Project Details	
Project Code	MRCPHS26Br Brooks Pollock
Title	New approaches for modelling tuberculosis transmission in low incidence settings
Research Theme	PHS
Project Type	Dry lab
Summary	Tuberculosis (TB) has caused more deaths than any other infectious disease and remains challenging to control. Although TB rates declined in the UK between 2011 and 2022, they have recently increased, particularly among individuals born outside the UK, who accounted for nearly 80% of cases in 2023. This project uses genomic data and mathematical modelling—including branching and agent based models—to understand TB transmission and the impact of migration. You'll assess policy interventions and work closely with policymakers and the public to support TB elimination efforts in low-incidence settings like England.
Description	**Background** Tuberculosis (TB) remains a leading global health challenge. Caused by Mycobacterium tuberculosis, it is transmitted through aerosolized droplets when an infected person coughs or speaks. TB is difficult to control because most exposed individuals do not develop symptoms immediately, and when symptoms occur, it can be years later. This long latent period, combined with slow transmission and complex treatment, presents challenges for designing effective interventions. In England, TB incidence declined from 2011 to 2022, reaching 8.5 per 100,000—below the WHO's low-incidence threshold of 10 per 100,000. However, recent increases suggest the UK is not on track to meet the WHO End TB Strategy goal of elimination by 2035. Most TB cases in England are in people born outside the UK, accounting for nearly 80% of diagnoses in 2023. This underscores the importance of understanding how international migration, social structure, and population diversity influence TB transmission and clustering. Whole-genome sequencing (WGS) has transformed TB surveillance, allowing detailed identification of strains, clusters, and likely transmission links. Combined with demographic data, it can highlight outbreaks and inform interventions. However, modelling TB transmission in low-incidence settings like England is particularly complex due to sparse and stochastic transmission chains, heterogeneity in risk factors, and variable effects of interventions such as screening and contact tracing. **Key Research Question** How do migration patterns and social structures influence the formation and growth of TB transmission clusters in low-incidence settings, and how can mathematical models inform more effective public health interventions? **Project Objectives** Objective 1: Review and Contextualisation - Conduct a targeted literature review on TB transmission in low-incidence countries, with a focus on migration and latent infection. - Review relevant modelling techniques, particularly branching process and stochastic models.

	- Explore TB genomic data and metadata (e.g., strain type, location, diagnosis date). Ownership opportunity: The student can focus on a specific sub-theme (e.g., role of super-spreaders or diagnosis delays) and incorporate it into later modelling. Objective 2: Model Development and Simulation - Build mathematical models to simulate TB transmission dynamics. - Use branching process models for early-stage or subcritical spread (e.g. Brooks-Pollock et al., 2020). - Develop stochastic compartmental or agent-based models to represent individual-level variation in infection and outcomes. - Include migration patterns and demographic differences using available data sources. - Conduct sensitivity analysis to assess key model parameters. Ownership opportunity: The student can shape the model structure and assumptions based on their own interests—e.g., testing different migration or infectiousness scenarios. Objective 3: Data Integration and Calibration - Analyse anonymised genomic data to identify transmission clusters in England. - Compare observed clusters with simulated outcomes to test and refine model assumptions. - Evaluate how well different model structures reproduce real-world patterns. Ownership opportunity: The student may focus on a specific region, time period, or population group for in-depth analysis. Objective 4: Policy Scenarios and Stakeholder Engagement - Use the developed models to simulate the impact of public health interventions (e.g., screening, pre-arrival testing, contact tracing). - Estimate how these actions may affect England's progress towards TB elimination. - Work with public health partners and community organisations to co-interpret model findings and ensure relevance. - Collaborate with the Health Protection Research Unit in Evaluation and Behavioural Science to support community involvement. - Produce a policy briefing or visualisation product to support knowledge translation. Ownership opportunity: The student will select and develop their own intervention scenarios and lead the creation of outputs for stakeholders and non-academic audiences. **Training and Supervision** The student will receive multidisciplinary training in infectious disease modelling, TB epidemiology, genomic analysis, and public health. They will develop programming skills (in R or Python), data handling, and scientific communication. Regular supervision and mentoring will support both technical and career development, with structured meetings and integration into active research teams. Prof Ellen Brooks-Pollock (University of Bristol) brings expertise in TB and epidemic modelling and leads the TB theme of the NIHR Health Protection Research Unit in Respiratory Infections.

	Dr Ruth Bowness (University of Bath) leads an MRC-funded programme on within-host and population-level modelling of TB. Dr Rajeka Lazarus (NHS, University Hospitals Bristol & Weston) is a clinical TB expert who brings real-world insight and links to genomic surveillance data. The student will also benefit from opportunities to present at seminars, publish research, and engage with collaborators including UKHSA. **Conclusion** This project offers a unique opportunity to contribute to TB control in a low-incidence setting, using cutting-edge modelling and genomic data. The student will be supported to develop strong analytical, translational, and policy-relevant skills, with flexibility to steer the research toward their own interests. The project is ideally suited for candidates interested in infectious disease modelling, epidemiology, and global or public health.
Supervisory Team	
Lead Supervisor	
Name	Professor Ellen Brooks Pollock
Affiliation	Bristol
College/Faculty	Health and Life Sciences
Department/School	Population Health Sciences
Email Address	ellen.brooks-pollock@bristol.ac.uk
Co-Supervisor 1	
Name	Dr Ruth Bowness
Affiliation	Bath
College/Faculty	Science
Department/School	Department of Mathematical Sciences
Co-Supervisor 2	
Name	Dr Rajeka Lazarus
Affiliation	Bristol
College/Faculty	Health and Life Sciences
Department/School	Bristol Medical School
Co-Supervisor 3	
Name	
Affiliation	
College/Faculty	
Department/School	