ABSTRACT
Seasonal influenza is a significant cause of morbidity and mortality, measured in terms of illness, loss of days from school or work, hospitalizations, and death. The best means to limit that impact is prevention through vaccination, the use of non-pharmacological interventions, and, in some settings, the use of prophylactic treatment with antiviral medications. Healthcare workers (HCWs) with influenza that is symptomatic or asymptomatic can become a vector for transmission of infection to others, yet vaccine acceptance nationwide among HCWs is only 42%, thus efforts to prevent nosocomial transmission of seasonal influenza in hospitals are essential. Antivirals, including oseltamivir and zanamivir, are both effective in preventing influenza infection and in reducing the duration of symptoms and secondary disease transmission in families when administered within 48 hours of symptom onset. During the “Spanish Flu” pandemic of 1918 to 1919, as many as 500,000 individuals in the United States became infected, and between 50 and 100 million individuals died worldwide. Most of the 322 reported cases of H5N1 influenza, an influenza subtype currently circulating among birds and occasionally people, have been teenagers or young adults. If H5N1 influenza mutates so that it is easily spread from person to person, and if it drives a pandemic that is the equivalent of the 1918 pandemic in terms of morbidity and mortality, meeting the needs of pandemic influenza patients in the United States would require twice the numbers of hospital beds and ventilators, and nearly 5 times the intensive care unit capacity, than are currently available. Guidelines for pandemic planning describe the components of a comprehensive plan to manage influenza, should a pandemic develop. (Adv Stud Nurs. 2007;5(2):43-61)

SEASONAL INFLUENZA: EPIDEMIOLOGY AND CLINICAL PRESENTATION
Influenza is a respiratory illness that may lead to serious complications or death. The highest illness rates occur among school-age children, but approximately 20% of all adults are also affected (Figure 1). The clinical presentation of influenza differs by age (Figure 2). Adults and adolescents are most likely to present with fever, chills, cough, headache, sore throat, and myalgia. Common physical signs of influenza infection include fever, flushed face, hyperemic mucous membranes, and nasal discharge. However, in children, influenza may present as gastrointestinal symptoms, such as nausea, vomiting, abdominal pain, and diarrhea. Elderly patients may initially have only cough or malaise.

THE IMPACT OF SEASONAL INFLUENZA
The impact of seasonal influenza can be measured...
on both an individual and institutional level. Individuals may feel the impact from mild illness, as the average adult loses 2.8 days of work due to influenza annually, and those that continue to work are less effective at their jobs. The personal impact is especially high if complications develop. For example, up to 45% of young children with influenza may develop otitis media. As many as 17% of adults and adolescents develop secondary bacterial infections that require treatment with antibiotics.

Influenza or its complications are reportable to public health authorities in most states in the United States. Data derived from laboratory-reported cases of influenza from individual health departments is concatenated by the Centers for Disease Control and Prevention (CDC) weekly from October through May during the influenza season (Figure 3). Although influenza peaks during the influenza season from November to March each year, the disease occurs year round.

The magnitude of the economic impact of seasonal influenza each year is huge (Figure 4). In particular, seasonal influenza leads to up to 500,000 hospitalizations, which last an average of 5 days, and for which hospitals typically recoup only 66% of their costs because influenza care is typically reimbursed by insurance companies at a lower rate than other diagnoses (Figure 5).

Determining whether a surge in hospitalizations is due to true influenza or other illnesses is difficult. There are approximately 226,000 hospitalizations due to pneumonia and influenza per year; a large proportion of these hospitalizations are in the elderly. Physician and emergency department visits tend to increase during the peak

---

**Figure 1. Influenza Virus Infection and Illness Rates: Houston Family Study, 1976–1984**

![Graph showing influenza infection rates by age group.](image)


---

**Figure 2. Symptoms of Clinical Influenza by Age Group**

<table>
<thead>
<tr>
<th>Sign/Symptom</th>
<th>Children</th>
<th>Adults</th>
<th>Elderly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cough (nonproductive)</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Fever</td>
<td>+++</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>Myalgia</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Headache</td>
<td>++</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Malaise</td>
<td>+</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>Sore throat</td>
<td>+</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Rhinitis/nasal congestion</td>
<td>++</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Abdominal pain/diarrhea</td>
<td>+</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>Nausea/vomiting</td>
<td>++</td>
<td>–</td>
<td>+</td>
</tr>
</tbody>
</table>

Children are more likely to present with gastrointestinal symptoms than are adults or the elderly.

+++ = most frequent sign/symptom; + = least frequent; – = not found.

Data from Cox and Subbarao; Monto et al.

---

**Figure 3. Influenza Cases Sent to the US/WHO Laboratory, 2006–2007**

![Graph showing influenza cases sent to the US/WHO Laboratory.](image)

Laboratory-confirmed influenza data collected during the entire year, including the peak influenza season, in the US, 2006–2007.

\* *n* = 179,268.

1As of August 6, 2007.

WHO = World Health Organization.

influenza season. Based on laboratory-confirmed influenza, during interim periods between influenza seasons, approximately 8.75% of all physician visits are due to respiratory complaints compared to 17.7% of all visits during peak influenza season. For every 100 cases of influenza in a community, ambulance and emergency room (ER) diversion increased by approximately 2.5 hours a week in an average ER.11

Figure 6 illustrates data from the New Vaccine Surveillance Network, which is a prospective laboratory-based surveillance network in Rochester, Cincinnati, and Nashville.13 Among children aged 5 years or younger, 50 visits per thousand children were attributable to laboratory-confirmed influenza during a mild season (2002–2003) compared to 95 visits per 1000 children during a severe season (2003–2004).13 The estimated number of outpatient visits due to influenza in this population per thousand children ranged from 357 to 711, with a similar pattern seen for emergency department visits. These data were primarily responsible for the broadening of national recommendations to vaccinate children up to 5 years of age.

The current Advisory Council for Immunization Practices (ACIP) recommendations are to prioritize providing influenza vaccine to 218 million people (72.7% of US population), including children 6 months to 59 months old, adults older than 50 years, high-risk individuals 5 years to 49 years of age, pregnant women, healthcare workers (HCWs)/caregivers, and household contacts of children younger than 5 years.14

Another way to measure the burden of influenza is from statistics about mortality from influenza or pneumonia. Seasonal influenza causes approximately 36 000 deaths in the United States annually.9 Influenza may exacerbate chronic respiratory and cardiovascular diseases, but death certificates (which are used to collate mortality statistics) ascribe the primary cause of death as the underlying illness, not influenza. Thus, the burden of influenza may be underestimated.

