The Malaria Elimination Task Force *in silico*

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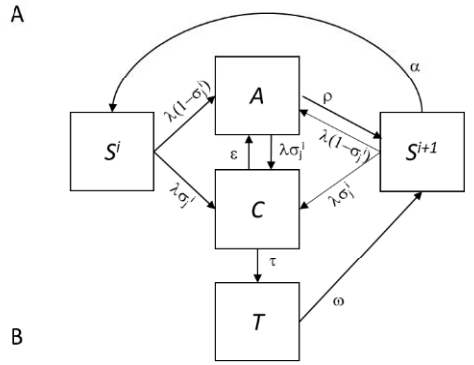
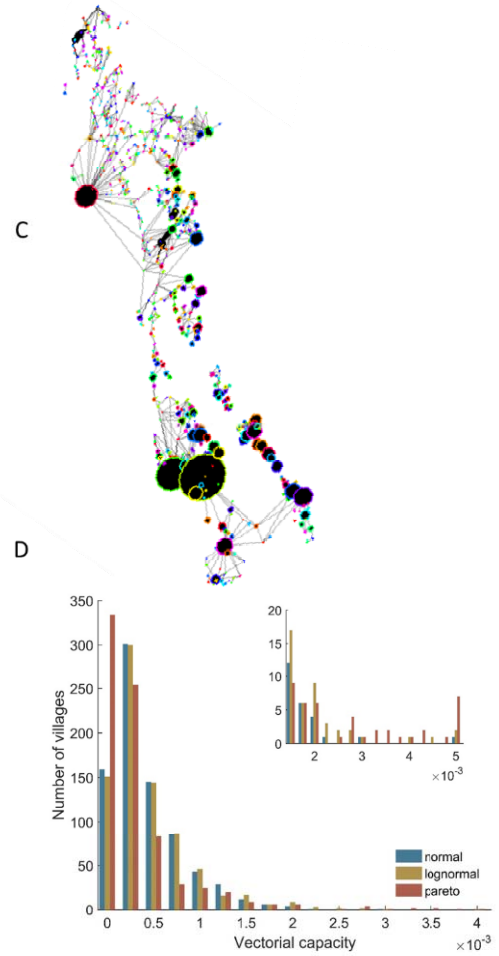
The METF Model

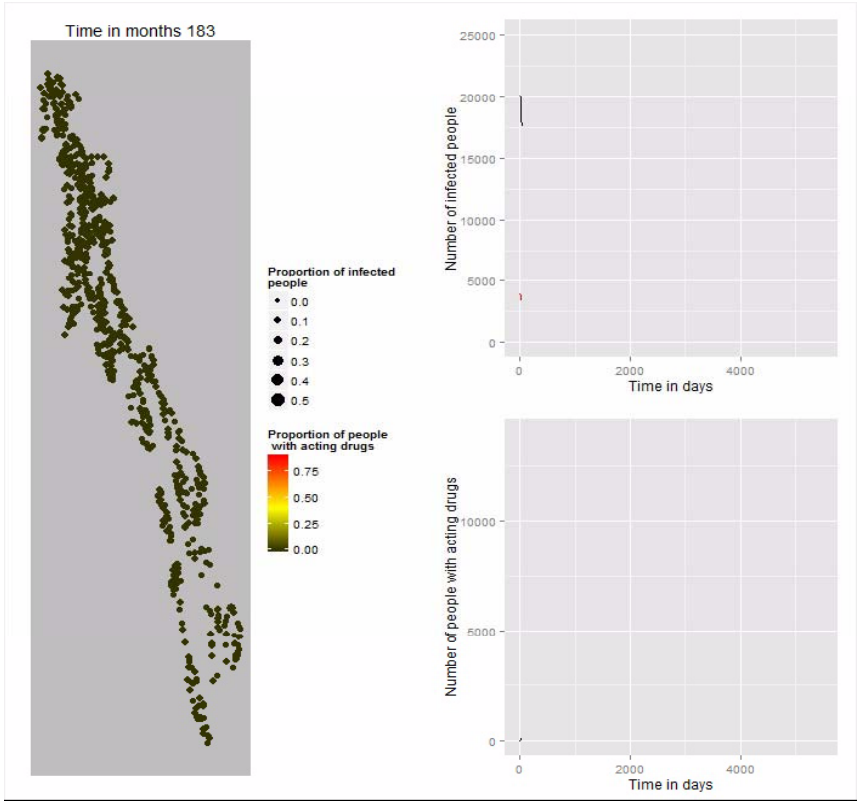
- A computer-based reproduction of the real METF strategy
- Individual-based transmission dynamics
- Simulated population has the same spatial distribution as the real population
- Acquisition and loss of immunity
- Resistance



