Looking Ahead: Recommendations for Planning and Improving Adult Vaccination Programs

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INTRODUCTION

The number of people over the age of 65 years continues to grow each decade and is expected to double by the year 2020.\(^1\) The health care needs of the aging population differ from those of other adults, and this is attributable in large part to age-related changes in body composition and physiology. Older people have an increased susceptibility to many infectious diseases because of a decrease in immune system functioning and an increase in the incidence of concomitant diseases. Because of this increased risk of infection, special recommendations for immunization are necessary in this population.

Older adults experience higher rates of vaccine-preventable infections (e.g., influenza, pneumonia, tetanus) than younger adults do; in addition, these infections are associated with greater morbidity and mortality rates in elderly people.\(^2\) For this reason, vaccine campaigns are often targeted to this high-risk population.

Vaccination provides a cost-effective means of protecting older adults from the significant morbidity and mortality associated with influenza, pneumococcal disease, and tetanus. Furthermore, vaccination can decrease the number of hospitalizations caused by vaccine-preventable diseases.\(^3,4\)

This article reviews the epidemiology of vaccine-preventable diseases in geriatric patients, presents the currently recommended immunization schedules for adults over 65 years of age, discusses factors that limit the success of vaccine programs in the elderly, and includes recommendations for improving vaccination rates in this population.

HOST SUSCEPTIBILITY

Elderly patients are at an increased risk of infection because of an age-related senescence of the immune system.\(^5\) Several mechanisms have been implicated in this decline of the immune response, including (1) impaired functioning of the thymus gland, (2) a decline in T-cell maturation and function, and (3) a reduced B-cell response.

Although these factors are associated with an attenuated immune response to offending organisms, the etiologic mechanism of these impairments is not fully understood. Proposed mechanisms include nutritional deficiencies, declining cytokine levels, and changes in intercellular messenger responses.\(^6-8\) The increased prevalence of chronic disease and medication use may well account for much of the decline in immune function observed in older people. The resulting immunosenescence can impair the host’s ability to mount a proper immune response to vaccines. Unfortunately, there is no proven reliable predictor of immune system viability.

Cellular immunity refers to the immune response that is mediated primarily by lymphocytes and macrophages. This portion of the immune system is responsible for killing viruses and tumor-containing cells, mounting delayed hypersensitivity reactions, and rejecting transplanted organs. Dysfunction of the thymus gland has been implicated as one cause of the observed age-related decline in cellular immunity in the elderly. Investigators have discovered that the serum concentrations of thymic hormone decline with age.\(^9,10\)

Humoral-mediated immunity refers to the immune response that is mediated primarily by antibodies and complement proteins produced by mature B lymphocytes. The humoral response accounts for antigen-specific and nonspecific immunity-to-host invaders.

Antibody production is compromised in elderly patients. One postulated cause is altered B-cell and immunoregulatory T-lymphocyte function. In the elderly, these deficiencies can result in lower than expected antibody responses to vaccinations.

VACCINES

The following vaccines are recommended for use in elderly patients:

- hepatitis B vaccine
- influenza vaccine
- measles-mumps-rubella (MMR) vaccine
- 23-valent pneumococcal polysaccharide vaccine
- tetanus-diphtheria toxoid
- varicella vaccine

Because many of the elderly have active immunity to MMR and varicella from vaccination or childhood disease and because hepatitis B vaccine is recommended only for a small group of elderly patients, vaccination campaigns are targeted at pneumococcus, tetanus, and influenza. Despite these efforts, a large portion of older adults remain at risk for vaccine-preventable disease.\(^11\) Influenza and pneumococcal disease...
account for 50 to 100 times more deaths than all other vaccine-preventable diseases combined. Together, these illnesses represent the fifth leading cause of death among the elderly.

