David Rémy Bellamy

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Personal website
LinkedIn: drbellamy
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PhD Candidate in Medical Machine Learning

I am a Canadian PhD candidate in my final year of Epidemiology and Biostatistics at the Harvard School of Public Health. My interests are multifaceted, but in a health context I study medical phenotypes in terms of mathematical structures, such as (high-dimensional) vector spaces and graphs. I am currently working on machine learning methods for improving risk prediction models in healthcare. My application domain is currently the ICU, but my interests extend beyond healthcare and into AI research more generally. I am a highly capable self-starter, having acquired skills in software engineering, algorithm design and analysis, and higher mathematics independently. My formal training has been in the molecular sciences, epidemiology and statistics, but I am always in the process of learning new things.

SKILLS

Communication	English, French
Natural Sciences	Molecular biology, (epi)genetics
Quantitative Sciences	Deep learning, causal inference, statistics
Tools and Languages	Python (TF/Keras, PyTorch, Pandas, Numpy, etc.), R (tidyverse), Cloud (Azure)
	Git, Makefile, Slurm, Bash/Linux, LaTeX, MarkDown, SQL, unit testing, OOP

EDUCATION

Doctor of Philosophy in Epidemiology, Harvard University	Sep 2018 — Present
Masters of Science in Biostatistics, Harvard University	Sep 2018 — Present
Doctor of Philosophy in Biomedical Science, Harvard University	Sep 2016 — Jan 2018 (left)
Honours Bachelor of Science in Biochemistry, University of Ottawa, *summa cum laude*	Sep 2011 — May 2016

PUBLICATIONS

Published Articles

Deep Learning Methods for Proximal Inference via Maximum Moment Restriction   2022
NeurIPS 2022 Main Conference, Preprint here: arXiv

- Ben Kompa*, David Bellamy*, Tom Kolokotrones, James Robins, Andrew L. Beam.

A structural characterization of shortcut features for prediction   2022
European Journal of Epidemiology, Paper here

- David Bellamy, Miguel Hernan, Andrew L. Beam.

Evaluating Progress on Machine Learning for Longitudinal Electronic Healthcare Data   2020
Preprint here: arXiv

- David Bellamy, Leo Celi, Andrew L. Beam.
- Under preparation for submission to a conference.

Charity Care: Do Nonprofit Hospitals Give More than For-Profit Hospitals?   2020
Journal of General Internal Medicine, Paper here

- Joseph D. Bruch, David Bellamy.

Reciprocal cellular cross-talk within the tumor microenvironment promotes oncolytic virus activity   2015
Nature Medicine, Paper here

- Carolina S Ilkow, Monique Marguerie, Cory Batenchuk, Justin Mayer, Daniela Ben Neriah, Sophie Cousineau, Theresa Falls, Victoria A Jennings, Meaghan Boileau, David Bellamy, et al.

Manuscripts under Preparation

Extending Transformers to massive laboratory datasets in electronic health records   2022
Target journal: Nature Digital Medicine

- David Bellamy, Bhawesh Kumar, Cindy Wang, Andrew L. Beam.
- My first dissertation paper, coming soon.

Minimax optimization of the proximal inference bridge function   2023
Target conference: ICLR 2023

- David Bellamy*, Tom Kolokotrones*, James Robins, Andrew L. Beam.

Theoretical equivalence between the Transport algorithm and a simple set of graphical criteria   2023
Target conference: IJCAI 2023

- David Bellamy, James Robins.

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PolyMed: a massively multimodal Transformer for electronic health records   **2023**
Target conference: ICML 2023

- David Bellamy*, Anil Panepu*, Andrew L. Beam.

HONORS & AWARDS

2nd place in the Harvard LISH datathon   **Feb 2022**
- Placed second out of 60 teams from top US institutions doing a binary prediction task. Our solution used an ensemble of random forest and XGBoost models.

$1500 McMahon Fund   **Jan 2022**
- Awarded to attend a technical causal inference workshop at The Simons Institute, Theory of Computing.

$60,000 UCB Pharma Fellowship   **2021 — Present**
- Selected as the recipient by the Department of Epidemiology, to support the remainder of my PhD.

First place $1000 prize at Connecting Young Minds   **2015**
- Won first place at the University of Ottawa's research presentation competition by popular vote.

Canada's $8000 NSERC-USRA   **2013 & 2015**
- The Canadian Natural Sciences and Engineering Council offers undergraduate student research awards to top applicants.
- I conducted two summers of research with this funding.

OHRI's Best Summer Student Researcher   **2014**
- The Ottawa Hospital Research Institute awarded $500 to the most promising student.

J. Armand Bombardier $4000 Scholarship for Research Abroad   **2014**
- I moved to Boston in the fall of 2014 to conduct epigenetics research at Harvard Medical School.

First place at Healthcare Symposium   **2014**
- The University of Ottawa held a research presentation competition for healthcare.

Merit scholarship for exceptional standing   **2012 — 2016**
- The University of Ottawa awarded this to undergraduates in the top percentile of the grade distribution.

RESEARCH EXPERIENCE

PhD Candidate with Drs. Andrew Beam and Miguel Hernan   **July 2020 — Present**
Harvard School of Public Health   *Cambridge, MA*

- Completing my dissertation research in the Harvard CAUSALab.
- Developing novel deep learning architectures better-suited for medical data.
- Currently extending the Transformer model to handle continuous data.
- Also developing applications of deep learning algorithms in causal inference with Dr. James Robins.

