What Happens in Vegas, Doesn't Stay in Vegas: Traveling Waves of Influenza in the US Elderly Population, 1991-2004

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OBJECTIVE

In surveillance it is imperative that we know when and where a disease first begins. The objective of this study was to examine trends in traveling waves of influenza in the US elderly population. Preparedness for influenza is an important yet difficult public health goal due to variability in annual strains, timing, and shift of the influenza virus. In order to better prepare for influenza epidemics, it is important to assess seasonal variation across individual influenza seasons on a state-by-state basis. This approach will lead to effective interventions especially for susceptible populations such as the elderly.

BACKGROUND

Influenza is a significant public health problems in the US leading to over one million hospitalizations in the elderly population (age 65 and over) annually.[1] While influenza preparedness is an important public health issue, previous research has not provided comprehensive analysis of season-by-season timing and geographic shift of influenza in the elderly population.[2] These findings fail to document the intricacies of each unique influenza season, which would benefit influenza preparedness and intervention. The annual harmonic regression (AHR) model fits each season of disease incidence characterized by its own unique curve. Using this model, characteristics of the seasonal curve for each state and each season can be compared. We hypothesize that travelling waves of influenza in the 48 contiguous states differ dramatically in each influenza season.

METHODS

Analysis of hospitalization rates for influenza among elderly aged 65+ years were extracted from Centers for Medicare and Medicaid Service (CMS) for the years 1991 through 2004. A total of 248,889 cases were extracted. Influenza was defined using International Classification of Diseases, Ninth Revision, Clinical Modification Codes (ICD-9CM) 487 for any of the diagnosis coding slots. To calculate hospitalization rates, we obtained US population estimates from the US Census 2000. Influenza hospitalizations for each state and each week were divided by the annual total population count. Thirteen influenza seasons, defined as July 1st through June 30th of the subsequent calendar year, were examined for similarity in seasonal characteristics for each of the 48 contiguous states and Washington, DC (subsequently referred to as 48 states). Each state was also categorized by one of the nine US Census Bureau divisions. Poisson AHR models were used to assess seasonal characteristics such as peak timing, the week at which disease incidence was highest, and absolute intensity, the difference between the maximum seasonal incidence and minimum seasonal incidence, for each state.

RESULTS

Over the course of 13 seasons, the seasonal duration (the difference in peak time in the 1st infected state to the peak time in the last infected state) of influenza was 4 weeks. However, individual seasons varied in seasonal duration, ranging from 5 weeks during the 1999-2000 influenza season to 22 weeks in the 2002-2003 season. During the majority of the 13 seasons, influenza shifted in a general west to east pattern (beginning in Nevada and ending in New England), however, this trend was not consistent across seasons. For example, in the 1991-1992 season, peak timing of influenza began in late November in West and East South Central and continued west toward the Mountain and Pacific divisions, ending in New England in mid-January. An inverse relationship between peak week and absolute intensity was found for all 48 states; the earlier the arrival of influenza the more intensely the states experience illness. Interestingly, Nevada, generally the first receiver of influenza, experienced the illness less intensely than other states. The West North Central division, which tended to fall in the middle of the seasonal duration, consistently experienced the most intense influenza season; often times twice as high as other regions.

CONCLUSIONS

Seasonal variation of influenza in the US presents a significant challenge for preparedness. Each state needs to be informed as to the trends within and between states in order to identify these patterns and be able to provide proper interventions for susceptible populations.

REFERENCES

[1]Thompson WW, Shay DK, Weintraub E, Brammer L, Bridges CB, Cox NJ, Fukada K. Influenza-associated hospitalizations in the United States. JAMA 2004;292:1333-1340.

[2]Greene SK, Ionides EL, Wilson ML. Patterns of influenza-associated mortality among US elderly by geographic region and virus subtype, 1968-1998. Am J Epidemiol 2006;163:316-326.