Failure to effectively inoculate elderly patients whose vaccinations are not up to date contributes greatly to this risk. The fact that many elderly people are afflicted with chronic diseases (e.g., diabetes and cardiovascular, pulmonary, and renal diseases) further complicates the efficacy of these programs. These disorders may decrease the immunogenicity of some vaccines, rendering them less effective.12

Two major sources of information on vaccines for adults in the U.S. are the National Coalition for Adult Immunization (NCAI) and the Advisory Committee on Immunization Practices (ACIP).13 Established in 1988, the NCAI consists of 130 organizations, including professional associations, voluntary organizations, advocacy groups, vaccine manufacturers, government health agencies, and state and local coalitions. Its goal is to improve vaccine use in adults by educating health care providers and patients about vaccines. The NCAI maintains a Web site of vaccine-related materials for patients and health care providers.

The ACIP also issues vaccine recommendations in the U.S.14 This 15-member committee is selected by the Secretary of the U.S. Department of Health and Human Services (DHHS) to provide advice and guidance to the Secretary, the Assistant Secretary for Health, and the Centers for Disease Control and Prevention (CDC) on the most effective means to avoid vaccine-preventable diseases. During January of each year, the ACIP issues recommendations for the routine administration of vaccines to children and adults, including schedules, dosages, and contraindications applicable to each vaccine. These recommendations are published in the CDC’s journal, Morbidity and Mortality Weekly Reports, and in Annals of Internal Medicine.

Influenza Vaccine

Influenza is responsible for nearly 20,000 deaths per year in the U.S.15 The cause-specific mortality rates are highest among persons aged 65 years or older and those with chronic illnesses. Patients 50 to 64 years of age are more likely to have chronic diseases, which increases their risk of influenza.

Influenza vaccinations are associated with reductions in influenza-related respiratory illness, hospitalizations, and deaths in these high-risk populations.5,16 The vaccine is approximately 58% effective in uninstitutionalized adults older than age 60, but the vaccine’s efficacy is further decreased in adults older than age 70.17 The vaccine is also effective in preventing hospitalization for pneumonia and influenza.

In two studies of elderly patients living outside nursing homes and long-term care facilities, the influenza vaccine was 30% to 70% effective at preventing hospitalization.3,4 In one study of institutionalized patients, the vaccine helped 50% to 60% of patients avoid hospitalization for pneumonia. These studies demonstrate the potential health care savings of successful vaccination programs.

Cases of influenza are most commonly reported during the winter months, particularly from November until March. For this reason, vaccination campaigns are usually undertaken in October and November (known as the influenza season). Adults at the highest risk of morbidity should be vaccinated first. The ACIP recommends that the following groups be vaccinated in October regardless of the setting in which the vaccination is given:15

- persons at increased risk for influenza-related complications (those over 65 years of age, those aged six months to 64 years with certain medical conditions, and healthy children aged six to 23 months)
- health care workers
- household contacts of persons at increased risk for influenza-related complications (including contacts of infants younger than six months of age who are not eligible for influenza vaccine)
- children aged six months to up to nine years of age who are receiving influenza vaccine for the first time

If patients are not vaccinated in October or November, vaccination should still be offered throughout the influenza season. Older people and patients with chronic disease may develop lower post-vaccination titers to influenza than healthy young adults and therefore are more susceptible to influenza-related infections.18 This makes aggressive vaccine campaigns even more important for the elderly population.

Influenza is a rapidly evolving and changing virus. Different strains may be responsible for epidemics from year to year. For this reason, the influenza vaccine is reformulated each year to include the strains that are most likely to be encountered in a given “flu” season.

