburn P, Jr. A/NJ/8/76 influenza vaccination program: effects on maternal health and pregnancy outcome. *Am J Obstet Gynecol* 1981;140:240-5. Englund JA, Mbawuike IN, Hammill H, Holleman MC, Baxter BD, Glezen WP. Maternal immunization with influenza or tetanus toxoid vaccine for passive antibody protection in young infants. *J Infect Dis* 1993;168:647-56. Freeman DW, Barno A. Deaths from Asian influenza associated with pregnancy. *Am J Obstet Gynecol* 1959;78:1172-5. Heininen OP, Shapiro S, Monson RR, Hartz SC, Rosenberg L, Slone D. Immunization during pregnancy against poliomyelitis and influenza in relation to childhood malignancy. *Inter J Epidemiol* 1973;2:229-35. Mullooly JP, Barker WH, Nolan TF Jr. Risk of acute respiratory disease among pregnant women during influenza A epidemics. *Public Health Rep* 1986;101:205-11. Neuzil KM, Reed GW, Mitchel EF, Griffin MR. Influenza morbidity increases in late pregnancy. Abstracts of the IDSA, 34th Annual Meeting, 1996:48. Puck JM, Glezen WP, Frank AL, Six HR. Protection of infants from infection with influenza A virus by transplacentally acquired antibody. *J Infect Dis* 1980;142:844-9. Schoenbaum SC, Weinstein L. Respiratory infection in pregnancy. *Clin Obstet Gynecol* 1979;22:293-300. Shahab SZ, Glezen WP. Influenza virus. In: Gonik B, ed. *Viral diseases in pregnancy*. New York, NY: Springer-Verlag, 1994. Sumaya CV, Gibbs RS. Immunization of pregnant women with influenza A/New Jersey/76 virus vaccine: reactogenicity and immunogenicity in mother and infant. *J Infect Dis* 1979;140: 141-6.

Vaccination of Persons Infected with HIV Chapman L, Hartley M, Khan A, et al. Changes in plasma HIV RNA after immune activation by vaccinations and acute illnessess {Abstract}. In: Program and abstracts of the 2nd national conference: human retroviruses and related infections. Washington, DC: American Society for Microbiology, 1995. Glesby MJ, Hoover DR, Farzadegan H, Margolick JB, Saah AJ. The effect of influenza vaccination on human immunodeficiency virus type 1 load: a randomized, double-blinded, placebo-controlled study. *J Infect Dis* 1996;174:1332-6. Huang KL, Ruben FL, Rinaldo CR Jr, Kingsley L, Lyter DW,

Ho M. Antibody responses after influenza and pneumococcal immunization in HIV-infected homosexual men. *JAMA* 1987; 257:2047-50. Jackson CR, Vavro CL, Pennington KN, et al. Effect of influenza immunization on immunologic and virologic parameters in HIV+ pediatric patients {Abstract}. In: Program and abstracts of the 2nd national conference: human retroviruses and related infections. Washington, DC: American Society for Microbiology, 1995. Miotti PG, Nelson KE, Dallabetta GA, Farzadegan H, Margolick J, Clements ML. The influence of HIV infection on antibody responses to a two-dose regimen of influenza vaccine. *JAMA* 1989;262:779-83. Nelson KE, Clements ML, Miotti P, Cohn S, Polk BF. The influence of human immunodeficiency virus (HIV) infection on antibody responses to influenza vaccines. *Ann Intern Med* 1988; 109:383-8. O'Brien WA, Grovit-Ferbas K, Namazi A, et al. Human immunodeficiency virus-type 1 replication can be increased in peripheral blood of seropositive patients after influenza vaccination. *Blood* 1995;86:1082-9. Safrin S, Rush JD, Mills J. Influenza in patients with human immunodeficiency virus infection. *Chest* 1990;98:33-7. Staprans SI, Hamilton BL, Follansbee SE, et al. Activation of virus replication after vaccination of HIV-1-infected individuals. *J Exper Med* 1995;182:1727-37. Steigbigel RT, Craddock BC, Cate TR. Antibody responses to influenza vaccination in HIV-infected people and effect of HIV load {Abstract}. In: Program and abstracts of the 33rd Interscience Conference on Antimicrobial Agents and Chemotherapy. Washington, DC: American Society for Microbiology, 1993. Thurn JR, Henry K. Influenza A pneumonitis in a patient infected with the human immunodeficiency virus (HIV). *Chest* 1989;95:807-10. Yerly S, Wunderli W, Wyler CA, et al. Influenza immunization of HIV-1-infected individuals does not increase HIV-1 viral load. *AIDS* 1994; 8:1503-4. Vaccination of Foreign Travelers CDC. Update: influenza activity -- worldwide and recommendations for influenza vaccine composition for the 1990-91 influenza season. *MMWR* 1990;39:293-6. CDC. Acute respiratory illness among cruise-ship passengers -- Asia. *MMWR* 1988; 37:63-6.

