Joe Hilton

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Profile

I am a research fellow based in the Manchester Centre for Health Economics (MCHE). My research uses mathematical and statistical modelling to address questions in public health, with a particular focus on stochastic processes, statistical inference, and structured population models.

Current position

2023- **Research fellow in mathematical modelling, MCHE, University of Manchester, UK**
Contributing mathematical modelling expertise to multiple projects in MCHE, with a focus on cost-effectiveness 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.

2016 **Research Internship, University of Warwick, UK**
Research topic: Modelling infection, households and demographic change. Funded by the EPSRC Global Challenges Research Fund.

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.

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.

2013 **Undergraduate Research Scholarship, University of Warwick, UK**
Research topic: A numerical probability approach to rumour spreading with stifling complex contagion.

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

PHD	Bowen Yang, 2024 - present, modelling the health economic impact of hazardous opioid prescription. Joe Brooks, 2023 - present, developing inference methods for household-level epidemiological studies. Irene Garcia-Munoz, 2023 - present, developing simulation and inference techniques for longitudinal infection data.
Undergraduate	Joe Brooks, June - August 2021, modelling the wellbeing impact of infectious disease controls. Supported by Warwick's Undergraduate Research Scholarship program. Joe Brooks went on to publish this work in Reinvention: an International Journal of Undergraduate Research.

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.

Policy contributions and media

2020 – present	Contributions to the UK's Scientific Pandemic Influenza Group on Modelling (SPI-M) and the SPI-M Operational Subgroup (SPI-M-O), providing modelling input on non-pharmaceutical interventions against COVID-19 and situational awareness for MPox.
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

October 2025	JUNIPER fellowship scheme. Awarded by the JUNIPER epidemic modelling consortium to support leadership skills development, network building, and fellowship applications, including funding for travel to collaborators.
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. Awarded by IBM to support my research on models of non-pharmeceutical interventions against COVID-19. Value: £20,000
December 2018	IMA Small Grant Scheme, awarded by the Institute of Mathematics and its Applications to fund my attendance at the 10th Swedish Meeting on Mathematics in Biology. Value: £420

Conference contributions

January 2026	Invited talk: *Bringing mathematical models into health economic analyses: self-sampling for HPV* Workshop on Multiscale Modelling in Infectious Diseases, University of Warwick, UK.
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

2025 | Hayes S, **Hilton J** (joint first authorship with S. Hayes), Mould-Quevedo J, Donnelly C, Baylis M, Brierley L
Ecology and environment predict spatially stratified risk of H5 highly pathogenic avian influenza clade 2.3.4.4b in wild birds across Europe
Nature Scientific Reports 16, 997.

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)

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.