Health Impact of Influenza in the United States

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Summary

Influenza infection is associated with significant morbidity and mortality. The purpose of this investigation was to describe the health effects of influenza in the US. Although a number of different data sources have been used to provide estimates of the health impact of influenza in the US, estimates provided in this article are primarily based upon the experiences reported in community-based studies performed in Houston, Texas, and Tecumseh, Michigan. Estimates of the annual average are provided for the following: (1) infection rate; (2) number of influenza-associated respiratory illnesses; (3) number of ill days with influenza; (4) number of bed and activity restriction days due to influenza illness; (5) physician visits; (6) hospitalisations and days hospitalised; and (7) mortality. Large differences were found between estimates from Houston and Tecumseh, and possible explanations for these are provided. However, all estimates find that influenza is an important cause of morbidity and mortality in the US.

Influenza has been classically characterised as the ‘last great uncontrolled plague of mankind’, because of its associated morbidity and mortality.\[1\] Although this statement was made before the appearance of HIV/AIDS, it does emphasise the ability of influenza to cause epidemics and pandemics over which we have little control. Vaccination and chemoprophylaxis can, however, prevent or modify disease in individuals. Estimates of the impact of influenza are problematical because of the difficulty in distinguishing morbidity and mortality due to influenza from morbidity and mortality due to other respiratory pathogens. As a result of these uncertainties, an Institute of Medicine report on New Vaccine Development, when attempting to quantify the impact of various infectious agents, stated that ‘very little data exist from which estimates of the influenza disease ... burden can be made’.\[2\]

This article presents some of the methodological issues involved in measuring influenza disease burden, followed by estimates of the average health impact of influenza in the US. However, there are often strong age, influenza strain, and year-to-year differences in the impact of this disease.

A number of approaches have been used to estimate the disease burden of influenza because of the difficulty in determining whether an individual with a respiratory illness has an influenza infection or an infection due to a different respiratory pathogen. Four of these approaches are described below.

1. All respiratory illnesses and respiratory-related events during a specific time period are attributed to influenza. In this approach, an influenza season is generally determined by the isolation of influenza
virus in the population. Some of the estimates of the health impact of influenza on individuals resident in Houston, Texas, are based on this approach.[3-5] The rationale and justification for this method by the Houston investigators include the following:

- The peak occurrence of acute respiratory disease-related medical visits coincides with influenza virus activity.
- The peak occurrence of hospitalisations due to acute respiratory disease is generally one week after the peak of influenza virus activity.
- An increase in mortality attributable to pneumonia and influenza generally occurs 2 weeks after the peak of influenza virus activity.

This method probably overestimates the impact of influenza, because other respiratory agents are likely to be in circulation at the same time. The definition of the period of influenza activity is somewhat arbitrary.

2. With this method, the 'expected' frequency of events from noninfluenza seasons (i.e. the 'usual' frequency of medical events during seasons in which there is little or no influenza activity) is compared with the 'observed' frequency of the same events from a specific influenza season. This method is used to estimate pneumonia and influenza mortality in the US.[6]

Data from years with minimal influenza activity are combined and statistically smoothed, then compared with data from years with influenza activity. There are some concerns that in the US there appear to be no years in which influenza is totally absent.[3] In community studies in Houston and Tecumseh, influenza infections were documented in each of the years studied. Therefore, because the 'noninfluenza' seasons probably have some influenza activity, this method may underestimate the health impact of influenza.

3. Information about respiratory illnesses is collected from a cohort of individuals, and an attempt is made to determine whether each individual is infected with an influenza virus, on the basis of isolation of the virus, serology, or both. A number of cohort or community studies have been performed in the US. Under ideal conditions, every time a respiratory illness occurred within a cohort, attempts would be made to isolate the virus so that the illness could be classified as due to influenza or to another respiratory agent. While this strategy might be methodologically sound, there are a number of practical limitations. First, it is labour intensive because of the need to obtain specimens early in the illness and the requirement for extensive laboratory resources. Second, the method for isolating the virus can lack sensitivity and/or specificity.[7] Because these studies are expensive, the sample sizes tend to be relatively small, which restricts the analysis to relatively common events.

In cohort studies, serum specimens are collected and attempts are made to isolate the viruses responsible for a sample of respiratory illnesses. This method was used in the Tecumseh Community Studies.[8] The frequency of respiratory-related events can be compared between groups of individuals who are infected and groups not infected with influenza virus. This method is relatively resource intensive, and the sample size, which is generally less than 1000 individuals, is too small to enable rare outcomes such as hospitalisations and mortality to be analysed. When the findings are based primarily on serological results obtained before and after the influenza season, it is not possible to associate the influenza infection with any single respiratory illness. Another consideration is the fact that the laboratory methods are not 100% sensitive or specific,[7] which can result in misclassification of the infection status.

4. A different approach can be used when influenza vaccination is recommended for older individuals and for those with chronic conditions. Within a cohort of such individuals, some are vaccinated and others are not. These 2 groups are compared to determine differences in hospitalisations, mortality, and other outcomes occurring during the influenza season. A potential weakness of this type of design is that there is no control over who is vaccinated and who is not, although differences, if they exist, might be controllable in the analysis. This method