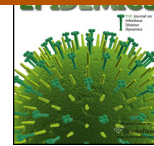




Epidemics

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Challenges in Modelling Infectious Disease Dynamics: Preface



This special issue of *Epidemics* arises from a research programme on 'Infectious Disease Dynamics' held at the Isaac Newton Institute for Mathematical Sciences in Cambridge, UK in August–September 2013, with a follow-up in May–June 2014.¹ This programme marked the 20-year anniversary of a 1993 programme on 'Epidemic Models' at the Newton Institute, which played a major role in consolidating progress and charting a path forward for the field. Many readers of *Epidemics* will be familiar with the three 'blue books' that gathered the insights from this seminal gathering (Mollison, 1995; Grenfell and Dobson, 1995; Isham and Medley, 1996). The 2013 programme began with a week-long symposium, at which an international roster of speakers described progress from the last 20 years and presented their vision of progress to come. This was followed by three weeks of close interactions and intensive discussions among a smaller group, focused on identifying the major challenges currently faced by the field. This volume presents the outcome of these and subsequent discussions.

Our aim is to provide a forward-looking summary of research and practice in infectious disease dynamics. Given the current state of the art, what are the most important challenges facing our field, and where are the most exciting breakthroughs likely to occur in the coming decade? To approach this aim, we identified a set of topics and themes that span the breadth of infectious disease dynamics. Teams of authors, which self-assembled from programme participants and the broader research community, were asked to formulate roughly 10 challenges for each topic. The challenges could pertain to methodological problems, key data needs for modelling, or conceptual issues, but they must be discrete and well-specified. Authors were specifically asked not to provide weighty reviews of their topic, but rather to cite a few select references that illustrate their points and provide essential background; these guidelines were enforced with limits on length and the number of citations. Given these parameters, the lists of challenges could not be exhaustive, but instead reflect the judgment

and insights of the author teams. All manuscripts were reviewed by at least two leading experts in the relevant field, with an eye to ensuring that the challenges were indeed important and clearly described, and that previous developments were recognized appropriately.

The papers are organised around modelling challenges emerging in the context of five major themes: Classes of Infections, Understanding Dynamics, Data Analysis and Integration, Modelling Methodology, and The Interface with Policy. We deliberately allowed overlap in content across papers to reflect that groups working on different problems often converge on the same issues, and to capture a range of perspectives on those central issues. For example, a major and welcome development in research in infectious disease dynamics over the past two decades has been the growth of closer collaboration between theoretical, applied and empirical researchers, and challenges at the interface of models and data and policy are raised throughout this volume. Another recurring theme is the essential habit of re-examining our most basic assumptions: what is a 'contact'? How much detail on population structure is needed to address a given question? What biological processes have been oversimplified, and when are simpler representations appropriate? How can we link dynamics occurring at different scales? The final paper highlights the universality and interconnectedness of challenges across subdisciplines, showing how challenges from many of the other papers can inform policy-relevant modelling of HIV, tuberculosis and malaria.

From the first conception of this special issue, the guiding principle has been to provide a collection of clearly posed problems that need solving, in the hope that graduate students, post-doctoral researchers, or others new to infectious disease dynamics will take up these challenges and advance the field. It will be a marker of success if many of the challenges described here are outdated in a decade or two – or at least are the subjects of review articles summarizing on-going progress – and if many major contributions came from researchers who are not presently known to the field. The authors in this issue, who include leading researchers in infectious disease dynamics from around the world, have been generous in sharing their best ideas about research priorities and potential paths to new insights. This exemplifies the spirit of collegiality that is so prevalent and so valuable in our field, and which arises in part from the relationships formed at the 1993 Newton Institute

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meeting. It is our hope that this special issue, and the research that it encourages, will strengthen this spirit and extend it to the many related disciplines that are increasingly woven into research on infectious disease dynamics. In this way we can best combine our efforts and talents to tackle problems of social and ecological importance, whether through fundamental advances or applied analyses of particular infectious disease problems. We look forward to being a part of this progress.

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