Kate M. Bubar

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Education

University of Colorado at Boulder (expected Summer 2024)
PhD in Computer Science
Certificate in Interdisciplinary Quantitative Biology
Advisor: Dan Larremore (daniel.larremore@colorado.edu)

University of Colorado at Boulder 2019–2022
M.S. in Applied Math

Colorado School of Mines 2015–2019
B.S. in Applied Math and Statistics (*summa cum laude*)
Emphasis in Computational and Applied Math
Advisor: Cecilia Diniz Behn (cdinizbe@mines.edu)

Honors and Awards

BioFrontiers Outstanding Contribution Award 2023
NSF Graduate Research Fellowship, $37,000/year for 3 years Awarded 2021
Outstanding Graduating Senior in Applied Math 2019
Mines Undergraduate Research Fellowship 2018–2019
President's Scholarship, Mines 2015–2019
Dean's List, all semesters at Mines 2015–2019

Research Experience

National Science Foundation Graduate Research Fellow Boulder, CO
University of Colorado at Boulder 2020-Present

- Developed and implemented an age-structured SEIR model to evaluate vaccine prioritization strategies for COVID-19. Ran sensitivity analyses over a wide range of parameters to understand how policy recommendations might vary depending on vaccine properties and location.
- Developed and implemented an SEIR model stratified by immune status to explore SARS-CoV-2 transmission in populations with mixed vaccination status in order to evaluate the impact of vaccinate-or-test policies.
- Developed a general probabilistic modelling framework to evaluate the effectiveness of traveler screening for emerging infectious diseases with state-of-the-art molecular diagnostics. Characterized a fundamental limit to the effectiveness of traveler screening that holds for all pathogens and tests.

Complex Systems Summer School Participant Santa Fe, NM
Santa Fe Institute June 2023
Fully funded by Biofrontiers' Interdisciplinary Quantitative Biology Program ($4,500)

- Led a team of highly interdisciplinary scientists including sociologists and political scientists in developing a network model of individuals' perceptions of political polarization.
- Led a team of highly interdisciplinary scientists including linguists and ecologists in developing an agent-based model to describe the spatial and temporal dynamics of dialect formation in languages.

Graduate Research Assistant Boulder, CO
University of Colorado at Boulder 2019-2020
Fully funded by Biofrontiers' Interdisciplinary Quantitative Biology Program ($32,000)

- Completed three interdisciplinary rotation projects with professors from Computer Science, Applied Math and Molecular, Cellular and Developmental Biology.
- Developed an innovative approach to measure the diversity in short read genomic data to account for the lack of assembled malaria *Var* genes.
- Explored the theory and implementation of the parameter cascading method for parameter estimation of partial differential equations with the goal of applying this approach to PDE models in ecology and economics.
- Learned wet lab techniques like PCR to gain insight into the capabilities and constraints of experimental biology while contributing to an ongoing project focused on understanding which proteins are correlated with the innate immune response.

Computational Sciences Intern Los Alamos, NM
Los Alamos National Lab Summer 2019

- Cleaned and analyzed data from Marburg virus epidemics in a general spatial and temporal infectious disease transmission model to estimate epidemiological parameters of Marburg virus.

Undergraduate Research Assistant Golden, CO
Colorado School of Mines 2017-2019

- Implemented the Kuramoto model in Matlab to study *Per2* gene effects on circadian rhythm synchronization in *Per2* knockout and wildtype mice.
- Explored relationship between melatonin secretion offset and sleep timing between female adolescents with PCOS and control group using linear regression.
- Implemented a one-compartment differential equation model of glycerol dynamics during an oral glucose tolerance test to quantify adipose insulin resistance in adolescents.

Colorado Summer Institute in Biostatistics Participant Denver, CO
University of Colorado Anschutz Medical Campus Summer 2018
Selected participant, fully funded by CoSIBS program

- Characterized the lung microbiome of mechanically-ventilated patients as part of a pilot study describing pediatric patients' susceptibility to ventilator-acquired pneumonia.

