Make Invisible Infectious Disease Risks Visible

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His professional interests include the study of the effectiveness of pharmaceutical and non-pharmaceutical interventions against infectious disease. Using a variety of epidemiological methods and statistical/mathematical modelling, he aims to identify optimal public health strategies based on scientific data that can lead effective policy-making decisions.

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Infectious disease epidemiology

1. Estimating age- and region-specific excess mortality caused by influenza and respiratory syncytial viruses in Japan

Influenza and respiratory syncytial virus (RSV) infections greatly contribute to morbidity and mortality in humans, but such epidemiological impact is yet to be assessed in the super-aged nations using up-to-date methods. The present study aimed to estimate pandemic and winter-seasonal excess mortality rates associated with influenza and RSV across prefectures in Japan from 2006 to 2014.

We constructed a baseline using a generalized additive model that captures seasonal and long-term trends, and then estimated excess mortality rates associated with influenza and RSV using a (quasi-)Poisson regression model. Time series data were stratified according to age groups, underlying causes and prefectures. Statistical models were employed to assess the associations between excess mortality and socio-demographic, environmental and healthcare factors.

Across 8 seasons from 2006-2014, seasonal influenza was on average associated with around 5,000-6000 annual deaths, and similarly around 5,000 annual deaths in the 2009 influenza pandemic. RSV was associated with around 10,000-15,000 annual deaths. For both infectious diseases, excess mortality rates were highest among seniors, especially aged ≥ 80 years for seasonal influenza. Compared with our estimate of the actual number of excess deaths associated with the 2009 A/H1N1 influenza pandemic in Japan in 2009, the number of notified laboratory-confirmed deaths during the 2009 pandemic was much smaller. Smaller estimates of influenza-associated mortality for Japan were obtained, compared to published estimates over a decade ago. Moreover, our results revealed comparable mortality burdens exerted by RSV and influenza in Japan. In particular, seniors are disproportionately affected, especially those aged ≥ 80 years, indicating that a rapidly aging population could exacerbate mortality associated with these respiratory diseases. [1]

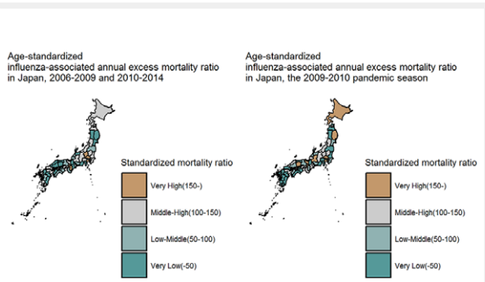

Figure 1

Influenza-associated annual excess mortality rates in Japan, 2006-2014 (Seasonal influenza and the 2009 pandemic)

2. Underlying dynamics of infectious diseases

Japan has made great strides improving the vaccination coverage against childhood infectious diseases and, in 2015, the World Health Organization (WHO) verified that the country had eliminated measles. However, in subsequent years several outbreaks originating from imported cases have been sporadically reported in Japan. An outbreak of measles was reported in Okinawa Prefecture during March to May 2018, with the first (index) case reported on 20 March. The index case was a foreign traveller who visited Okinawa and had onset of symptoms on 14 March during his stay. The outbreak was declared over on 11 June 2018. A number of cases presenting with modified measles as a result of insufficient protection against the disease were reported during the outbreak. As of 25 May 2018, there were a total of 99 autochthonous reported cases, primarily in Okinawa Prefecture. Using quantitative modeling, we quantified the transmission potential of measles according to symptomatic status (classic vs. modified measles) during the outbreak. Furthermore, we also found low ascertainment probabilities among those with modified measles. This supports the idea that intensified public health interventions should be implemented targeting this group in order to rapidly contain the outbreak. [2]

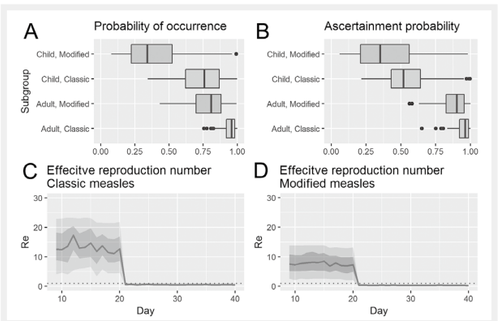

Figure 2

Probabilities of measles cases (A) occurrence, (B) ascertainment, and time–dependant effective reproduction number of (C) classic measles, (D) modified measles, Japan, 14 March–10 May 2018 (n=99))

3. Assessing the infectious disease transmission risk following natural disasters.

Predicting the impact of natural disasters such as hurricanes on the transmission dynamics of infectious diseases poses significant challenges. We put forward a simple modelling framework to investigate the impact of heavy rainfall events (HRE) on mosquito-borne disease transmission in temperate areas of the world such as the southern coastal areas of the United States. In particular, we explore the impact of the timing of HREs relative to the transmission season via analyses that test the sensitivity of HRE-induced epidemics to variation in the effects of rainfall on the dynamics of mosquito breeding capacity, and the intensity and temporal profile of human population displacement patterns. The recent Hurricane Harvey in Texas motivates the simulations reported. Overall, we find that the impact of vector-borne disease transmission is likely to be greater the earlier the HREs occur in the transmission season. Simulations based on data for Hurricane Harvey suggest that the limited impact it had on vector-borne disease transmission was in part because of when it occurred (late August) relative to the local transmission season, and in part because of the mitigating effect of the displacement of people. We also highlight key data gaps related to models of vector-borne disease transmission in the context of natural disasters. [3]

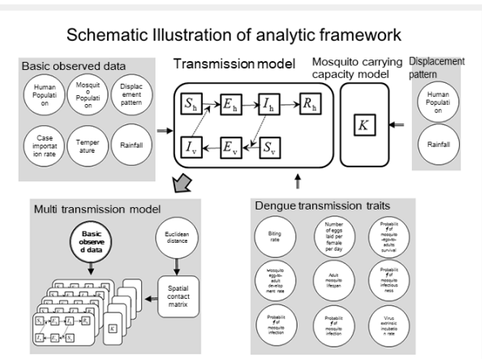

Figure 3

Schematic Illustration of analytic framework

References

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