While the majority of cases of serious illness and death from influenza occur primarily in high-risk persons (those older than 65, children younger than 2 years of age, and persons of any age who have underlying medical conditions that put them at increased risk), influenza can affect all age groups. In any given influenza season, researchers estimate that between 5% and 20% of the population will become ill from influenza. Because high concentrations of persons at increased risk for complications from the disease are found in health care settings, immunization of health care personnel is an effective means of preventing transmission to such persons in these settings. This chapter examines the effectiveness of the vaccine in reducing the transmission of influenza among HCP, timing considerations, similarities and differences between the vaccines, and vaccine supply issues.

**Vaccine Effectiveness, Decreasing Transmission of Illness**

Studies of vaccine efficacy (the prevention of illness among persons immunized in clinical trials) and effectiveness (the prevention of illness in immunized populations) have used different outcomes, which influences the way results are interpreted. Studies providing specific outcomes, such as laboratory-confirmed tests for the influenza virus, can provide better estimates of the impact of influenza vaccine in preventing disease than studies with nonspecific outcomes (such as influenza-like illness that may include illnesses not caused by influenza). According to the Centers for Disease Control and Prevention (CDC), in the years when circulating influenza viruses and the vaccine are well matched, the vaccine can be expected to reduce laboratory-confirmed influenza by as much as 70% to 90% in healthy adults who are younger than age 65. A number of studies have also found reductions in febrile illness, absenteeism due to influenza, use of antibiotics, and visits to physicians’ offices. Examples of such studies include the following:

- Jefferson et al. reviewed 38 studies, evaluating the effects of the vaccine (efficacy, effectiveness, and harm) against influenza in healthy adults. They concluded that the vaccine was 80% effective in reducing the number of cases of influenza, particularly when the vaccine strains were well matched to strains of influenza in circulation. Even
when the vaccine was not well matched, they found that the vaccine’s effectiveness was 50% overall.4

Nichol et al. evaluated the effectiveness of the intranasally administered live, attenuated influenza vaccine (LAIV) in healthy adults during the 1997–1998 influenza season, a year in which the vaccine was not well matched with the predominant circulating strain. These researchers found that the vaccine reduced the incidence of self-reported flu symptoms during peak outbreak periods, presumably due to the crossover protection against the variant strain. They also found decreased absenteeism and reduced use of health care resources, antibiotics, and over-the-counter medications.5

Wang et al. evaluated the effectiveness of the LAIV and the trivalent inactivated influenza vaccine (TIV) in more than 1 million military service members between the ages of 17 and 49 in three consecutive influenza seasons, beginning with the 2004–2005 season. They found that immunization with TIV was associated with a significantly lower incidence of clinical visits for influenza and pneumonia during each of the three influenza seasons. They concluded that, in highly immunized adult populations, TIV may be more effective than LAIV in preventing influenza and pneumonia morbidity, while LAIV may be better suited for those with no prior influenza vaccination, such as military recruits.6

Wilde et al. serologically identified influenza infection and collected self-reported symptoms of respiratory and febrile illness from more than 200 HCP during a three-year period. The researchers found the vaccine to be 88% effective in preventing influenza A and 89% effective in preventing influenza B; only 1.7% of those who received the vaccine developed influenza. Among those who were not vaccinated, 13.9% developed influenza.7

Bridges et al. found that vaccinating healthy adults younger than age 65 against influenza reduced rates of influenza-like illness and a 44% lower mortality rate in this elderly population. Vaccination of patients did not have any significant effects on the mortality rate.9

Carman et al. found that influenza vaccination of long term care HCP was associated with a significant decrease in mortality among patients.10

Hayward et al. studied the impact of influenza vaccinations among long term care HCP on influenza illness in residents of the facilities. They found that the vaccinations prevented influenza-related deaths and also reduced use of health services and influenza-like illness among residents.11

Salgado et al. found that an increase in the number of HCP receiving the influenza vaccination resulted in a significant drop in the number of laboratory-confirmed influenza cases among HCP and fewer cases of health care–associated influenza among hospitalized patients.12

