

BRODY H FOY

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EDUCATION

University of Oxford D.Phil in Computer Science (Computational Biology) Thesis Title: <i>Applied Mathematical Modelling of Pulmonary Function Tests</i> <i>Rhodes Scholarship</i>	<i>Oct 2015 - Sep 2018</i>
Queensland University of Technology B.Math (Hons) in Applied and Computational Mathematics GPA: 7.00 (out of 7.00) <i>University Medal</i>	<i>Jan 2011 - Dec 2014</i>

RESEARCH EXPERIENCE

Research Fellow <i>Systems Biology/Pathology Department</i>	<i>Harvard Medical School/Massachusetts General Hospital</i>	2018 - Present
<ul style="list-style-type: none">· Use machine learning to identify novel clinical diagnostic and prognostic signals.· Design mathematical models of blood cell dynamics to explore mechanistic responses to disease.· Design image analyse pipelines to investigate cell morphology changes during inflammatory events		
Co-Founder, Chief Technology Officer <i>Rhodes Artificial Intelligence Lab (RAIL)</i>		2016 - 2018 <i>Oxford, UK</i>
<ul style="list-style-type: none">· Founded a non-profit AI research consultancy for social impact projects.· Coordinated and supervised >30 graduate students on fast-paced interdisciplinary research projects.· Example projects: Improving homeless service delivery for the NYC government; Drug discovery with Public Health England; Moderating internet toxicity with Google Jigsaw.		
Research Assistant <i>School of Mathematical Sciences</i>	<i>Queensland University of Technology</i>	2015
<ul style="list-style-type: none">· Designed new computational and mathematical techniques for simulating fluid flow.		

SCHOLARSHIPS, FELLOWSHIPS, GRANTS

Postdoctoral

Mercatus FastGrants Program (Co-Author)	\$ 40,000	2020
One Brave Idea Grant (Co-Author)	\$180,000/yr	2019-2021
Schmidt Science Fellowship	Shortlisted finalist	2019

Postgraduate

Rhodes Scholarship	Full tuition and stipend	2015
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Undergraduate

AMSI Vacation Research Scholarship	\$ 6,000	2013
QUT Vice Chancellor's Scholarship	\$ 24,000	2011
QUT Dean's Scholarship	Full tuition	2011

TEACHING EXPERIENCE

Instructor 2018 - Present
Health Sciences & Technology Stream *Harvard Medical School*

- Teach sections on biomedical mathematical modelling and data analysis for MD candidates. Courses are cross listed at Massachusetts Institute of Technology (graduate level).

Instructor 2016 - 2018
Multiple Departments *University of Oxford*

- Taught graduate level mathematics courses in the interdisciplinary Doctoral Training Centre.
- Tutored undergraduate students in applied mathematics.

Lecturer, Assistant Unit Coordinator 2015
Science & Engineering Faculty *Queensland University of Technology*

- Lectured undergraduate courses in engineering and mathematics. Wrote lectures, and assessment.
- Coordinated team of >10 teaching assistants in subject with >800 student enrolment.
- Received QUT Teaching Excellence Award due to overwhelmingly positive student feedback.
- From 2011-2014 ran tutorials, sections and practicals for > 10 subjects across multiple faculties.

VOLUNTEER EXPERIENCE

Logistics Manager 2014 - 2015
Spur Projects *Brisbane, AUS*

- Developed and implemented mental health programming across Australia.
- Helped coordinated [How is the World Feeling?](#) an international campaign with over 10,000 participants.

State Director (QLD) 2013 - 2014
Left-Right Think-Tank *Brisbane, AUS*

- Ran state branch of youth policy think-tank.
- Coordinated large team through policy research, writing, and advocacy to state and federal government.

Founder, President 2012 - 2014
Mathematics Society *Queensland University of Technology*

- Founded society, and built to >200 members within 2 years.
- Organised student mentoring programs, social programs and successfully advocated for student-oriented changes to the mathematics degree structure.

HONORS

QUT Performance Excellence Award	2015
QUT Teaching Excellence Award	2015
QUT University Medal (top graduating student)	2014
QUT Student Leader of the Year	2013
QUT Volunteer of the Year	2013
Australian Student Prize (top 500 secondary school students in country)	2010

PROFESSIONAL ASSOCIATIONS

American Society of Hematology
American Mathematical Society
Association of American Rhodes Scholars
Australian Rhodes Scholar Association

PUBLICATIONS

My research is broadly focused on the use of computational tools to generate clinically translatable mechanistic insights about human disease. As a computationalist I translatably work on many bodily systems, with a primary focus on the hematologic, cardiac, and pulmonary systems. My full publication list can be found at [personal website](#) and my [google scholar](#).

