Joe Hilton

joe.b.hilton@gmail.com

Manchester Centre for Health Economics
Jean McFarlaneBbuilding
University of Manchester
M13 9PY

Profile

I am a research fellow based in the Manchester Centre for Health Economics (MCHE). My research to date has used mathematical modelling to address questions in public health, with a particular focus on the impact of social and spatial heterogeneities on the dynamics of infectious diseases.

Current position

2023-	**Research fellow in mathematical modelling, MCHE, University of Manchester, UK** Contributing mathematical modelling expertise to multiple projects in MCHE, mainly focussing on cost-effectiveness and environmental impact of screening programs and health interventions. Includes an affiliation with Manchester's Department of Mathematics, where I am attached to a Wellcome Trust-funded project on the epidemiology of COVID-19.

Past positions

2023-2024	**Postdoctoral research associate, Department of Livestock and One Health, University of Liverpool, UK** Research post attached to a project on avian influenza, specifically focusing on the use of machine learning methods to identify ecological factors associated with avian flu incidence in wild birds.
2019-2023	**Research Fellow, SBIDER, University of Warwick, UK** Employed on the NIHR-funded GeMVi grant and Wellcome Trust-funded CIMEA grant to combine mathematical modelling and bioinformatics to understand community-based spread of infectious diseases, in collaboration with the KEMRI-Wellcome Trust Research Programme in Kenya. From January 2020 onwards this post included modelling of the ongoing COVID-19 pandemic in both Kenya and the UK, as well as on the international scale.

Education

2015–2019	**PhD, MathSys CDT, University of Warwick, UK.** Thesis title: *Stochastic Models of Infectious Disease in Heterogeneous Populations.* Supervisors: Matt Keeling (University of Warwick) & Ian Hall (University of Manchester). Award: Full EPSRC Scholarship. Thesis available upon request.
2014–2015	**MSc in Mathematics of Systems with Distinction, University of Warwick, UK.** Group research project: The critical community size and extinctions for livestock diseases. Individual research project: Branching process models for weakly transmissible diseases. Award: Full EPSRC Scholarship.
2010–2014	**Master of Mathematics (MMath) with 1st class honours, University of Warwick, UK.** Research project: Levins metapopulation dynamics for stochastic populations.

Other research experience

2016	**Research Internship, University of Warwick, UK** Research topic: Modelling infection, household and demographic change. Supervisor: Matt Keeling. This work was funded by the EPSRC Global Challenges Research Fund and formed the basis for the endemic diseases section of my PhD.
2013	**Undergraduate Research Scholarship, University of Warwick, UK** Research topic: A numerical probability approach to rumour spreading with stifling complex contagion. Supervisor: Thomas House.

Teaching

2019–2021	Workshop coordinator: GeMVi Capacity Building Course, University of Warwick and KEMRI-Wellcome Trust. This was a remote learning course aimed at researchers based in East Africa consisting of seven half-day workshops. I was responsible for planning the overall structure of the course, as well as writing and delivering two of the workshops.
2017–2018	Teaching assistant: Population Dynamics, University of Warwick. Responsible for planning and leading weekly problem sessions for final year undergraduates and MSc students. Content focused on mathematical modelling in ecology and epidemiology, including compartmental models, spatial structure, and stochasticity.
2013–2014	Supervisor: 1st year undergraduate mathematics students, University of Warwick. Responsible for marking assignments and leading biweekly tutorial sessions for a group of four students. Topics covered included algebra, analysis, geometry and differential equations.
2011	Teaching assistant: 1st year undergraduate analysis classes, University of Warwick Responsible for providing support and guidance to first-year undergraduates working on analysis assignments in a classroom setting.

Supervision

July–August 2021	**Undergraduate Research Scholarship, University of Warwick, UK** Research topic: Modelling wellbeing during public health interventions. Student name: Joe Brooks

Skills and other training

Mathematical modelling	Epidemic modelling, stochastic processes, statistical inference.
Programming	Proficiency in R, Julia, Matlab, Python, experience in C++.
Research ethics	Completed the "Introduction to Research Ethics" course offered by TRREE. I also attended a two-day course during my PhD, during which I took part in group discussions on ethical issues in research and prepared and gave a presentation on ethical questions in vaccination policy.

Other Professional activities

SIAM Exec 2015–2017	Member of executive committee for Warwick's student chapter of the Society for Industrial and Applied Mathematics. Responsibilities focused on co-organising seminars and mini-conferences, including contacting speakers, promotion and arranging catering.

Research impact

May 2020–December 2021	Contributions to the UK's Scientific Pandemic Influenza Group on Modelling (SPI-M), advising on non-pharmaceutical interventions against COVID-19.
May 2020	Quoted in Times article "Coronavirus: Why some countries seem to have escaped its grip" on the impact of family structures on COVID-19 transmission.
March 2020	Preprint *"Estimation of country-level basic reproductive ratios for novel Coronavirus (COVID-19) using synthetic contact matrices"* listed in the collection "Scientific evidence supporting the government response to coronavirus (COVID-19)" on the `gov.uk` website.

Awards and grants

July 2021	School of Life Science Post-Doctoral Research Prize for the Faculty of Science, Engineering, and Medicine. Awarded by the university of Warwick in recognition of my work on COVID-19, specifically the paper *Estimation of country-level basic reproductive ratios for novel Coronavirus (SARS-CoV-2/COVID-19) using synthetic contact matrices*.
September 2020	IBM Science for Social Good grant. Grant of £20,000 awarded by IBM to support my research on models of non-pharmeceutical interventions against COVID-19.
December 2018	IMA Small Grant Scheme, awarded by the Institute of Mathematics and its Applications in order to fund my attendance at the 10th Swedish Meeting on Mathematics in Biology.