PhD student with Dr. Elise Robinson   **Sep 2018 — July 2020**
Stanley Center for Psychiatric Research at Broad Institute   *Boston, MA*

- Began my PhD here, working on a massive factor analysis of the UK BioBank's questionnaire data.
- Modelled factor scores for each patient as a function of genetic markers.
- This permitted the discovery of novel SNPs associated with latent constructs like depression and anxiety.

PhD student with Dr. Eric Greer / Heritable epigenetics   **Sep 2016 — Dec 2016**
Harvard Medical School   *Boston, MA*

- Studied regulators of DNA methylation and how they influence transgenerational gene expression.
- Developed a screening assay using biochemical fractionation and an HPLC-MS methylation assay to discover new regulators.
- Performed a knock-out screen in *C. elegans* to assess transgenerational phenotypes.

Researcher with Dr. Kathryn Wright / Virology   **Sep 2015 — May 2016**
University of Ottawa   *Ottawa, Canada*

- Studied curcumin's inhibition of the HPIV3 virus's replication.

Researcher with Dr. Daniel Figeys / Mass spectrometry   **May 2015 — Aug 2015**
Ottawa Institute of Systems Biology   *Ottawa, Canada*

- Developed a mass spec.-based technique for identifying novel low molecular weight peptides in the hypothalamus and hippocampus of Mus musculus for applications to human disease profiling.

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Researcher with Dr. Yang Shi / Epigenetics   Sep 2014 — Dec 2014
Boston Children's Hospital   *Boston, MA*

- Studied the epigenetic factors in the myeloid differentiation block in acute myeloid leukemia.
- Conducted high-throughput RNAi and chemical inhibitor screens of chromatin-regulating enzymes.
- Followed up the screen with CRISPR knockouts of promising candidates.

Researcher with Dr. John Bell / Viral cancer therapy   Jan 2014 — Aug 2014
Ottawa Hospital Research Institute   *Ottawa, Canada*

- Conducted a high-throughput RNAi screen of a virus library in search of enhancer miRNAs.
- Cloned candidate miRNAs into clinically approved oncolytic viruses (VSV & MG-1).
- Performed *in vitro* and *in vivo* testing of cloned viruses.

Researcher with Dr. Darrin Richeson / Inorganic chemistry   May 2013 — Sep 2013
Chemistry department, University of Ottawa   *Ottawa, Canada*

- Designed the synthesis of a high molecular weight ligand, capable of binding Rhenium ions.
- The Rhenium-ligand complex was tested for its capacity to reduce CO_2 to formic acid when stimulated by UV.

Mentorship Experience

Cindy Wang / Harvard Undergraduate in CS & Pre-Med   June 2021 — Present
- Held weekly meetings from her freshman year onwards.
- We are currently collaborating on a deep learning project.

Bhawesh Kumar / Harvard MSc student in Health Data Science   Sep 2021 — Present
- Held weekly meetings throughout his MSc.
- We are currently collaborating on a deep learning project.

Michael Smith / Harvard MSc student in Epidemiology   Sep 2021 — Present
- Held monthly meetings throughout his MSc.
- I help formalize his research interests in causality and machine learning.

Denys Shay / Harvard PhD student in Epidemiology   Sep 2021 — Present
- I am his assigned "epi buddy."
- I have helped him pick courses for the first 2 years of his PhD in Epidemiology.

Zhaoxun Hou / Harvard MSc student in Epidemiology   Sep 2021 — Present
- I am his assigned "epi buddy."
- I have helped him pick courses and prepare applications to Biostatistics PhD programs.

Sarthak Agarwal / Matriculating PhD student in Nutritional Epidemiology   Oct 2021 — Present
- I edited his application to the HSPH PhD program and he was accepted.

Brandon Spiegel / Data Scientist at Qventus   Oct 2021 — Present
- A data scientist in the private sector who I have educated on causality, ML and graduate education.

Teaching Experience

Deep Learning Teaching Fellow   March 2022 — May 2022
Harvard EPI290 / BMI707

- Worked as a teaching fellow with Drs. Andrew Beam and Kun-Hsing Yu in the main course on deep learning at the Harvard Medical campus.
- This course used Tensorflow/Keras.

Epidemiology Department Tutor   Feb 2022 — May 2022
Harvard School of Public Health

- Tutored Masters students in Epidemiology for statistics, learning R, and the core epidemiologic methods courses (EPI201/202/289/203/204).

Epidemiology & Biostatistics Teaching Fellow   June 2021 — Aug 2021
Harvard ID207 & ID208

- Assisted Drs. Brian Healy and Pamela Rist in the full-time summer foundations course for the Masters of Public Health in Epidemiology.
- Led programming tutorials for students to learn how to analyze data with STATA.

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Biochemistry Teaching Fellow (French)   Jan 2016 — April 2016
University of Ottawa BCH2333
- Gave sections for the core second year class in Biochemistry in French (150 students).

ACTIVITIES

Journal reviewer
- Nature Communications, Nature Scientific Data, uOttawa Journal of Medicine.

Harvard student mental health representative
- Assisted Dr. Paul Barreira in tailoring a mental health survey to the Population Health Sciences PhD students.

Biochemistry curriculum representative
- Provided perspectives on biochemistry learning objectives and course content.
- Participated in redesigning the undergraduate biochemistry curriculum at the University of Ottawa.
- Helped create a more research-focused biochemistry degree.