Within-Host Malaria Parasite Dynamics - A Mathematical Study

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Malaria is a disease involving three interacting populations: the human, the parasite that causes the disease and the vector that transmits the parasite from one human to another. A full understanding of the disease requires a good understanding of each of the interacting population dynamics and their role in sustaining disease propagation. In this talk, I will present a mathematical model involving a system of nonlinear ordinary differential equations that describe the within human-host dynamics of the malaria parasite and discuss how this model sets the stage for future understanding of drug treatment on malaria parasite. The model integrates the major blood stage parasitic forms (the pathogenic asexual forms and the transmissible sexual forms), involved in the development and progression of the malaria disease within a human. It also incorporates the role of immunity and the corresponding mechanisms involved in the activation of the human immune response in inhibiting and diminishing the success of the malaria parasite within the human. Some assumptions on the rate of healthy red blood cells production and depletion in the presence and absence of innate and adaptive immunity are evoked in the model formulation. Model analysis reveals the existence of a threshold parameter that determines the existence of a non-trivial steady state solutions which can be driven to oscillatory solutions that are reminiscent of malaria parasitemia in humans. The existence of a positive merozoite parasite form that leads to the depletion of the human's healthy red blood cells in an immune-suppressed model allows us to investigate the role of immunity in inhibiting parasite success.

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