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Insight into Malaria Transmission and Control in Endemic Areas

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Objective

To examine the likely impact of malaria parasite intervention points for a steady state regional control program in endemic areas

Introduction

The global effort of malaria control is in line with the one world one health concept, but then a globally defined ''one-size-fits-all'' malaria control strategy would be inefficient in endemic areas. *Plasmodium falciparum* is the type of malaria parasite that most often causes severe and life-threatening malaria. People get malaria by being bitten by an infective female *Anopheles* mosquito. Regional malaria elimination campaigns in 1940s followed by the Global Malaria Eradication Program in 1955 did not succeed in eliminating malaria from sub-Saharan Africa, which accounts for 80% of today's burden of malaria ([1,2]). The basic reproductive number, Ro, has played a central role in epidemiological theory for malaria and other infectious diseases because it provides an index of transmission intensity and establishes threshold criteria ([3]).

Methods

Use of systematic literature review to propose a simple model on the likely impact of targeted intervention points on control of malaria parasite. Assumptions were varied about two targeted epidemiologic control points on the basic reproductive number, Ro, which is affected by different factors and upon which the status of malaria in any community will depend. Taking β to be expected number of infectious bites per person over a given time period; β_1 as the effective contact between susceptible individuals and malaria vectors; β_2 as the effective contact between individuals under intervention and malaria vectors; β_3 as the effective contact between susceptible malaria vectors and infected individuals; S= susceptible population, V= population under intervention, D= dead mosquitoes and R= immune humans. At any time t in a population, j, vectoral capacity $C(t) = \sum m_j(t)\, a_j^2\, p_j^n/(-\ln p_j)$ ([4]); infected human
j=1
population at intervention point, $I^h(t)=C(t)\,(\beta_1 S_h + (1-\gamma)\,\beta_2 V) - R$; infected mosquito population at intervention point, $I^m(t)= (1-\gamma)\,\beta_3 S_m(C(t))$. If γ is the degree of protective intervention, which is also equal to 1. Thus 1 - γ is the intervention failure. Intervention will reduce the probability of infection when exposed to malaria pathogens and this equals the degree of protection $\gamma = I^h(t)/ I^m(t)$; $Ro \propto 1/\gamma$; $Ro= b/\gamma$ where b is infectivity of humans to mosquitoes.

Results

Population important in malaria transmission are the susceptible, infected and infectious *Anopheles* mosquitoes and human populations. Three factors in this basic model that can affect Ro are the infectivity of humans, b, the effective or adequate contact between vector and individuals, β, and the vectoral capacity, C(t). Increase in Ro will inversely decrease γ. For there to be decrease in Ro, control has to be effective. When there is interventions targeted at reducing density of mosquitoes and humans through destruction of breeding sites and prophylaxis/treatment/use of nets respectively over a given time period, number infected will be immuned at which point, Ro = 1, more immune individuals wil llead to Ro1 until when there is a steady state control program at which point Ro=0. This is the point that intervention is very effective.

Conclusions

The two targeted control points should be considered for any effective malaria control and eradication program in endemic areas so that Ro can be consistently lowered to a level that is below threshold.

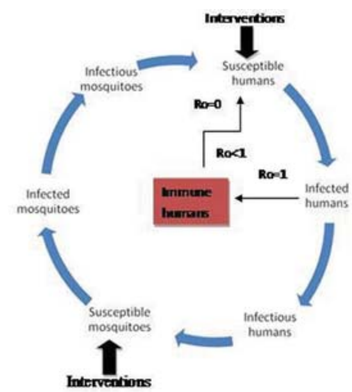

Figure 1: Cycle of transmission and possible intervention points of malaria parasite in endemic areas over a given time period

Keywords

Malaria; Control; Endemic

References

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