



The Death and Life of Bacterial Infections

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Healthcare Infections & Antibiotic Resistance

- **Healthcare-associated infections:**
 - ~ 1.7 million HAIs in US per year (1 in 25 US hospital patients)
 - ~ 100k deaths in US per year (5-10% absolute attributable mortality)
 - limit the success of surgery, cancer treatment, organ transplantation
- HAIs drive an **epidemic of antibiotic resistance:**
 - 2.8 million antibiotic-resistant infections in US per year
 - 35,000 deaths from AR infections in US per year

A New Paradigm for Bacterial Infection

- High-throughput sequencing: a new lens on complex microbial communities
- Fecal microbiota transplant (FMT): "ecobiotic" therapies exert large effects
- **A new molecular epidemiology of infectious diseases:**
 - new microbiome measures & interventions
 - reframe familiar outcomes and exposures (e.g., antibiotics)
 - integrate methods and tools from microbial ecology
 - need for new modeling and computational approaches

Studies & Key Findings

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Methods
Resources &
Collaborations

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Future
Directions

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Bacterial pneumonia during critical illness

- 3 prospective cohort studies (K23 NIAID, CDC BAA 2016, CDC BAA 2018)
- respiratory microbiome → pneumonia; commensal bacteria reduce infection risk

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- randomized trial of fecal transplant (CDC - Lautenbach PI)

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COVID-19

- bacterial superinfection, antibiotic use and resistance (CDC - Lautenbach PI)
- molecular epidemiology of SARS-CoV-2 ~ vaccination (Kelly PI, Wiebe Co-I)

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Measurement: Director, Antibiotic Resistance Epidemiologic Studies (ARES) Laboratory

- bacterial culture, microbiome & whole genome sequencing
- ARES lab investigators: Kelly / Lautenbach / David / Ziegler / Anesi
- collaborations with microbiology (Bushman, Abt, Zackular)

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Modeling: Multilevel Bayesian Regression for Microbiome Data

- collaboration with Dr. Jason Roy (DBEI → Rutgers University): mediation

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Teaching: EPID 674: Measuring the Microbiome

- created & co-direct course (Dr. Kyle Bittinger, PCMP)

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- spatial component to molecular epidemiology of infectious diseases
- collaboration with Doug Wiebe & SpaceTimeEpi Group

