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Mathematical Modeling to Support Malaria Control and Elimination

We use numerical simulation of an ensemble of mathematical models of malaria in humans and mosquitoes to help develop target product profiles for new interventions and to provide robust quantitative predictions of effectiveness and cost-effectiveness of different strategies in reducing transmission, morbidity and mortality.

The individual-based stochastic simulation models include seasonality of infection; multiple mosquito populations; superinfection, acquired immunity, and variations in parasite densities in humans; and the effects of health systems. We describe the model and show results of simulations of combinations of different interventions including indoor residual spraying (IRS), insecticide-treated nets (ITNs), improved case management, intermittent preventive treatment, and potential vaccine candidates.

Our results suggest that sustained coverage of ITNs and/or IRS reduces malaria prevalence in two to three years but does not lead to further gains. However, in some settings, even with sustained coverage, clinical incidence of malaria increases as the population loses its naturally acquired immunity. In some low to medium transmission settings, our simulations suggest that high coverage of both interventions can lead to interruption of transmission, especially if coupled with an effective transmission blocking vaccine.