
ANALYSIS OF HIV/AIDS MODEL WITH RISK COMPENSATION EFFECTS AMONG PRE-EXPOSURE PROPHYLAXIS USERS AND INFECTIOUS IMMIGRANTS

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ABSTRACT

Pre-Exposure Prophylaxis (PrEP) is a promising HIV prevention strategy, and its provision has grown rapidly in several countries, including those in Sub-Saharan Africa. However, lingering concerns remain that introducing PrEP may lead to unintended consequences, such as decreased adherence to other prevention methods and increased risky sexual behaviour, culminating in risk compensation. This study employs a six-compartment mathematical model to investigate the effects of risk compensation behaviour among PrEP users in a population with an influx of infectious immigrants. The model exhibits only disease-free equilibrium points in the absence of infective immigrants and endemic equilibrium with the influx of infected immigrants. The disease-free equilibrium point exists and is locally and globally asymptotically stable in the absence of infective immigrants when the basic reproduction number is less than one. In contrast, the model exhibits only endemic equilibrium in the presence of infective immigrants, which is asymptotically stable when basic reproduction number exceeds unity. A sensitivity analysis of the parameters associated with R_1 was performed using the normalized forward sensitivity index to determine the most influential parameter. The analysis revealed that the number of sexual partners had the greatest influence on disease endemicity. Numerical simulations supported the analytical findings, showing that risk compensation undermines PrEP effectiveness and that multiple sexual partners increase new HIV infections. However, PrEP can significantly reduce new infections in a population with varying immigrant influx and no risk compensation behaviour, highlighting its potential impact in controlling HIV spread. The effectiveness of PrEP depends on strict adherence to usage in combination with other preventive measures. The disease persists with the inflow of infective immigrants.

Keywords Bifurcation · Infectious immigrants · Pre-Exposure Prophylaxis(PrEP) · Prevention · Risk compensation

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