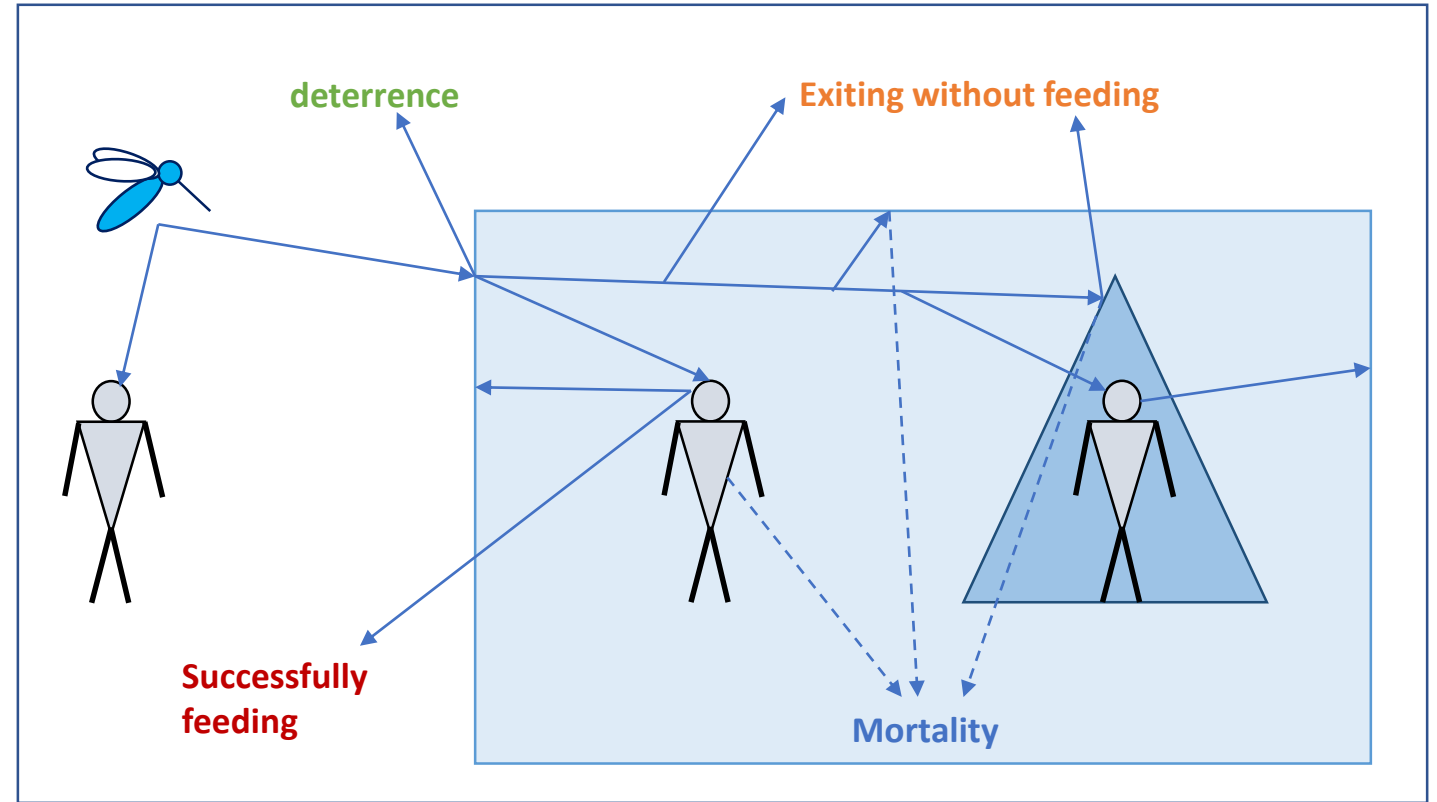# Understanding the impact of IRS and complementary MDA interventions

