Project Details	
Project Code	PHS27Br HFraser
Title	Modelling HIV transmission and the impact of innovations in pre-exposure prophylaxis against a background of structural and behavioural complexity
Research Theme	Population Health Sciences
Project Type	Dry lab
Summary	This project would suit someone with a STEM background wanting to apply their talents to one of the most current challenges in global health. Since its introduction in 2012, pre-exposure prophylaxis (PrEP) has profoundly impacted efforts to eliminate HIV. This PhD programme will establish a deep understanding of HIV transmission in diverse populations where the use of PrEP is influenced heavily by social and behavioural factors. The student will develop mathematical models to explore the interaction between risk perception, PrEP adherence, and HIV transmission, focussing on the newly introduced long-acting PrEP and providing policy recommendations on HIV control.
Description	Since Pre-exposure Prophylaxis for HIV prevention (PrEP) was approved in 2012, it has become a critical component in The United Nations programme to end AIDS by 2030. By taking an oral tablet daily, PrEP users substantially reduce their risk of acquiring HIV. Despite its success, factors like stigma and medication fatigue mean that many at risk individuals have insufficient uptake of this life-changing medication. Long-acting injectable formulations recently recommended by the WHO and NHS have the potential to overcome these challenges, offering both convenience and discretion. However, as these products become more widely available, questions need to be asked about their impact on the epidemiology of HIV. Mathematical models are frequently used to predict the outcome of pharmaceutical interventions. Vaccination campaigns, for example, routinely use models to decide between different delivery strategies and determine the coverage required to achieve population immunity. Unlike vaccination, however, the effectiveness of PrEP depends on the individual's adherence to the specified regimen. This is further complicated by the growing diversity of PrEP formulations, including daily oral tablets and long-acting injectable options. To predict how these developments will impact the epidemiology of HIV, modelling needs to account for the following factors: 1. The effectiveness of PrEP depends on adherence to the prescribed regimen. Moreover, the dynamics of protection levels depend on formulation; while missing an oral dose immediately impacts the risk of HIV acquisition, the protection provided by a long-acting dose may wane over time if follow-up appointments are missed. 2. Factors influencing adherence can be structural (e.g. access, cost, social, religious stigma) or can act at the individual level (e.g. risk perception, family stigma). Injectable PrEP offers an alternative for those who struggle to adhere to oral regimens. 3. There is evidence of an association between PrEP use and risk compensatory behaviours such as decreased condom use, having more sexual partners, and increasing sexual contact with HIV positive partners.

	The central theme of this project is the complex interplay between risk perception, risk taking, and the transmission of disease. It will primarily focus on the continuing development of [HF1.1]behaviour-driven mathematical models. Our goal is to answer the following: How does the complex interplay between risk behaviour, PrEP formulation (oral vs injectable), and adherence affect the epidemiology of HIV? We outline three specific objectives: Objective 1: Build a comprehensive understanding of the factors influencing the effectiveness of PrEP to control HIV transmission The student will review a diverse evidence base spanning psychology, medicine, and mathematics to build a coherent narrative describing the role of PrEP in reducing HIV incidence. They will become familiar with previous mathematical modelling of HIV and PrEP, and they will monitor developing evidence of the differences between oral and injectable PrEP, including adherence patterns, acceptability and service delivery. During this phase, the student will decide on a direction to steer their project based on gaps they have found in the literature; they may choose to focus on low-prevalence or high-prevalence settings, key populations (e.g. people who inject drugs, men who have sex with men, female sex workers), or examine how different PrEP formulations are adopted across settings. Objective 2: Explore the dynamics of behaviour-driven models of infectious disease The infectious diseases modelling community increasingly recognizes the role that human behaviour plays epidemic dynamics. The student will advance theoretical understanding within this field using the PrEP-HIV system as a case study. For example, they may address how service-level constraints affect population-level protection, the differences in impact of missing injectable appointments compared to missing oral doses, and under what conditions injectable PrEP provides a greater level of population protection. Using this framework, the student will provide critical analysis of current HIV modelling approaches, particularly their treatment (or omission) of behavioural heterogeneity and formulation-specific dynamics. Objective 3: Model the impact of PrEP in real world settings The ultimate goal of the project is to apply modelling in real-world settings where structural factors and risk-taking behaviour interact to shape HIV transmission. A key focus will be on comparing delivery strategies for oral and injectable PrEP, including their feasibility, effectiveness, and equity. The student will work with existing or newly sourced datasets and develop a calibrated dynamic transmission model to evaluate policy-relevant questions. We are specifically interested in research that will inform planning decisions as injectable PrEP becomes more widely available. Results will be disseminated at academic conferences and with relevant stakeholders with the aim of directly informing HIV prevention policy. The project will provide a future-proof framework for evaluating PrEP in an evolving biomedical landscape.
Can be completed part time?	Yes

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