**Impact of Seasonal Influenza on the Workforce**

Absenteism is of particular concern in the healthcare field, as staff shortages may compromise patient care. Presenteeism, the opposite problem, occurs when individuals come to work even though they are sick. Individuals exposed to influenza virus experimentally shed virus within 24 hours of inoculation (Figure 7).15 Assuming this process occurs with naturally acquired influenza infections, HCWs with early, asymptomatic influenza may thus become a vector for transmission of infection to patients, visitors, and other staff. One study found that 76.6% of HCWs came to work with an influenza-like illness, and they worked a mean of 2.5 days while sick.16

Nosocomial outbreaks of influenza have been documented on general medical, organ transplant, oncology, and pediatric units, in neonatal intensive care units, and in long-term care facilities (LTCFs).17 The incidence of nosocomial influenza has been measured as 3 per 1000 admissions, but this rate may be an underestimate.18 As lengths of stay get shorter at hospitals, individuals may get exposed to influenza in the hospital but do not develop respiratory illness until

**Figure 4. Impact of Epidemic Influenza in the United States**

| Cases | 25–50* million cases |
| Days of illness | 100–200 million days |
| Work and school loss | Tens of millions |
| Hospitalizations | 85 000–550 000* |
| Deaths | 34 000–51 000† |
| Costs | Billions of dollars |

Epidemic influenza continues to have a huge annual impact.


Data from Thompson et al8; Thompson et al9; Adams et al10; Bridges et al.11

**Figure 5. Impact of Influenza: Costs of Seasonal Influenza**

| Average length of stay | 5.32 days |
| Average total hospital charges | $15 135 |
| Average total hospital cost | $6527 |
| Average total hospital reimbursed amount | $4332 |

Annual statistics for hospitalizations for seasonal influenza in the United States.

after discharge. Data from these cases are not captured as nosocomial infections.

These data highlight the importance of ensuring that the hospital workforce be vaccinated against the seasonal influenza each year to minimize both staff absenteeism and the risk of nosocomial spread from staff to patient. The ACIP recommends that all HCWs be vaccinated annually against influenza, yet vaccine acceptance nationwide among HCWs is only 42%. Hospitals should provide vaccination free of charge in-house and during all shifts to ensure uptake and minimize nosocomial infections. One 600-bed hospital provided influenza vaccinations to HCWs using a mobile cart, and vaccination rates increased from 4% in 1987 to 1988 to 67% in 1999 to 2000 ($P < .0001$). Proportions of nosocomial-acquired influenza cases among employees or patients both declined significantly ($P < .0001$). As of January 1, 2007, the Joint Commission on the Accreditation of Healthcare Organizations requires that hospitals offer influenza vaccinations to all HCWs who have close patient contact and report HCW vaccination rates as part of the accreditation process.

**Figure 6. Impact of Influenza: Outpatient and ED Visits for Fever and Acute Respiratory Infection and Influenza in Children**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% (95% CI)</td>
<td>No./1000 children (95% CI)</td>
<td>No./1000 children (95% CI)</td>
<td>No./1000 children (95% CI)</td>
</tr>
<tr>
<td><strong>Outpatient Clinics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–5 mo</td>
<td>4.6 (0.1–15.5)</td>
<td>9.7 (4.0–19.0)</td>
<td>611 (428–794)</td>
<td>28 (7–111)</td>
</tr>
<tr>
<td>6–23 mo</td>
<td>7.3 (4.0–11.9)</td>
<td>17.5 (12.8–23.1)</td>
<td>711 (555–869)</td>
<td>52 (30–90)</td>
</tr>
<tr>
<td>24–59 mo</td>
<td>14.9 (10.0–21.1)</td>
<td>24.8 (19.0–31.2)</td>
<td>357 (277–437)</td>
<td>53 (35–81)</td>
</tr>
<tr>
<td>0–59 mo</td>
<td>10.2 (7.5–13.6)</td>
<td>19.4 (16.0–23.1)</td>
<td>489 (387–591)</td>
<td>50 (35–71)</td>
</tr>
<tr>
<td><strong>Emergency departments</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–5 mo</td>
<td>0.0 (0–4.1)</td>
<td>18.2 (11.8–26.2)</td>
<td>127 (95–159)</td>
<td>0</td>
</tr>
<tr>
<td>6–23 mo</td>
<td>5.5 (2.6–10.2)</td>
<td>26.2 (20.9–32.1)</td>
<td>150 (127–173)</td>
<td>8 (4–16)</td>
</tr>
<tr>
<td>24–59 mo</td>
<td>11.4 (6.0–19.1)</td>
<td>39.0 (32.0–46.4)</td>
<td>60 (49–71)</td>
<td>7 (4–12)</td>
</tr>
<tr>
<td>0–59 mo</td>
<td>5.9 (3.7–8.9)</td>
<td>28.8 (25.0–32.7)</td>
<td>94 (78–110)</td>
<td>6 (4–9)</td>
</tr>
</tbody>
</table>


**Figure 7. Viral Shedding and Symptoms in Experimental Influenza**

Oseltamivir (100 mg once or twice daily) was dispensed to 24 healthy adults; 12 controls received placebo. All participants were then inoculated with H1N1 influenza virus 26 hours later. Viral titers in oseltamivir-treated patients dropped to undetectable levels within 36 hours.

*Viral shedding: mean 107 hours.

TRANSMISSION AND PREVENTION OF SEASONAL INFLUENZA

For an influenza virus to spread sufficiently to cause an outbreak there must be a chain of infection—an infectious virus, a susceptible host, and a method of transmission. In humans, influenza is transmitted via respiratory droplets released during coughing or sneezing, from one person to another who may be up to 3 feet away. Or someone may touch a porous surface that is contaminated with influenza virus and transmit the virus to mucous membranes in the eyes, nose, ears, or mouth. Thus, an effective method of preventing transmission of influenza is frequent hand washing. In addition, nurses treating influenza patients should use droplet precautions for the duration of the patients’ illnesses. Droplet precautions involve placing the patient in a private room, wearing a mask when working within 3 feet of the patient, and having the patient wear a mask when being transported within the hospital. Other nonmedical interventions include social distancing, cold etiquette, and the use of face masks.

IMMUNOPROPHYLAXIS: SEASONAL INFLUENZA VACCINATION

In the United States, 2 types of influenza vaccines are available for immunoprophylaxis. Trivalent inactivated influenza vaccine is administered as an injection, and approved for all individuals 6 months of age and older. Live attenuated vaccine is administered nasally, and is approved for healthy individuals 5 to 49 years.23 Vaccines for seasonal influenza include 3 strains (2 of influenza type A and 1 type B) and are reformulated each year in an attempt to match the most commonly circulating viral strains. The number of influenza cases at Johns Hopkins Hospital from 2000 to 2007 is shown in Figure 8. If the annual influenza vaccine matches the subtypes that are circulating, the pattern of the bar graph (the epidemiological curve) can be used to anticipate the likely pattern of influenza cases for the upcoming year. The dotted lines of the graph for 2004 to 2005 illustrate what happened when the annual influenza vaccination did not match the circulating influenza subtypes well.

Vaccinating children in a community against seasonal influenza has the potential to confer herd immunity (Table 1) on the entire population. This phenomenon happens because children have the highest attack rates for influenza, and play an active role in introducing influenza into the household and the community at large.