Ellie Sherrard-Smith and Hannah Slater

Understanding IRS impact
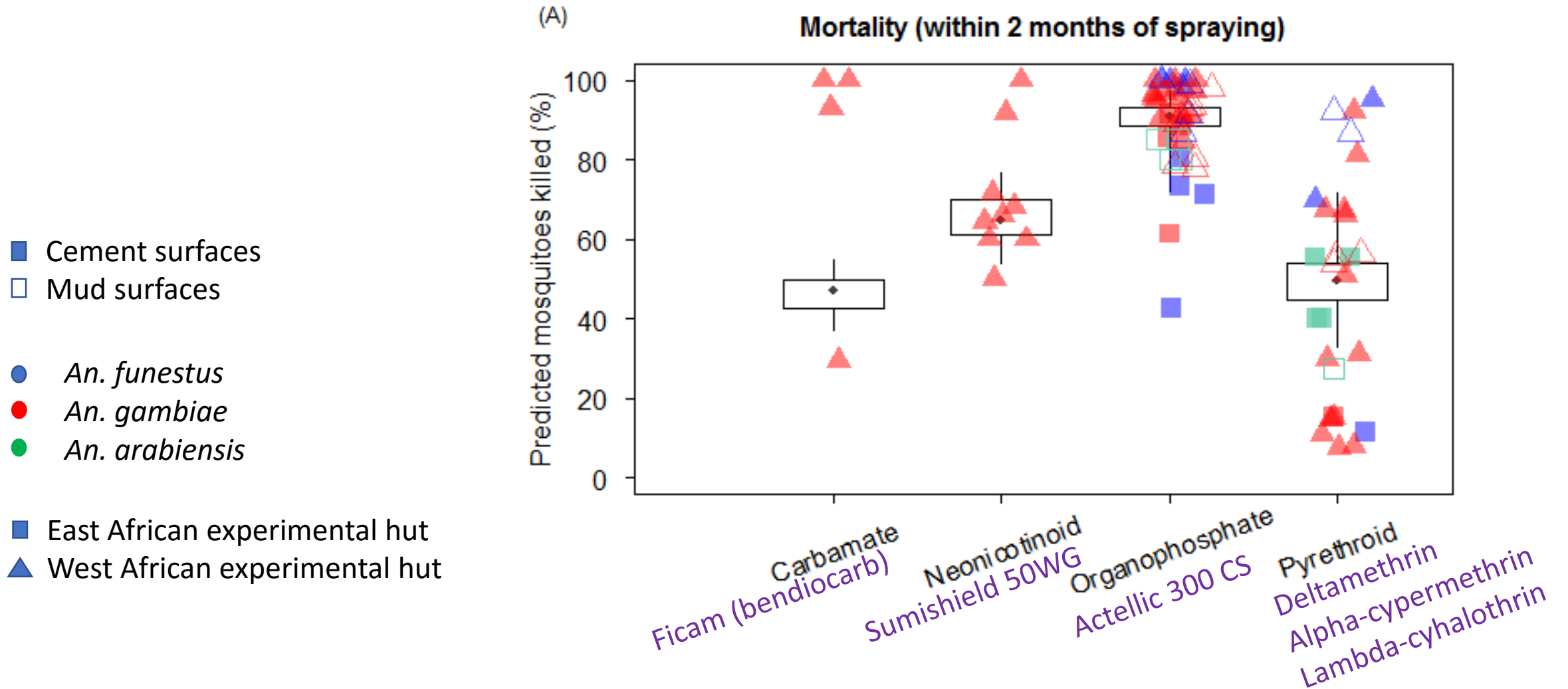

deterrence

Exiting without feeding

Successfully feeding

Mortality

➤ Initial impact (optimal effect)
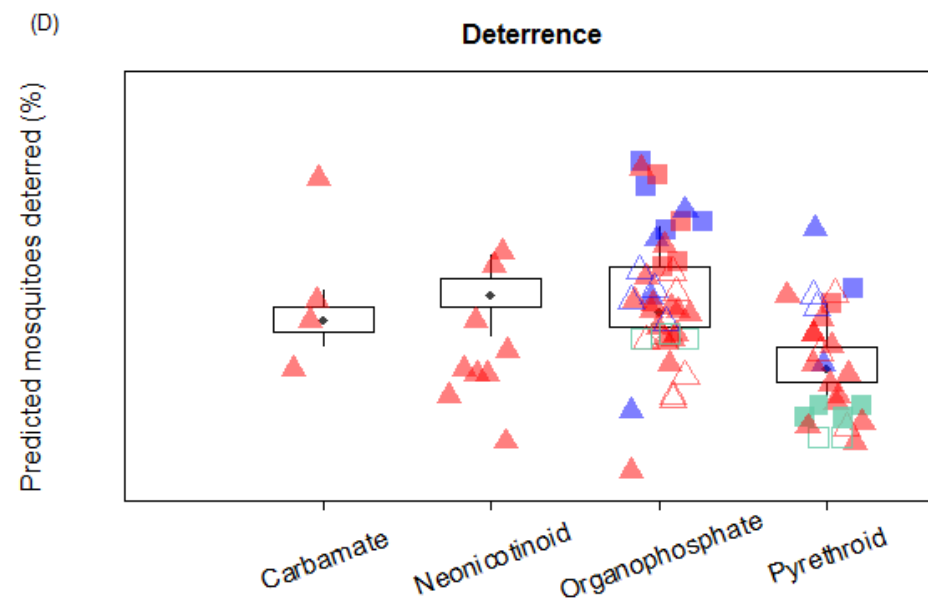
➤ Effect duration

