PhD Project Advertisement

Project No/title: FBS2026 70 Siggins sr / *Engineering next-generation bacterial vaccines that target lymph nodes to combat infection and AMR*

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Project Details

Antimicrobial resistance (AMR) is one of the most serious and rapidly intensifying threats to global health, food systems, and modern medicine. Preventing infections through vaccination is a key strategy to slow AMR, but many bacterial vaccines do not generate strong or long-lasting immunity.

Across both humans and livestock, lymph nodes are the body's hubs for building long-lasting immune protection. Delivering more antigen to lymph nodes over a longer period produces stronger protection, but current vaccine approaches rarely achieve this.

This project builds directly on our *Nature Communications* discovery that certain pathogenic bacteria move through the lymphatic system and reach lymph nodes, where long-lived immune responses are formed. Using these insights, we are engineering harmless bacteria into lymph-node-homing vaccines designed to generate stronger and longer-lasting immune protection than conventional approaches. This work will advance accessible, low-cost, next-generation solutions to tackle AMR in global health and food production.

Research aims: To engineer and validate a low-cost, lymph-node-targeting bacterial vaccine. We aim to show that this accessible technology drives stronger, longer-lasting immunity against infections, creating a platform with exciting potential to improve global health and tackle AMR across both humans and livestock.

What you will do:

Objective 1: Engineering lymph-node-targeting bacterial vaccines. The student will refine a safe, food-grade bacterium into an improved vaccine vector by optimising antigen expression, secretion, and biosafety. They will gain hands-on experience designing and engineering bacterial strains and using molecular microbiology approaches to shape and test how these vaccines maximise lymph node delivery.
Objective 2: Determining how lymph-node-targeted vaccination enhances immunity. The student will lead investigation of how engineered vaccines activate the immune system, quantifying antibody, T-cell, B-cell, and long-lived plasma-cell responses, and evaluating protection in mouse challenge models. They will use cutting-edge methods, including lymph-node organoid culture, high-parameter flow cytometry, confocal imaging and AI-driven analysis. The student will validate results in a translational oral vaccination study in pigs, gaining valuable experience in mucosal immunity and livestock vaccinology.

Their research will uncover the immunological mechanisms that drive stronger, broader, and longer-lasting vaccine responses and support translational advances in vaccines targeting AMR.

References:

1. Siggins MK, Lynskey NN, Lamb LE, Johnson LA, Huse KK, Pearson M, Banerji S, Turner CE, Woollard K, Jackson DG, Sriskandan S. Extracellular bacterial lymphatic metastasis drives Streptococcus pyogenes systemic infection. Nat Commun. 2020 Sep 17;11(1):4697. doi: 10.1038/s41467-020-18454-0. PMID: 32943639; PMCID: PMC7498588.

2. Siggins MK, Sriskandan S. Bacterial Lymphatic Metastasis in Infection and Immunity. Cells. 2021 Dec 23;11(1):33. doi: 10.3390/cells11010033. PMID: 35011595; PMCID: PMC8750085.
3. Pollard AJ, Bijker EM. A guide to vaccinology: from basic principles to new developments. Nat Rev Immunol. 2021 Feb;21(2):83-100. doi: 10.1038/s41577-020-00479-7.
4. Siggins MK, Thwaites RS, Openshaw PJM. Durability of Immunity to SARS-CoV-2 and Other Respiratory Viruses. Trends Microbiol. 2021 Jul;29(7):648-662. doi: 10.1016/j.tim.2021.03.016.
5. Bachmann MF, Jennings GT. Vaccine delivery: a matter of size, geometry, kinetics and molecular patterns. Nat Rev Immunol. 2010 Nov;10(11):787-96. doi: 10.1038/nri2868. PMID: 20948547.
6. Vekemans J, Hasso-Agopsowicz M, Kang G, Hausdorff WP, Fiore A, Tayler E, Klemm EJ, Laxminarayan R, Srikantiah P, Friede M, Lipsitch M. Leveraging Vaccines to Reduce Antibiotic Use and Prevent Antimicrobial Resistance: A World Health Organization Action Framework. Clin Infect Dis. 2021 Aug 16;73(4):e1011-e1017. doi: 10.1093/cid/ciab062. PMID: 33493317; PMCID: PMC8366823.

