



University of Venda

HYBRID MULTI-SCALE MATHEMATICAL MODELLING
OF MALARIA INFECTION TRANSMISSION

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Abstract

Malaria is a life-threatening disease caused by a protozoan parasite called plasmodium, which lives part of its life in the humans and part in Anopheles mosquito. The development of malaria parasite in a human host commence in the liver cells where the malaria parasites undergo asexual multiplication to produce merozoites that are eventually released into the blood stream to invade red blood cells. The infected red blood cells burst after 2-3 days to release merozoites and gametocytes into the blood stream. This is associated with the clinical symptoms of the disease. Anopheles mosquito become infected when they feed and ingest human blood that contains mature gametocytes. The gametocytes develop into male and female gametes that fertilize to become zygotes in the mid-gut wall of the mosquito.

We model malaria using non-linear differential equations. We analyse the existence and stability of steady state solution, existence of equilibrium point without disease, local stability of disease free equilibrium, existence of endemic equilibrium state, local stability of endemic equilibrium, global stability of the disease free equilibrium. The key to our model analysis is to calculate the reproduction number. We also perform the sensitive analysis using the reproduction number R_0 with respect to the parameter. This sensitive analysis allow us to compare the effectiveness of different control strategies.