The vaccine is composed of inactivated virus grown in purified egg protein. Products may differ in preservative composition and quantity among manufacturers. The 2002–2003 trivalent vaccine virus strains are A/Moscow/10/99 (H3N2)-like, A/New Caledonia/20/99 (H1N1)-like, and B/Hong Kong/330/2001-like strains, which were forecasted to be the most likely strains encountered in the U.S. in the 2002–2003 season.15

Typically, vaccine manufacturers begin shipping the influenza vaccine in late September each year, but most companies require advanced orders of the desired vaccine. Thus, program administrators must be able to anticipate precise quantities of vaccine that will be needed for both patients and health care providers. Manufacturers begin to accept influenza vaccine orders in early March for the upcoming flu season. A representative from one large manufacturer of flu vaccine reported that during the spring of 2002, the company had stopped accepting orders by early April. For this reason, it is important to determine the extent of use of the previous year’s product at the end of the flu season and to anticipate needs for the coming year’s campaign.

The first shipment of influenza vaccine is sent in September; generally, this delivery constitutes about 50% of the total order for the institution. The second shipment, which makes up an additional 25% of the total order, arrives in mid to late October, and the final shipment is sent in early November. Because there have been several shortages of influenza vaccine in recent years, it is important to note that underestimating the need for vaccine can result in inadequate supplies and a lack of opportunities to restock.
Pneumococcal Polysaccharide Vaccine

Streptococcus pneumoniae (pneumococcus) infection is the leading cause of death among vaccine-preventable bacterial diseases in the U.S. Those who are at most risk for contracting pneumococcal invasive disease are children younger than two years of age, adults older than 65 years of age, and patients with chronic medical disorders (e.g., diabetes, cardiovascular, liver, kidney, lung, or immune system disease).

Pneumococcus is the most commonly identified pathogen in elderly patients with pneumonia. For example, the incidence of pneumococcal bacteremia in renal transplant recipients is nearly double that of the general population. Each year, pneumococcal disease causes approximately 500,000 cases of pneumonia in the U.S., with 10% to 25% of cases resulting in bacteremia. An alarming 30% to 40% of pneumococcal bacteremia cases in the elderly result in death. According to the ACIP, approximately half of these deaths have the potential to be prevented through the use of vaccine.

A study of the cost-effectiveness of the pneumococcal vaccine estimated that for people aged 65 years and older, vaccination resulted in net medical cost savings of $8.27 and in a gain of 1.21 quality-adjusted days of life per person vaccinated. In the authors’ cost-effectiveness model, 23 million elderly people who remained unvaccinated in 1993 would have gained about 78,000 years of healthy life and would have saved $194 million if they had received the vaccine. This demonstrates the importance of an effective pneumococcus vaccine campaign targeted at adults over age 65.

Two vaccines are currently used to protect patients from invasive pneumococcal disease:

- **PPV-23**, a 23-valent pneumococcal polysaccharide vaccine. PPV-23 contains 23 antigens from bacterial capsular protein types and represents at least 90% of the serotypes that cause invasive pneumococcal infections among children and adults in the U.S. PPV-23 is used to immunize adults and children over two years of age against pneumococcal disease.

- **PCV-7**, a 7-valent pneumococcal conjugate vaccine. PCV-7 is designed to enhance immunogenicity in children younger than two years of age. The capsular proteins represented in this vaccine protect against the serotypes that are most likely to cause invasive pneumococcal disease in children younger than age two years. PCV-7 is not recommended for older adults.

The effectiveness of PPV-23 against invasive pneumococcal disease has been assessed in several case-control studies. PPV-23 has been found to be 56% to 81% effective; in these studies, patients older than age 65 tended to demonstrate higher effectiveness rates than younger patients did, probably because of an increase in the prevalence of invasive pneumococcal disease in the elderly population. In 80% of healthy young adults, the PPV-23 vaccine creates a two-fold rise in antigen-specific titers. However, this immunological effect can vary for different serotypes that are represented in the vaccine. In addition, the optimal antibody response that correlates with protection against pneumococcal invasive disease has not been clearly defined. Thus, pneumococcal titers may not predict protection against invasive disease.

