

# Alexander Beams

Graduate Teaching Assistant  
University of Utah  
Department of Mathematics  
LCB 326  
Salt Lake City, UT 84112

Phone: (801) 913-9416  
Email: alex.beams@hsc.utah.edu

## Education

PhD Mathematics, 2018-Present, University of Utah

H.B.S. Mathematics with a Minor in Chemistry *Cum Laude*, University of Utah 2015.

## Personal Statement

On the mathematical side, my main interests are in nonlinear dynamics, while I am mainly curious about evolution and ecology on the biological side. Studying transmission dynamics of pathogens provides an opportunity to do both of these things, and that has been the focus of most of my research to date. During my undergraduate studies I researched antibiotic resistance evolution and gained valuable experience with mathematical models under the guidance of my mentor Dr. Frederick Adler. That project resulted in my first peer-reviewed publication, which is in the *Bulletin of Mathematical Biology*, and I had the opportunity to travel to the Mathematical Biosciences Institute at The Ohio State University to present my work. At the time I graduated from college, I was interested in going to medical school to become a physician. Ultimately, I decided that I was more interested in pursuing research. During my time in graduate school, I have continued thinking about drug resistance evolution, but have since branched out to start thinking more about viruses as well. I have had some more exposure to Bayesian and Monte Carlo methods, and have learned to use some of the techniques from the field of applied mathematics, like bifurcation analysis and perturbation theory. Being a student in mathematical biology at the University of Utah also means that I have learned a lot of new biology from my peers, whose interests range from cellular physiology to fluid dynamics. In the coming years I plan to hone my skills developing models, analyzing them, and comparing them to data to gain insight into complex adaptive biological systems.

## Honors & Awards

Phi Kappa Phi Honor Society

Pi Mu Epsilon Honor Society

Undergraduate Research Scholar

Dean's List, Fall 2011-Spring 2015

Honors at Entrance Scholarship, August 2011

UROP Assistantship, Spring & Summer 2014

Utah Math Department REU, Fall 2014 & Spring 2015

## Employment

Division of Epidemiology - Biostatistician I, January 2018- August 2018

Univeristy of Utah School of Medicine

Intermountain Healthcare - Phlebotomist, 2016-2018

## Research Experience

**Undergraduate** Under the guidance of Dr. Frederick Adler, I studied the dynamics of antibiotic resistance evolution, specifically considering how coinfecting hosts carrying both antibiotic resistant and susceptible bacteria determine whether susceptible and resistant strains can coexist, or one drives the other to extinction. Our model predicts that it could be possible to manage resistance levels through selective antibiotic use, reserving strong doses for individuals who are unlikely to harbor resistant organisms. Our paper, "Harnessing Intra-Host Strain Competition to Limit Antibiotic Resistance: Mathematical Model Results" was published in the Bulletin of Mathematical Biology in 2016, not long after I graduated from college. During the course of my work, I received two REU's from the Math Department and two UROP Assistantships.

**Graduate** As a graduate student, I continued working with Dr. Frederick Adler, who is my advisor now. I have worked on a variety of projects in close coordination with Dr. Adler, as well as Drs. Damon Toth and Lindsay Keegan, who have appointments in the Division of Epidemiology. The first project of graduate school uses Hidden Markov Models to estimate the rate of *Staphylococcus aureus* (SA) transmission between healthcare workers. I used previously published longitudinal data of SA carriage to estimate exposure rates and carriage durations of the organism. We recently submitted a manuscript to the American Journal of Epidemiology titled "Staphylococcus aureus Carrier Types are not Evidence of Population Heterogeneity". After the COVID-19 pandemic began, I had the opportunity to help mentor one of Dr. Adler's undergraduate REU students to study the long-term severity of SARS-CoV-2 infections. We characterized the situations under which SARS-CoV-2 will attenuate in severity over time. We have a paper published in Viruses under the title "Will SARS-CoV-2 Become Just Another Seasonal Coronavirus?". Since then I have been working to develop simplified mathematical models of interactions between SARS-CoV2 and other respiratory pathogens like human rhinovirus. Recently, Dr. Adler and I began a collaboration with BioMerieux to study their TREND data, which contains results of respiratory viral panels which can detect rhinovirus, seasonal coronaviruses, influenza, SARS-CoV-2, and others.

## Departmental Service

GSAC co-chair Fall 2020 - Fall 2021

GSAC colloquium chair, Fall 2021 - Spring 2022

## Publications

Alexander B. Beams, Lindsay T. Keegan, Frederick R. Adler, Matthew H. Samore, Karim Khader, and Damon J.A. Toth, *Staphylococcus aureus* Carrier Types are not Evidence of Population Heterogeneity, 2021, under review at *The American Journal of Epidemiology*

Alexander B. Beams, Rebecca Bateman, and Frederick R. Adler, Will SARS-CoV-2 Become Just Another Seasonal Coronavirus?, 2021, *Viruses* 13,5.

Alexander B. Beams, Damon J.A. Toth, Karim Khader, and Frederick R. Adler, Harnessing Intra-Host Strain Competition to Limit Antibiotic Resistance: Mathematical Model Results, 2016, *Bulletin of Mathematical Biology* 78, 1828.

Damon J. A. Toth, Alexander B. Beams, Lindsay T. Keegan, Yue Zhang, Tom Greene, Brian Orleans, Nathan Seegert, Adam Looney, Stephen C. Alder, and Matthew H. Samore, High variability in transmission of SARS-CoV-2 within households and implications for control, 2021, *PLoS One* 16, 11.

Hannah R Meredith, Emerson Arehart, Kyra H Grantz, Alexander Beams, Theresa Sheets, Richard Nelson, Yue Zhang, Russell G Vinik, Darryl Barfuss, Jacob C Pettit, Keegan McCaffrey, Angela C Dunn, Michael Good, Shannon Frattaroli, Matthew H Samore, Justin Lessler, Elizabeth C Lee, and Lindsay T Keegan, Coordinated strategy for a model-based decision support tool for coronavirus disease, Utah, USA, 2021, *Emerging Infectious Diseases* 27, 5.

Damon JA Toth, Karim Khader, Alexander Beams, and Matthew H Samore, Model-based Assessment of the Effect of Contact Precautions Applied to Surveillance-detected Carriers of Carbapenemase-producing Enterobacteriaceae in Long-term Acute Care Hospitals, 2019, *Clinical Infectious Diseases* 69, Issue Supplement 3.

Bishav Bhattarai, Sierra Quinn Sahulka, Aditi Podder, Soklida Hong, Hanyan Li, Eddie Gilcrease, Alex Beams, Rebecca Steed, and Ramesh Goel, Prevalence of SARS-CoV-2 genes in water reclamation facilities: From influent to anaerobic digester, 2021, *Science of the Total Environment* 796.

## Courses Taught

Math 1180 Lab TA, Spring 2022

Math 1170 Lab TA, Fall 2021

## Funding Sources

Modeling and Simulation to Support Epidemiological Decision-Making in Healthcare Settings (MIND - Healthcare)/CC/CDC HHS/United States

August 2018 - April 2020, and January-August 2021

Mathematically modeling the impact of viral interactions and evolution on the COVID-19 pandemic, COVID-19 Special Emphasis Award from the University of Utah VPR/University of Utah

May 1 - Dec 31 2020