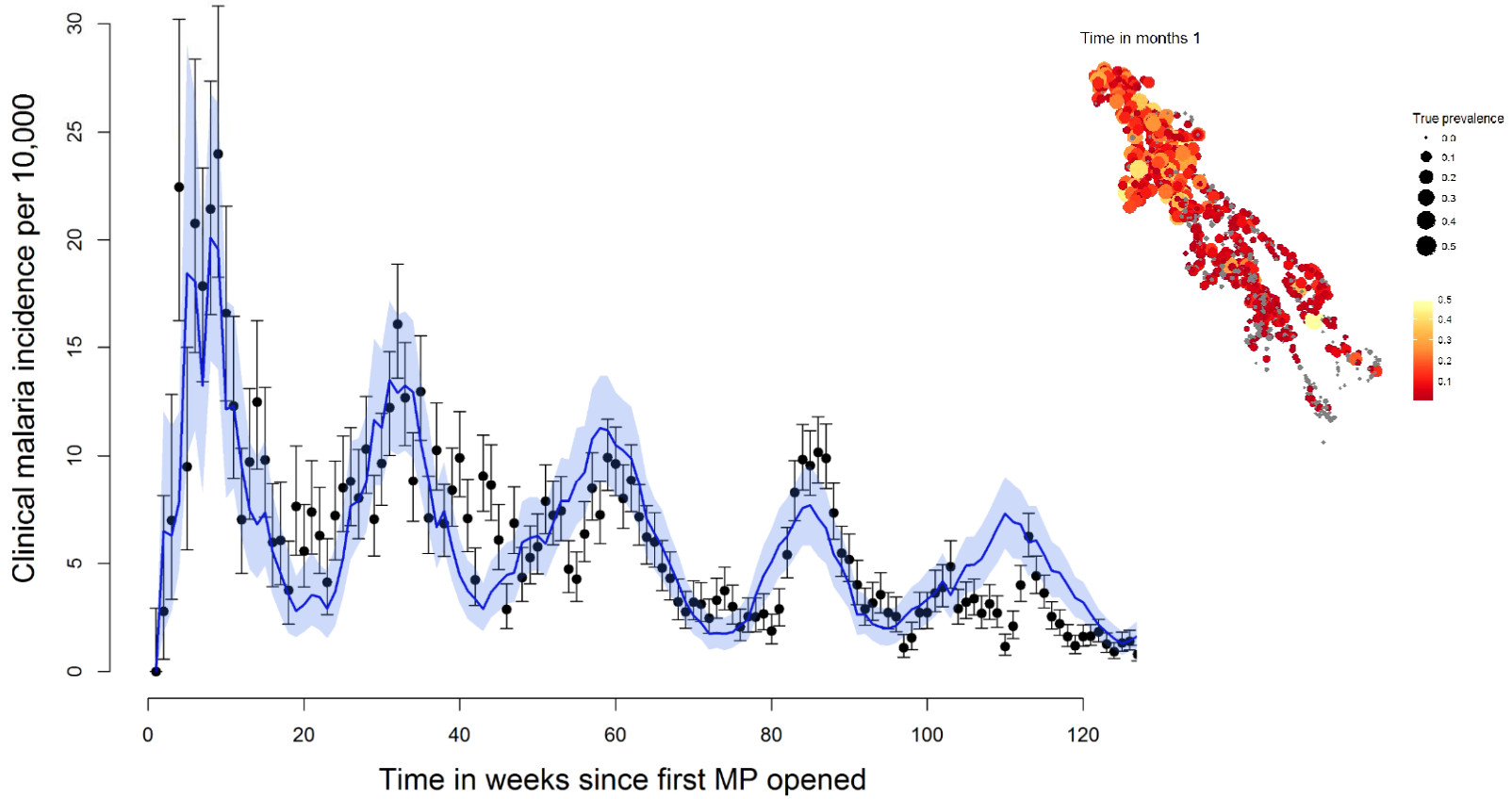


Spatiotemporal dynamics and resistance

- Each village is represented by a dot
- The size of the dot represents the *P. falciparum* prevalence at any time point
- The colour of the dot represents the proportion of villagers with acting drugs
- MDA is not delivered simultaneously in all hotpots
- The model predicts prevalence of resistant infections



