Robust Analytics for Malaria Policy:

What is the Role for Individual-Based Models?

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Mathematical models have played a role in malaria research, but there is a renewed demand for quantitative advice that has put greater demands on their use in making malaria policy. Some aspects of malaria can and must be dealt with using simple models, but there is also a critical role for individual based models, which are the most efficient way of dealing with systems like malaria that are heterogeneous and complex. Malaria transmission involves complex interactions between hosts, vectors, pathogens, and the interventions put in place to control malaria. A common theme running through all of malaria epidemiology and control is the role of heterogeneity. The intensity of exposure and transmission is heterogeneous because of the underlying mosquito populations. Mosquito habitats are spatially heterogeneous, and weather and mosquito ecology establish conditions to support pathogen transmission over both time (*e.g.* seasonal or ephemeral) and space (*e.g.* focality). Immunity to malaria is heterogeneous in populations, depending on age and exposure; immunity to malaria has a poor memory, and it develops differently in people depending on the intensity and patterns of exposure. There are multiple modes of vector control, and there are multiple ways of using anti-malarial drugs to cure malaria and reduce transmission. Malaria connectivity is also an important feature of these systems as malaria parasites move around in infected mosquitoes and humans.  The policy questions driving malaria modeling are how to stratify geographical areas for control, which involves 1) subdivision into areas; 2) choosing combinations of interventions that are tailored to the specific conditions and programmatic goals; and 3) coordinating malaria across areas. Here, we discuss the use of individual based models to design interventions for forest malaria in the Greater Mekong System, the role of individual based models for the design of randomized control trials for mosquito-borne pathogens, and the role of human behavior in malaria elimination.