Side Effects, Adverse Reactions, Interactions Aberer W. Vaccination despite thimerosal sensitivity. *Contact Dermatitis* 1991;24: 6-10. American Academy of Pediatrics Committee on Infectious Diseases. *The Red Book: report of the Committee on Infectious Disease*. 23rd ed. Elk Grove, IL: American Academy of Pediatrics, 1994. Bierman CW, Shapiro GG, Pierson WE, Taylor JW, Foy HM, Fox JP. Safety of influenza vaccination in allergic children. *J Infect Dis* 1977;136(suppl):S652-S655. Chen R, Kent J, Rhodes P, Simon P, Schonberger L. Investigation of a possible association between influenza vaccination and Guillain-Barre Syndrome in the United States, 1990-1991 (Abstract). *Post Marketing Surveillance* 1992;6:5-6. Govaert TME, Aretz K, Masurel N, et al. Adverse reactions to influenza vaccine in elderly people: a randomized double blind placebo controlled trial. *Br Med J* 1993; 307:988-90. Hurwitz ES, Schonberger LB, Nelson DB, Holman RC. Guillain-Barre syndrome and the 1978-1979 influenza vaccine. *N Engl J Med* 1981;304:1557-61. Kaplan JE, Katona P, Hurwitz ES, Schonberger LB. Guillain-Barre syndrome in the United States, 1979-1980 and 1980-1981: lack of an association with influenza vaccination. *JAMA* 1982; 248: 698-700. Margolis KL, Nichol KL, Poland GA, Pluhar RE. Frequency of adverse reactions to influenza vaccine in the elderly: a randomized, placebo-controlled trial. *JAMA* 1990; 307:988-90. Margolis KL, Poland GA, Nichol KL, et al. Frequency of adverse reactions after influenza vaccination. *Am J Med* 1990;88:27-30. Murphy KR, Strunk RC. Safe administration of influenza vaccine in asthmatic children hypersensitive to egg proteins. *J Pediatr* 1985;106:931-3.

Simultaneous Administration of Other Vaccines ACIP. Recommendations of the ACIP: pneumococcal polysaccharide vaccine. *MMWR* 1989;38: 64-8,73-6. DeStefano F, Goodman RA, Noble GR, McClary GD, Smith J, Broome CV. Simultaneous administration of influenza and pneumococcal vaccines. *JAMA* 1982;247:2551-4. Peter G, ed. Summaries of infectious diseases: influenza. In: Report of the Committee on Infectious Diseases. 21st ed. Elk Grove Village, IL: American Academy of Pediatrics, 1988:243-51.

INFLUENZA IN THE INSTITUTIONAL SETTING Bean B, Rhame FS, Hughes RS, Weiler MD, Peterson LR, Gerding DN. Influenza B: hospital activity during a community epidemic. *Diagn Microbiol Infect Dis* 1983;1: 177-83. Gomolin IH, Leib HB, Arden NH, Sherman FT. Control of influenza outbreaks in the nursing home: guidelines for diagnosis and management. *J Am Geriatr Soc* 1995; 43:71-4. Pachucki CT, Walsh Pappas SA, Fuller GF, Krause SL, Lentino JR, Schaaff DM. Influenza A among hospital personnel and

patients: implications for recognition, prevention, and control. *Arch Intern Med* 1989;149:77-80.