Student profile

Essential for project: A background in biological sciences, including microbiology, immunology, molecular biology, veterinary or animal sciences, food science, or related fields. An interest in immunity, infection, or vaccines.
Desirable for project: Prior laboratory or data analysis experience. We welcome applicants from diverse backgrounds; full expert guidance and training in all techniques will be provided.
Minimum requirements for all FoodBioSystems applicants: An upper 2nd class degree (or equivalent) in a subject relevant to the project. Candidates with a lower class of bachelor's degree, but merit or above at master's level will also be considered**.** Demonstrable skills in problem-solving, team-working, communication and time management.

Training

Project specific training opportunities: This PhD provides expert interdisciplinary training across molecular biology, microbiology, immunology, AI, and vaccinology. The student gain experience with cutting-edge molecular, cellular, imaging, and computational techniques, including molecular cloning, tissue organoid culture, flow cytometry, confocal microscopy, and AI-driven analysis. They will receive full Home Office certification and training for work with mouse and pig models. The supervisory team—Dr Matthew Siggins, Dr Marie Lewis, Dr Jorge Gutierrez-Merino, and Prof Christine Rollier—offers leading expertise and an excellent track record of high-impact research, strong research culture, and successful student development. The student will benefit from collaboration opportunities with experts at Imperial College London and APHA, along with support to attend conferences and present work. They will receive backing to apply for pilot funding and fellowships to develop research ideas. A PIPS placement, with options including the British Society for Immunology and Zoetis-vHive, will open pathways to academia, industry, and the wider biosciences.

FoodBioSystems training opportunities: Throughout their studentship, all FoodBioSystems doctoral researchers participate in cohort training that covers four key themes: food systems, big data (data analytics and modelling), business, and research fundamentals. All doctoral researchers complete a placement: either project-related with a non-academic (CASE) partner, or unrelated to the project and outside the academic environment (PIPS). Details of training are available on the DTP website: https://research.reading.ac.uk/foodbiosystems/training/.

Project supervision style

The PhD student will be supervised by Dr Matthew Siggins (UoS, lead), with co-supervision from Dr Marie Lewis (UoR), Dr Jorge Gutierrez-Merino (UoS), and Professor Christine Rollier (UoS). Weekly one-to-one meetings with the lead supervisor, MS, will support research design, data interpretation, and training goals. The full supervisory team will meet every four months to review milestones and coordinate work. The student will participate in fortnightly lab meetings and maintain a shared digital lab notebook for open, reproducible practice. A lab handbook, developed at induction, will define expectations, communication, and authorship. Written feedback will be provided within two weeks for short work and four weeks for longer. Formal annual reviews, with the supervisory team and assessors will formally monitor progress. Wellbeing will be prioritised with quarterly check-ins, and signposting to UoS resources. The student will be supported to identify an independent senior and peer mentor for additional guidance and development.

Stipend (Salary)

FoodBioSystems DTP students receive an annual tax-free stipend (salary) that is paid in instalments throughout the year. For 2025/26 this is £20,780 and it will increase slightly each year at rate set by UKRI.

Equity Diversity and Inclusion

The FoodBioSystems DTP is committed to equity, diversity and inclusion (EDI), to building a doctoral researcher (DR) and staff body that reflects the diversity of society, and to encourage applications from under-represented and disadvantaged groups. Our actions to promote diversity and inclusion are detailed on the FoodBioSystems DTP website and include:

- Offering reasonable adjustments at interview for shortlisted candidates who have disclosed a disability or specific learning difference.
- Guaranteed interview and applicant mentoring schemes for applicants, with UK home fees status, from eligible under-represented ethnic groups who also meet academic eligibility criteria and the student profile essential for the project.

These are opt-in processes**.**

Our studentships can be offered to home students on a part-time basis, and studentship end date and stipend payments will be amended to reflect the part-time registration. The minimum registration for DTP funded part-time students is 0.5 FTE (studying an average of 20 hours per week over 8 years). We regret that part time registration is not available to international students due to complexities of visa restrictions.

Funding note

We welcome applications from candidates with Home/ROI fees and international fees status. This studentship is funded by UKRI and covers stipend, fees at Home/ROI rate, and research costs. The host university will not charge UKRI funded international students the difference between Home/ROI fees and international fees.
Costs that must be found from other sources or met by the individual student include: visa fees, healthcare surcharge, relocation costs and guarantor services.

For up to date information on funding eligibility, studentship rates and part-time registration, please visit the FoodBioSystems website.