One study carried out at 2 sites in Moscow, Russia, provided proof of the concept that if the majority of school children were vaccinated against influenza, the entire population would develop herd immunity.24 Investigators immunized 57% of preschool children and 72% of school children against influenza. They subsequently compared rates of influenza and complications in unvaccinated community-dwelling adults 60 years of age and older (Figure 9). Fewer than 1% of elderly adults in the intervention and control communities were vaccinated against influenza because of a shortage of influenza vaccination during the study period. The rates for influenza-like illness, pneumonia, asthma, and bronchitis in adults older than 60 years were significantly lower at the intervention site than at the control site. Only a miniscule percentage of elderly adults developed an influenza-like illness—.07% in the intervention group.

During the 2004–2005 influenza season the annual influenza vaccination did not match the circulating influenza subtypes well, and influenza cases rose dramatically compared to previous years. Data as of May 27, 2007. Image courtesy of Johns Hopkins Medicine, Department of Hospital Epidemiology and Infection Control, May 27, 2007.
and .24% in the control group (P < .01). Most children lived in 3-generation households, thus the grandparents had direct contact with the children who were immunized during the program. The 28 000 doses of vaccine that were administered not only protected 64% of the children from developing influenza, but also protected the 82 000 high-risk individuals older than age 60 who were not immunized.

Influenza vaccines generate optimal immune responses in healthy school children and working adults. Thus, one way to maximize “herd immunity” is to eliminate barriers to vaccination of school children and working adults by establishing school- or workplace-based vaccination clinics.

Elderly individuals, particularly African Americans, do not mount as effective an immune response to influenza vaccination as do younger individuals.25,26 Although vaccination may not prevent influenza in nursing home residents, among those who were vaccinated, rates of pneumonia, hospitalization, and death from respiratory illness were reduced approximately 50% in nursing home residents who were vaccinated.27

**ANTIVIRAL MEDICATIONS**

There are 2 classes of antiviral medications available in the United States for treatment of seasonal influenza (Table 2).19,28,29 One class, to which amantadine and rimantadine belong, targets the M2 protein channels in the influenza virus. On the recommendation of ACIP, neither amantadine nor rimantadine were used for prophylaxis or treatment during the 2005 to 2006 and 2006 to 2007 influenza seasons, although these drugs had been widely used for prophylaxis in earlier years because of evidence that more than 90% of influenza virus circulating in the United States had developed resistance to these drugs.19

Another class of antiviral medications, the neuraminidase (NA) inhibitors, which includes oseltamivir and zanamivir, is most effective when given early in the infection, and all benefit is largely gone once symptoms have been present for more than 48 hours. When administered within 12 hours of symptom onset, oseltamivir reduces the duration of illness by an average of 3 days.30

![Figure 9. Herd Protection of Elderly by Mass Influenza Immunization of Children: Moscow, 2001–2002](image-url)

The rates for influenza-like illness, pneumonia, asthma, and bronchitis in adults older than 60 years were significantly lower at the intervention site than at the control site. ILI = influenza-like illness.

Data from Ghendon et al.24

---

**Table 1. Glossary**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epidemic</td>
<td>An outbreak of more cases of a disease than would be expected in a given population during a given time period.</td>
</tr>
<tr>
<td>Hemagglutinin</td>
<td>A protein found in the outer coat of influenza virus that enables the virus to bind to cells.</td>
</tr>
<tr>
<td>Herd immunity</td>
<td>The ability of an entire population group to resist infection even though only a minority of individuals from that group have been vaccinated against the disease.</td>
</tr>
<tr>
<td>Isolation</td>
<td>Separation and restriction of movement for individuals with an infectious disease. The CDC defines isolation based on suspected transmission. People in isolation may be cared for in their homes, in hospitals, or at designated healthcare facilities.</td>
</tr>
<tr>
<td>Mitigation</td>
<td>The process of lessening the impact of a disease on an individual or a community.</td>
</tr>
<tr>
<td>Neuraminidase</td>
<td>An enzyme present on the viral envelope of the influenza virus that enables newly formed virus particles to be released from an infected cell.</td>
</tr>
<tr>
<td>Nosocomial</td>
<td>Acquired in a hospital or a healthcare setting, especially in reference to an infection.</td>
</tr>
<tr>
<td>Pandemic</td>
<td>A worldwide epidemic.</td>
</tr>
<tr>
<td>PPE</td>
<td>Personal protective equipment, such as gloves, gowns, masks, or portable respirators. Types of PPE recommended depend on suspected transmission.</td>
</tr>
<tr>
<td>Quarantine</td>
<td>Enforced confinement of an individual with no symptoms of illness but who has been exposed to an individual infected with an easily transmissible disease.</td>
</tr>
<tr>
<td>SARS</td>
<td>Severe acute respiratory syndrome.</td>
</tr>
<tr>
<td>Surge capacity</td>
<td>The ability to obtain additional resources when needed during an emergency.</td>
</tr>
</tbody>
</table>

CDC = Centers for Disease Control and Prevention.
Onset, oseltamivir and zanamivir reduce both the duration of influenza symptoms by 1 to 2 days and secondary disease transmission in families. Oseltamivir reduces the duration of fever by 1 to 2 days and acute otitis media in children by 44%. Zanamivir reduces antibiotic use by approximately 30%.

The standard dose for oseltamivir for treatment of seasonal influenza in adults and adolescents 13 years of age and older is 75 mg twice a day for 5 days. The standard therapeutic dose of zanamivir for adults and children ages 7 years and older is 10 mg by inhalation twice a day for 5 days.

Although there is evidence that oseltamivir is effective in preventing flu pneumonia in patients treated early enough, there is no evidence that antivirals are effective in treating patients who present with influenza that has already progressed to flu pneumonia because participants in oseltamivir and zanamivir clinical trials were eligible only if symptoms had lasted for 2 days or less.

Nurses should be aware that 32 children with influenza who were treated with oseltamivir experienced neuropsychiatric symptoms, such as delirium, abnormal behavior, hallucinations, convulsions, and encephalitis, although it could not be determined whether these events were secondary to the underlying influenza itself or due to the drug.

For all that antivirals play an important therapeutic role, nurses should be aware that there is some evidence that influenza viruses started to develop resistance to oseltamivir within the first 3 years of their use. However, strains that were oseltamivir resistant usually retained sensitivity to zanamivir.