STRATEGIES FOR VACCINATION OF HIGH-RISK GROUPS Buffington J, Bell KM, LaForce FM, et al. A target-based model for increasing influenza immunizations in private practice. *J Gen Intern Med* 1991;6:204-9. CDC. Influenza and pneumococcal vaccination coverage levels among persons aged greater than or equal to 65 years -- United States, 1973-1993. *MMWR* 1995;44:506-7,513-5. Fedson DS. Immunizations for health care workers and patients in hospitals. In: Wenzel RP, ed. *Prevention and control of nosocomial infections*. Baltimore, MD: Williams & Wilkins, 1987: 116-74. Fedson DS, Kessler HA. A hospital-based influenza immunization program, 1977-78. *Am J Public Health* 1983;73:442-5. Margolis KL, Lofgren RP, Korn JE. Organizational strategies to improve influenza vaccine delivery: a standing order in a general medical clinic. *Arch Intern Med* 1988;148:2205-7. Nichol KL, Korn JE, Margolis KL, Poland GA, Petzel RA, Lofgren RP. Achieving the national health objective for influenza immunization: success of an institution-wide vaccination program. *Am Journal Med* 1990;89:156-60. Nichol KL. Improving influenza vaccination rates for high-risk inpatients. *Am J Med* 1991;91: 584-8. Public Health Service. *Healthy people 2000: national health promotion and disease prevention objectives -- full report, with commentary*. Washington, DC: US Department of Health and Human Services, Public Health Service, 1991; DHHS publication no. (PHS)91-50212. Weingarten S, Riedinger M, Bolton LB, Miles P, Ault M. Barriers to influenza vaccine acceptance: a survey of physicians and nurses. *Am J Infect Control* 1989;17:202-7. 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;108:616-25.

DIAGNOSTIC METHODS Harmon MW. Influenza viruses. In: Lennette EH, ed. *Laboratory diagnosis of viral infections*. 2nd ed. New York: Marcel Dekker Inc., 1992:515-34. Leonardi GP, Leib H, Birkhead GS, et al. Comparison of rapid detection methods for influenza A virus and their value in health-care management for institutionalized geriatric patients. *J Clin Microbiol* 1994;32:70-4. Ziegler T, Cox NJ. Influenza viruses. In: Murray PR et al., eds. *Manual of Clinical Microbiology*. 6th ed. Washington, DC. ASM Press, 1995:918-25

