Influenza transmission modelling with online model assessment, including detecting and accounting for conflicting evidence

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For a fast-moving infectious disease such as influenza, whether seasonal or pandemic, or a newly emergent infectious disease, the ability to quickly evaluate the current spread of disease is crucial for understanding and forecasting the burden, particularly severe burden, on public health services such as GPs and hospitals. Evidence synthesis approaches to influenza transmission and severity estimation (e.g. Birrell et al (2011, 2018), Presanis et al (2014)) lead to complex hierarchical models, possibly non-linear, based on multiple data sources that are observational, may be subject to selection and other biases, and may be arriving daily in the midst of an outbreak. Such data sources might include GP consultations for influenza-like-illness and sentinel surveillance of virological testing and hospital admissions, for example.

In such a context, it is important to understand the consistency of the model with each data source and of each data source with each other. Understanding such potential conflict, e.g. between model predictions and observations, is even more crucial when modelling transmission in real-time, to allow for rapid model adaptation and development to account for such conflict. Methods to assess predictive ability such as scoring rules (Held et al, 2017), which are highly related to the “conflict p-value” (Presanis et al (2013, 2018)), a posterior predictive approach to measure conflict, based on cross-validation approaches separating evidence into independent partitions, will be explored in the context of real-time estimation (Birrell et al (2018), Nemeth et al (2014)).

Further potential directions to investigate, in application to influenza transmission modelling, include: real-time evaluation of the value of each data source and decision-making (Jackson et al, 2018); adapting approximate computational approaches (e.g. Ferkingstad et al (2017)) or efficient model-building methods (Goudie et al, 2018) to the problem of systematic conflict assessment; or investigating the relationship between power to detect conflict and methods measuring the value of collecting more information.

This project would suit a student motivated by developing methods to solve substantive public health problems, that will have a direct impact on public health policy. The project will be carried out in close collaboration with the Respiratory and Statistics departments at Public Health England, and will interact with a NIHR-funded project on related topics in vaccine epidemiology in collaboration with Oxford and Harvard Universities.

**Start date:** Easter Term (April) or Michaelmas Term (October) 2019

All application queries regarding eligibility should be directed to phdstudy@mrc-bsu.cam.ac.uk

**How to Apply:** Applications should be made on-line via www.graduate.study.cam.ac.uk/applicant-portal selecting course details MDBI22 PhD in Biostatistics
Deadline for applications: 3rd January 2019