Mathematical Modelling of Transmission and Control of Malaria

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Abstract

Malaria starts with plasmodium sporozoites infection of the host liver, where development into blood stage parasites occurs. A number of deterministic models are developed in this thesis. The release of modified mosquitoes aims to displace gradually the wild (natural) mosquito from the habitat.We discuss the suitability of this technique when applied to pre-domestically adapted plasmodium falciparum mosquitoes which are transmissor of malaria disease. The dynamics of interaction of sporozoites, liver cells, merozoites and red blood cells which cause the symptoms and pathology of the disease is comprehensively studied. We then show how variability of host-parasite immunity is incorporated in the model which are constructed to include liver and blood compartments by subdividing the host population into various mutually exclusive compartments. The increase in eggs, larval and pupal stages of mosquitoes increase the vector mosquito population and transmission of the disease, hence the suggestion that immature and adult mosquitoes be controlled extensively. The models which are in the form of nonlinear ordinary differential equations are rigorously analysed using extensively analytic and numerical techniques to determine important epidemiological thresholds, stability of the steady states and the persistence of infection in the respective populations. Conclusions are made based on the results obtained from the analyses of the models of malaria that have been developed.