Currently under review (authors + titles, major contributions only)

BH Foy*, JA Stefely*, PK Bendapudi, et al. Single-cell erythrocyte computer vision analysis provides novel diagnostic, prognostic, and mechanistic insight. (*Associated preliminary results won Harvard Medical School Pathology Department best poster award for 2022*)

KA Kooshesh, KGU Gustafsson, **BH Foy**, et al. The thymus is critical for adult immune function.

BH Foy, K Burrage, I Turner. A meshfree radial basis function method for simulation of multi-dimensional conservation problems.

Published articles

BH Foy, T Sundt, JCT Carlson, AD Aguirre, JM Higgins. 2022. Human acute inflammatory recovery is defined by co-regulatory dynamics of white blood cell and platelet populations. *Nature Communications*.

PM Miller, GG Fell, **BH Foy**, et al. 2022. Clonal hematopoiesis of indeterminate potential and risk of death from covid-19. *Blood*. (In Press).

MJ Schloss, M Hulsmans, D Rohde, I Lee, N Severe, **BH Foy**, et al. B lymphocyte-derived acetylcholine limits steady-state and emergency hematopoiesis. *Nature Immunology*. **23**(4): 605-618.

J Grune, AJM Lewis, M Yamazoe, M Hulsmans, D Rohde, L Xiao, S Zhang, C ott, DM Calcagno, Y Zhou, K Timm, M Shanmuganathan, FE Pulous, MJ Schloss, **BH Foy**, et al. 2022. Neutrophils incite and macrophages avert electrical storm after myocardial infarction. *Nature Cardiovascular Research*. **1**(7): 649-664.

SAB Verbanck, **BH Foy**. 2022. In asthma positive phase III slopes can result from structural heterogeneity of the bronchial tree. *Journal of Applied Physiology*. **132**(4): 947-955.

BH Foy, S Siddiqui. 2021. Shifting the focus to measuring early disease in the sm(all) airways. *Journal of Applied Physiology*. **131**(6): 1845-1846.

BH Foy, B Wahl, K Mehta, et al. 2021. Comparing COVID-19 vaccine allocation strategies in India: A mathematical modelling study. *International Journal of Infectious Diseases*. **103**: 431-438.

BH Foy, B Wahl. 2021. How do we best relax control measures as vaccine coverage rises for SARS-CoV-2 rises? *Lancet Regional Health-Western Pacific*. **15**.

PG Campbell, IB Stewart, AC Sirotic, C Drovandi, **BH Foy**, GM Minett. 2021. Analysing the predictive capacity and dose-response of wellness in load monitoring. *Journal of Sports Sciences*. **39**(12): 1339-1347.

SS Mukerji, S Das, H Alabsi, LN Brenner, A Jain, C Magdamo, SI Collens, E Ye, K Keller, CL Boutros, MJ Leone, A Newhouse, **BH Foy**, et al. Prolonged intubation in patients with prior cerebrovascular disease and COVID-19. *Frontiers in Neurology*. **12**: 642912.

BH Foy, JCT Carlson, E Reinertsen, et al. 2020. Association of red blood cell distribution width with mortality risk in adults hospitalized with COVID-19 infection. *JAMA Network Open*. **3**(9):e2022058.

BH Foy, A Li, JP McClung, R Ranganath, JM Higgins. 2020. Data-driven physiologic thresholds for iron deficiency associated with hematologic decline. *American Journal of Hematology*. **95**(3): 302-309.