Publications

[1] **K.M. Bubar***, C. Middleton*, K. Bjorkman, R. Parker, and D. B. Larremore, "SARS-CoV-2 transmission and impacts of unvaccinated-only screening in populations of mixed vaccination status", *Nature Communications*, vol. 13, pp. 1–11, 2022.

[2] **K.M. Bubar**, S. M. Kissler, M. Lipsitch, S. Cobey, Y. Grad, and D. B. Larremore, "Model-informed COVID-19 vaccine prioritization strategies by age and serostatus", *Science*, vol. 371, no. 6532, pp. 916–921, 2021.

[3] D. B. Larremore, B. K. Fosdick, **K.M. Bubar**, S. Zhang, S. M. Kissler, C. J. E. Metcalf, C. Buckee, and Y. Grad, "Estimating SARS-CoV-2 seroprevalence and epidemiological parameters with uncertainty from serological surveys", *eLife*, vol. 10, e64206, 2021.

[4] C. D. Behn, E. S. Jin, **K. Bubar**, C. Malloy, E. J. Parks, and M. Cree-Green, "Advances in stable isotope tracer methodology part 1: Hepatic metabolism via isotopomer analysis and postprandial lipolysis modeling", *Journal of Investigative Medicine*, vol. 68, no. 1, pp. 3–10, 2020.

[5] D. B. Larremore, **K.M. Bubar**, and Y. H. Grad, "Implications of test characteristics and population seroprevalence on 'immune passport' strategies", *Clinical Infectious Diseases*, 2020.

[6] S. L. Simon, L. McWhirter, C. Diniz Behn, **K.M. Bubar**, J. L. Kaar, L. Pyle, H. Rahat, Y. Garcia-Reyes, A.-M. Carreau, K. P. Wright Jr, *et al.*, "Morning circadian misalignment is associated with insulin resistance in girls with obesity and polycystic ovarian syndrome", *The Journal of Clinical Endocrinology & Metabolism*, vol. 104, no. 8, pp. 3525–3534, 2019.

Presentations

Invited Talks

- Fundamental Limits to the Effectiveness of Traveler Screening with Molecular Tests. October 2023
  Colorado School of Mines Applied Math Colloquium
- COVID-19 vaccine prioritization strategies by age and serostatus. December 2021
  University of Cambridge Optimal Vaccination Strategies Workshop
- COVID-19 vaccine prioritization strategies by age and serostatus. January 2021
  UF Center for Statistics and Quantitative Infectious Diseases Working Group
- Vaccine prioritization strategies. January 2021
  Dana Farber Cancer Institute Data Science Zoominar
- Using models of SARS-CoV-2 dynamics to inform vaccine prioritization. July 2020
  WHO SAGE Working Group on COVID-19 vaccines

Contributed Talks and Presentations

- Fundamental Limits to the Effectiveness of Traveler Screening with Molecular Tests. September 2023
  IDDconf 2023
- A model-informed approach for COVID-19 vaccine prioritization. November 2022
  CU Boulder Meet a Data Scientist Series
- Evaluating the impact of immunosenescence on vaccine prioritization. May 2021
  MIDAS Annual Meeting
- Model-informed COVID-19 vaccine prioritization strategies by age and serostatus. October 2020
  UCSD COVID-19 Dynamics and Evolution Conference
- Estimating the overlap between malaria parasite sequence reads. October 2019
  University of Colorado Boulder Mathematical Biology Seminar
- EpiGrid: A hybrid mode for disease spread. July 2019
  Los Alamos National Lab 2019 Theoretical Division Lightning Talk Series
- Characteristics of the lung microbiome in mechanically ventilated PICU patients. September 2018
  Colorado School of Mines Mathematical Biology Seminar

Posters

- Fundamental Limits to the Effectiveness of Traveler Screening with Molecular Tests. November 2023
  Epidemics conference
- Fundamental Limits to the Effectiveness of Traveler Screening with Molecular Tests. May 2023
  Ecology and Evolution of Infectious Disease conference
- SARS-CoV-2 Transmission and Impacts of Unvaccinated-Only Screening in Populations of Mixed Vaccination Status. September 2022
  MIDAS Annual Meeting
- Modeling glycerol dynamics during an oral glucose tolerance test. April 2019
  Mines Undergraduate Research Symposium
- Modeling glycerol dynamics during an oral glucose tolerance test. January 2019
  Nebraska Conference for Undergraduate Women in Math

