Enteric Disease Surveillance: Seasonal Changes in Population Profiles

Meena Doshi, M.S.,[1] Alfred DeMaria, M.D.,[2] Elena N. Naumova, Ph.D. [1]

[1]*Tufts University School of Medicine, Boston MA*
[2]*Massachusetts Department of Public Health, Boston MA*

OBJECTIVES

The objective of this communication is two-fold: 1) to introduce an analytical approach for assessing temporal changes in the surveillance reporting with respect to population profile; and 2) to demonstrate the utility of this method using laboratory-confirmed cases for four reportable enteric infections (cryptosporidiosis, giardiasis, shigellosis, and salmonellosis) recorded by the Massachusetts Department of Public Health over the last 12 years. This new approach for assessing seasonal changes is based on comparison of gender-specific single-year age distributions, which constitute population profiles.

BACKGROUND

In the last decade, time series analysis has become one of the most important tools of surveillance systems. Understanding the nature of temporal fluctuations is essential for successful development of outbreak detection algorithms, aberration assessment, and to control for seasonal variations. Typically, in applying the time series methods to health outcomes collected over an extended period of time it is assumed that population profiles remain constant. In practice, such assumptions have been rarely tested. At best, the temporal analysis is performed using stratification by age or other discriminating factors if heterogeneity is suspected. Any community can experience population changes in various forms. Long-term trends of inflow/outflow migration and rapid transient fluctuations associated with specific events are typical examples of changes in population profile. Seasonality, as an intrinsic property of infectious diseases manifestation in a community, is typically attributed to periodic changes in transmissibility of pathogens. To some extent, seasonal fluctuations in the incidence of infectious diseases could also be associated with the changes in population profiles. The ability to detect and describe such changes would provide valuable clues into seasonally changing factors associated with an infection.

METHODS

We examined the decadal change of Massachusetts population by comparing single-year age distributions based on Census 1990 and 2000. Similarly, gender-specific single-year age distributions were calculated for all reported cases in the four infections. Next, sets of four time series of daily counts were compiled for each infection. Each set included time series for all population and three age groups (<18y, 18-64y, 65y+). To estimate daily rates we calculated daily population using linear inter/extrapolation for each time series. Next, we determined periods of seasonal increase for each infection using δ-method [1]. Finally, single-year age distributions of rates were calculated for the periods of seasonal increase (in-season rates) and for the rest of the year (off-season rates). The similarity in in-season and off-season rates was assessed via standard techniques for distribution comparison.

RESULTS

As expected, the highest rate averaged across all ages was observed in reported salmonellosis (1.256±0.837 cases per day per 1,000,000 persons), followed by giardiasis (0.764±0.497), shigellosis (0.133±0.162), and cryptosporidiosis (0.026±0.032). The single-year age-specific rates were well correlated among all four infections: Pearson correlation coefficients ranged from 0.94 (shigellosis vs giardiasis) to 0.63 (cryptosporidiosis vs salmonellosis), mostly due to the fact that for each infection, children (<5y) and adults (25-30y) exhibited high incidence rates. However, in all infections the similarity in population profiles became much weaker when in-season and off-season rates were compared primarily due to increased rates of infections in older individuals (>50y) during off-season periods. Our analysis indicates that traditionally pre-selected age breaks of 18 and 65 years are quite arbitrary to properly assess seasonal change in reported infections.

CONCLUSIONS

The proposed technique allows detailed assessment of temporal changes in the demographic profiles of surveyed populations over extended and short time periods. Such analysis provides valuable information for detecting age groups disproportionately affected by infections in different time periods. The method can be applied in various scenarios and readily available to supplement existing surveillance systems.

REFERENCES

[1] Naumova EN *et al*. Seasonality in six enterically transmitted diseases seasonality and ambient temperature. *Epidemiol. Infect*. 2007;136. (forthcoming)