- BH Foy**, D Kay, S Siddiqui, CE Brightling, M Paiva, S Verbanck. 2020. Increased ventilation heterogeneity in asthma can be attributed to proximal bronchioles. *European Respiratory Journal*. **55(3)**.
- S Cremer, MJ Schloss, C Vinegoni, **BH Foy**, et al. 2020. Diminished reactive hematopoiesis and cardiac inflammation in a mouse model of recurrent myocardial infarction. *Journal of the American College of Cardiology*. **75(8)**: 901-915.
- BH Foy**, BP Goncalves, JM Higgins. 2020. Unravelling disease pathophysiology with mathematical modeling. *Annual Review of Pathology: Mechanisms of Disease*. **15**: 371-394.
- BH Foy**, M Soares, R Bordas, et al. 2019. Lung computational models and the role of the small airways in asthma. *American Journal of Respiratory and Critical Care Medicine*. **200(8)** 982-991.
- BH Foy**, D Kay. 2019. A computationally tractable scheme for simulation of the human pulmonary system. *Journal of Computational Physics*. **388**: 371-393.
- AJ Bell, **BH Foy**, M Richardson, et al. 2019. Functional CT imaging for identification of the spatial determinants of small-airways disease in adults with asthma. *Journal of Allergy and Clinical Immunology*. **144(1)**: 83-93.
- BH Foy**, S Gonem, CE Brightling, S Siddiqui, D Kay. 2018. Modelling the effect of gravity on inert-gas washout outputs. *Physiologic Reports*. **6(10)**: e13709.
- BH Foy**, D Kay. 2017. A computational comparison of the multiple-breath washout and forced oscillation technique as markers of bronchoconstriction. *Respiratory Physiology & Neurobiology*. **240**: 61-69.
- BH Foy**, D Kay, R Bordas. 2017. Modelling responses of the inert-gas washout and MRI to bronchoconstriction. *Respiratory Physiology & Neurobiology*. **235**: 8-17.
- BH Foy**, P Perre, I Turner. 2017. The meshfree finite volume method with application to multi-phase porous media models. *Journal of Computational Physics*. **333**: 369-386.

RECENT PRESENTATIONS, SEMINARS AND POSTERS

- Grand Rounds: Adaptive patient benchmarking following cardiac surgery (and other inflammatory events). *Toronto Health Network*. 2022. (invited seminar).
- An automated red cell differential identifies diagnostic and prognostic signatures of hematologic disease. *Karolinska Institute, Huddinge Department of Medicine*. 2022. (invited seminar).
- Quantifying the hematologic dynamics of the human inflammatory response. *University of Melbourne, Department of Mathematical Biology*. 2021. (invited seminar).
- Physiologic phenotyping: the role of computational modelling. *American Thoracic Society Congress*. Virtual. 2021. (symposium speaker).
- Using mass balance equations to quantify properties of red blood cell production and growth. *Joint Mathematical Meetings Conference*. Virtual. 2021. (invited conference presentation).
- A combined computational-clinical approach to improving pulmonary function diagnosis. *Brigham and Women's Hospital, Applied Chest Imaging Laboratory*. Boston, USA. 2020. (invited seminar).
- Estimating the age of red blood cells through mathematical simulation: a validated population dynamics approach. *Joint Mathematical Meetings Conference*, Denver, USA. 2020. (conference presentation).
- Linking preoperative risk to postoperative outcomes using routine clinical measurements. *MIT, Computational Medicine*. Cambridge, USA. 2019. (invited seminar).
- Classifying inflammatory response using blood count trajectories and cell morphology. *Massachusetts General Hospital, Cardiac Surgery Division*. Boston, USA. 2019. (invited seminar).

A computational framework for simulating the human pulmonary system. *Queensland University of Technology, School of Mathematical Sciences*. Brisbane, AUS. 2018. (invited seminar).

RAIL: A model for social impact driven machine learning. *Bayesian and Big Data for Social Good Conference*, Marseille, FRA. 2018. (invited seminar).

Low frequency lung resistance is a global bronchoconstriction detection measure, but is still sensitive to small airways disease. *American Thoracic Society Congress*. 2017. San Diego, USA. (poster session).

Sacin responds to total compliance heterogeneity and is less sensitive to regionalisation than scnd. *American Thoracic Society Congress*. 2017. San Diego, USA. (poster session).

REVIEW

I have acted as a reviewer for many journals, including: Nature Human Behaviour, Annals of Internal Medicine, American Journal of Respiratory and Critical Care Medicine, JAMA Network Open, PLOS One, Lancet Regional Health, Respiratory Medicine, Respiratory Physiology and Neurobiology, Journal of Asthma, Journal of Computational Physics, Journal of Mathematical Biology.

REFEREES

Professor John M Higgins, MD
Systems Biology Department, Harvard Medical School
Department of Pathology, Massachusetts General Hospital
Relationship: Postdoctoral research advisor.
john_higgins@hms.harvard.edu

Associate Professor David Kay, PhD
Department of Computer Science, University of Oxford
Relationship: Doctoral thesis advisor
david.kay@cs.ox.ac.uk

Professor Salman Siddiqui, BM, FRCPF, PhD
Professor of Airway Disease and Respiratory Medicine
Leicester University and NIHR Respiratory Biomedical Research Unit
Relationship: Long standing research collaborator
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