

2. Epidemiology & Prevention of Influenza

2. EPIDEMIOLOGY AND PREVENTION OF INFLUENZA

2.1. Epidemiology of Influenza

Influenza is caused by one of three viral types: A, B, or C. Types A and B are recognized as the primary causes of influenza disease in humans while Type C is clinically less important.

Influenza A viruses are classified into subtypes on the basis of two surface antigens: hemagglutinin (HA) and neuraminidase (NA). Three subtypes of hemagglutinin (H1, H2, and H3) and two subtypes of neuraminidase (N1 and N2) are now recognized among influenza viruses that have caused widespread human disease. An immune response to these antigens, especially to the hemagglutinin, reduces the likelihood of infection and lessens the severity of disease if infection does occur. However, immunity to a virus of one subtype confers little or no protection against viruses of other subtypes.

The illness caused by Type A or B influenza virus is typically an acute, self-limited, febrile respiratory illness accompanied by myalgias, sore throat, and cough. Influenza may also result in syndromes similar to those caused by other respiratory viruses, including croup, tracheobronchitis, bronchiolitis or pneumonia. The illness associated with influenza infection is usually more severe than that caused by other common respiratory viruses, and very serious illness can result if either primary influenza pneumonia or secondary bacterial pneumonia occurs. The medical and economic consequences of influenza include increased medical care costs (e.g., physician, hospitalization, drugs) and years of life lost due to premature deaths, as well as time lost from work, school, or other normal activities. While both Influenza A and B are responsible for yearly epidemics of this disease, Influenza A generally causes higher mortality and is responsible for pandemics. Influenza viruses are highly contagious agents that are transmitted from person to person, usually by the airborne route (small particle aerosol), but also by contact with nasal secretions. Healthy children are one of the most important population groups in the propagation of influenza epidemics. Children transmit influenza readily to each other and to their families.

Antigenic Shift and Drift

There are several different molecular mechanisms of influenza virus evolution. Because the RNA genome of influenza viruses is segmented, new strains can be produced by reassortment of gene segments in cells that are dually infected with different influenza strains. In rare instances, reassortant viruses bear new hemagglutinin (HA) and neuraminidase (NA) antigens to which the majority of the population is susceptible. This process, termed antigenic shift,

results in the sudden appearance of influenza strains that can cause pandemics. More commonly, between pandemic seasons, influenza viruses evolve by stepwise mutation and immune selection of viral strains with minor changes in either the HA or NA antigen. This is referred to as antigenic drift.

Disease Burden of Influenza

Annually in the US, an average of 10 to 20 percent of the population is infected with influenza. Epidemiology studies indicate that the usual attack rate ranges from a low of 5 percent in persons over age 65 to a high of 40 percent in children under 18 years of age, with the highest attack rate being in school age children.

Influenza activity in the community is marked by increased medical contacts for febrile respiratory illness, increased absenteeism from work and school, increased hospitalizations due to pneumonia and exacerbations of cardiopulmonary disorders, as well as increased mortality in the elderly and in other high-risk groups. Over 90 percent of influenza-related deaths occur in people over age 65, but children under the age of five and women in the second and third trimesters of pregnancy are also at higher risk for serious complications. In addition, children less than five years of age are at risk for increased influenza morbidity with increased rates of lower respiratory infection and hospitalization.

In the US, there are approximately 20,000 to 40,000 deaths per year from influenza, with 35 to 50 million Americans becoming infected during each influenza season. At the peak of a typical epidemic, 9 to 22 percent of all physician office visits are for influenza-like symptoms. For every 100,000 persons ≥ 65 years of age in the US, approximately 500–800 are hospitalized with complications of influenza and approximately 30 to more than 150 per 100,000 will die. In pandemic influenza seasons, morbidity and mortality are greatly increased.

2.2. Prevention of Influenza with Licensed Vaccine

Several inactivated influenza vaccines are licensed for prevention of influenza, and the Advisory Committee on Immunization Practices (ACIP) makes recommendations for their use in the US. Vaccination policy has focused on reducing influenza-associated mortality rates in populations at high risk. Persons with chronic cardiovascular, bronchopulmonary, renal or metabolic diseases, and those who are immunocompromised (e.g., HIV-infected, cancer patients, organ transplant patients receiving immunosuppressive therapy) are recognized as being at increased risk. The ACIP has long recommended routine influenza vaccination for elderly adults (those ≥ 65 years of age) and others at high risk.

In 1984, the ACIP expanded their recommendation to include routine immunization of persons capable of transmitting influenza to high-risk patients, i.e., all health care workers in acute and long-term facilities, members of high-risk patients' households, and providers of home care to high-risk persons. In 1999, the American Academy of Family Practitioners (AAFP) and in 2000, the Advisory Committee on Immunization Practices (ACIP) extended recommendations to include routine immunization of healthy adults over 50 years of age.

Epidemiologic studies show that children are a primary source for spreading influenza virus in the population. Children are more susceptible than adults to infection because they lack immunity. Once infected, they pass influenza to other children through everyday contact. The virus then spreads to their families, amplifying the epidemic.

Children with underlying chronic diseases are recommended to be vaccinated with the inactivated influenza vaccine, but this population of high-risk children is too small to alter the spread of the virus during outbreaks. Some experts have proposed universal immunization of children to reduce morbidity and dampen the spread of influenza in the community. Supporting this concept, mass vaccination of schoolchildren had a measurable effect on the overall incidence of A/Hong Kong/68 in Tecumseh, Michigan, during the 1968 epidemic. The indirect protective effect was most evident in adults aged 20 to 30 years, which suggests that immunization of children lowered the incidence of influenza in their parents. Additionally, a recent study from Japan showed that mandatory vaccination of school-aged children against influenza may have provided protection and reduced mortality from influenza among older persons. Thus, vaccination of children may limit the spread of influenza in their families and throughout the community. However, vaccination of healthy children against influenza is currently hampered by the need to add yet another injection to the many vaccines already given to this age group.

Another factor shaping vaccination policy is the issue of vaccine supply. As an influenza virus of pandemic potential could appear at any time, it is important to improve methods of vaccine production so that supplies will not be limited at critical points in the epidemic. Repeated demonstration of the effectiveness of vaccination of the elderly in preventing hospitalization and death confirms that the traditional high-risk groups should be given priority. However, since vaccination of children may help to interrupt community transmission, an effective strategy to reduce the impact of influenza epidemics should plan for the production of sufficient vaccine to support routine immunization of healthy children.