

# FIRST CSU MATHEMATICAL CONFERENCE

## CSUN, NOVEMBER 11-12, 2022

### PLENARY LECTURE II

#### *Modelling Immunity: Multi-scale Considerations*

**JANE HEFFERNAN**

*Immunity is gained from infection and vaccination, but effective immunity can also wane over time, with antibody and/or memory cell decay in the body, and with the evolution of a pathogen to more fit strains/variants. We have developed mathematical models of infection and immunity at the in-host and population levels. At the in-host level, we track the interaction of the immune system with a pathogen or vaccine proteins to quantify the generation of antibodies and memory cells in the body. We also estimate the probability of individual infection given particular immunity characteristics and pathogen immune escape mechanisms at the time of pathogen exposure. Results from the in-host models are used to inform immunity and infection severity dynamics in population-level models of pathogen spread and public health vaccination programs. In this talk, we will review in-host models of vaccination and infection, and we will provide an overview of infection and immunity incorporation into mathematical epidemiological models of disease spread and vaccination programs. Particular attention will be made to estimation of population seroprevalance with application to COVID-19.*

#### **Short Biography**

Dr Jane Heffernan is a Professor of Mathematics & Statistics at York University, Toronto, Canada, where she leads the Modelling Infection & Immunity Lab (Mi2). Dr Heffernan's research program centers on understanding the spread and persistence of infectious diseases in hosts and in populations, with a focus on studies of immunity and behavior change. Her expertise includes mathematical models of disease (including COVID-19, HIV, HCV, HSV, TB, measles, pertussis, and influenza), changes in behavior (i.e., vaccine uptake, social distancing), and forecasting health care demand (e.g., ward and ICU hospital beds). Dr Heffernan is a co-Director of the Canadian Centre for Disease Modelling, a member of the Royal Society of Canada's College of New Scholars, Artists and Scientists, an inaugural York Research Chair, and President-Elect for the international Society for Mathematical Biology. She leads national and international research groups in in-host and immunity modelling. During COVID-19, Dr Heffernan advised Health Canada, and the Canadian COVID Immunity Task Force on models of healthcare demand, infection, and vaccination. Recently, Dr Heffernan was named a Game Changer in Health Innovation and Health Research, for her work in Immunity Modelling.