### Table 2. Antiviral Medications Complement Vaccination

<table>
<thead>
<tr>
<th>Agent</th>
<th>Effective Against</th>
<th>How Administered</th>
<th>Treatment</th>
<th>Prophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2 Protein Inhibitors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amantadine*</td>
<td>A</td>
<td>Oral</td>
<td>Age Group</td>
<td>Dosage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1–12 years</td>
<td>See package insert†</td>
<td>1–12 years</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;12 years to &lt;65 years</td>
<td>Two 100-mg tablets once daily until 24–48 hours after signs and symptoms disappear‡</td>
<td>&gt;12 years to &lt;65 years</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adults &gt;65 years</td>
<td>One 100-mg tablet once daily§</td>
<td>≥65 years</td>
</tr>
<tr>
<td>Rimantadine*</td>
<td>A</td>
<td>Oral</td>
<td>≥10 years</td>
<td>100 mg twice daily for 7 days‡</td>
</tr>
<tr>
<td>Neuraminidase Inhibitors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oseltamivir</td>
<td>A &amp; B</td>
<td>Oral</td>
<td>≥1 year</td>
<td>75 mg twice daily for 5 days (if &lt;88 lbs refer to the weight base table for children)</td>
</tr>
<tr>
<td>Zanamivir</td>
<td>A &amp; B</td>
<td>Inhalation</td>
<td>≥7 years</td>
<td>10 mg (2 inhalations) twice daily for 5 days§</td>
</tr>
</tbody>
</table>

*Not used during 2005 to 2006 influenza season.
**Antiviral Prophylaxis to Prevent Influenza**

Oseltamivir and zanamivir are both approved by the US Food and Drug Administration (FDA) for prevention of seasonal influenza in the United States. The standard prophylactic dose for oseltamivir in adolescents and adults exposed to an infected individual is 75 mg once daily for at least 10 days. During a community outbreak, if prophylactic antivirals are given simultaneously with influenza vaccination, the duration of antiviral treatment can be stopped after 2 weeks, once the immune response from the vaccination occurs. Oseltamivir is safe and effective as prophylaxis for up to 6 weeks in individuals for whom vaccine is contraindicated, so long as dosing is continuous. The standard prophylactic dose for zanamivir in adolescents and adults exposed to an infected individual is 10 mg (2 inhalations) once daily for 10 days in a household setting and for 28 days during a community outbreak.

Indications for oseltamivir or zanamivir prophylaxis include the need for an adjunct to vaccination in high-risk individuals or in immunodeficient individuals who are likely to have a poor response to vaccine, unvaccinated individuals caring for high-risk individuals, or individuals with contraindications to influenza vaccine such as severe egg allergy.

Hayden et al pretreated 24 healthy adults with oseltamivir (100 mg either once or twice daily) and 12 participants with placebo, then inoculated all participants with H1N1 influenza virus 26 hours later. None of the oseltamivir patients shed any virus (Figure 7). This study has important implications for hospitals because eliminating viral shedding among patients and HCWs would likely be an advantage in preventing nosocomial infections.

Prophylaxis with NA inhibitors is also effective among the elderly in LTCFs. In 1 randomized study, residents in US and European LTCFs received placebo or oseltamivir before and during a 6-week-long local influenza outbreak. Laboratory-confirmed, clinical influenza dropped 92% in the entire population. There was also a 91% reduction in laboratory-confirmed influenza among participants who were vaccinated when oseltamivir was prescribed prophylactically.

Based on a nonrandomized trial in a nursing home with 50 patients having multiple comorbidities who were exposed to both influenza A and B during a community outbreak, zanamivir was 91% effective in preventing influenza.

**Challenges in Managing Seasonal Influenza**

One challenge in managing seasonal influenza involves poor vaccine acceptance among consumers. In a recent survey at a large teaching hospital of 153 individuals caring for children ages 6 to 23 months, 20% believed that influenza vaccine can cause influenza. Nearly 33% of the more than 2000 individuals who participated in a CDC survey believed the same thing. Parents may perceive wrongly that influenza is not serious enough to justify vaccinating their children, and some physicians apparently do not recommend influenza vaccination appropriately.

Disturbingly, only 29% of children aged 2 to 17 years with asthma got immunized for influenza during the 2004 to 2005 influenza season, even though such children are a recognized high-risk group. Approximately 65% of individuals older than 65 years received influenza vaccination in 2004, well below the national health objectives for the 2010 goal for 90% coverage in this age group. HCWs can encourage vaccine acceptance by reviewing the ACIP recommendations of and recommending vaccination to those patients that meet the high-priority criteria. Other methods to improve vaccine acceptance among patients include providing standing orders for vaccinations, establishing special influenza clinics, posting signs encouraging vaccination in public areas, and notifying patients with a computer-based reminder system.

Another challenge is the availability of vaccine. During the 2004 to 2005 influenza season, there was a shortage of vaccine because of the temporary shutdown of a manufacturing plant belonging to a major vaccine supplier to the United States. Some large pharmacy or grocery chains received vaccine for distribution early in the season, whereas many hospitals or doctor’s offices received supplies later or not at all. Influenza vaccine manufacturers and distributors eventually addressed these concerns about allocation of influenza vaccine, and availability has not been a problem during recent influenza seasons.

Hospital visitors pose another challenge to minimizing the spread of seasonal influenza. At the height of the influenza season, hospitals might consider offering masks to individuals and cohorting, or placing individuals with respiratory symptoms in separate waiting areas.

Long-term care facilities face particular challenges in managing influenza, as they have a minimal capaci-
ty to deal with influenza outbreaks. Short-term residents arrive from the hospital having been discharged more quickly than in the past. Physicians may visit only once every 30 days and laboratory results may take 7 days. These facilities generally have only part-time infection control practitioners.

**THE ROLE OF THE NURSE IN SEASONAL INFLUENZA**

Nurses should act as role models to their patients and others and be vaccinated against seasonal influenza each year to protect themselves, their families, and their patients from infection. During a typical influenza season, floor nurses identify influenza patients at high risk of complications and administer any prescribed antiviral medications.

Before each flu season, hospital staff should be reminded of the importance of using good hand hygiene, social distancing, and droplet precautions to prevent transmission of influenza.

**PANDEMIC INFLUENZA**

Health professionals and consumers throughout the United States are concerned with the possibility that the H5N1 strain of avian influenza currently circulating among birds in Asia, Europe, and the Middle East, and associated with limited disease in humans, will develop the potential to cause a pandemic. For a pandemic to occur, 3 conditions must be met: a new influenza subtype that has not previously circulated in humans needs to emerge (a rare event), the new subtype must be capable of causing disease in humans, and the virus must be capable of being passed easily among humans. Only the last condition has yet to be fulfilled by H5N1. As long as the virus continues to circulate in animals, there will be a risk for the virus to infect and adapt to humans.

Unfortunately, no one is able to accurately predict whether H5N1 will actually trigger a pandemic and, if it does, no one can be sure of the duration and consequences.

The first signs of a pandemic could be clusters of respiratory illness from one region or area. These clusters of illness could indicate transmission among humans, including casual contacts. Once cases are identified as a new influenza strain, the disease may spread rapidly into the general population.

**INFLUENZA STRUCTURE AND GENETICS**

Influenza are single-stranded RNA viruses that belong to the group *Orthomyxoviridae*. Two surface proteins on the influenza virus determine the naming conventions that identify subtypes of infection. The first part of the name refers to the hemagglutinin (HA) antigen, of which there are 16 subtypes. HA allows the virus to attach to the host cell. Birds are the natural reservoir of influenza and they are susceptible to all 16 HA subtypes. In general, humans are susceptible only to influenza subtypes H1, H2, and H3.

The second antigen of importance is NA, of which there are 9 subtypes. After the virus replicates within a host cell, NA allows mature virus particles to be released from host cells.

