**Deterministic modelling of infectious diseases: monitoring H1N1 virus in UK**

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In August 2010, after the influenza A/H1N1 outbreak in 2009, WHO announced the beginning of a post pandemic phase and encouraged development of monitoring and surveillance tools at national level.

UK Severe Influenza Surveillance System (USISS) [1] is a hospital based surveillance scheme for severe cases of influenza, through which all the severe cases admitted to Intensive Care Units (ICU) and High Dependency Units (HDU) in all NHS trusts are registered. Further, a sentinel scheme [2], run over a sample of trusts, collects individual level data on patients admitted to ICU/HDU and aggregate counts of cases admitted at all levels of care.

This work investigates the use of USISS data to estimate and monitor disease transmission.

Following from previous work on Influenza pandemic [3] a deterministic transmission model is formulated to approximate the disease dynamics in the population. An observational model links the weekly number of new ICU admissions to the transmission model. The aim of the analysis is the estimation of transmission parameters and, consequently, of the basic and net reproduction numbers R0 and Rn. The analysis is conducted within a Bayesian framework which combines, through hierarchical modelling, information from different sources and appropriately deals with missing information on the transmission processes.

Preliminary results are obtained by assuming very informative priors on all the parameters except for the infection rate. From season 2013/14, Rn is estimated to be 1:135 (CrI: 1.126 - 1.145).

Many challenges are still to be tackled, in particular: the problem of immunity and endemicity (since influenza is seasonal) and the issue of more general priors. A stochastic version of this model is also investigated.

**References**

1. PHE, *UK Severe Influenza Surveillance System (USISS) Protocol for all NHS Acute Trusts 2011-12* (2011).
2. PHE, *UK Severe Influenza Surveillance System (USISS) Protocol for sentinel Acute NHS Trusts 2011-12* (2011).
3. Birrell, P. J. et al. (2011). *Bayesian modeling to unmask and predict influenza A/H1N1pdm dynamics in London*. In: PNAS, November 8, 2011, vol. 108, no. 45, pages 18238–18243, doi: 10.1073/pnas.1103002108

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