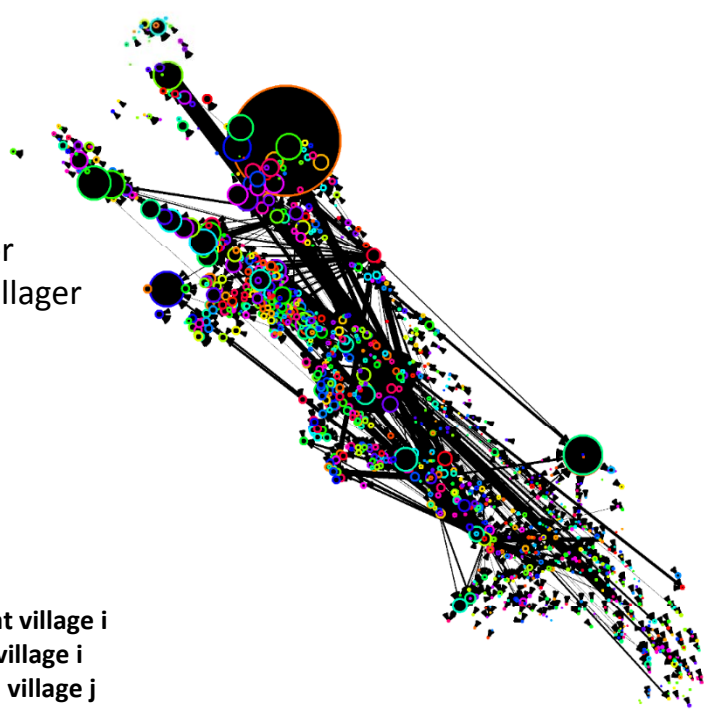
The METF Model versus the METF data



Sinks

Sources

Infected visitor
infects local villager

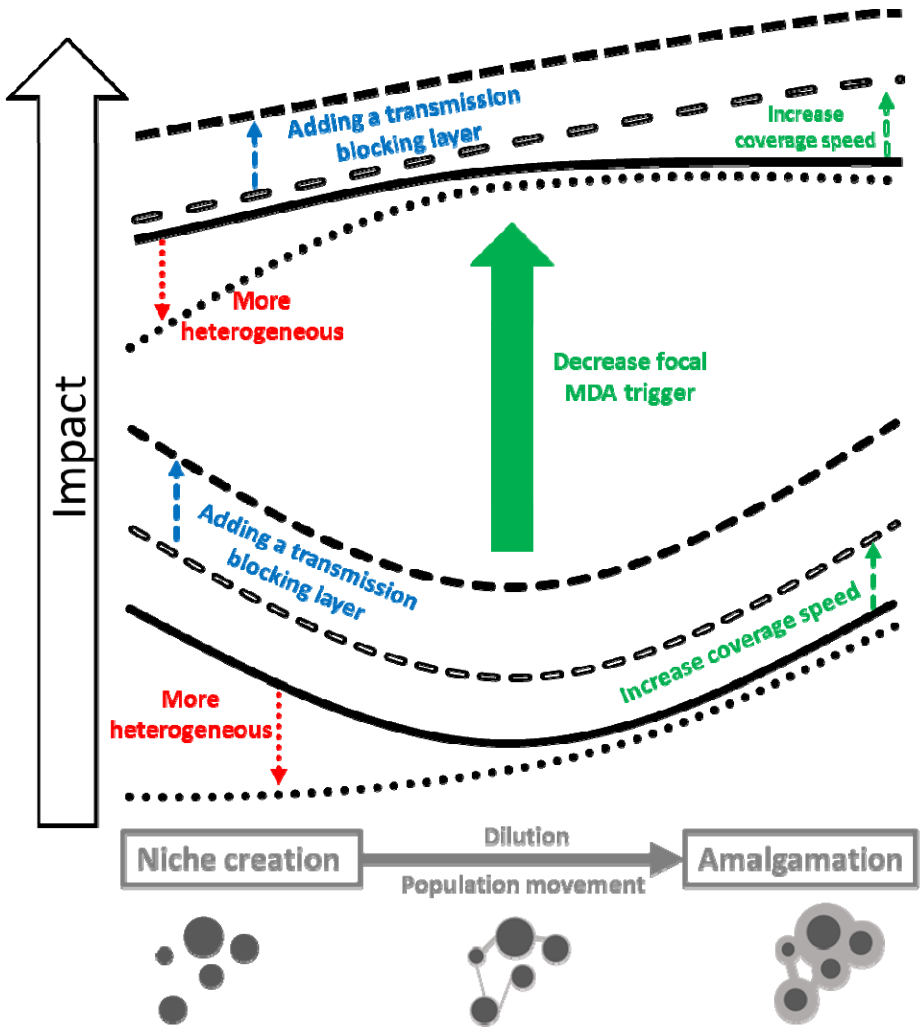


Local villager gets infected outside the village and brings a new infection back to home village

M = mosquito at village i
R = resident in village i
V = visitor from village j
Red = infectious
Black = susceptible

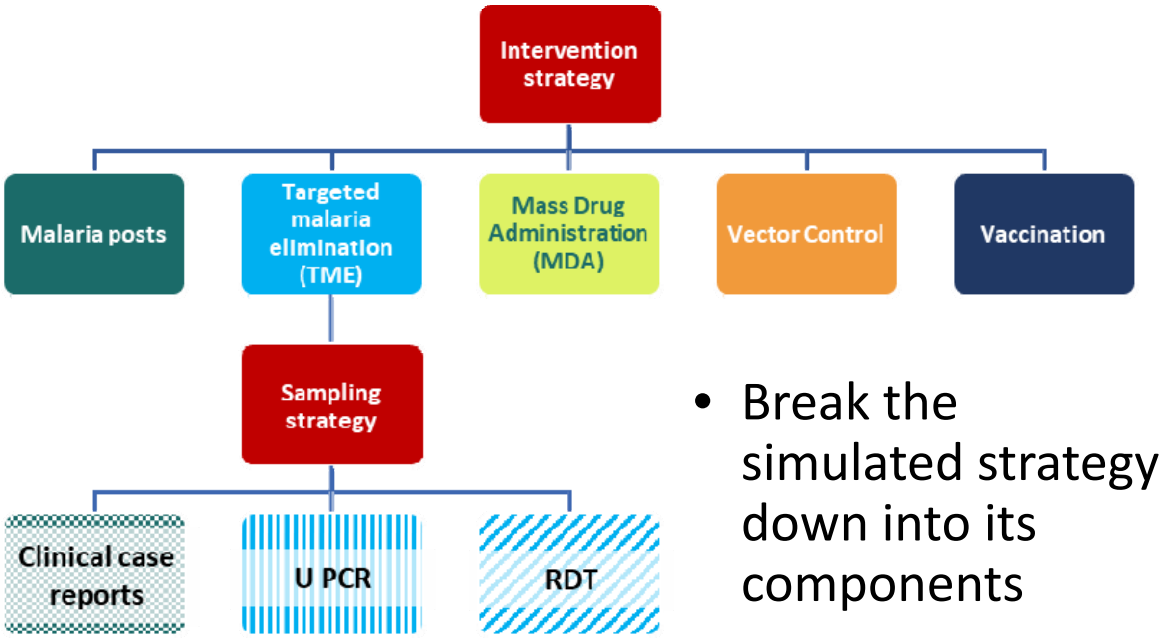
Logistics

- The level of connectivity of the villages will influence the impact of the intervention
- Very isolated villages lead to a series of mini-extinctions, but can also create niches where resistance prevents elimination
- Highly connected villages act as one large “patch” where the cold spots gain a herd effect from the eliminations in the hot spots
- Decreasing the threshold for hotspot definition is likely to increase impact



What can we do with the model?