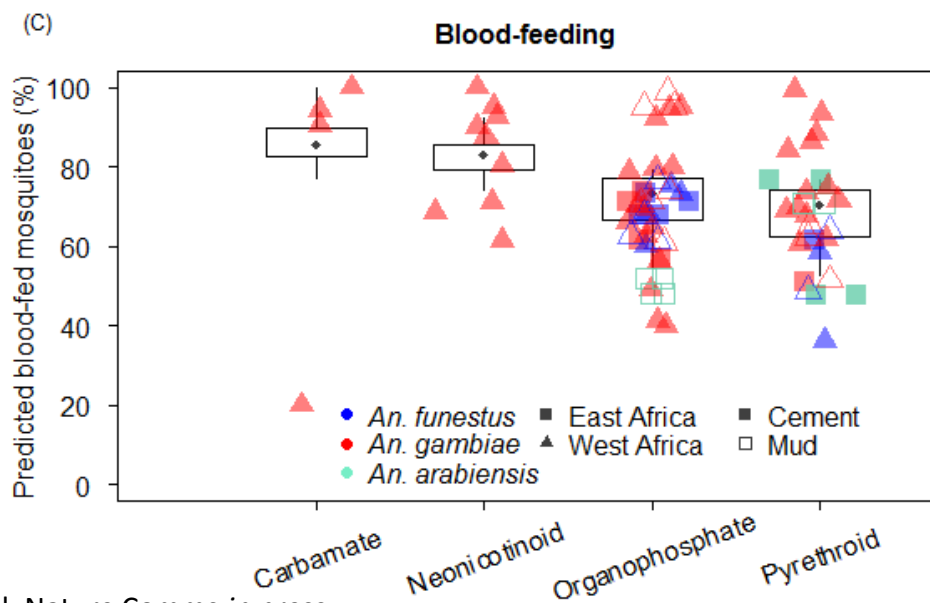# Understanding IRS impact

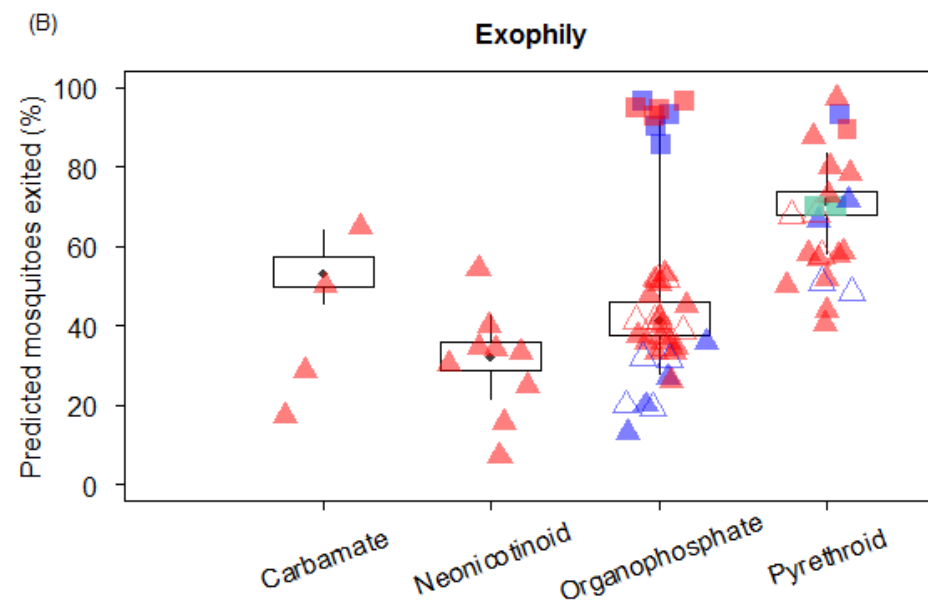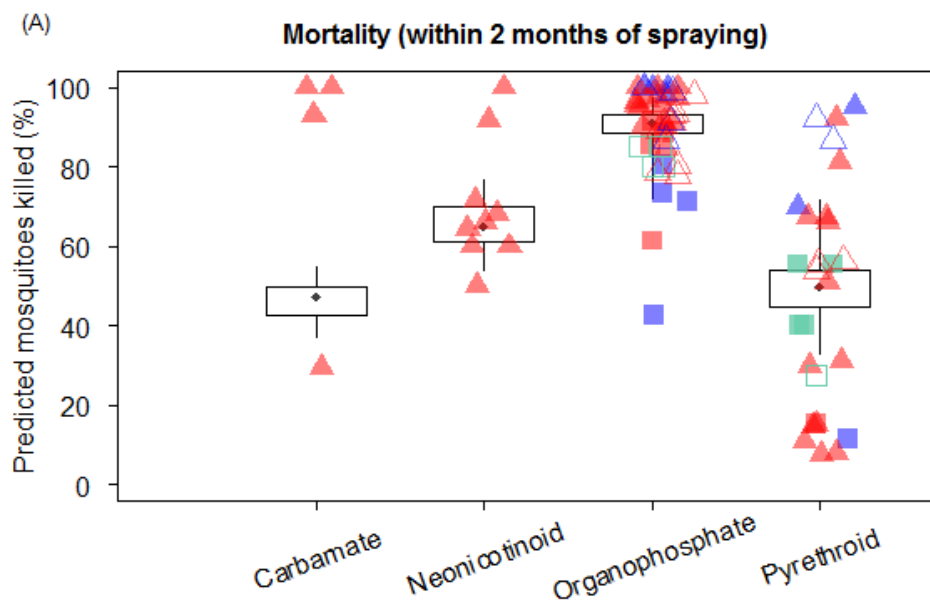A tool box of different chemistries with different mechanisms of action

