

# Canadian Centre for Disease Modelling Distinguished Lecture Series

## Modeling and Control of Infectious Diseases

### Harnessing Dynamical footprints to detect disease emergence



**Dr. Pej Rohani**

University of Georgia

**Thursday, December 10**

10:30 am - 11:30 am (Eastern Time)

**Webinar:** Connect at

<https://yorku.zoom.us/j/99459742714?pwd=cTA2Unp3VXR5SnozWTK4Vktxa24rdz09>

Also see announcement at [cdm.yorku.ca](http://cdm.yorku.ca)

**Abstract:** Developing methods for anticipating the emergence or re-emergence of infectious diseases is both important and timely, however traditional model-based approaches are stymied by uncertainty surrounding the underlying drivers. Here, we demonstrate an operational, mechanism-agnostic detection algorithm for disease (re-)emergence based on early-warning signals (EWS) derived from the theory of critical slowing down. Specifically, we used computer simulations to train a supervised learning algorithm to detect the dynamical footprints of (re-)emergence present in epidemiological data. Our algorithm was then challenged to forecast the slowly manifesting, spatially-replicated re-emergence of mumps in England in the mid-2000s and pertussis post-1980 in the US. Our method successfully anticipated mumps re-emergence four years in advance, during which time mitigation efforts could have been implemented. From 1980 onwards, our model identified resurgent states with increasing accuracy, leading to reliable classification starting in 1992. Additionally, we successfully applied the detection algorithm to two vector-transmitted case studies, namely outbreaks of dengue serotypes in Puerto Rico and a rapidly unfolding outbreak of plague in 2017 in Madagascar. Taken together, these findings illustrate the power of theoretically-informed machine learning techniques to develop early warning systems for the (re-)emergence of infectious diseases.

**Bio:** Pej Rohani is a professor of Ecology, Infectious Diseases and Bioinformatics at the University of Georgia. Research in his group has focused on the population biology of infectious disease systems, model-based inquiry of childhood disease systems and interactions among pathogens. His interdisciplinary work has been supported by grants, from a range of funding sources including the National Institutes of Health, the National Science Foundation, the Centers for Disease Control and Prevention and the Ellison Medical Foundation. Dr Rohani has coauthored a book published by Princeton University Press, edited a volume published by Oxford University Press and published more than 130 peer-reviewed publications. He is a fellow of the American Association for the Advancement of Science.

**Organizing committee:** Julien Arino (U Manitoba), Jacques Belair (U Montreal), Jane Heffernan (YorkU), Jude Kong (York U), Michael Li (U Alberta), Junling Ma (U Victoria) James Watmough (U NewBrunswick), Huaiping Zhu (Lead, York U)

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