The genes that encode for HA and NA within the same subtype of influenza viruses mutate from year to year, a process known as antigenic drift. This process drives the need for a new seasonal influenza vaccine every year to match the most common circulating variants. Sometimes, portions of the HA and NA genes reassort within host cells in birds, pigs, or other animals. This process, which results in a new influenza subtype, is known as antigenic shift. When antigenic shift occurs, the risk for a pandemic increases because humans, never having been exposed to the new virus before, have not developed antibodies to it.

**POTENTIAL IMPACT OF PANDEMIC INFLUENZA**

The currently circulating H5N1 influenza is highly pathogenic to birds, and transmits easily from bird to bird. Experts are concerned that infected poultry transmit H5N1 influenza to wild, migratory birds, which are at least partially responsible for the spread of the virus beyond its epicenter in Asia. Currently, H5N1 influenza does not transmit easily from person to person, and human to human transmission of H5N1 has been postulated only rarely. However, because H5N1 is rapidly mutating, public health experts are concerned that H5N1 has pandemic potential. Pandemics occur rarely, but when they do, the impact on the world population is immense.

The worst pandemic in the 20th century, the so-called “Spanish Flu,” occurred between 1918 and 1919. It is estimated that 500,000 individuals in the United States became infected, and between 50 and 100 million individuals died worldwide.
The demiology of the Spanish Flu was unusual in that many young, seemingly healthy individuals quickly developed severe respiratory symptoms and died. Thus, the combined influenza and pneumonia mortality curve for this pandemic is W-shaped, in contrast to the U-shape of the interpandemic period from 1911 to 1918 (Figure 10).55

If the current H5N1 mutates so that it is easily spread from person to person, meeting the needs of pandemic influenza patients in the United States would require twice the numbers of hospital beds and ventilators, and nearly 5 times the intensive care unit capacity than are currently available.56 Depending on the severity of such a potential pandemic, 675 000 to 1.9 million people could die in the United States alone. The US FDA recently approved a prepandemic H5N1 vaccine.57 However, if H5N1 mutates into a pandemic strain, the goal will be to produce 300 million doses of an up-to-date vaccine that matches the new strain within 6 months.54 Unfortunately, the manufacturing capacity to meet this goal presents a challenge and does not exist at this time.

In helping states and local jurisdictions to plan for a potential pandemic, the Department of Health and Human Services (HHS) starts from a series of assumptions.59 These assumptions include:

- All individuals will be susceptible to the pandemic virus
- On average, 30% of the population will become ill, of whom 50% will seek medical care
- Between 2% and 20% of the population will be hospitalized (depending upon how virulent the pandemic strain)
- During an 8-week outbreak, 40% of workers will be absent
- Hospitals will have at least 25% more patients than usual

As of May 2007, there has been no evidence of highly pathogenic H5N1 among birds or humans in North America. It is not guaranteed that the currently circulating H5N1 will develop pandemic potential. However, there are a number of other avian strains that periodically become transmitted to humans, any of which could become a pandemic strain.

**CURRENT STATUS OF HUMAN CASES OF H5N1 INFLUENZA WORLDWIDE**

Of the 322 reported cases of H5N1 influenza among people that have occurred from 1997 to date, approximately 80% have been from Asia, although human cases have been identified in Azerbaijan, Egypt, Iraq, Nigeria, and Turkey.60 The majority of H5N1-infected individuals have been teenagers or young adults (Figure 11).61 Almost all H5N1-infected people had direct contact with sick poultry at live bird markets, on

**Figure 10. Age-Related Death Rate: Influenza**

**Figure 11. Human Avian Influenza A (H5N1) Cases by Age Group and Outcome**

The majority of H5N1-infected individuals worldwide have been teenagers or young adults.

*As of August 16, 2007, a total of 321 cases were reported to the World Health Organization. The 12 cases in Turkey were excluded. Reprinted from the World Health Organization. Human influenza A (H5N1) cases by age group and outcome. Available at: http://www.wpro.who.int/sites/cs/data/data_Graphs.htm. Accessed August 31, 2007.*
farms, or from backyard flocks, but there have also been 10 clusters of H5N1 among family members. The disease has an incubation period of 2 to 5 days, after which the patient quickly develops lower acute respiratory disease symptoms, multigorgan failure, and sepsis. Of the 322 reported human cases, 195 (60.6%) have died.

Although research indicates that oseltamivir and zanamivir are effective in preventing H5N1 virus from replicating in the lungs of mice, no randomized clinical trials of oseltamivir treatment have been done in H5N1 patients. In a series of 8 Vietnamese patients with H5N1, 50% died despite being treated with 75 mg of oseltamivir twice daily. Two of the 4 deceased patients exhibited resistance to oseltamivir, but 1 of them had not started treatment until 6 days after symptom onset.

FINANCIAL COSTS OF PLANNING FOR PANDEMIC INFLUENZA

It would likely cost $1 million for an average hospital (164 beds) to develop and buy the supplies to implement a pandemic influenza preparedness plan (Figure 12). Once the plan is complete, hospitals would also need to budget for stockpiling supplies, communication plans, education and drills, and recurring annual costs of $200 000 to maintain preparedness for a large-scale health emergency. Hospitals may want to consider sharing resources (eg, educational campaigns) with other local facilities to minimize some costs.

Many hospitals already operate at slim (1.9%) profit margins—30% are losing money. Add an ongoing shortage of personnel, and a pandemic would likely cause some to close. Good planning is essential to mitigating the effects of a pandemic should it occur.

LESSONS FROM SARS: THE PANDEMIC THAT COULD HAVE BEEN

The city of Toronto learned many valuable lessons while handling the SARS (severe acute respiratory syndrome) outbreak that can be applied to planning for pandemic influenza. Prior to that outbreak, HCWs didn’t use special precautions with patients who had community-acquired pneumonia. The coronavirus that causes SARS is spread via airborne transmission of tiny droplet nuclei as well as by direct and indirect contact with large droplets. The SARS experience taught HCWs to use droplet precautions with all patients, and airborne precautions (private room with negative air pressure; N95 respirator) with patients with SARS. Hospitals relaxed precautions too early, which led to a second outbreak, in which 44 people died, approximately 45% of whom were HCWs. HCWs who used personal protective equipment (PPE) consistently were significantly less likely to become infected with influenza (Figure 13). Hospitals learned that taking a temperature and a history from every individual who came into the healthcare setting was an important factor in helping to minimize the spread of the disease.

COMPONENTS OF PANDEMIC PLANNING

Planning should start on the regional level with public health authorities and existing emergency management infrastructure to avoid duplication of effort. This is especially important for planning alternative care facilities (surge capacity) to provide care for individuals once all local hospital beds are occupied. The availability and distribution of vaccine and antiviral drugs, and the guidelines and accountability for their use, will also be determined on a regional level.

