

# MICHAEL DAVID NICHOLSON

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*Last updated: October 2024*

## EDUCATION

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### University of Edinburgh

*Edinburgh, Scotland*

Doctor of Philosophy

November, 2018

Thesis title: *Applications of branching processes to cancer evolution and initiation*

Supervisors: Dr Tibor Antal (School of Mathematics), Dr Bartłomiej Waclaw (School of Physics and Astronomy)

### University of Edinburgh

*Edinburgh, Scotland*

Master of Mathematics (First Class Honours)

July 2014

## RESEARCH CAREER

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### School of Mathematics

*Edinburgh, Scotland*

### University of Edinburgh

*Chancellor's Fellow*

September 2024-present

Independent research focused tenure-track academic appointment.

Research overview: Mathematical modelling for somatic genomics, focusing on genome stability, cancer evolution, and ageing.

### Institute of Genetics and Cancer

*Edinburgh, Scotland*

### University of Edinburgh

*CRUK Cross-Disciplinary Research Fellow*

September 2020-August 2024

Research overview: Independent research fellowship developing mathematical methods to measure and understand mutation rate variation in cancer.

### Data Sciences, Dana-Farber Cancer Institute

*Boston, USA*

### Department of Biostatistics, Harvard T.H. Chan School of Public Health, and Department of Stem Cell and Regenerative Biology, Harvard University

*Postdoctoral Research Fellow*

September 2018-August 2020

Mentor: Professor Franziska Michor

Projects included: Pairing mathematical models of copy number alteration acquisition with single cell DNA sequencing from triple negative breast cancers, inference of transmission dynamics from genomic data in the spread of COVID-19.

### Image Analysis, Canon Medical Research Europe

*Edinburgh, Scotland*

*Research Intern*

June-August 2017

Supervisor: Dr Marco Razeto

Statistical methods for improving image registration.

### Program for Evolutionary Dynamics, Harvard University

*Boston, USA*

*Guest Researcher*

April-May 2015

Supervisors: Dr Tibor Antal, Professor Martin Nowak

Research focused on modelling metastasis in cancer. Funded by a Scottish University Physics Alliance grant.

### Modelling and Translational Biology, GlaxoSmithKline

*Ware, England*

*Research Intern*

July-September 2014

Supervisors: Dr Enuo He, Mrs Carole Shardlow

Modelling intracellular dynamics for drug specific targeting.

## PUBLICATIONS

\*denotes co-first author †denotes co-second author

‡denotes corresponding author □denotes co-senior author

Meritxell Brunet Guasch, Nathalie Feeley, Ignacio Soriano, Steve Thorn, Ian Tomlinson□, **Michael D. Nicholson**‡□, Tibor Antal□ (2024). *Quantifying “just-right” APC inactivation for colorectal cancer initiation*. Submitted.

Hanghui Ye\*, Thomas O McDonald\*, Emi Sei, Darlan Conterno Minussi, Min Hu, Chenling Tang, Junke Wang, Kaile Wang, Robert J Downey, Anna Casasent, **Michael D. Nicholson**, Hui Chen, Franziska Michor‡ and Nicholas Navin‡ (2024) *A pan-cancer single-cell analysis of intratumoral copy number diversity and evolution*. Submitted.

Craig J. Anderson\*, Lana Talmane, Juliet Luft, John Connelly, **Michael D. Nicholson**, Oriol Pich, Susan Campbell1, Vasavi Sundaram, Frances Connor, Paul A. Ginno, Liver Cancer Evolution Consortium, Núria López-Bigas, Paul Flicek, Colin A. Semple, Duncan T. Odom, Sarah J. Aitken, Martin S. Taylor (2024) *Strand-resolved mutagenicity of DNA damage and repair*. Nature, <https://doi.org/10.1038/s41586-024-07490-1>

**Michael D. Nicholson**‡, Craig J. Anderson, Duncan T. Odom, Sarah J. Aitken, Martin S. Taylor‡ (2024) *DNA lesion bypass and the stochastic dynamics of transcription coupled repair*. Proceedings of the National Academy of Sciences, <https://doi.org/10.1073/pnas.2403871121>.