- Create a simulated version of the real strategy

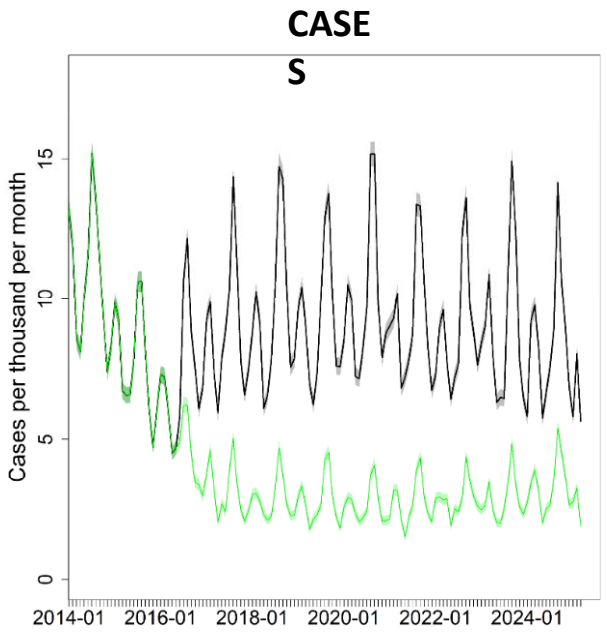


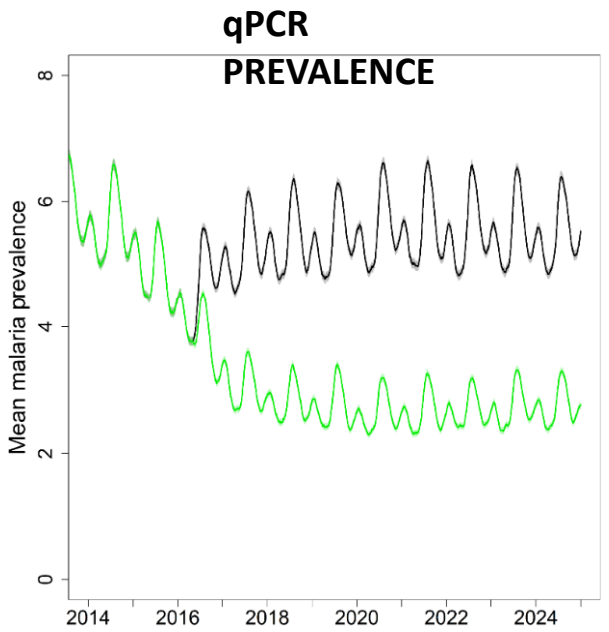
- Break the simulated strategy down into its components

- Rebuild to create bespoke simulated strategies
- Predict their potential impact and cost

Predicted long term impact of malaria posts

- **Universal coverage of MP**
- **Closing MP in June 2016**

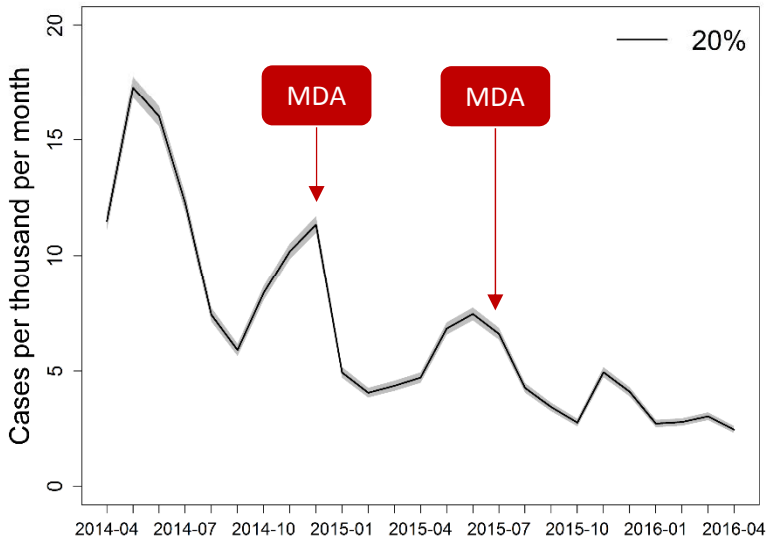




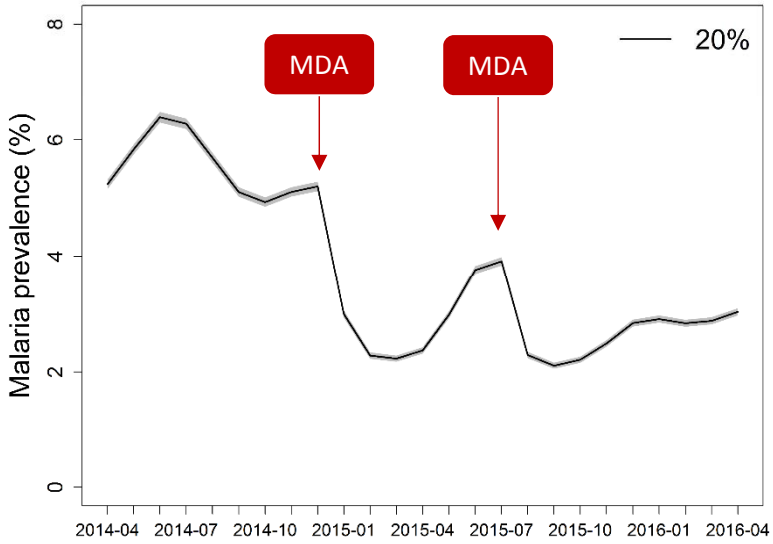
- Close MP -> full resurgence in 3 years
- Universal coverage of MP -> less malaria BUT not elimination

