Project Details	
Project Code	MRCPHS26Br Bayliss
Title	Protecting UK public health by identifying high-risk international routes of foodborne disease transmission
Research Theme	PHS
Project Type	Dry lab
Summary	Illness caused by contaminated food is a major threat to public health and the economy in the UK. This project focuses on Salmonella enterica, a leading cause of foodborne illness, to understand how international food trade networks contribute to outbreaks and the spread of antimicrobial resistance. The successful student will integrate cutting-edge genomic data, food network analysis, and risk modelling to develop tools for outbreak prevention, enabling public health agencies to act more quickly and effectively. This interdisciplinary project offers excellent training in bioinformatics, data science, and public health policy, preparing students for impactful careers in infectious disease research.
Description	Zoonotic foodborne pathogens, which spread from animals to humans, have significant public health and economic impacts, affecting an estimated 2.4 million UK residents annually and costing the economy approximately £9.1 billion. As demand for animal-derived products and fresh produce — both vectors for gastrointestinal (GI) pathogens — continues to grow, infection rates are expected to rise. This is further exacerbated by increased level of antimicrobial resistant (AMR) pathogens found in imported food products. However, there is limited understanding of the role global food trade networks play in spreading GI pathogens and AMR internationally or how these imported foodstuffs contribute to local UK disease incidence and foodborne disease outbreak risks. Addressing these knowledge gaps could help inform more effective public health policies for managing foodborne disease outbreaks. This project focuses on Salmonella enterica, one of the UK's most commonly reported human GI pathogens, associated with a range of food products. It will investigate the role of global food trade networks in the dissemination of GI diseases by combining trade network analysis, molecular epidemiology, and mathematical modelling approaches. Project outcomes will provide evidence to inform public and animal health policies aimed at reducing the incidence and transmission of gastrointestinal diseases. **Aims and Objectives:** Project objectives are structured into three work packages (WPs): WP1: Network analysis of international food trade networks This work package aims to identify the major and minor UK trade partners that could impact GI pathogen transmission to the UK. Trade volumes for key food products (e.g. eggs, meat, live animals) will be used to construct bidirectional network models. These networks will identify countries that are central to UK trade, as well as those which trade indirectly with the UK, alongside historical shifts in trade patterns over time, which have implications for disease control and transmission. WP2: Characterise the relationship between imported foodstuffs and UK GI disease incidence This objective will link the volume of imported foodstuffs per country directly to UK foodborne outbreaks. This will be achieved by integrating a dataset of S. Enteritidis genomes collected over approximately ten years of genomic

	surveillance by the UK Health Security Agency (UKHSA) with trade network analysis from WP1. Existing methods for assigning putative geographical sources (e.g. 10.7554/eLife.84167) will be used to assign the country of origin to related bacterial lineages, allowing comparison of these clusters against trade data to assess how trade dynamics influence the introduction or reintroduction of pathogenic lineages and AMR genes to the UK. WP3: Develop risk prediction models for geographical sources of human foodborne disease outbreaks This work package will focus on quantifying and modelling risk within food networks, both in terms of outbreak risk and AMR, to inform public health disease monitoring and food security policies. Using a mathematical risk-modelling approach, work from previous work packages, alongside existing data from other sources and databases, will be used to identify the variable risk associated with specific trading partners and commodities. The project would suit an applicant with a strong first degree or Master's involving bioinformatics or computational biology. The project will be tailored to the student; those with a mathematical background open to learning skills in bioinformatics, data analysis, or those with a biological/biomedical background and experience in basic programming, data science, or machine learning will also be considered. The project provides multiple areas where the student might take direct ownership of the research direction, particularly in approaches for integrating trade data with existing large genomic datasets and the creation of stakeholder-facing outputs to inform public health policy decision-making.
Supervisory Team	
Lead Supervisor	
Name	Dr Sion Bayliss
Affiliation	Bristol
College/Faculty	Faculty of Health Sciences
Department/School	Bristol Veterinary School
Email Address	s.bayliss@bristol.ac.uk;
Co-Supervisor 1	
Name	Professor Paul Wigley
Affiliation	Bristol
College/Faculty	Faculty of Health Sciences
Department/School	Bristol Veterinary School
Co-Supervisor 2	
Name	Dr Lauren Cowley
Affiliation	Bath
College/Faculty	Faculty of Life Science
Department/School	Milner Centre for Evolution
Co-Supervisor 3	
Name	Dr Selina Bruns
Affiliation	Bristol
College/Faculty	Faculty of Health Sciences
Department/School	Bristol Veterinary School