(A) **Mortality (within 2 months of spraying)**

Legend:
- ■ Cement surfaces
- □ Mud surfaces

- ● *An. funestus*
- ● *An. gambiae*
- ● *An. arabiensis*

- ■ East African experimental hut
- ▲ West African experimental hut

X-axis categories:
- Carbamate — Ficam (bendiocarb)
- Neonicotinoid — Sumishield 50WG
- Organophosphate — Actellic 300 CS
- Pyrethroid — Deltamethrin, Alpha-cypermethrin, Lambda-cyhalothrin

Y-axis: Predicted mosquitoes killed (%)

Understanding IRS impact

Sherrard-Smith et al. Nature Comms *in press*

Understanding IRS impact

Pirimiphos-methyl

Sherrard-Smith et al. Nature Comms *in press*

Understanding IRS impact

Sherrard-Smith et al. Nature Comms *in press*

The utility of models to predict IRS impact

Actellic 300CS in Kagera, Tanzania

Protopopoff et al. 2018 Lancet

Nets only

Nets + IRS

Bendiocarb in Kagera, Tanzania
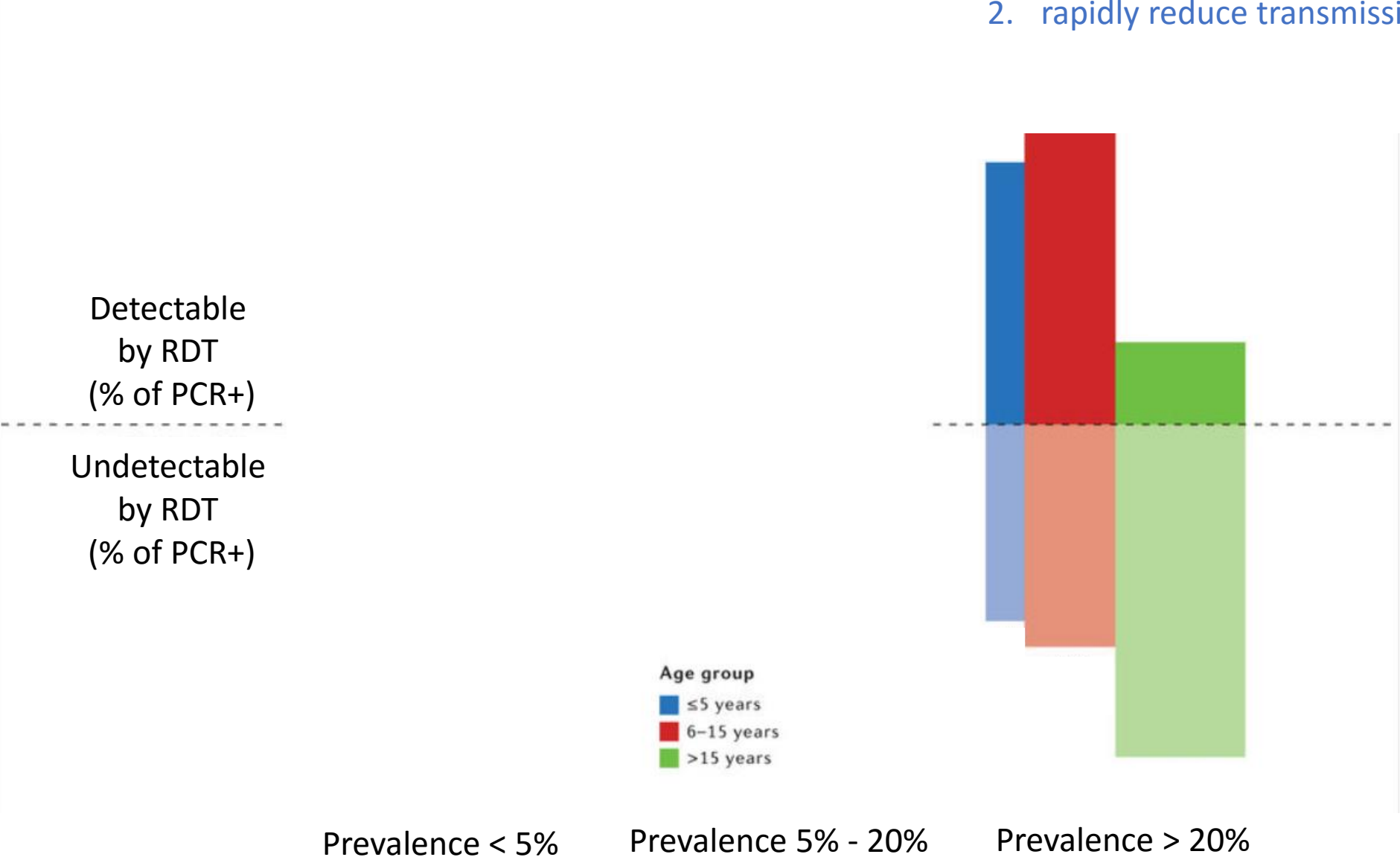
West et al. 2014 PloS Med
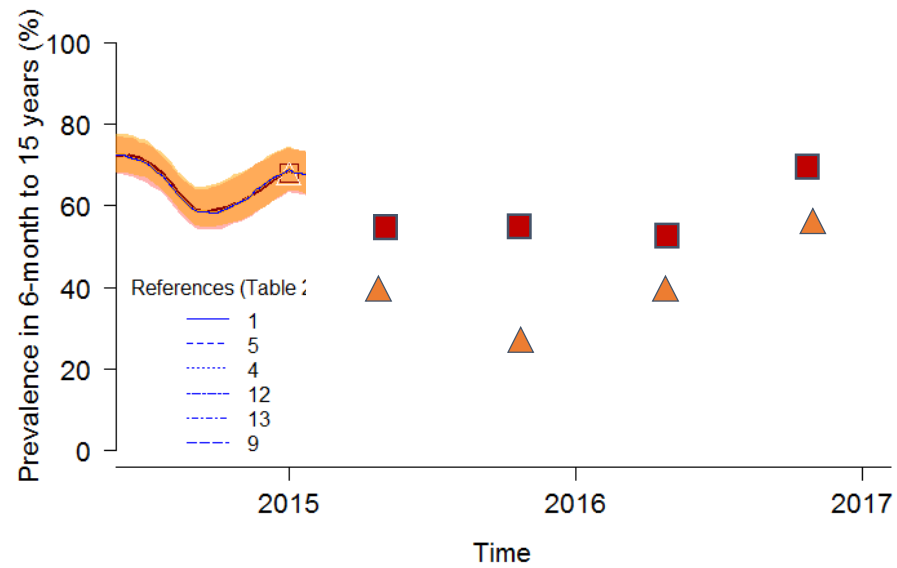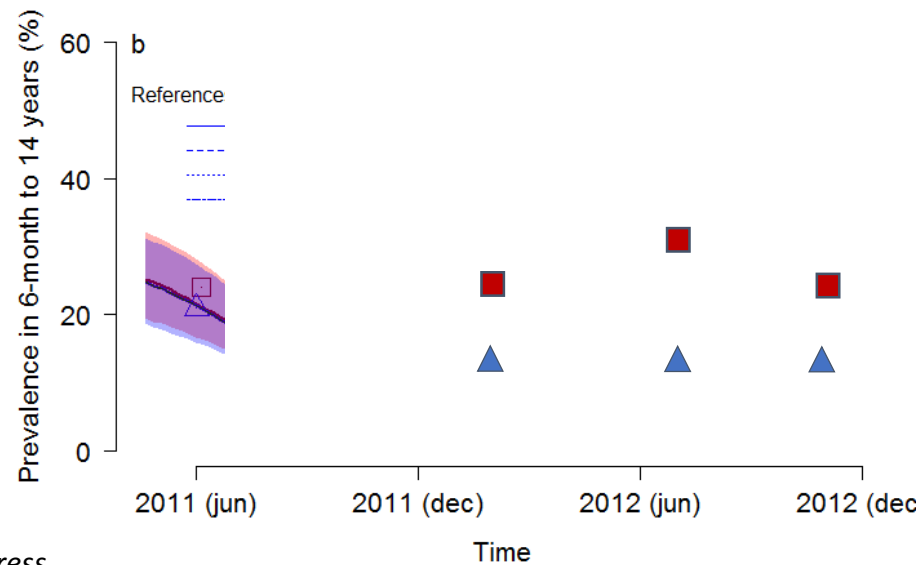
Nets only

Nets + IRS

Detecting cases of malaria

Mass drug administration to
1. clear chronic asymptomatic infections
2. rapidly reduce transmission

Detectable
by RDT
(% of PCR+)

Undetectable
by RDT
(% of PCR+)