Guidelines and checklists for hospital planning exist to use as templates for developing a comprehensive and realistic pandemic plan, while using the State Health Department to guide them. Such planning requires a multidisciplinary team that includes decision makers who can approve financial outlays. Physicians, nurses, and pharmacists on staff should also be involved in the planning process. The planning

---

**Figure 12. Pandemic Planning: Million Dollar Price Tag**

<table>
<thead>
<tr>
<th>Component</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development of plan</td>
<td>$200 000</td>
</tr>
<tr>
<td>Staff training</td>
<td>$160 000</td>
</tr>
<tr>
<td>Obtain personal protective</td>
<td>$400 00</td>
</tr>
<tr>
<td>equipment</td>
<td></td>
</tr>
<tr>
<td>Obtain basic supplies</td>
<td>$240 000</td>
</tr>
<tr>
<td></td>
<td>$1 000 000</td>
</tr>
</tbody>
</table>

The likely cost for an average hospital (164 beds) to develop a pandemic influenza preparedness plan is $1 million. Data from Toner et al.
committee may elicit input from outpatient medical groups, professional associations, emergency medical services, and home health and long-term care providers. In addition, experts in palliative care should be involved in planning the provision of psychosocial services for the many people who will likely not receive antiviral treatment because of scarce resources. In addition, planning should include a discussion of the ethical decisions that may need to be made should there be a shortage of supply and medications.

**COMPONENTS OF A PANDEMIC INFLUENZA PLAN**

The Department of Health and Human Services has identified 10 essential components of a Pandemic Influenza Plan, of which 7 will be detailed in this article.69

**SURVEILLANCE**

Each hospital must establish a pandemic influenza surveillance strategy that starts with a standard case definition, and includes written protocols for standardization of hospital surveillance methods, developing a data collection and periodic reporting mechanism, and collating that information as needed to report to local and state public health agencies.

**COMMUNICATION**

Good communication is essential to ensure that community clinicians become aware of when pandemic influenza starts to circulate, how severe the epidemic is, and what the impact is on other facilities. Other important information will need to be disseminated, such as potential changes in screening criteria and case definitions, vaccine availability, or whether official recommendations permit shifting from using antiviral medications only for treatment to prophylaxis. Ideally, hospitals will channel communication methods that already exist as part of the regional emergency response system.

**TRIAGE, CLINICAL EVALUATION, AND ADMISSION PROCEDURES**

Once an outbreak of pandemic influenza is identified within the community or hospital, or both, then plans already put in place to establish triage and build surge capacity will need to be implemented.

Hospitals will need to revise criteria for admission. This may mean no direct admissions, limiting or canceling elective surgeries, discharging patients early, and using standardized clinical management protocols adapted for special populations—children, pregnant women, or immunocompromised individuals.

Screening criteria need to be established at hospital entrances to identify HCWs and visitors with respiratory symptoms. The plan should establish a predetermined treatment algorithm for managing pandemic flu patients clinically. One such algorithm might designate that nurses would give all patients who have respiratory symptoms a mask, obtain a nasopharyngeal aspirate, and direct the individual to a section of the waiting room designated for symptomatic individuals.

A graphic representation of such a triage plan developed by the State of New Mexico is shown in Figure 14.70 In case of pandemic, patients with respiratory

<table>
<thead>
<tr>
<th>Type of PPE</th>
<th>Consistent</th>
<th>Inconsistent</th>
<th>Relative Risk (95% CI)</th>
<th>2-Tailed Fisher Exact P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gown</td>
<td>3/20 (15)</td>
<td>5/12 (42)</td>
<td>.36 (.10–1.24)</td>
<td>.12</td>
</tr>
<tr>
<td>Gloves</td>
<td>4/22 (18)</td>
<td>4/10 (40)</td>
<td>.45 (.14–1.46)</td>
<td>.22</td>
</tr>
<tr>
<td>N95 or surgical mask</td>
<td>3/23 (13)</td>
<td>5/9 (56)</td>
<td>.23 (.07–.778)</td>
<td>.02</td>
</tr>
<tr>
<td>N95</td>
<td>2/16 (13)</td>
<td>5/9 (56)</td>
<td>.22 (.05–.93)</td>
<td>.06</td>
</tr>
<tr>
<td>Surgical mask</td>
<td>1/4 (25)</td>
<td>5/9 (56)</td>
<td>.45 (.07–2.71)</td>
<td>.56</td>
</tr>
<tr>
<td>N95 versus surgical mask</td>
<td>2/16 (13)</td>
<td>1/4 (25)</td>
<td>.50 (.06–4.23)</td>
<td>.51</td>
</tr>
</tbody>
</table>

During the SARS outbreak in Toronto, Canada, healthcare workers who used precautions consistently were significantly less likely to become infected with influenza. CI = confidence interval; PPE = personal protective equipment; SARS = severe acute respiratory syndrome. Reprinted with permission from Loeb et al. Emerg Infect Dis. 2004;10:251-255.67

**Figure 13. Lessons from SARS: PPE Effectiveness for Influenza**
symptoms consistent with influenza will go to a triage center, known as a Neighborhood Help Center. From there, patients will be sent to either the hospital or an acute care center, which will provide outpatient care.

**Surge Capacity**

The planning committee will need to inventory the current availability of beds, staff, PPE, antiviral medications, and mortuary capacity. Additional intensive care unit critical care patients could be treated outside of conventional units using post-op, anesthesia recovery, and any other facilities that have oxygen available. Surge capacity also refers to decisions such as where stockpiles of vaccine and antiviral medications, if available, will be stored.

On a regional level, planners can estimate the number of individuals who may develop pandemic influenza, and anticipate needs for hospital beds, outpatient services, and supplies using a free, downloadable software package called FluAid 2.0. On a hospital level, planners can use a spreadsheet-based software package, FluSurge 2.0, which allows administrators to estimate the increased need for hospital-based services during an influenza pandemic. With this software, planners can specify the duration and severity of a hypothetical pandemic and estimate the number of hospitalizations, individuals who will require intensive care unit care or ventilator support, and deaths that would result. These data are needed to drive the development of surge capacity.

**Infection Control Practices**

The classic public health interventions of isolation and quarantine (Table 1) are attempts to limit the community-wide spread of disease during infectious disease outbreaks. Nurses should be aware of federal and local laws governing establishment and rigorous enforcement of these techniques. However, there are little data to support the use of social distancing measures, such as closing schools, churches, or malls, or travel restrictions to help slow or limit the spread of pandemic influenza. However, the CDC’s Mitigation Plan for Pandemic Influenza recommends these measures as community strategies.

Efforts to control the spread require the establishment and enforcement of rigorous infection control practices in hospitals. The most basic practice includes hand washing and respiratory hygiene. Strict hand hygiene practices should be followed at all times and alcohol-based dispensers should be provided throughout patient care areas. Intermediate infection control practices involve establishing isolation units (ideally with high-efficiency particulate arresting filtration and negative air pressure systems) where patients can enter and exit in an orderly fashion with minimal contamination with the rest of the hospital. Advanced practices involve protection of workers during high-risk activities-intubation and suction cleaning respirators, especially positive air pressure respirators. The latter will need replacement batteries, which will also be in short supply.