Changing the threshold for defining hotspots (75 villages)

CASES



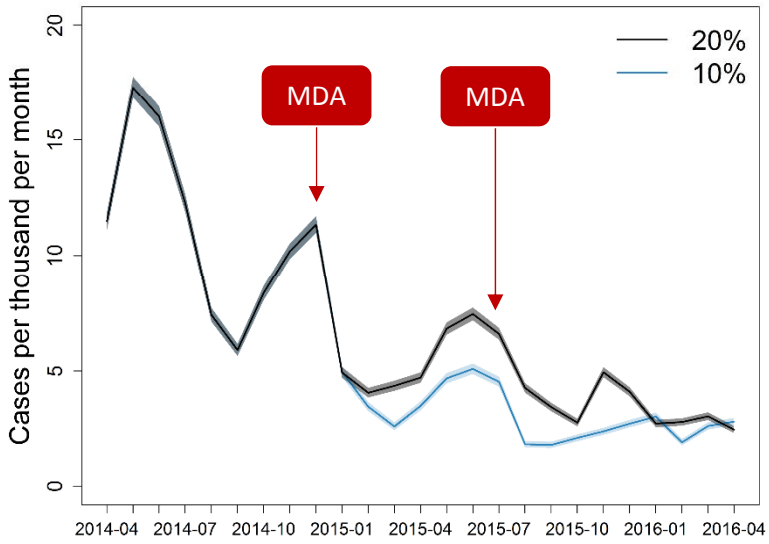
qPCR PREVALENCE



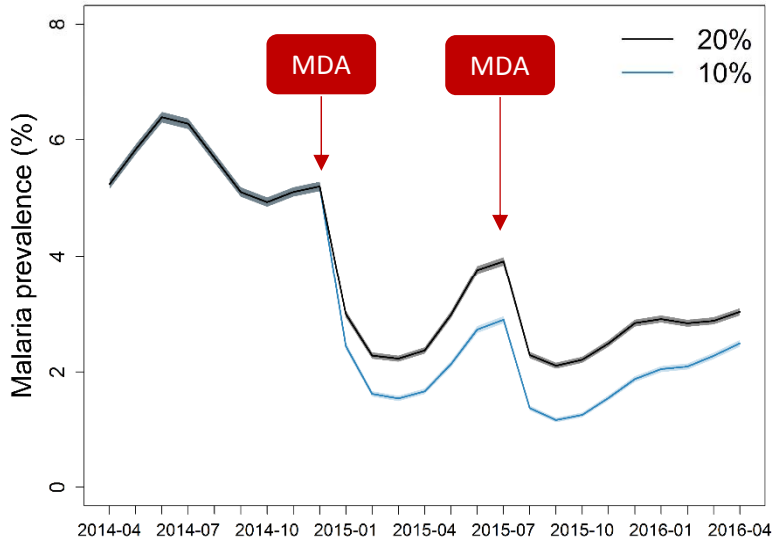
- Lower threshold -> More MDA villages -> Faster decline

Changing the threshold for defining hotspots (106 villages)