ANTIVIRAL AGENTS Aoki FY, Sitar DS. Amantadine kinetics in healthy elderly men: implications for influenza prevention. *Clin Pharmacol Ther* 1985;37:137-44. Aoki FY, Sitar DS. Clinical pharmacokinetics of amantadine hydrochloride. *Clin Pharmacokinet* 1988;14:35-51. Atkinson WL, Arden NH, Patriarca PA, Leslie N, Lui KJ, Gohd R. Amantadine prophylaxis during an institutional outbreak of type A (H1N1) influenza. *Arch Intern Med* 1986;146:1751-6. Balfour HH Jr, Englund JA. Antiviral drugs in pediatrics. *Am J Dis Child* 1989;143: 1307-16. Belshe RB, Burk B, Newman F, Cerruti RL, Sim IS. Resistance of influenza A virus to amantadine and rimantadine: results of one decade of surveillance. *J Infect Dis* 1989; 159:430-5. Dolin R, Reichman RC, Madore HP, Maynard R, Linton PN, Webber-Jones J. A controlled trial of amantadine and rimantadine in the prophylaxis of influenza A infection. *N Engl J Med* 1982; 307:580-3. Douglas RG. Drug therapy: prophylaxis and treatment of influenza. *N Engl J Med* 1990;322: 443-50. Guay DRP. Amantadine and rimantadine prophylaxis of influenza A in nursing homes: a tolerability perspective. *Drugs and Aging* 1994;5:8-19. Hall CB, Dolin R, Gala CL, et al. Children with influenza A infection: treatment with rimantadine. *Pediatrics* 1987;80:275-82. Hayden FG, Couch RB. Clinical and epidemiological importance of influenza A viruses resistant to amantadine and rimantadine. *Reviews in Medical Virology* 1992; 2:89-96. Hayden FG, Hay AJ. Emergence and transmission of influenza A viruses resistant to amantadine and rimantadine. *Curr Top in Microbiol and Immunol* 1992;176:120-30. Horadam VW, Sharp JG, Smilack JD, et al. Pharmacokinetics of amantadine hydrochloride in subjects with normal and impaired renal function. *Ann Intern Med* 1981;94:454-8. Mast EE, Harmon MW, Gravenstein S, et al. Emergence and possible transmission of amantadine-resistant viruses during nursing home outbreaks of influenza A(H3N2). *Am J Epidemiol* 1991;133:988-97. Monto AS, Arden NH. Implications of viral resistance to amantadine in control of influenza A. *Clin Infect Dis* 1992;15:362-7. Monto AS, Ohmut SE, Hornbuckle K, Pearce CL. Safety and efficacy of long-term use of rimantadine for prophylaxis of type A influenza in nursing homes. *Antimicrob Agents Chemother* 1995;39:2224-8. Pettersson RF, Hellstrom PE, Penttinen K, et al. Evaluation of amantadine in the prophylaxis of influenza A (H1N1) virus infection: a controlled field trial among young adults and high-risk

patients. *J Infect Dis* 1980;142:377-83. Sears SD, Clements ML. Protective efficacy of low-dose amantadine in adults challenged with wild-type influenza A virus. *Antimicrob Agents Chemother* 1987;31:1470-3. Somani SK, Degelau J, Cooper SL, et al. Comparison of pharmacokinetic and safety profiles of amantadine 50- and 100-mg daily doses in elderly nursing home residents. *Pharmacotherapy* 1991;11:460-6. Stange KC, Little DW, Blatnick B. Adverse reactions to amantadine prophylaxis of influenza in a retirement home. *J Am Geriatr Soc* 1991;39:700-5. Tominack RL, Hayden FG. Rimantadine hydrochloride and amantadine hydrochloride use in influenza A virus infections. *Infect Dis Clin North Am* 1987;1:459-78. Wintermeyer SM, Nahata MC. Rimantadine: a clinical perspective. *Ann Pharmacother* 1988;29:299-310.

Table_1

Note: To print large tables and graphs users may have to change their printer settings to landscape and use a small font size.

TABLE 1. Influenza vaccine* dosage, by age group --United States, 1997-98 season

Age group	Product +	Dosage	No. of doses	Route &
6-35 mos	Split virus only	0. 25 mL	1 or 2 @	IM **
3- 8 yrs	Split virus only	0. 50 mL	1 or 2 @	IM
9-12 yrs	Split virus only	0. 50 mL	1	IM
>12 yrs	Whole or split virus	0. 50 mL	1	IM

* Contains 15 mg each of A/Bayern/07/95-like (H1N1), A/Wuhan/359/95-like (H3N2), and B/Beijing/184/93-like hemagglutinin antigens in each 0.5 mL. For the A/Bayern/07/95-like, A/Wuhan/359/95-like, and B/Beijing/184/93-like antigens, U.S. manufacturers will use the antigenically equivalent strains A/Johannesburg/82/96(H1N1), A/Nanchang/933/95 (H3N2), and B/Harbin/07/94 because of their growth properties. Manufacturers include: Connaught Laboratories, Inc. (Fluzone (R) whole or split); Evans Medical Ltd. (an affiliate of Medeva Pharmaceuticals, Inc.) (Fluvirin (TM) purified surface antigen vaccine) and Wyeth-Ayerst Laboratories (Flushield (TM) split). For further product information call Connaught, (800) 822-2463; Evans/Medeva, (800) 932-1950 or Wyeth-Ayerst, (800) 358-7443.