Although pneumococcal antibody concentrations persist for five years in healthy adults before these levels decline, older adults and patients with certain chronic health problems experience a rapid decline, with prevaccination levels observed after five to 10 years. Other groups of patients who have experienced rapidly declining levels of antibodies include those who have undergone a splenectomy following trauma and patients with hematological disorders.

The ACIP recommends PPV-23 for the following groups of elderly people:

- adults aged 65 years or older, with all persons in this category to receive the pneumococcal vaccine, including previously unvaccinated persons
- adults who have not been vaccinated within five years (and who were younger than 65 years of age at the time of vaccination)
- all adults whose vaccination status is unknown (one dose of vaccine recommended)
- adults with chronic health problems such as diabetes, cardiovascular disease, functional or anatomic asplenia, and lung disease
- immunocompromised patients of any age

Clinicians must carefully assess patients’ vaccination histories so that they can determine who should receive the pneumococcal vaccine. The ACIP has developed an algorithm (Figure 1) to assist clinicians in determining pneumococcal vaccine candidates among the elderly.

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**Figure 1** Algorithm for determining who should receive pneumococcal vaccine in persons aged 65 or older. (From Prevention of pneumococcal disease: Recommendations of the Advisory Committee on Immunization Practices [ACIP]. *Morb Mortal Wkly Rep* 1997;46[RR-8].)
PPV-23 can be administered via the subcutaneous (SQ) or the intramuscular (IM) route as a single 0.5-ml dose. Especially important for elderly adults, PPV-23, influenza vaccine, and diphtheria/tetanus toxoid can be administered simultaneously without any decrease in efficacy. This strategy can help to prevent a missed opportunity to administer other vaccines that the patient needs.

Tetanus Toxoid

Although tetanus is rare in the U.S., it is associated with high mortality rates. Tetanus infections occur primarily after a cut or a penetrating injury in people who have not been properly immunized. In the U.S., tetanus is primarily a disease of older adults. In surveillance data on 99 patients with tetanus, 68% were 50 years of age or older.40,41 Serosurveys show that many American adults lack the protective antibody to tetanus. A study published in 2002 noted that only 60% of Americans six years of age or older had fully protective levels of diphtheria antibody and that 72% had protective levels of the tetanus antibody.11 As the age of the group increased, the percentage of people with protective antibodies declined. Among those 70 years of age and older, only 29.5% had protective antibodies against diphtheria and 31.0% had protection against tetanus. These results agree with those of older studies showing older adults to be largely unprotected from tetanus and diphtheria.42,43

Another barrier to adequate immunity among the elderly is the fact that 81% of patients with tetanus who visited a health care provider for treatment did not receive prophylaxis, as recommended by ACIP guidelines.40 Tetanus toxoid is available in combination with diphtheria toxoid and acellular pertussis vaccine (DTaP), in combination with diphtheria toxoid only (Td, TD) or as tetanus toxoid (TT) alone. DTaP is used primarily to immunize children. The vaccine provides active immunity against all three represented antigens.

The dose of diphtheria toxoid that is contained in both DTaP and TD is greater than that contained in Td. This larger dose is intended to elicit a primary immune response in recipients who have not previously completed a series of diphtheria immunizations (e.g., children receiving their first series of immunizations). Tetanus toxoid should be used only for patients who cannot tolerate diphtheria toxoid. All other adults should receive Td as a booster when needed.

The ACIP has issued the following recommendations for tetanus and diphtheria immunization in adults:40

- Adults with an uncertain history of a complete primary vaccination series should receive a primary series using the combined Td toxoid.
- Booster doses of Td should be given every 10 years.

Patients who sustain injuries should be assessed for a history of tetanus immunization. Although tetanus rarely occurs in people who have documentation of having received a primary series of toxoid injections, some patients may need a booster dose of Td to ensure proper immunity to tetanus. The ACIP has issued the following guidelines for immunization of patients who have sustained a wound:

- Patients with an unknown or an uncertain history of previous vaccination should be considered as having received no previous tetanus toxoid doses.
- Patients who have received a primary immunization series for tetanus need only a booster dose every 10 years if they have sustained a minor and uncontaminated wound.
- For patients who have sustained any other type of wound, a booster injection is appropriate if no tetanus toxoid has been administered within the preceding five years.