CASES



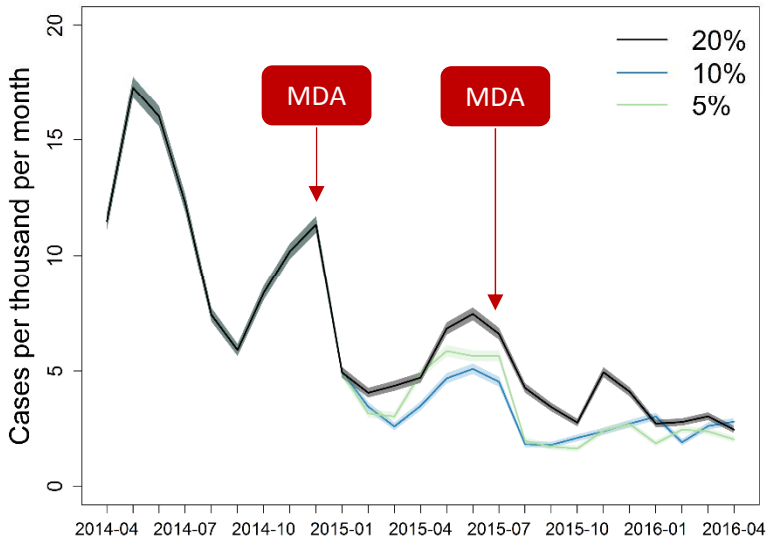
qPCR PREVALENCE



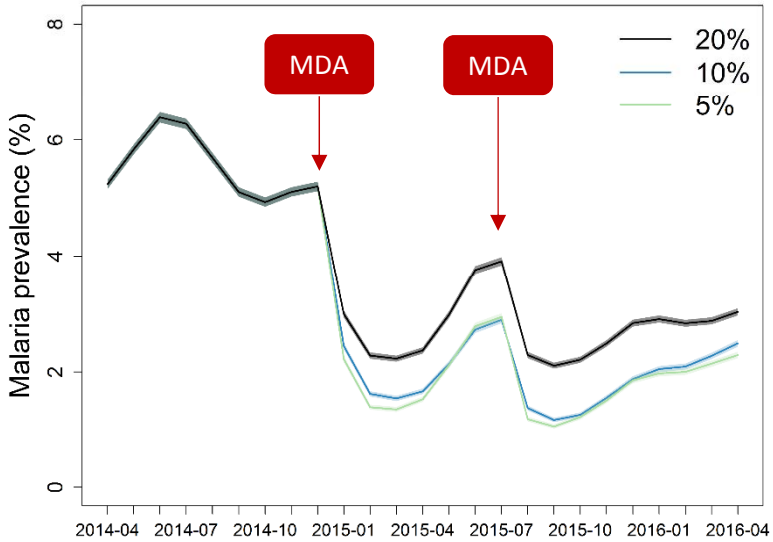
- Lower threshold -> More MDA villages -> Faster decline

Changing the threshold for defining hotspots (144 villages)

CASES



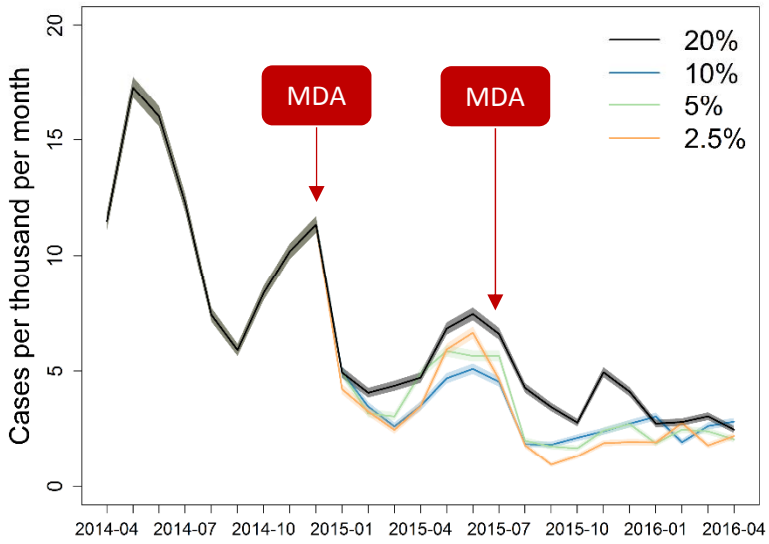
qPCR PREVALENCE



- Lower threshold -> More MDA villages -> Faster decline

Changing the threshold for defining hotspots (171 villages)

