

## **Modelling HIV progression using multistate Markov models**

Tarylee Reddy\*

Medical Research Council, South Africa  
School of Mathematics, Statistics and Computer Science, University of  
KwaZulu Natal, South Africa

[tarylee.reddy@mrc.ac.za](mailto:tarylee.reddy@mrc.ac.za)

Henry Mwambi

School of Mathematics, Statistics and Computer Science, University of  
KwaZulu Natal, South Africa [mwambih@ukzn.ac.za](mailto:mwambih@ukzn.ac.za)

An understanding of human immunodeficiency virus (HIV) progression and factors that influence disease progression can have great value in the development of new treatment strategies. Although Sub-Saharan Africa is noted for its high HIV prevalence there is an absence of research on the HIV progression and factors which affect it. A cohort of 451 antiretroviral (ARV) therapy naive HIV positive individuals enrolled into the Sinikithemba study conducted in Durban, South Africa is studied. HIV progression is investigated through the application of a five state Markov model with reversible transitions. The four transient states are based on CD4 count intervals with ARV initiation as an absorbing fifth state. Proportional hazards models are used to determine the effect of age, gender, baseline CD4 count and viral load on individual transition rates. A key finding, consistent with previous research, is that the rate of decline in CD4 count tends to decrease at lower levels. It was also noted that patients enrolling with a CD4 count less than 350 have a far lower chance of immune recovery, and a substantially higher chance of immune deterioration compared to patients with a higher CD4 count. This study found multistate models to be a powerful tool in HIV/AIDS research which can offer a deeper understanding of the natural progression of the disease.

**Key Words:** human immunodeficiency virus, disease progression, multistate model, Markov assumption, proportional hazards model