**Timing of Vaccination: When to Begin and How Long to Continue**

The goal of HCP immunization programs is to administer the influenza vaccine to as many HCP as possible, preferably before influenza activity in the community begins. Precisely timing the beginning of an influenza season is difficult because influenza seasons vary in both onset and duration and because more than one outbreak can occur in a community in a given season.1 Seasonal influenza activity in the United States has begun as early as October, but, more typically, it doesn’t peak until January or later (and the peak often corresponds to the midpoint of influenza activity for the season).1 In fact, in more than 80% of the influenza seasons since 1976, the peak has occurred no earlier than January; in more than 60%, the peak was February or later (see Figure 1-1, page 3).1

According to the CDC, health care providers should begin offering vaccinations soon after the vaccine becomes available and, if possible, by October. But because the start and duration of the influenza season are so variable across communities, the CDC recommends continuing to offer the vaccine in December and throughout the influenza season, as long as vaccine supplies last.1,13
Adults develop peak antibody protection against influenza two weeks after receiving the vaccine. The CDC recommends that persons or health care organizations planning immunization campaigns should consider scheduling them after mid-October, as the availability of vaccine in any given location cannot be guaranteed in the early fall.

Each year since 2006, the CDC has sponsored a “National Influenza Vaccination Week” (NIVW) to help raise awareness about the seriousness of influenza and the importance of annual influenza vaccination throughout the entire influenza season. The CDC has partnered with the United States Department of Health and Human Services, the National Influenza Vaccine Summit, and others in support of ongoing seasonal influenza immunization efforts. During NIVW these organizations sponsor podcasts, “Health-e-Cards,” and other electronic health-related activities. For example, the e-card system allows one to send a personalized message along with the CDC message to either individual HCP or to groups. The e-card system and other free promotional materials are available at http://www.cdc.gov/flu/nivw/help.htm.

The Vaccines: Similarities and Differences

Both the intranasal LAIV and the intramuscular TIV are directed at two specific influenza A viruses and one specific influenza B virus. Each year, one or more virus strains in the vaccine may be changed, based on global influenza virus surveillance.

Both TIV and LAIV are available in the United States, and both are effective in preventing influenza in vaccinated individuals. The major differences include the following:
TIV contains killed viruses and therefore cannot cause influenza; LAIV contains live, attenuated viruses that can potentially cause mild signs or symptoms such as runny nose, fever, sore throat, and nasal congestion. This vaccine, however, cannot cause influenza infection in the lower respiratory tract.

TIV is administered by injection intramuscularly; LAIV is administered by an intranasal spray.

TIV is licensed for use by persons 6 months of age or older, including healthy individuals and those with chronic medical conditions; LAIV is licensed for use by healthy nonpregnant individuals between 2 and 49 years of age. The effectiveness of LAIV has not been established for those who have underlying medical conditions associated with a higher risk of complications from influenza.

In a study by Belshe et al., LAIV was shown to be more protective in preventing culture-confirmed influenza than TIV in children 6 to 59 months of age and to be safe for use in children without a history of wheezing or asthma.16

Table 1-1 on page 5 compares the two types of vaccines.

**Vaccine Supply Considerations**

Table 1-2, page 6, lists the influenza vaccine manufacturers for the 2008–2009 influenza season.

Because the influenza viruses change over time as a result of antigenic drift, the vaccines must be updated annually to include the strains most likely to be in circulation in the upcoming season. Manufacturers of the vaccines are under a tight production time line to produce, test, release, and distribute the vaccines. Because problems encountered in any phase of vaccine production can result in shortages or delays in getting the vaccine to the public, the annual supply and timing of vaccine distribution cannot be guaranteed in any given year.1


In response to the 2004–2005 vaccine shortage, uncertainties about the number of doses that would be available, and the timing of vaccine distribution, the CDC issued recommendations for prioritizing available TIV in high-risk populations in 2004.18 In 2005 the CDC updated its recommendations,17,19 identifying priority high-risk groups who should preferentially receive the vaccine in the initial weeks of the influenza season until the TIV supply is stabilized. Groups who should be given priority include HCP who provide direct patient care (For a list of the 2008 CDC recommendations about prioritizing the vaccination of individuals at high risk for medical complications, see Text Box 1-1 on page 7). LAIV is recommended only for use in healthy nonpregnant individuals ages 2 to 49, therefore the CDC recommends use of LAIV only for such persons when feasible and when TIV is in short supply,19 and it makes no recommendations about prioritization. More information about the dynamics of influenza vaccine supply and demand is available on the Prevent Influenza Now! Web site: http://www.preventinfluenza.org/profs_production.asp.