CASES



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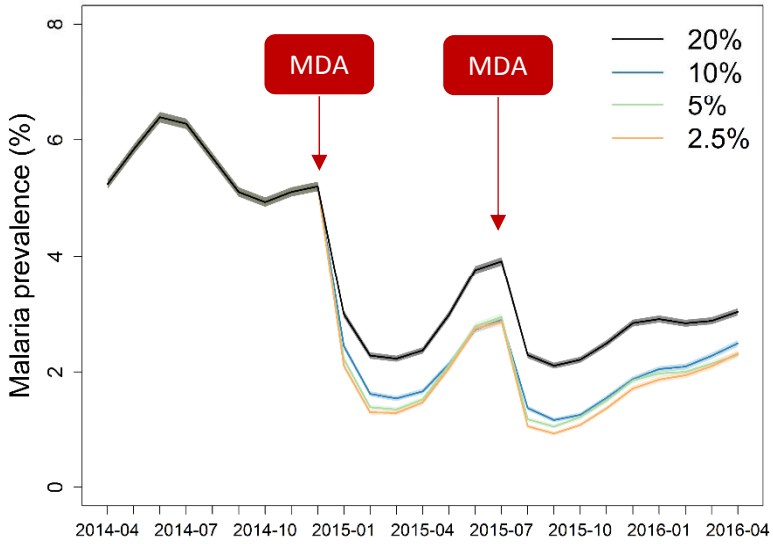
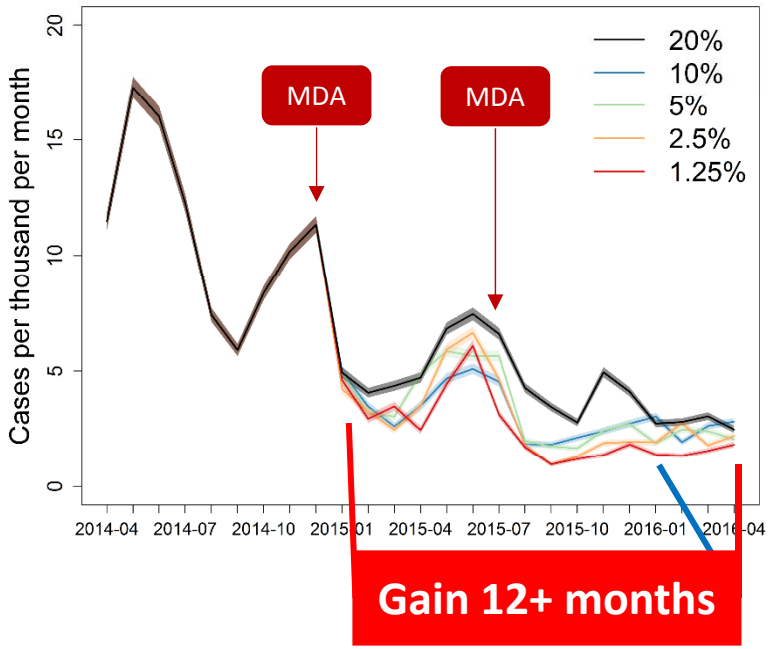


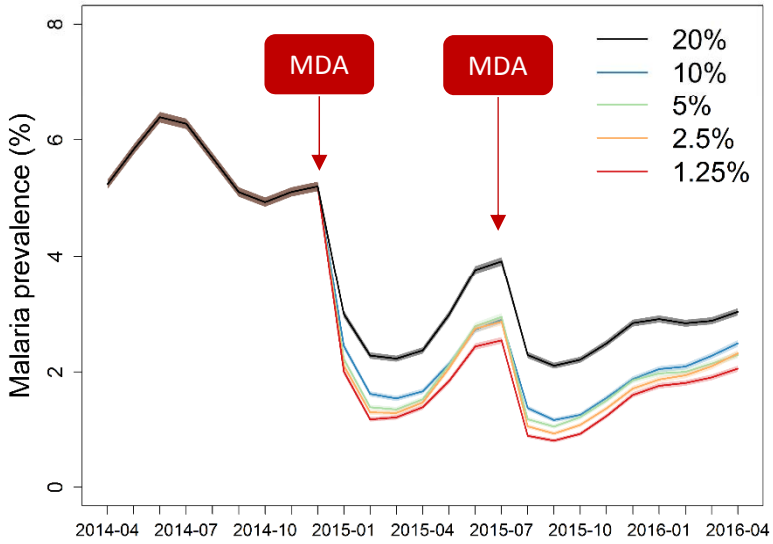
- Lower threshold -> More MDA villages -> Faster decline

Changing the threshold for defining hotspots (237 villages)

CASES



qPCR PREVALENCE



- Lower threshold -> More MDA villages -> Faster decline

Conclusions

- We have a simulated version of the METF strategy
- We can use this model to
  - Explore the relative contributions of the various components of the strategy
  - Project the long term impact of the strategy
  - Predict the impact of counterfactual scenarios (such as closing down malaria posts)
  - Project the impact in different settings using the same or modified strategies
- Future work will be to incorporate costs

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