**Michael D. Nicholson**‡, David Cheek, Tibor Antal (2023) *Sequential mutations in exponentially growing populations*. PLOS Computational Biology. <https://doi.org/10.1371/journal.pcbi.1011289>

Martin A.M. Reijns\*, David A. Parry\*, Thomas C. Williams\*, Ferran Nadeu, Rebecca L. Hindshaw, Diana Rios Szwed, **Michael D. Nicholson**, Paula Carroll, Shelagh Boyle, Romina Royo, Alex Cornish, Hang Xiang, Kate Ridout, The Genomics England Research Consortium, Colorectal Cancer Domain UK 100,000 Genomes Project, Anna Schuh, Konrad Aden, Claire Palles, Elias Campo, Tatjana Stankovic, Martin S. Taylor, Andrew P. Jackson (2022) *Signatures of TOP1 transcription-associated mutagenesis in cancer and germline*. Nature, <https://doi.org/10.1038/s41586-022-04403-y>

**Michael D. Nicholson**, Lukas Endler, Alexandra Popa, Jakob-Wendelin Genger, Christoph Bock, Franziska Michor, and Andreas Bergthaler (2021) *Response to comment on “Genomic epidemiology of superspreading events in Austria reveals mutational dynamics and transmission properties of SARS-CoV-2”*. Science Translational Medicine, <https://doi.org/10.1126/scitranslmed.abj3222>

Rachael R. Kirkbride, Emily Larkin, Mark Tuttle, **Michael D. Nicholson**, Brian G Jiang, Rokas Liubauskas, Jason Matos, Michael Gavin, Diana E Litmanovich (2021) *Quality and diagnostic performance of coronary computed tomography angiogram (CCTA): A comparison between pre-liver and pre-kidney transplant patients*. European Journal of Radiology, <https://doi.org/10.1016/j.ejrad.2021.109886>.

Darlan Conterno Minussi\*, **Michael D. Nicholson**\*, Hanghui Ye\*, Alexander Davis, Kaile Wang, Emi Sei1, Haowei Du, Mashiya Rabbani, Cheng Peng, Min Hu, Shanshan Bai, Thomas McDonald, Aislyn Schalck, Anna Casasent, Angelica Barrera, Hui Chen, Bora Lim, Banu Arun, Funda Meric-Bernstam, Franziska Michor, and Nicholas Navin (2021) *Breast tumours maintain a reservoir of subclonal diversity during expansion*. Nature, <https://doi.org/10.1038/s41586-021-03357-x>

Alexandra Popa\*, Jakob-Wendelin Genger\*, **Michael D. Nicholson**†, Thomas Penz†, Daniela Schmid†, Stephan W. Aberle†, Benedikt Agerer†, Alexander Lercher†, Lukas Endler, Henrique Colaco, Mark

Smyth, Michael Schuster , Miguel Grau, Francisco Martinez, Oriol Pich, Wegene Borena, Erich Pawelka, Zsofia Keszei, Martin Senekowitsch, Jan Laine, Judith H. Aberle, Monika Redlberger-Fritz, Mario Karolyi, Alexander Zoufaly, Sabine Maritschnik, Martin Borkovec , Peter Hufnagl, Manfred Nairz, Günter Weiss, Michael T. Wolfinger, Dorothee von Laer, Giulio Superti-Furga, Nuria Lopez-Bigas, Elisabeth Puchhammer-Stöckl, Franz Allerberger, Franziska Michor, Christoph Bock, and Andreas Bergthaler (2020) *Genomic epidemiology of superspreading events in Austria reveals mutational dynamics and transmission properties of SARS-CoV-2*. Science Translational Medicine, <https://doi.org/10.1126/scitranslmed.abe2555>.

Martín Carballo-Pacheco\*, **Michael D. Nicholson\***, Elin E. Lilja, Rosalind J.Allen, and Bartłomiej Waclaw (2020) *Phenotypic delay in the evolution of bacterial antibiotic resistance: mechanistic models and their implications*. PLOS Computational Biology, 16(5): e1007930. <https://doi.org/10.1371/journal.pcbi.1007930>

**Michael D. Nicholson**<sup>#</sup> and Tibor Antal (2019) *Competing evolutionary paths in growing populations with applications to multidrug resistance*. PLOS Computational Biology, 15(4): e1006866. <https://doi.org/10.1371/journal.pcbi.1006866>

**Michael D. Nicholson**<sup>#</sup> and Tibor Antal (2016) *Universal asymptotic clone size distribution for general population growth*. The Bulletin of Mathematical Biology, 78(11), 2243-2276. <https://doi.org/10.1007/s11538-016-0221-x>

### FUNDING

Cross-Disciplinary Fellowship from the University of Edinburgh	£200K
EPSRC PhD award	Tuition and stipend for 3.5 years
IMO 5 sponsorship	Flights, accommodation and subsistence
Scottish University Physics Alliance short term visits	£1650
Corporate sponsorship of mathematics society	£1300