Age group
- ≤5 years
- 6–15 years
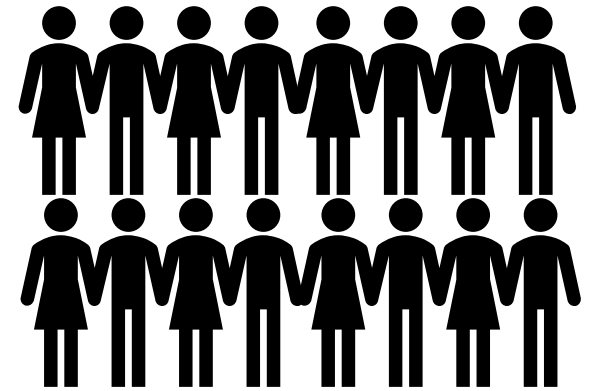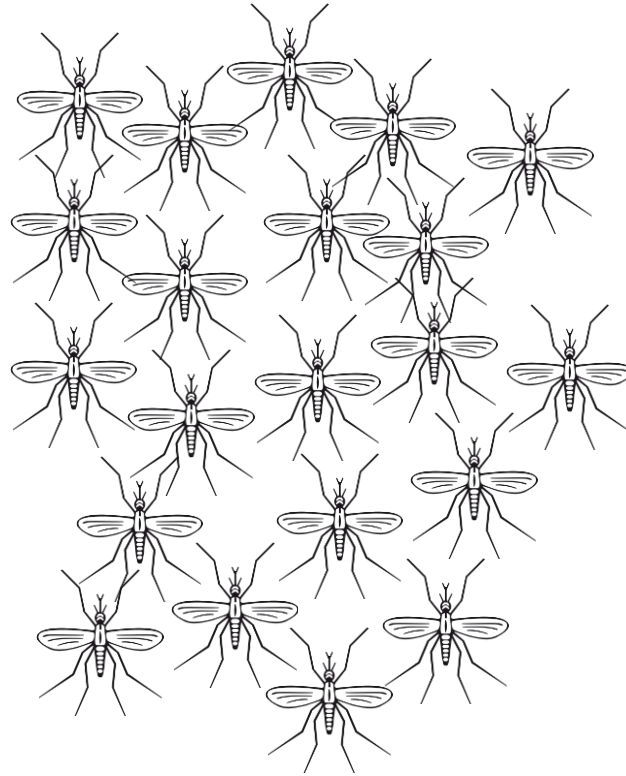- >15 years

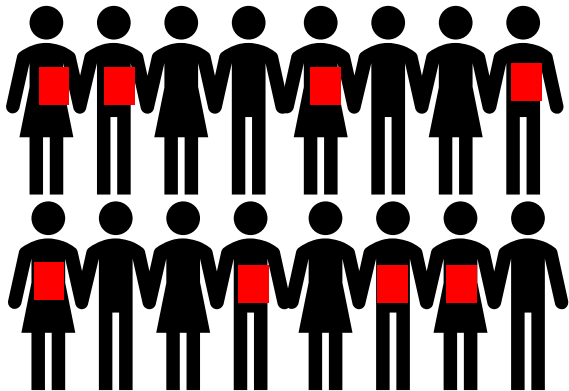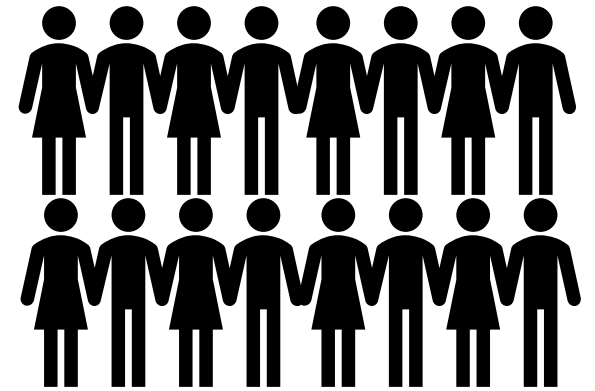Prevalence < 5%   Prevalence 5% - 20%   Prevalence > 20%
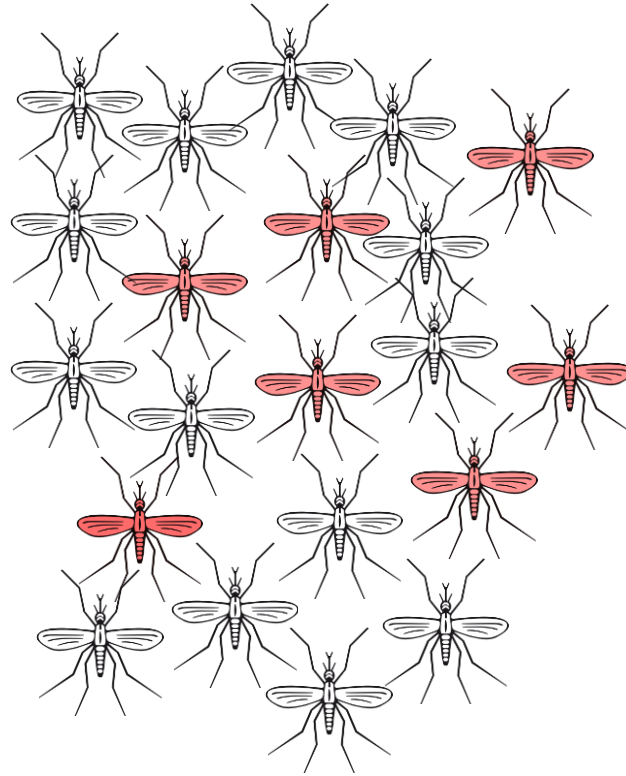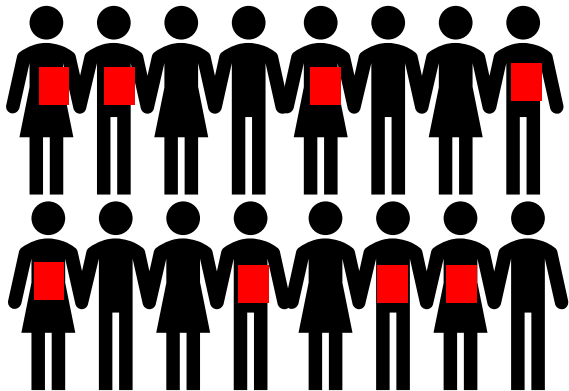
Rapid diagnostic tests (RDT)