**Education and Training**

All staff members are likely to be assigned new roles and responsibilities in a large-scale pandemic influenza outbreak. Thus, if a pandemic strain does arise, clinicians will need to increase their index of suspicion for influenza. This may require cohorting all patients who present with cough or other respiratory symptoms in a single unit and applying droplet precautions until the period of communicability passes, the symptoms resolve, or antibody tests or culture results disprove the putative diagnosis of pandemic influenza.

Currently, test kits for H5N1 are only available to

---

**Figure 14. MEMS Flow Map**

public health laboratories. Thus, physicians, nurses, or other appropriate hospital staff should be trained to understand the procedures that are necessary to have a specimen tested through public health laboratories.

The SARS epidemic in Toronto also demonstrated that HCWs must be trained about disease risk and transmission, how to don and safely remove protective equipment, and how to use airborne precautions correctly and reliably (Figure 15). During that outbreak, 60% of HCWs did not know why they were being quarantined. As a result of these studies, nurse managers should be aware that staff involved in direct patient care may need remedial training about safety precautions. If possible, house influenza patients in airborne isolation or cohort all respiratory patients together. Plain language signs should be posted outside isolation rooms that specify that HCWs should wear specific types of masks or respirators.

There are no hard data to confirm that respiratory etiquette lessens the spread of influenza. Nevertheless, if a pandemic occurs, hospitals should also educate visitors about the way influenza spreads because patients may continue to be communicable once they leave the facility. Staff should prominently post signs instructing visitors with symptoms of a respiratory infection to cover their noses and mouths when coughing or sneezing, use and dispose of tissues, and wash their hands afterwards. Some hospitals provide tissues, no-touch disposal cans, and instructions about respiratory hygiene in or near waiting areas.

There are educational resources, including fact sheets and slide shows, suitable for training HCWs about pandemic influenza available from government and pharmaceutical industry sources.

**ETHICAL FRAMEWORK**

Each pandemic plan needs a standardized but flexible ethical framework to prioritize who receives the vaccine and antiviral medications when supplies will be scarce. For example, if a pandemic develops in the near future, all available vaccine and antiviral medications may be prioritized to the military and those involved in vaccine and antiviral production. Theoretically, a plan could allocate all available vaccine or treatment courses randomly by lottery, although these distribution plans are difficult to administer. Some plans may stratify 50% of any available vaccine or treatment doses to patients and 50% to HCWs, followed by a lottery to allocate to individuals. Pandemic plans should specify in advance of need whether a transplant patient would receive higher priority for influenza treatment than a patient with cancer or HIV. Regardless of what distribution scheme is established, hospitals will need to assure in advance that vaccine and antiviral stockpiles can be stored securely.

**CHALLENGES IN PLANNING FOR AN INFLUENZA PANDEMIC**

There is little financial support available from the federal government for pandemic influenza planning. Until 2006, the Health Resources and Services Administration (HRSA) provided funds to hospitals to increase surge capacity in case of bioterrorism or other health emergencies; pandemic influenza counted as an eligible event. It is unclear if this program will continue. Further information is available from each state’s hospital preparedness coordinator.

**Figure 15. Removing Personal Protectice Equipment**

- **Gloves**: Outside of gloves are contaminated! - Grasp outside of glove with opposite gloved hand; peel off - Hold removed glove in gloved hand - Slide fingers of ungloved hand under remaining glove at wrist
- **Goggles/Face Shield**: Outside of goggles or face shield are contaminated! - To remove, handle by “clean” head band or ear pieces - Place in designated receptacle for reprocessing or in waste container
- **Gown**: Gown front and sleeves are contaminated! - Unfasten neck, the waist ties - Remove gown using a peeling motion; pull gown from each shoulder toward the same hand - Gown will turn inside out - Hold removed gown away from body, roll into a bundle, and discard into waste or linen receptacle
- **Mask or Respirator**: Front of mask/respirator is contaminated - DO NOT TOUCH - Grasp bottom then top ties/elastic and remove - Discard in waste container

This brochure from the CDC illustrates how to don and safely remove PPE. CDC = Centers for Disease Control and Prevention; PPE = personal protective equipment. Adapted with permission from Centers for Disease Control and Prevention. Guidance for the selection and use of personal protective equipment (PPE) in healthcare settings. Available at: www.cdc.gov/ncidod/dhqs/pdf/ppe/PPEslides6-29-04.pdf. Accessed August 23, 2007.
**Vaccine**

The US government is collecting prepandemic vaccine in the National Strategic Stockpile even though it is possible that this prepandemic vaccine may not be effective for whatever strain eventually becomes the pandemic strain. Even if it is effective, 1 year of production in the United States will yield enough vaccine for less than 5% of the population. In addition, there may be unanticipated reactions associated with newly developed H5N1 vaccines. In any case, any available vaccine would be distributed to state health departments for distribution to HCWs and high-risk individuals only after the military and vaccine producers receive their vaccine.

Whatever vaccine will be available will require 2 doses 1 month apart to establish immunity, thus physicians in community practice must ensure that there is a call-back system in place to ensure that patients get their second dose.

**Diagnostic Testing**

The influenza diagnostic tests that are widely available currently in the United States can identify influenza types A or B, but cannot distinguish the H5N1 subtype. At the moment, H5N1 can only be identified at a limited number of US laboratories, and those tests take approximately 24 hours to perform. Because treatment with antiviral medications must be started within 48 hours of symptom onset, there is a pressing need for rapid, point-of-care diagnostic tests that can reliably identify whether a patient is infected with H5N1 or another influenza subtype. The H5N1 polymerase chain reaction field test for H5N1 that is currently used gives results in 4 hours, but it is allocated only to the 140+ participants in the Laboratory Response Network. The CDC recently awarded $11.4 million in contracts to 4 companies to foster development of such diagnostic tests.

**Antiviral Medications**

The US government plans to stockpile 81 million courses of oseltamivir, enough to treat only 25% of the US population. As of February 2006, only 15 states have been certified by the CDC as being capable of distributing drugs from the stockpile. It should be noted that individuals should not be personally stockpiling antiviral medications in anticipation of a possible pandemic.

Another challenge is a knowledge gap about shelf life of antiviral medications. The official shelf life of oseltamivir is 36 months, but under ideal conditions the capsules actually start to disintegrate after 5 years. Bulk drugs may be stable for 10 years.

**Role of the Nurse in Pandemic Influenza**

Nurses, whether working in a hospital, community, clinic, or university setting, should keep abreast of the news about H5N1 influenza worldwide. They should also understand the concepts of isolation versus quarantine and how to follow hospital rules about appropriate PPE.