+ Because of their decreased potential for causing febrile reactions, only split-virus vaccines should be used for children. They may be labeled as "split," "subvirion," or "purified-surface-antigen" vaccine. Immunogenicity and side effects of split- and whole-virus vaccines are similar among adults when vaccines are administered at the recommended dosage.

& For adults and children, the recommended site of vaccination is the deltoid muscle. The preferred site for infants and young children is the anterolateral aspect of the thigh.

@ Two doses administered at least 1 month apart are recommended for children aged <9 years who are receiving influenza vaccine for the first time.

** Intramuscular.

Return to top.

Table_2

Note: To print large tables and graphs users may have to change their printer settings to landscape and use a small font size.

TABLE 2. Recommended dosage for amantadine and rimantadine treatment and prophylaxis

Antiviral agent	Age (yrs)			
	1-9	10-13	14-64	>=65
Amantadine *				
Treatment	5 mg/kg/day up to 150 mg + in two divided doses	100 mg twice daily &	100 mg twice daily	<=100 mg/day

Prophylaxis	5 mg/kg/day up to 150 mg + in two divided doses	100 mg twice daily &	100 mg twice daily	<=100 mg/day
Rimantadine @ Treatment	NA	NA	100 mg twice daily	100 or 200 ** mg/day
Prophylaxis	5 mg/kg/day up to 150 mg + in two divided doses	100 mg twice daily &	100 mg twice daily	100 or 200 ** mg/day

* Amantadine manufacturers include: Dupont Pharma (Symmetrel (R) -- syrup); Solvay Pharmaceuticals (Symadine (TM) -- capsule); Chase Pharmaceuticals and Invamed (Amantadine HCL -- capsule); and Copley Pharmaceuticals, Barre National, and Mikart (Amantadine HCL -- syrup). Rimantadine is manufactured by Forest Laboratories (Flumandine (R) -- tablet and syrup). The drug package insert should be consulted for dosage recommendations for administering amantadine to persons with creatinine clearance <=50 mL/min/1.73m superscript 2.

+ 5 mg/kg of amantadine or rimantadine syrup = 1 tsp/22 lbs.

& Children aged >=10 years who weigh <40 kg should be administered amantadine or rimantadine at a dose of 5 mg/kg/day.

@ A reduction in dose to 100 mg/day of rimantadine is recommended for persons who have severe hepatic dysfunction or those with creatinine clearance <=10 mL/min. Other persons with less severe hepatic or renal dysfunction taking >100 mg/day of rimantadine should be observed closely, and the dosage should be reduced or the drug discontinued, if necessary.

** Elderly nursing-home residents should be administered only 100 mg/day of rimantadine. A reduction in dose to 100 mg/day should be considered for all persons aged >=65 years if they experience possible side effects when taking 200 mg/day.

NA=Not applicable.

Return to top.

Disclaimer All *MMWR* HTML versions of articles are electronic conversions from ASCII text into HTML. This conversion may have resulted in character translation or format errors in the HTML version. Users should not rely on this HTML document, but are referred to the electronic PDF version and/or the original *MMWR* paper copy for the official text, figures, and tables. An original paper copy of this issue can be obtained from the Superintendent of Documents, U.S. Government Printing Office (GPO), Washington, DC 20402-9371; telephone: (202) 512-1800. Contact GPO for current prices.

**Questions or messages regarding errors in formatting should be addressed to mmwrq@cdc.gov.

Page converted: 09/19/98

[HOME](#) | [ABOUT MMWR](#) | [MMWR SEARCH](#) | [DOWNLOADS](#) | [RSS](#) | [CONTACT](#)
[POLICY](#) | [DISCLAIMER](#) | [ACCESSIBILITY](#)

SAFER • HEALTHIER • PEOPLE™

Morbidity and Mortality Weekly Report
Centers for Disease Control and Prevention
1600 Clifton Rd, MailStop K-95, Atlanta, GA 30333,
U.S.A

FIRSTGOV
Your First Click to the U.S. Government



Department of Health
and Human Services

This page last reviewed 5/2/01