Teaching Experience

University of Colorado at Boulder

Teaching Assistant, Calculus II — Fall 2020

Colorado School of Mines

Guest lecturer, Mathematical Biology — October 2020
Teaching Assistant, Mathematical Biology — Spring 2019
Teaching Assistant, Mathematical Biology — Fall 2017
Teaching Assistant, Honors Differential Equations — Spring 2017
Teaching Assistant, Honors Calculus III — Fall 2016

Coursework

University of Colorado at Boulder, 2019-present

CSCI5352 Network Analysis and Modeling (Python)
CSCI5423 Biologically-inspired Multi-agent Systems (NetLogo)
CSCI7000 Computational and Mathematical Modeling of Infectious Diseases
CSCI5854 Foundations of Autonomous Systems (C++, Matlab)
STAT5530 Mathematical Statistics (R)
APPM5560 Markov Processes (R)
APPM5720 Data-driven Modeling (Matlab)
APPM5440 Applied Analysis I and II
APPM5600 Numerical Analysis I and II (Matlab)
MCDB5520 Bioinformatics and Genomics
MCDB5312 Quantitative Optical Imaging (Matlab)
MCDB3160 Infectious Diseases
GRAD5000 Responsible Conduct of Research

Santa Fe Institute Complex Systems Summer School, June 2023

Intensive four-week introduction to complex behavior in mathematical, physical, living, and social systems

Summer Institute in Statistics and Modeling in Infectious Diseases, July 2021
University of Washington, funded by MIDAS Coordination Center.

Reconstructing Transmission with Genomic Data
Stochastic Epidemic Models with Inference
Pathogen Evolution, Selection and Immunity

Colorado School of Mines (selected courses), 2015-2019

MATH307 Introduction to Scientific Computing (Matlab)
MATH331 Mathematical Biology (Matlab)
MATH334 Introduction to Probability
MATH408 Computational Differential Equations
MATH455 Partial Differential Equations
MATH484 Mathematical and Computational Modeling (Matlab)
MATH498 Spatial Processes in Biology (Matlab)
MATH510 ODEs and Dynamical Systems

MATH514 Applied Math I
CSCI261 Programming Concepts (C++)
CSCI262 Data Structures (C++)

Colorado Summer Institute in Biostatistics (CoSIBS), Summer 2018
University of Colorado Denver

Introduction to Methods used in Biostatistics
Introduction to the Theory of Biostatistics

University of Queensland (Brisbane, Australia)
Study abroad, Spring 2018

Mathematical Statistics
Bifurcations and Chaos
Australian terrestrial environment
Australian marine environment

Aarhus Summer University (Aarhus, Denmark)
Study abroad, Summer 2017

Exploring Cultural Big Data

Selected Press

"The Hard Lessons of Modeling the Coronavirus Pandemic." *Quanta Magazine.* January 28, 2021.

"Colorado researchers contribute to the fight against COVID-19." *The Denver Channel.* December 14, 2020.

"COVID-19 vaccines poised for launch, but impact on pandemic unclear." *Nature News.* November 25, 2020.

"What Is the Best Strategy to Deploy a Covid-19 Vaccine?" *Undark Magazine.* November 18, 2020.

Professional Service and Extracurricular Activities

Participant, Volleyball of the Rockies beach volleyball leagues and tournaments	2019-present
Panelist, Society of Women in Math Conference, Colorado School of Mines	November 2023
Seminar Coordinator, BioFrontiers Quantitative Exploration and Discussion Group	2020–2023
Peer Mentor, CU Graduate Student Association	2021–2022
Reading Group Coordinator, Association for Women in Mathematics at CU Boulder	2019–2022
Secretary and Fundraising Chair, Alpha Phi Omega (National Co-ed Service Fraternity)	2016-2019
Participant and Risk Manager, Club Volleyball, Colorado School of Mines	2015–2018
Member, Society of Women in Math, Colorado School of Mines	2016–2019