

Contribution ID: 132

Type: Oral Presentation

Metapopulation epidemic model fitted to spatiotemporal spread of rubella in Japan, 2012-13

Thursday, 12 July 2018 10:30 (30 minutes)

Background: Japan experienced a nationwide rubella epidemic from 2012 to 2013, mostly in urban prefectures with large population sizes. The present study aimed to capture the spatiotemporal patterns of rubella using a parsimonious metapopulation epidemic model and examine the potential usefulness of spatial vaccination.

Methodology/Principal Findings: A metapopulation epidemic model in discrete time and space was devised and applied to rubella notification data from 2012 to 2013. Linearly approximating growth patterns in six different time periods using the particle Markov chain Monte Carlo method yielded estimates of effective reproduction numbers of 1.37 (95% CrI: 1.12, 1.77) and 1.37 (95% CrI: 1.24, 1.48) in Tokyo and Osaka groups, respectively, during the growing phase of the epidemic in 2013. The rubella epidemic in 2012 involved substantial uncertainties in its parameter estimates and forecasts. We examined multiple scenarios of spatial vaccination with coverages of 1%, 3% and 5% for all of Japan to be distributed in different combinations of prefectures. Scenarios indicated that vaccinating the top six populous urban prefectures (i.e., Tokyo, Kanagawa, Osaka, Aichi, Saitama and Chiba) could potentially be more effective than random allocation. However, greater uncertainty was yielded by initial seeds of infectious individuals, initial fraction susceptible and stochasticity.

Conclusions: While the forecast in 2012 was accompanied by broad uncertainties, a narrower uncertainty bound of parameters and reliable forecast were achieved during the greater rubella epidemic in 2013. By better capturing the underlying epidemic dynamics, possibly with age-dependent and prefecture-specific susceptibility distributions, spatial vaccination could potentially be substantially discriminated from random vaccination.

Primary authors: Dr NISHIURA, Hiroshi (Hokkaido University); Dr SAITO, Masaya (The Institute of Statistical Mathematics)

Presenter: Dr NISHIURA, Hiroshi (Hokkaido University)

Session Classification: Population heterogeneity and disease spread (Mathematical Epidemiology subgroup)

Track Classification: Minisymposium: Population heterogeneity and disease spread, Mathematical Epidemiology subgroup