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ABSTRACT

Estimating the number of deaths attributable to nine common infectious pathogens adjusted for seasonality and temperature

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Objective
Mortality exhibits clear seasonality mainly caused by an increase in deaths in the elderly in winter. As there may be substantial hidden mortality for a number of common pathogens,[1,2] we estimated the number of elderly deaths attributable to common seasonal viruses and bacteria for which robust weekly laboratory surveillance data were available.

Introduction
Accurately assigning causes or contributing causes to deaths remains a universal challenge, especially in the elderly with underlying disease. Cause of death statistics commonly record the underlying cause of death, and influenza deaths in winter are often attributed to underlying circulatory disorders. Estimating the number of deaths attributable to influenza is, therefore, usually performed using statistical models. These regression models (usually linear or poisson regression are applied) are flexible and can be built to incorporate trends in addition to influenza virus activity such as surveillance data on other viruses, bacteria, pure seasonal trends and temperature trends.

Methods
On weekly time series (1999–2007), we used Poisson regression models (which included linear and periodic components) to characterize the association of total death counts with trends in common seasonal viruses and bacteria (influenza A and influenza B, RSV, parainfluenza, enterovirus, rotavirus, norovirus, campylobacter and salmonella) adjusted for extreme outdoor temperatures and stratified by age. Model coefficients were used to calculate the numbers of deaths attributable to the various included pathogens.

Results
With increasing age, the number of pathogens (all viruses) significantly associated with mortality also increased: influenza A, RSV, influenza B and parainfluenza were significant contributors in individuals aged 75–85, and additionally norovirus in those aged 85 years and older. Adjusting for temperature decreased parameter magnitudes. Influenza attributable mortality was directly associated with mortality (that is, not lagged), while other viruses were associated with deaths 1–4 weeks later. Our most conservative models attributed 6.9% of all deaths in those aged 85 years and older to multiple winter viruses. The attributed proportion decreased with decreasing age (75–85 years: 3.6%; 65–75years: 1.5%; 55–65years: 1.1%), also because with decreasing age less viruses were significantly associated with death (but always including influenza A for which the estimated attributable overall mortality ranged from 2% in the eldest down to 0.6% in the youngest age group of 55–65 years) (Figure 1).

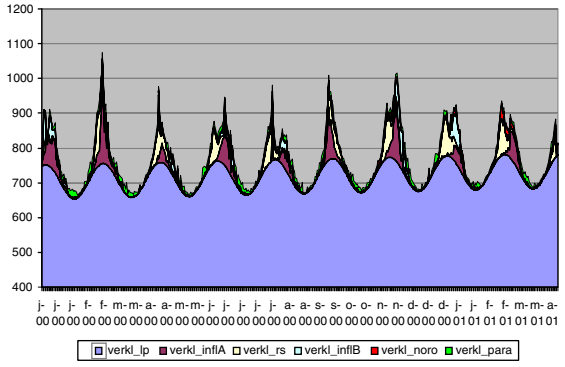

Figure 1 Modeled weekly deaths attributable to respiratory and gastrointestinal pathogens in individuals aged 85 years and older (stacked and adjusted for high temperature).

Conclusions
In the population of 55 years and older, the number of common viruses that were associated with overall mortality increased with increasing age to include: influenza A, respiratory syncytial virus, influenza B, norovirus and parainfluenza.

Together, these pathogens were associated with 6.9% of all deaths in the individuals aged 85 years and older.

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References

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