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**Year:** 2019

**Title:** Modelling the impact of transitioning from universal to targeted indoor residual spraying for *P. falciparum* malaria

**Abstract:**

**Background**: Many malaria endemic areas have successfully achieved control through regular mass indoor residual spraying (IRS) campaigns. However, it is costly to maintain mass IRS given competing health priorities and limited resources. Malaria control programmes are faced with the decision of whether to scale back mass IRS coverage and focus instead on targeting remaining hotspots, while retaining control and avoiding resurgence. Mathematical modelling can help decision makers with this process and guide priorities for future field studies.

**Aim**: To develop a dynamic mathematical model that will estimate the epidemiologic impact of transitioning from universal to targeted IRS for *P. falciparum* malaria control in different hypothetical settings.

**Methods**: I develop a spatial, dynamic, deterministic compartmental model using non-linear ordinary differential equations, solved in R. The model builds on the basic Ross-Macdonald malaria model with human and vector components, extended to include latency periods and acquired immunity. I model several scenarios covering different intervention strategies, transmission settings and treatment levels. For estimated epidemiologic impact, I report: 1) true prevalence of *P. falciparum* malaria; and 2) treated cases of clinical *P. falciparum* malaria.

**Findings**: Universal IRS produces the lowest malaria prevalence levels (7.3% on average). However, removing IRS from low transmission areas and increasing IRS in high transmission areas leads only to a small increase in prevalence (9.1% prevalence, which is 1.8 percentage points higher than the baseline). This conclusion is consistent across each of the four contexts considered. Where IRS is removed from moderate transmission areas, there is a substantial increase in prevalence (9.5 percentage points higher on average) compared to the baseline.

**Conclusion**: My model suggests that it is possible to pursue a successful strategy of IRS targeting with minimal increase in prevalence. However, if IRS is removed from too many areas at once, or from areas that do not have a sufficiently low level of transmission, resurgence is likely. Therefore, for effective targeting, knowledge is needed about the prevalence and underlying transmission intensity of different geographical units. To prevent outbreaks or handle upswings in prevalence, it is vital to monitor changes over time and be prepared to respond appropriately. Higher treatment levels can help mitigate the risk of resurgence from IRS targeting.