Presentations and conference contributions

July 2024	Contributed talk: *Identifying environmental and ecological risk factors for highly pathogenic avian influenza in wild birds* European Conference of Mathematical and Theoretical Biology, Toledo, Spain.
December 2023	Poster: *Analysing an outbreak of ebolavirus disease using stochastic simulation and Bayesian inference* Epidemics 9, Bologna, Italy.
November 2023	Online poster: *Mapping the risks of avian influenza outbreaks across Europe via machine learning* ESCAIDE, Barcelona, Spain.
September 2023	Poster: *Mapping the risks of avian influenza outbreaks across Europe via machine learning* 9th ESWI Influenza Conference, Valencia, Spain.
September 2023	Contributed talk: *Predicting avian flu outbreaks in Europe: what can ecological methods do for infectious disease modellers?* IDDconf, Ambleside, UK.
June 2022	Poster: *A household-structured approach to modelling interventions during the COVID-19 pandemic* Modelling the Covid-19 Pandemic: Achievements and Lessons event at the Royal Society, London, UK.
Dec 2021	Poster: *A household-structured approach to modelling interventions during the COVID-19 pandemic* Epidemics 8, Online conference.
Dec 2019	Contributed talk: *A household-structured approach to endemic infections* Epidemics 7, Charleston, USA.
Sept 2019	Contributed talk: *A household-structured approach to endemic infections* Workshop on Stochastic Modelling in Health & Disease, University of Leeds, UK.
Feb 2019	Invited seminar: *Endemic diseases with household structure and demography* Epidemiology seminar series, Imperial College London, UK.
Dec 2018	Contributed talk: *Endemic diseases with household structure and demography* 10th Swedish Meeting on Mathematics in Biology, Stockholm, Sweden.
Sept 2018	Poster: *Modelling endemic infections with households and demography* IDDconf, Ambleside, UK.
July 2018	Contributed talk: *Household models for endemic diseases* European Conference of Mathematical and Theoretical Biology, Lisbon, Portugal.
Dec 2017	Contributed talk: *Extending household models to endemic settings* Epidemics 6, Sitges, Spain.
Sept 2017	Poster: *Extending household models to endemic settings* Zeeman Institute Launch Event: Mathematical Challenges From The Life Sciences, Warwick, UK.
Sept 2017	Contributed talk: *Extending household models to endemic settings* Conference on Infectious Disease Dynamics, Ambleside, UK.
July 2017	Contributed talk: *Modelling near-critical diseases with branching processes* University of Melbourne-University of Manchester joint research workshop: New approaches to infectious disease modelling for epidemiological understanding and public health impact, Manchester, UK.
April 2017	Poster: *Modelling emerging diseases using branching processes* Conference: Developing efficient methodologies for modelling stochastic dynamical systems in biology, Bath, UK.
March 2017	Poster: *Modelling emerging diseases using branching processes* Public Health England Research and Applied Epidemiology Conference, Warwick, UK.

Publications

2024	**Hilton J**, Hall I *A beta-Poisson model for infectious disease transmission* PLoS Computational Biology 20(2).
2023	Brand SPC, Cavallaro M, Cumming F, Turner C, Florence I, Blomquist P, **Hilton J**, Guzman-Rincon LM, House T, Keeling MJ, Nokes DJ *The role of vaccination and public awareness in medium-term forecasts of Mpox incidence in the United Kingdom* Nature Commununications 14, 4100.
2022	**Hilton J** *et al* *A computational framework for modelling infectious disease policy based on age and household structure with applications to the COVID-19 pandemic* PLoS Computational Biology 18(9).
2021	Parisi A, Brand SPC, **Hilton J**, Aziza R, Keeling MJ, Nokes DJ *Spatially resolved simulations of the spread of COVID-19 in three European countries* PLOS Computational Biology 17(7).
2020	Leng, T., White, C., **Hilton, J.**, Kucharski, A., Pellis, L., Stage, H., Davies, N. G., Centre for Mathematical Modelling of Infectious Disease 2019 nCoV Working Group, Keeling, M. J., & Flasche, S. *The effectiveness of social bubbles as part of a Covid-19 lockdown exit strategy, a modelling study* Wellcome Open Research 5, 213.
2020	**Hilton J**, Keeling M *Estimation of country-level basic reproductive ratios for novel Coronavirus (SARS-CoV-2/COVID-19) using synthetic contact matrices* PLOS Computational Biology 16(7).
2019	**Hilton J**, Keeling M *Incorporating household structure and demography into models of endemic disease* Journal of the Royal Society Interface Volume 16, Issue 157.

Preprints (not yet peer reviewed)

2024	Hayes S, Hilton J, Mould-Quevedo J, Donnelly C, Baylis M, Brierley L *Ecology and environment predict spatially stratified risk of highly pathogenic avian influenza in wild birds across Europe* bioRxiv.
2020	Brand SPC, Aziza R, Kombe IK, Agoti CN, **Hilton J**, Rock KS, Parisi A, Nokes DJ, Keeling MJ, Barasa EW *Forecasting the scale of the COVID-19 epidemic in Kenya* medRxiv.