Some patients may experience adverse reactions following a tetanus injection. Many health care providers have misconceptions about these reactions and consider these events as contraindications to further immunization against tetanus, and some health care providers inappropriately consider certain conditions or circumstances as primary contraindications to DTaP vaccination. The following situations should not preclude the administration of tetanus and diphtheria toxoids:

- soreness, redness, or swelling at the DTaP vaccination site
- a fever below 40.5°C (105°F)
- mild, acute illness with low-grade fever or mild diarrhea that is affecting an otherwise healthy child
- current antimicrobial therapy
- the convalescent phase of an acute illness
- recent exposure of the patient to an infectious disease
- premature birth (the appropriate age for initiating vaccination among prematurely born infants is the usual chronological age from birth using full doses of vaccine—0.5 ml)
- a history of allergies or having relatives with allergies
- a family history of convulsions
- a family history of sudden infant death syndrome (SIDS)
- a family history of an adverse event following a DTaP vaccination

Patients should not receive further immunization with Td if they have a history of a neurological or severe hypersensitivity reaction following a previous dose. Intradermal skin testing should be considered for patients thought to have a hypersensitivity reaction to tetanus toxoid.45

In one study, most patients with a reported hypersensitivity reaction to tetanus toxoid had a negative skin test. For patients who have true contraindications to tetanus immunization, tetanus immune globulin can be considered for treatment of wounds that are neither clean nor minor. In patients requiring passive immunity because of an incomplete immunization history, separate syringes and separate injection sites can be used to administer tetanus toxoid at the same visit.

Other Vaccines

Several other vaccines are important, particularly those designed to protect against measles-mumps-rubella (MMR), varicella, and hepatitis B. Patients who were born before 1957 are considered immune to MMR and varicella if they had these diseases in childhood. Hepatitis B vaccine can be considered in adults over age 63, especially health care workers and sexually active homosexual men.13 Routine use of hepatitis B vaccine is not warranted in other elderly populations.
**STRATEGIES FOR INCREASING VACCINATION RATES**

Increasing immunity to disease among adults is best achieved by improving vaccination rates in this population. A number of strategies have been developed to accomplish this goal, such as standing orders, computerized record reminders, chart reminders, performance feedback, home visits, mailed or telephoned reminders, expanding access in clinical settings, patient education, and personal health records. Improving vaccination rates begins with seizing each opportunity to access a patient’s vaccination history and with vaccinating patients when immunization is recommended. Several practices can help to identify patients who need immunization.

**Standing Orders**

Vaccine standing orders are a set of orders that can be executed by nurses or pharmacists without a physician’s signature. These orders can be developed as physician-approved protocols in outpatient or institutional settings. Implementing a standing-order program has been shown to increase the rate of pneumococcal vaccinations in hospital settings. One hospital-based study showed an increase in the immunization rate from 0 to 78%.

The success of standing orders has been observed in both long-term care facilities and in outpatient clinic settings when pharmacists and nurses execute the orders. Pharmacists often have excellent opportunities to identify and to vaccinate elderly patients. Many older patients suffer from chronic disease and must visit a pharmacy at regular intervals for medications. These visits provide multiple opportunities to update immunization histories and to immunize patients as necessary. Although legal barriers in many states prevent pharmacists from administering vaccine, some states, including Washington and Mississippi, allow pharmacists to vaccinate patients at pharmacies.