Rationale for adding MDA to IRS

1) No intervention

Rationale for adding MDA to IRS

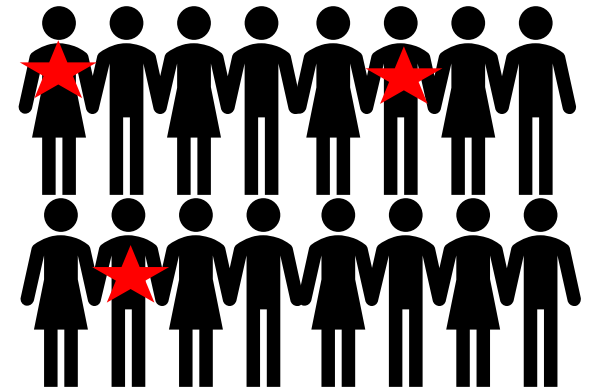## 1) No intervention
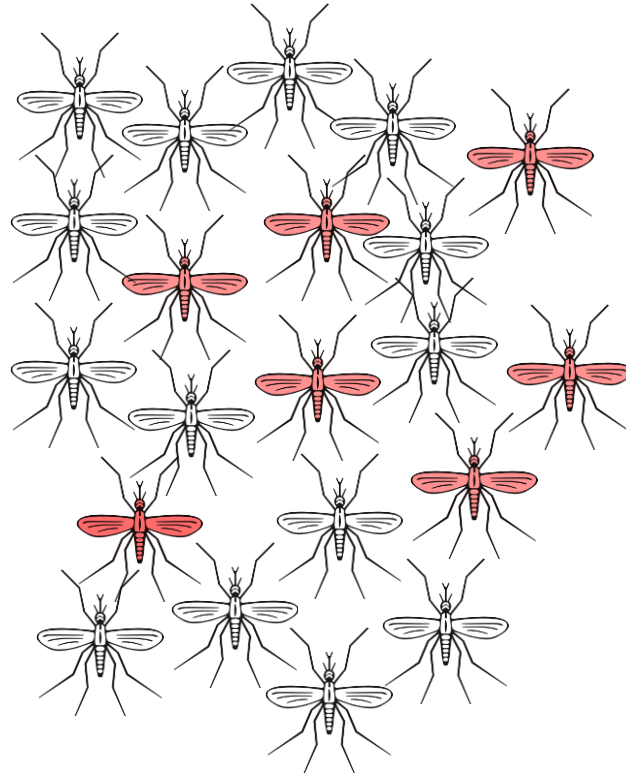
Rationale for adding MDA to IRS

1) No intervention

Rationale for adding MDA to IRS

2) With IRS

Rationale for adding MDA to IRS

2) With IRS

Rationale for adding MDA to IRS

2) With IRS

Rationale for adding MDA to IRS

2) Adding MDA to IRS

= gametocytaemic

= asexual parasites cleared (if any) + prophylactically protected from new infectious bites

