

**Title:** Application of agent-based models to better understand the transmission of respiratory infections and design strategies to control their spread

**Description:**

During the COVID-19 pandemic, mathematical and statistical modelling has been very useful in informing and advising policy decision making. Utilising existing methods across different disciplines and furnishing them with novel adaptations has been an important part of the pandemic response over the last three years. One stream of modelling that has been popularised during the pandemic is agent-based or individual-based models (ABMs/IBMs). Notably, Covasim [1] is an ABM that was developed in early 2020 to model the transmission of different SARS-CoV-2 strains and incorporate interventions such as contact tracing which are difficult to model with population-based compartmental models. Covasim has been widely used to track the COVID-19 epidemic across a number of countries. Notably in the UK it has been used to provide ongoing informed scientific advice to the UK Health Security Agency and the Department of Health and Social Care.

This BSP project will utilise the knowledge from the technical framework and the development of Covasim, to develop an England specific ABMs to model the transmission and vaccination against seasonal and pandemic influenza. The aim of the work is to adapt the design of Covasim to produce Flusim as a modular ABM taking care to include the specific characteristics of the seasonal/pandemic influenza vs SARS-CoV-2 variants, incorporate and test different social-contact networks and evaluate different vaccination strategies and antivirals use to mitigate transmission.

The work of the project will comprise:

- 1) Undertaking of a systematic review of seasonal and pandemic influenza existing models to synthesise knowledge and better understand the advantage of using an ABM over compartmental model for influenza transmission.
- 2) Learning how to use Covasim and how to adapt it to include influenza (both seasonal and pandemic) characteristics.
- 3) Developing of Flusim for England based the learning from 2) and using the transmission network modelled in [2], incorporating current knowledge of parameters in the model of how influenza spreads in England.
- 4) Test the impact of using different social networks within Flusim, while keeping the influenza characteristics the same.
- 5) Design different scenarios to capture different seasonal/pandemic influenza strains.
- 6) Design and evaluate the impact of different mitigation strategies (including immunisation and/or antivirals) against different influenza strains (including seasonal or pandemic) with application to England.

There is a scope to change/adapt/extent the above points if there is a direction that the student is particularly interested in exploring. Please get in touch with Jasmina if this is the case.

Outputs from the project could be used to offer informed advice to the Joint Committee for Vaccination and Immunisation (JCVI) who evaluate all the immunisation programmes in England.

**References:**

1. Covasim technical paper

<https://journals.plos.org/ploscompbiol/article/metrics?id=10.1371/journal.pcbi.1009149#citeHeader>

2. Modelling HPV in England <https://pubmed.ncbi.nlm.nih.gov/29307388/>

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