The CDC recommendations for allocating vaccine during vaccine shortages do not apply uniformly to all HCP.17 This issue was addressed by the Society for Healthcare Epidemiology of America (SHEA) in its 2005 position paper on influenza vaccination of HCP.20 In this paper, Talbot et al. summarize the many factors that need to be considered by health care organizations when vaccine supply is limited. The authors considered the range of issues that may affect decisions about vaccine allocation when vaccine is in short supply, noting that any allocation strategy must be both practical and transparent to HCP. Key factors to take into consideration when making decisions about allocation strategies include the following20:

- Prioritizing the vaccination of HCP by the nature, degree, and duration of their contact with patients. Those in close, prolonged, and repeated contact with patients are at greatest risk of exposure to and transmission of influenza. Providing the vaccine to these HCP could maximize the impact of a limited supply of vaccine.

- Providing vaccine to HCP who have the most intense and frequent contact with high-risk patients, such as the elderly or those with underlying medical conditions (CDC 2008). (See the CDC recommendations in Text Box 1-1 on page 7.)

- Considering which HCP provide essential services, without which the functioning of the health care facility would be jeopardized.
### Table 1-1. Live, Attenuated Influenza Vaccine (LAIV) Compared with Trivalent Inactivated Influenza Vaccine (TIV) for Seasonal Influenza, United States Formulations

<table>
<thead>
<tr>
<th>Factor</th>
<th>LAIV</th>
<th>TIV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route of administration</td>
<td>Intranasal spray</td>
<td>Intramuscular injection</td>
</tr>
<tr>
<td>Type of vaccine</td>
<td>Live-attenuated virus</td>
<td>Killed virus</td>
</tr>
<tr>
<td>Number of included virus strains</td>
<td>Three (two influenza A, one influenza B)</td>
<td>Three (two influenza A, one influenza B)</td>
</tr>
<tr>
<td>Vaccine virus strains updated</td>
<td>Annually</td>
<td>Annually</td>
</tr>
<tr>
<td>Frequency of administration</td>
<td>Annually*</td>
<td>Annually*</td>
</tr>
<tr>
<td>Approved age</td>
<td>Persons aged 2–49 yrs†</td>
<td>Persons aged ≥ 6 months</td>
</tr>
<tr>
<td>Interval between 2 doses recommended for children aged ≥ 6 months–8 years who are receiving influenza vaccine for the first time</td>
<td>4 weeks</td>
<td>4 weeks</td>
</tr>
<tr>
<td>Can be administered to persons with medical risk factors for influenza-related complications†</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Can be administered to children with asthma or children aged 2–4 years with wheezing during the preceding year‡</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Can be administered to family members or close contacts of immunosuppressed persons not requiring a protected environment</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Can be administered to family members or close contacts of immunosuppressed persons requiring a protected environment (e.g., hematopoietic stem cell transplant recipient)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Can be administered to family members or close contacts of persons at high risk but not severely immunosuppressed</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Can be simultaneously administered with other vaccines</td>
<td>Yes§‡</td>
<td>Yes**</td>
</tr>
<tr>
<td>If not simultaneously administered, can be administered within 4 weeks of another live vaccine</td>
<td>Prudent to space 4 weeks apart</td>
<td>Yes</td>
</tr>
<tr>
<td>If not simultaneously administered, can be administered within 4 weeks of an inactivated vaccine</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* Children aged 6 months–8 years who have never received influenza vaccine before should receive 2 doses. Those who only receive 1 dose in their first year of vaccination should receive 2 doses in the following year, spaced 4 weeks apart.

