Seasonal Patterns of Respiratory Diseases: a Proxy for Influenza?

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OBJECTIVE

One of the most important goals of disease surveillance is to identify the "what" and "when" of an epidemic. Influenza surveillance is made difficult by inconsistent laboratory testing, deficiencies in testing techniques, and coding subjectivity in hospital records. We hypothesized that respiratory diseases other than influenza may serve as a useful proxy for this infection in pediatric populations, due to similarities in the seasonal characteristics of these illnesses.

BACKGROUND

Seasonal fluctuations are characteristic for many infectious diseases when environmental factors play a role in transmission. A recent study demonstrated the increased potential for aerosol transmission of influenza in cold, dry air, which supports the observed increase in influenza incidence in the winter months in temperate climates.[1] Seasonal analysis of surveillance data is traditionally confined to the removal of a generic seasonal trend in order to detect any unusual events. These techniques assume that seasonality is independent of year-to-year fluctuations and thus potentially overlook new and unique insights that may arise from understanding the variation between seasons. The annual harmonic regression (AHR) model fits each season of disease incidence characterized by its own unique curve. Using this model, seasonal characteristics for various respiratory diseases can be compared.

METHODS

Inpatient and outpatient visits for respiratory diseases were extracted from billing records for all children aged 0-18 years admitted to Children's Hospital of Wisconsin between 1997 through 2006. A total of 46,496 records were extracted (72.1% Milwaukee). Primary diagnoses of bronchitis, pneumonia, other upper respiratory infections (URI), and influenza were grouped according to the International Classification of Diseases, Ninth Revision, Clinical Modification Codes (ICD-9CM) 465-496. Nine influenza seasons, defined as July 1st through June 30th of the subsequent calendar year, were examined for similarity in seasonal characteristics. Cases of each respiratory disease were fitted using a Poisson AHR model to assess seasonal characteristics. Spearman rho correlations for peak timing between respiratory diseases, the week at which disease incidence was highest, and absolute intensity, the difference between the maximum seasonal incidence and minimum seasonal incidence, were assessed. In addition lagged, non-parametric cross-correlations were performed between cases of each respiratory disease.

RESULTS

The average peak week of all respiratory diseases were during the winter months in Milwaukee and reached their peak in different intervals and at different intensities. URI peaked in week 28 (January 6), influenza in week 30 (January 20), pneumonia in week 31 (January 27), and bronchitis in week 32 (February 3). Moderate Spearman rho correlations for peak week of infection were found between influenza and URI (r_s=0.55). The lowest absolute intensity was for influenza (1.75) while bronchitis showed the highest absolute intensity among the four respiratory diseases (21.39). In terms of absolute intensity, moderate to strong correlations were found between influenza and bronchitis (r_s=0.53) and influenza and URI (r_s=-0.50). Cross correlations showed that influenza preceded bronchitis by 1 week (r_s=0.43) while URI preceded influenza by two weeks through the majority of the nine influenza seasons (r_s=0.22). (Results are shown in Table 1)

CONCLUSIONS

Seasonal respiratory diseases represent significant challenges in both surveillance and control, requiring carefully planned and deliberate epidemiological measurements combined with specialized statistical techniques. AHR provides a novel method, giving researchers the means to quantify the characteristics of seasonal outbreaks and to compare seasonal characteristics of multiyear time series of common pediatric respiratory diseases.

REFERENCES

[1] Lowen AC, Mubareka S, Steel J, Palese P. Influenza virus transmission is dependent on relative humidity and temperature. PLoS Pathog 3(10): 1470-1476.

Table 1	Peak Week (95% CI)	Date	Intensity (95% CI)	Upper RI	Influenza	Pneumonia	Bronchitis
Upper RI	27.9 (27.1, 28.7)	Jan 6	12.7 (12.4, 13.1)	*Peak Week*	r=-0.50	r=-0.17	r=-0.83
Influenza	30.4 (29.6, 31.2)	Jan 20	1.8 (1.2, 2.5)	r=0.55	*Intensity / Peak Week*	r=0.45	r=0.53
Pneumonia	30.9 (29.0, 31.9)	Jan 27	5.1 (4.8, 5.4)	r=0.87**	r=0.35	*Intensity / Peak Week*	r=0.28
Bronchitis	32.1 (31.9, 32.4)	Feb 3	21.4 (19.8, 23.1)	r=0.48	r=0.25	r=0.67*	*Intensity / Peak Week*