### SUPERVISION

University of Edinburgh	
Xell Brunet Guasch (PhD Mathematics): secondary supervisor	2022-present
James Hayes (PhD Human Genetics): secondary supervisor	2023-present
Jessica Codling (PhD Mathematics): primary supervisor	2023-present
Caterina Lue (PhD Mathematics): secondary supervisor	2024-present

### PROFESSIONAL SERVICES AND MEMBERSHIP

- Referee for: Bioinformatics, Bulletin of Mathematical Biology, Journal of Statistical Physics, Theory in Biosciences, Journal of Biological Dynamics, Frontiers in Ecology and Evolution, PLoS Computational Biology
- Co-organiser: Mathematical Biology seminars, University of Edinburgh
- Membership: Society for Mathematical Biology

### PRESENTATIONS

- *DNA lesion bypass and the stochastic dynamics of transcription-coupled repair*  
Edinburgh Next Generation of Genomics Symposium 2024

- *DNA lesion bypass and the stochastic dynamics of transcription-coupled repair*  
Mutagenesis Gordon Research Seminar, New Hampshire, USA
- *Quantifying the stochastic dynamics of transcription-coupled DNA repair*  
(Invited) Mathematical Biology seminar series, University of Edinburgh, January 2024
- *Quantifying the dynamics of transcription coupled repair*  
(Invited) Michor lab, Dana-Farber Cancer Institute, July 2023
- *Quantifying the dynamics of transcription coupled repair*  
(Invited) Naxerova lab, Massachusetts General Hospital, July 2023
- *Quantifying the dynamics of transcription coupled repair*  
(Invited) Somatic Evolution and Tumour Microenvironment Symposium, The Crick, December 2022
- *Characterising the stochastic dynamics of transcription coupled repair via lesion-phasing and mathematical modelling*  
(Select meeting) Bertinoro Computational Biology Meeting, September 2022
- *Evolutionary timescales in exponentially growing clonal populations with rare mutations*  
(Invited) Conference: “Mathematical Models in Ecology and Evolution”, July 2022
- *Mutational bias versus selective advantage in the determination of cancer driving mutations*  
(Invited) Chakrabarti lab, NCBS Bangalore (online), May 2022
- *Transient instability in TNBC examined via single cell DNA sequencing and mathematical modelling*  
(Invited) Mathematics colloquium at City, University of London, November 2021
- *Transient instability in TNBC examined via single cell DNA sequencing and mathematical modelling*  
Cancer Research UK City of London Centre Cancer Evolution Symposium, September 2021
- *TBC. Postponed due to Covid-19 pandemic*  
(Invited) Queen Mary University of London complex systems seminar
- *Breast tumours maintain a reservoir of subclonal diversity during expansion*  
(Invited) Reiter lab & Naxerova lab joint meeting, Stanford & Harvard, May 2021
- *Power laws in growing populations: 2 seminars*  
(Invited) Nitzan lab & Ovchinnikov lab joint meeting, Harvard, March 2020
- *Competing evolutionary paths in growing populations with applications to multidrug resistance*  
(Invited) Dartmouth applied and computational mathematics seminars, March 2019
- *Competing evolutionary paths in growing populations with applications to multidrug resistance*  
(Invited) Harvard biomathematics initiative, March 2019
- *Competing paths over fitness valleys in growing populations*  
Conference: “Stochastic models of evolving populations: from bacteria to cancer”, July 2018
- *Competing paths over fitness valleys in growing populations* (poster)  
Summer School: “Mathematical perspectives in the biology and therapeutics of cancer”, July 2018
- *Competing paths over fitness valleys in growing populations*  
Conference: “Modelling Diversity in Cancer and Virus Evolution”, May 2018
- *Universal asymptotic clone size distribution for general population growth*  
Spring school: “Probability in mathematics and physics”, March 2017

- *Randomly initiated population models*  
Theory Club, School of Physics, Edinburgh, February 2017
- *Universal asymptotic clone size distribution for general population growth*  
Summer school: “Levy processes”, August 2016.
- *Universal asymptotic clone size distribution for general population growth*  
Edinburgh physics seminar, May 2016
- *Introduction to regularly varying functions*  
Edinburgh probability working seminar, April 2016
- *Generalised Luria-Delbrück models*  
Program for Evolutionary Dynamics seminar, Harvard, May 2015

## TEACHING EXPERIENCE

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University of Edinburgh	
UG BSc and MMath dissertation supervisor	2024/2025
Computational and Applied Mathematics MSc dissertation supervisor	2024

Varied undergraduate and graduate tutoring within Schools of Mathematics, School of Physics, and Institute of Genetics and Cancer.

## LEADERSHIP EXPERIENCES

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University of Edinburgh Mathematics Society	Edinburgh, Scotland
<i>President</i>	2012/2013