† Persons at high risk for complications of influenza infection because of underlying medical conditions should not receive LAIV. Persons at higher risk for complications of influenza infection include adults and children with chronic disorders of the pulmonary or cardiovascular systems; adults and children with chronic metabolic diseases (including diabetes mellitus), renal dysfunction, hemoglobinopathies, or immunosuppression; children and adolescents receiving long-term aspirin therapy (at risk for developing Reye syndrome after wild-type influenza infection); persons who have any condition (e.g., cognitive dysfunction, spinal cord injuries, seizure disorders, or other neuromuscular disorders) that can compromise respiratory function or the handling of respiratory secretions or that can increase the risk for aspiration; pregnant women; and residents of nursing homes and other chronic-care facilities that house persons with chronic medical conditions.

‡ Clinicians and vaccination programs should screen for possible reactive airways diseases when considering use of LAIV for children aged 2–4 years, and should avoid use of this vaccine in children with asthma or a recent wheezing episode. Health-care providers should consult the medical record, when available, to identify children aged 2–4 years with asthma or recurrent wheezing that might indicate asthma. In addition, to identify children who might be at greater risk for asthma and possibly at increased risk for wheezing after receiving LAIV, parents or caregivers of children aged 2–4 years should be asked: “In the past 12 months, has a health-care provider ever told you that your child had wheezing or asthma?” Children whose parents or caregivers answer “yes” to this question and children who have asthma or who had a wheezing episode noted in the medical record during the preceding 12 months, should not receive FluMist.

§ Live attenuated influenza vaccine coadministration has been evaluated systematically only among children aged 12–15 months who received measles, mumps and rubella vaccine or varicella vaccine.

** Inactivated influenza vaccine coadministration has been evaluated systematically only among adults who received pneumococcal polysaccharide or zoster vaccine.

Identifying HCP who work in high-patient-traffic areas, such as units with high occupancy and rapid patient turnover. HCP in these areas are likely to be at increased risk for exposure to patients not yet identified as being ill with influenza, which could result in subsequent HCP transmission to a larger number of patients.

Identifying where influenza patients are initially seen before droplet precautions can be implemented. HCP working in emergency departments or walk-in clinics, or who are emergency first responders, could be in this category.

Using LAIV instead of TIV in eligible HCP, such as healthy, nonpregnant HCP younger than age 49. Although this vaccine has been modified into a non-virulent strain that cannot cause influenza disease, Talbot et al. note that the CDC advises HCP who have received this vaccine to avoid contact with severely immunocompromised patients requiring care in a protective environment (for example, a bone marrow transplant unit) for seven days following its administration due to a theoretical risk of transmission of live vaccine virus.

Using nonvaccine and nonpharmaceutical measures to prevent influenza among HCP, patients, and visitors (for example, proper hand hygiene, adherence to respiratory hygiene and cough etiquette, screening and exclusion of visitors who are ill, sick leave for HCP with febrile respiratory symptoms)

Consider using antiviral therapies for HCP at risk for influenza

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### Table 1-2. Influenza Vaccines for the 2008–2009 Influenza Vaccination Season

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Product</th>
<th>Formulation</th>
<th>Age Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSL Biotherapies</td>
<td>Afluria®</td>
<td>5.0 mL vial (10 doses)</td>
<td>18 years and older</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5 mL single-dose syringe</td>
<td></td>
</tr>
<tr>
<td>GlaxoSmithKline (GSK)</td>
<td>Fluarix™</td>
<td>0.5 mL prefilled syringe (single dose)</td>
<td>18 years and older</td>
</tr>
<tr>
<td>GlaxoSmithKline (GSK)</td>
<td>FluLaval™</td>
<td>5.0 mL vial (10 doses)</td>
<td>18 years and older</td>
</tr>
<tr>
<td>MedImmune</td>
<td>FluMist™</td>
<td>0.2 mL prefilled single-use sprayer (10-dose pack)</td>
<td>2 through 49 years</td>
</tr>
<tr>
<td>Novartis Vaccines</td>
<td>FluVirin™</td>
<td>0.5 mL single-dose syringe</td>
<td>4 years and older</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.0 mL vial (10 doses)</td>
<td></td>
</tr>
<tr>
<td>sanofi pasteur</td>
<td>FluZone®</td>
<td>5.0 mL vial (10 doses)</td>
<td>6 months and older</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5 mL single-dose syringe</td>
<td>36 months and older</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5 mL single-dose vial</td>
<td>36 months and older</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.25 mL single-dose syringe</td>
<td>6–35 months</td>
</tr>
</tbody>
</table>

Encouraging HCP who are not in an organization’s priority group but who are in a high-risk group, as identified by the CDC, to receive the vaccine from their own health care provider or health department.