The ACIP recommends that procedures be developed to address the following goals:

- identifying persons eligible for vaccination based on (1) their age, (2) their vaccination status (e.g., persons not previously vaccinated or those recommended for vaccination according to the schedule), or (3) the presence of a medical condition that puts them at high risk
- informing patients or their guardians about the risks and benefits of a vaccine and documenting the delivery of this information
- recording patient refusals or medical contraindications
- recording administration of a vaccine and any post-vaccination adverse events according to an institution-approved or a physician-approved protocol
- providing documentation of vaccine administration to patients and their primary care providers

The NCAI recommends that standing-order programs include a standard personal and institutional immunization record to verify the immunization status of patients and staff members. The orders can be constructed to meet the age-specific needs of patients seen in clinics or hospitals. With this documentation placed in the permanent medical record, it is readily retrievable when needed.

For pharmacist-administered vaccinations, the pharmacy computer system may be utilized to track and document immunizations. In order for hospitals, long-term care facilities, and home health agencies to be paid by Medicare or Medicaid for services provided, they must meet specific standards of practice, known as federal Conditions of Participation (COPs). However, no dual standard of care may exist such that patients with other payers would be cared for differently.

Until recently, a practitioner’s order was required for all immunizations to comply with COP standards. This requirement, however, can be met only if practitioners remember to order immunizations for patients who need them. Standing-order programs are designed to automatically order assessments and treatments without requiring a practitioner’s order. COP standards had not allowed such standing-order programs to function independently from practitioner orders. Ironically, standards created to improve care actually hindered immunization campaigns.

In October 2002, the DHHS changed the COPs for hospitals participating in Medicare and Medicaid. The new rules state the following:

All orders for drugs and biologicals must be in writing and signed by the practitioner or practitioners responsible for the care of the patient as specified under § 482.12(c) with the exception of influenza and pneumococcal polysaccharide vaccines, which may be administered per physician-approved hospital policy after an assessment for contraindications.

**Reminders**

Reminders, another successful method of improving immunization rates, can take several forms; technology systems can be used, or clinicians can simply place reminder notes in paper medical charts. These reminders may be targeted at health care providers or patients. Strategies for reminding health care providers include written notes in medical charts and computer messages that emphasize the need to immunize. Reminders for patients include telephone messages, mailed letters or postcards, and home visits. With many pharmacies already using such computers for prescription records and patient information, it is possible that this system might provide monthly reminders to patients to be immunized during influenza season or to seek a pneumococcal vaccination.

As computerized medical charts become more widespread, automated yearly reminder notes may become more common in clinic and hospital settings. Computerized reminders are less subject to human error and offer an advantage over paper and handwritten reminders.

**Patient Education**

Education programs have been implemented in both clinical settings and community-based programs (e.g., in printed materials and advertising campaigns). One evidence-based review of the medical literature found insufficient verification that these programs were effective at increasing vaccination rates.
Adult Vaccination Programs

rates. The authors cited small sample sizes and an inability to isolate interventions as the cause.

Increasing access to vaccinations can also improve the vaccine-preventable diseases. In fact, serosurveys and surveillance reports of vaccine-preventable diseases (i.e., influenza, invasive pneumococcal disease, and tetanus) show that older Americans are the group least protected from these illnesses. Patients remain at risk largely because of inadequate efforts to ensure appropriate immunization in this population.

Clinicians can improve vaccination rates by seizing on opportunities to assess their patients’ immunization histories and to vaccinate those patients who are at risk for infection. Standing orders and physician-approved protocols are effective means of increasing immunity in older populations. Vaccination campaigns provide an opportunity for pharmacists to partner with physicians to reach patients who might not visit a physician’s office. These initiatives are cost-effective measures that can improve immunity in the vulnerable elderly population.

Similar programs in hospitals and long-term care facilities have been successful.

Pharmacy information systems can play a crucial role in identifying and tracking people who are scheduled for immunizations. These systems can aid in pharmacist-administered vaccine programs by reminding patients to obtain vaccines each year. Pharmacists, physicians, nurses, health care organizations, and public health agencies need to collaborate to improve immunization rates in the community.

REFERENCES