In the course of a pandemic, the critical thinking skills of nurses will be challenged. Nurses will need to participate in the following:

- Planning for altered standards of care should there be a shortage of supplies and other resources
- Creating processes for triaging and screening all persons who enter the facility
- Creating clinical guidelines for patient treatment
- Developing strategies to increase bed capacity
- Creating contingency plans for dealing with extensive absenteeism due to illness, family responsibilities, or fear of illness
- Developing education and training programs for staff and the general public
- Developing programs for rapid vaccination of staff and others
- Hospital disease surveillance
- Decisions regarding the allocation of scarce consumable and durable resources

Hospitals will want to avoid or limit gatherings of large groups of people during a pandemic. Hospital cafeterias will need to limit services to pick up food only and eliminate seating. In addition, schools will likely be closed during a pandemic; managers may need to consider establishing onsite childcare services, thus the nursing staff will not be forced to stay home to care for their children.

**Research Still Needed**

Despite many advances, there is still much research into H5N1 influenza that still needs to be done:

- New methods are needed to produce 300 million doses of a vaccine directed to a new pandemic influenza variant within 6 months of recognition.
of a pandemic strain. New vaccines should require only a single dose with an effective adjuvant (an ingredient that facilitates or modifies the action of the vaccine), and production methods cannot be egg based.

- Healthcare institutions need access to rapid, accurate, and inexpensive point-of-care diagnostics for H5N1 influenza. As one step in that direction, in December 2006, the CDC awarded $11.4 million in grants to 4 companies developing new diagnostic tests that doctors and field epidemiologists could eventually use to quickly and accurately test patients for avian influenza H5N1 and differentiate influenza A H5N1 from seasonal human influenza viruses within 30 minutes.80

- The optimal dosages for existing antiviral medications for prophylaxis or treatment of patients with H5N1 influenza need to be determined.

- New antiviral medications need to be developed that are effective against late-stage influenza and against strains that are resistant to oseltamivir or zanamivir.

- In addition, similar strategies must be evaluated in acute and alternative healthcare settings to further assure disease transmission will be limited.

- There is a need for data on transmission of seasonal and pandemic influenza viruses and their prevention and control in healthcare settings.

- There is a need for actual data on whether community mitigation actions, such as closing schools and businesses, restricting travel, and quarantine, result in measurable slowing of influenza spread.

**Policy Changes are Needed**

- Financial
  - Given the financial challenges facing hospitals attempting to develop pandemic plans, policy changes are needed on every jurisdictional level. Ideally, the federal government should provide funding for pandemic influenza planning and to assure coverage for costs of caring for flu patients, as it would to care for individuals affected by a major hurricane or other natural disaster.

- Manpower
  - The HRSA plan is well intentioned, but the uptake is modest—they won't give out numbers. This is a potential crisis.

  - In addition, workplace leave policies will need to be modified to provide paid furloughs so that clinical staff will voluntarily stay home if they have respiratory symptoms. Current policies drive HCWs back to work because they are afraid to use up all their paid sick and vacation time.

- Surge capacity
  - US hospitals do not have the beds, equipment, or personnel to build surge capacity for the equivalent of a pandemic with the severity of 1918, but it may be possible to build enough capacity to care for as many patients as were affected by the 1958 pandemic.

- Leadership
  - The federal government needs to supplement the efforts of the states by providing reliable public health leadership about ethical issues, vaccine distribution, antiviral priorities, liability coverage, insurance reimbursement, emergency credentialing, etc.

  - There needs to be a standardized but flexible ethical framework to prioritize who receives the vaccine and antivirals when supplies will be scarce.76 For example, if a pandemic develops in the near future, all available vaccine and antiviral medications will be prioritized to the military and those involved in vaccine and antiviral production.77

  - There needs to be official federal policy about stockpiling supplies, such as N95 respirators, surgical masks, gloves, and gowns, in addition to patient care supplies such as ventilators.

  - Similarly, a policy needs to be established about the use of antivirals prophylactically as a substitute for vaccine, thus healthcare institutions can be eligible for reimbursement by HRSA.83

  - Inform health insurers that they will need to be flexible about what documentation will be required to ensure reimbursement. In a crisis, pharmacists will be concentrating on providing services for the maximum number of patients, not on thorough documentation.

  - The government should provide legal assurances that healthcare professionals will be exempt from liability during an influenza pandemic during which limited resources might result in a lower standard of patient care than usual.
CONCLUSIONS

Seasonal influenza is often misperceived as a minor disease. The disease and its complications have a major impact on individuals and healthcare institutions. Although vaccines and antiviral medications are effective in preventing and treating seasonal influenza, it still needs to be determined if that is true for H5N1 influenza. This influenza subtype, currently circulating widely among birds, causes high mortality among the relatively few humans that have been infected with it.

Many resources exist to help hospitals develop a comprehensive pandemic plan, but knowledge gaps and shortages of vaccine and antiviral medications will pose challenges to preventing and treating pandemic influenza.

ACKNOWLEDGEMENTS

This monograph is based on transcripts from the Influenza Consensus Meeting held on January 11, 2007, at Johns Hopkins University School of Medicine. The Johns Hopkins University School of Medicine would like to acknowledge and give thanks to the following course directors and participating faculty members for their contributions to the Influenza Educational Initiative: John Bartlett, MD, Professor of Medicine, Division of Infectious Diseases, Johns Hopkins University School of Medicine (Course Director); Trish M. Perl, MD, MSc, Professor, Department of Medicine, Division of Infectious Diseases, Johns Hopkins University School of Medicine (Course Director); Thomas C. Quinn, MD, MSc, Director, Johns Hopkins Center for Global Health, Professor of Medicine, Division of Infectious Diseases, Johns Hopkins University School of Medicine (Course Director); Suzanne F. Bradley, MD, Associate Professor of Internal Medicine, Divisions of Geriatric Medicine and Infectious Diseases, University of Michigan Medical School; Jeffrey S. Duchin, MD, FACP, FIDSA, Chief, Communicable Disease Control, Epidemiology, and Immunization Section, Public Health-Seattle and King County, Associate Professor in Medicine, Division of Allergy and Infectious Diseases, Adjunct Associate Professor, School of Public Health and Community Medicine, University of Washington; William Glezen, MD, Professor, Department of Molecular Virology and Microbiology, Professor and Head, Preventive Medicine Section, Department of Pediatrics at Baylor College of Medicine, Adjunct Professor of Epidemiology, School of Public Health, University of Texas Health Science Center, Houston; Thomas Inglesby, MD, Chief Operating Officer and Deputy Director, Center for Biosecurity, University of Pittsburgh Medical Center; Donald Low, MD, FRCP, Professor, University of Toronto, Microbiologist-in-Chief, Department of Microbiology, Mount Sinai Hospital, Medical Director, Ontario Public Health Laboratories; Kristin Nichol, MD, MPH, MBA, Professor of Medicine, University of Minnesota, Chief of Medicine, Minneapolis VA Medical Center; Kenneth E. Sands, MD, MPH, Senior Vice President and Medical Director of Health Care Quality at Beth Israel Deaconess Medical Center, Assistant Professor of Medicine, Harvard Medical School; Thomas R. Talbot, MD, MPH, Assistant Professor of Medicine and Preventive Medicine, Vanderbilt University School of Medicine, Chief Hospital Epidemiologist, Vanderbilt Medical Center.

REFERENCES


