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Research interests include:

- **Mathematical biology**
- **Mathematical epidemiology**

On-going GRF project

Pattern of influenza transmission and the implications of vaccination

Abstract

Influenza epidemics and pandemics have had a huge impact in the past and still pose a real threat nowadays. Influenza viruses evolve rapidly and spread among human and other species including avian, swine and equine. Vaccination is an effective control measure, and the virus components in the vaccine are updated annually. Vaccination policies and coverage vary across countries. It is unclear whether the differences in the vaccination policy have caused any large-scale spatio-temporal patterns of influenza transmission. Weekly laboratory-confirmations of samples from 138 countries are freely accessible via the World Health Organization (WHO) Influenza Surveillance Network (FluNet), which consist of influenza types A and B, subtypes H3N2, pre-pandemic H1N1 and H1N1pdm (the 2009 pandemic strain). Rich patterns of the emergence, displacement, co-existence and competition among different types and subtypes are vividly exhibited in these data. The impact of vaccination on the patterns of influenza spreading in these data has not been studied, to our knowledge. Our preliminary analysis indeed suggests a possible correlation. More specifically, we found that the H1N1pdm strain skipped the 2011/12 flu season in Europe and Eastern Asia, with an evidently low annual total compared to that of the previous and following flu seasons, whereas it showed consistently mild epidemics in Northern America. Using sophisticated mechanistic modeling and likelihood-based inference techniques, we propose to conduct an in-depth study of these patterns, to improve our understanding of the underlying mechanisms of the effect of consistent long-term vaccination on the large-scale patterns of influenza transmission across countries, the waning of immunity protection, and the interactions among different types and subtypes of influenza viruses.