Using vaccination strategies that can be adapted to the unique needs and services of the health care facility. Bringing together a multidisciplinary advisory board, including leaders in key areas such as infectious diseases, infection prevention, occupational health, pharmacy, ethics, and so on, may help the organization identify its high-risk areas and populations and develop a vaccine allocation plan.

Based on these key considerations, the SHEA position paper proposed a tiered approach to the distribution of vaccine to HCP in the event of an inadequate vaccine supply:

1A: HCP who are in close, prolonged, and repeated contact with high-risk patients in high-risk units
1B: HCP who are in close but not prolonged or repeated contact with high-risk patients
1C: HCP who work in high patient-traffic units or who perform essential patient care functions
2: HCP who have contact with patients who are not at high risk
3: All other HCP

HCP in all tier 1 levels should be considered equal except during times of severe vaccine shortages.

The Influenza Vaccine Availability Tracking System (IVATS) was created by the National Influenza Vaccine Summit, which is cosponsored by the CDC and the American Medical Association. The IVATS system was developed to address difficulties that immunization program managers may experience when trying to determine which distributors or manufacturers have influenza vaccine in stock. IVATS links HCP seeking vaccine with wholesale distributors or manufacturers who have supplies of the vaccine in stock for sale or available to order. The information on IVATS is provided by the distributors or manufacturers on a voluntary basis and is updated throughout the influenza season. This system can be particularly helpful in times when supply is limited. It is also useful for health care organizations that want to continue vaccinating their HCP over the course of an entire influenza season and want to maintain access to available supplies of vaccine. IVATS provides a

Text Box 1-1. 
Persons at Risk for Medical Complications

Vaccination to prevent influenza is particularly important for those who are at increased risk for severe complications from influenza or who are at increased risk for influenza-associated clinic, emergency department, or hospital visits:

- All children 6 months to 4 years (59 months) of age
- All persons 50 and older
- Children and adolescents (6 months to 18 years of age) who are receiving long-term aspirin therapy and who might be at risk for experiencing Reye syndrome after influenza virus infection
- Women who will be pregnant during the influenza season
- Adults and children who have chronic disorders of the pulmonary (including asthma), cardiovascular (except hypertension), renal, hepatic, hematological, or metabolic (including diabetes mellitus) systems
- Adults and children who are immunosuppressed (including immunosuppression caused by medications, HIV, or other conditions)
- Adults and children who have any condition (such as cognitive dysfunction, spinal cord injuries, seizure disorders, or other neuromuscular disorders) that can compromise respiratory function, impede the clearing of respiratory secretions, or increase the risk for aspiration
- Residents of long term care and other chronic-care facilities

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downloadable Microsoft Excel spreadsheet that contains the following information:

- The names of wholesale distributors or manufacturers that have supplies of the vaccine in stock for sale and to order
- Brands and formulations in stock for sale and to order
- How to order vaccine by telephone, e-mail, the Internet, or fax
- Projected dates of availability for vaccine being ordered

For more information about IVATS, go to http://www.preventinfluenza.org/ivats/.

Summary

This chapter examines vaccine effectiveness and factors that contribute to it, including vaccine availability, type, and supply; the timing of vaccination; and anticipation and management of shortages of vaccine, particularly when planning for the immunization of HCP. It also offers recommendations for the identification of HCP and patients most at risk for transmission of influenza. Chapter 2 explores immunization rates among HCP and considers research findings about practices designed to improve these rates.

References

CHAPTER 1: Vaccine Administration Considerations


