University of Venda

Stochastic Modelling of HIV/AIDS Epidemiology with TB Co-infection and Drug Reaction in South Africa

Shoko Claris (11629512)

Thesis submitted in fulfillment of the requirements for the

Masters degree in Statistics

School of Maths and Natural Sciences

Main Supervisor: Professor W. Garira

Co-Supervisor: Professor A. K. A. Amey

Co-Supervisor: Professor P. O. Bessong

February 2, 2015

Abstract

The study explores the stochastic approach to multi-state modeling of HIV dynamic evolution and identification of the model that best describes HIV progression on individuals under ART. The effects of TB co-infection, as well as the patients' development of adverse reaction to drugs to the transition rates are also examined. The study uses a cohort analysis of the surveillance data for HIV-infected patients under antiretroviral (ART) from the Wellness Clinic in Bela Bela, South Africa. The survey was conducted between 2005 and 2009 and a follow up was done after every 6 months. The method partitions the HIV infection period into five CD4-cell count intervals followed by the end points, that is, death and withdrawal from study. The analysis is based on transition probabilities, transition rates (hazards), mean sojourn times, and time to absorption. The effects of the covariates, namely sex, age, TB co-infection, drug reaction, body mass index (BMI), baseline viral load (VLBL) and the CD4+ cell count baseline on enrollment, on transition intensities for each model are also analysed. The likelihood ratio test is used to compare the fitted models, and the test shows that the time inhomogeneous model describes the data better than the time homogeneous models. The results show that the rates of immune recovery are generally higher than the rates of immune deterioration. The patients who developed TB during treatment have higher rates of immune deterioration than recovery. Having TB as the initial marker of AIDS has higher contributory effects to the deaths from all the stages except from the AIDS defining stage. Reaction to drugs was the leading cause of transition from a CD4+ cell count ≥ 750 to a CD4+ cell count between 500 and 750.

Keywords: Covariates; Homogeneous Markov models; Likelihood ratio test; Longitudinal data; Inhomogeneous Markov models.