UNIVERSITY OF CAMBRIDGE
Department of Veterinary Medicine

Department of Veterinary Medicine: PhD Project

Project Title: Deciphering the emergence of opportunistic pathogens in the human gut microbiome

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Project details: Our intestinal tract is colonised by a diverse community of commensal microorganisms with beneficial roles to human health. However, many microbial species naturally inhabiting the human gut have the potential to cause disease (deemed opportunistic pathogens). This switch from commensal to pathogen can occur for various reasons, including a compromised host immune system, depletion of the commensal microbiome, and acquisition of virulence/pathogenic traits. Some of the most notable examples of opportunistic pathogens are bacterial species belonging to the Enterobacteriaceae family, such as Escherichia coli and Klebsiella pneumoniae. A huge body of research has focused on characterising the biological functions of these organisms in a clinical setting to identify the main factors underlying their pathogenicity. However, much less is known about the variants that are circulating asymptomatically in the human population and how they differ from their pathogenic counterparts.

This project will leverage a large-scale dataset of over 30,000 global human gut metagenomes to uncover the hidden diversity, function, and ecology of opportunistic pathogens colonising healthy individuals worldwide. Using a combination of computational genomics methods, phylogenetics, multivariable statistics and machine learning, this work will identify the main genetic and functional traits distinguishing pathogenic from non-pathogenic lineages of known Enterobacteriaceae species with the potential to cause severe disease. Candidate genes and functions may be further experimentally characterized depending on the student's interest and experience. These data will then be further contextualized with the composition of the gut microbiome from the same individuals to identify evidence of colonisation resistance and better understand how the commensal microbiome influences pathogen evolution and adaptation. By characterising the bacterial populations asymptomatically carried in humans and their associated microbiomes, this project will provide a more complete view of the background diversity and function of enteric pathogens in urgent need of new treatments, paving the way for the development of targeted approaches to treat and mitigate disease onset and emergence.

Funding: This project is open to self-funding students or students wishing to apply for the Cambridge Postgraduate Funding competition. More info here: https://www.postgraduate.study.cam.ac.uk/funding-overview/university-funding

How to apply: Contact the Supervisor (aa2369@cam.ac.uk) to discuss the project before submitting an official application. More here on application process here: