

BRODY H FOY

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EDUCATION

University of Oxford 2015 - 2018

Doctor of Philosophy (Computer Science)

Thesis Title: *Applied Mathematical Modelling of Pulmonary Function Tests*

Rhodes Scholarship

Queensland University of Technology 2011 - 2014

Bachelor of Mathematics (Honors)

GPA: 7.00 (out of 7.00)

University Medal

RESEARCH EXPERIENCE

Assistant Professor 2024 - Present

Department of Laboratory Medicine & Pathology

University of Washington

- Running a computational research lab for improving bloodwork testing.
- Developing novel machine learning algorithms for blood marker analysis.
- Using biophysical models to generate mechanistic insights about human physiology.

Acting Assistant Professor 2023 - 2024

Department of Laboratory Medicine & Pathology

University of Washington

- Spent the first year at UW as an acting assistant professor. Duties were same as above.

Research Fellow 2018 - 2023

Systems Biology/Pathology Department

Harvard Medical School/Massachusetts General Hospital

- Use machine learning to identify novel clinical diagnostic and prognostic signals from bloodwork.
- Design mathematical models of blood cell dynamics to explore mechanistic responses to disease.

TEACHING EXPERIENCE

Instructor 2018 - 2023

Health Sciences & Technology Stream

Harvard Medical School

- Teach sections on biomedical 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

- Designed, lectured (2014-2015) and tutored (2011-2014) undergraduate courses in STEM.
- Coordinated team of >10 teaching assistants in subject with >800 student enrolment.
- Received QUT Teaching Excellence Award due to overwhelmingly positive student feedback.

VOLUNTEER EXPERIENCE

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|--|---|
| 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. | |
| Logistics Manager <i>Spur Projects</i> | 2014 - 2015 <i>Brisbane, AUS</i> |
| <ul style="list-style-type: none">· Developed and implemented mental health programming across Australia.· Helped coordinate How is the World Feeling? an international campaign with over 10,000 participants. | |
| State Director (QLD) <i>Left-Right Think-Tank</i> | 2013 - 2014 <i>Brisbane, AUS</i> |
| <ul style="list-style-type: none">· Ran state branch of youth policy think-tank.· Coordinated large team through policy research, writing, and advocacy to state and federal government. | |
| Founder, President <i>Mathematics Society</i> | 2012 - 2014 <i>Queensland University of Technology</i> |
| <ul style="list-style-type: none">· 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. | |

SCHOLARSHIPS, FELLOWSHIPS, AND FUNDING

Postdoctoral

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|---|--------------|-----------|
| Danaher (industry collaboration, Co-Author) | \$ 75,000 | 2021 |
| Mercatus FastGrants Program (Co-Author) | \$ 40,000 | 2020 |
| One Brave Idea Grant (Co-Author) | \$180,000/yr | 2019-2021 |

Postgraduate

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| Rhodes Scholarship | Full tuition and stipend | 2015 |
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Undergraduate

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

HONORS

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|---|------|
| 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 |

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 actionable tools that can create tangible benefit in the clinic. As a computationalist I translatable work on many bodily systems, with primary focus on the hematologic, cardiac, and pulmonary systems. My full publication list can be found at my [personal website](#) and [google scholar](#).

Intended research impact:

I care about using mathematics and computation to improve clinical practice and help patients. Medical practice involves collection of wide varieties of rich physiologic data, much of which is not utilized to its full potential. I want to improve how these data are utilized, for both operations and patient care.

Published articles

BH Foy, R Petherbridge, et al. 2023. Hematologic setpoints are a stable and patient-specific deep phenotype. *medRxiv*.

KA Kooshesh, **BH Foy**, et al. 2023. Health consequences of thymus removal in adults. *New England Journal of Medicine*. **389**(5): 406-417.

BH Foy*, JA Stefely*, PK Bendapudi, et al. 2023. Single-cell erythrocyte computer vision analysis provides novel diagnostic, prognostic, and mechanistic insight. *Blood Advances*. **7**(16): 4621-4630

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*. **13**(1): 4705.

PM Miller, GG Fell, **BH Foy**, et al. 2022. Clonal hematopoiesis of indeterminate potential and risk of death from covid-19. *Blood*. **140**(18): 1993-1997.

BH Foy, K Burrage, I Turner. 2022. A meshfree radial basis function method for simulation of multi-dimensional conservation problems. *Numerical Methods for Partial Differential Equations*. **39**(3): 2600-2629.

MJ Schloss, M Hulsmans, D Rohde, I Lee, N Severe, **BH Foy**, et al. 2022. 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 Verbancik. 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

Novel methods for adaptive inpatient benchmarking: the value of boring data. *University of Michigan, Department of Computational Medicine and Bioinformatics*. 2023. (invited seminar)

Time series analysis of high throughput hematologic data to define normality in abnormal settings. *University of California, San Francisco; University of California Berkeley, Computational Precision Health Department*. 2023. (invited seminar)

Novel methods for adaptive inpatient benchmarking: the value of boring data. *Yale University, Department of Biomedical Engineering*. 2023. (invited seminar)

Analysis of hematologic dynamics reveals novel and universal features of human inflammatory recovery. *University of Washington, Center for Cardiovascular Biology*. 2022 (invited seminar)

Grand Rounds: Adaptive patient benchmarking following cardiac surgery (and other inflammatory events). *Toronto Health Network, Cardiac Surgery Division*. 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).

Mathematical modelling of blood cell dynamics in acute and chronic disease settings. *University of North Carolina, Chapel Hill, Department of Mathematics*. 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. (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 scond. *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

Referees are available upon request.