Rationale for adding MDA to IRS

2) Adding MDA to IRS

■ = gametocytaemic

■ = asexual parasites cleared (if any) + prophylactically protected from new infectious bites
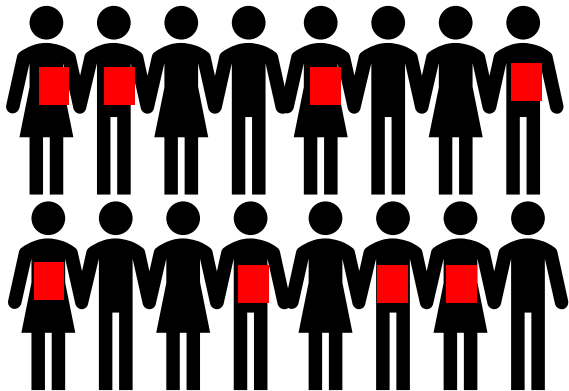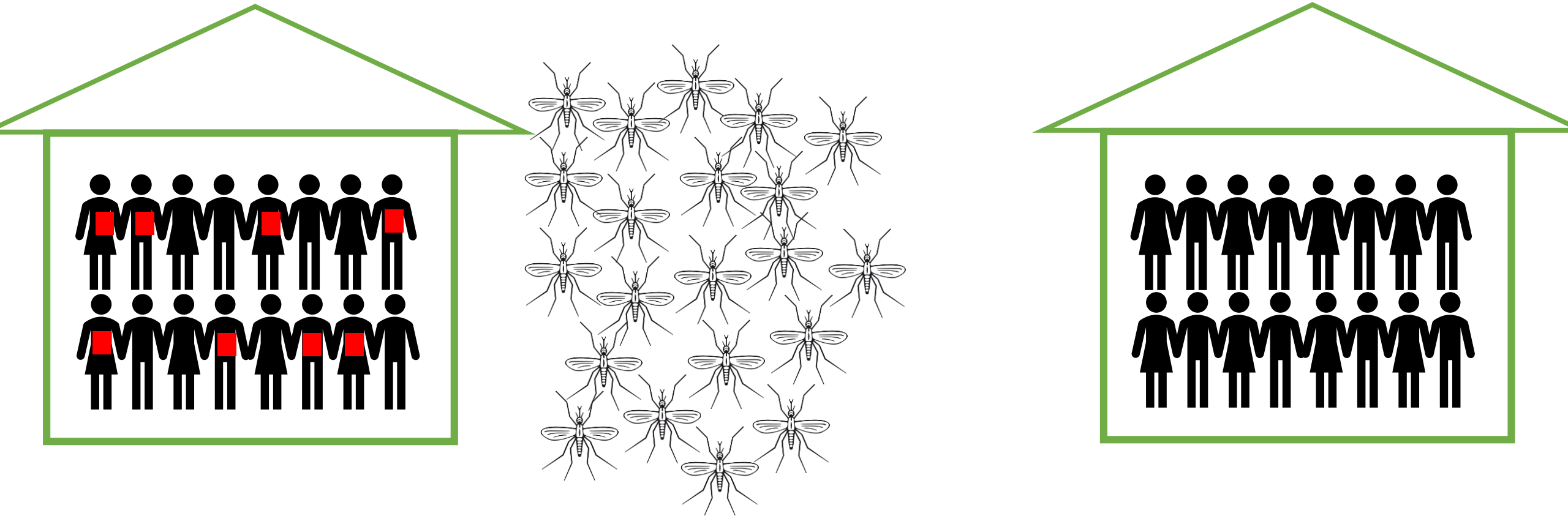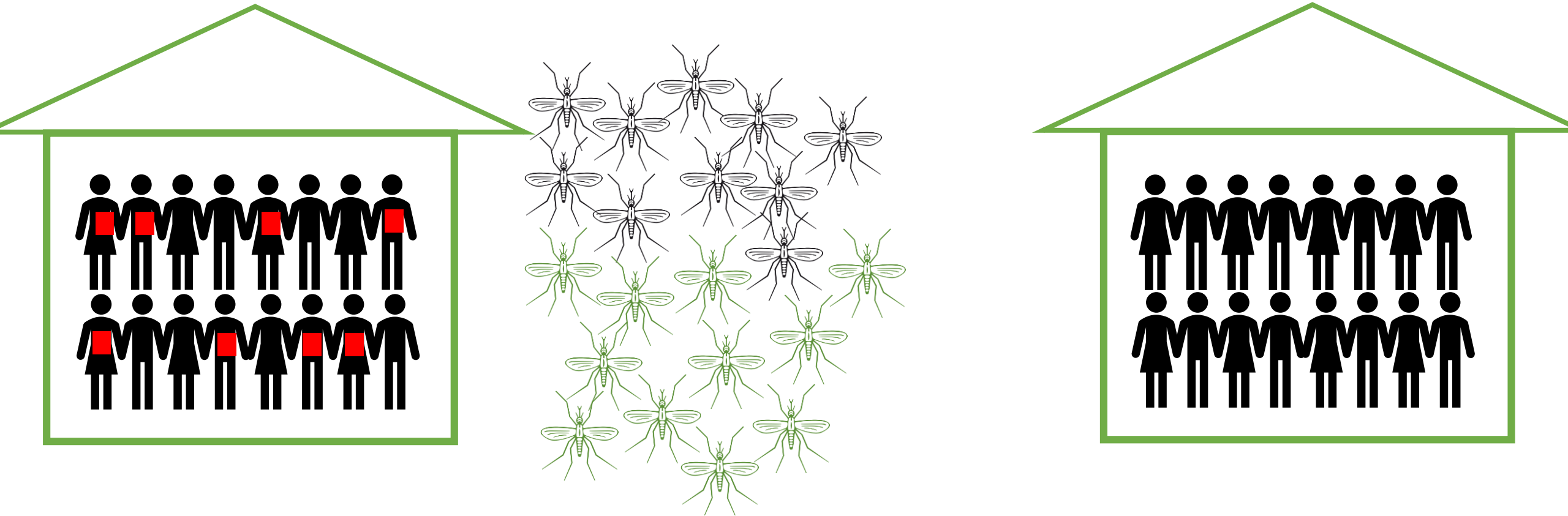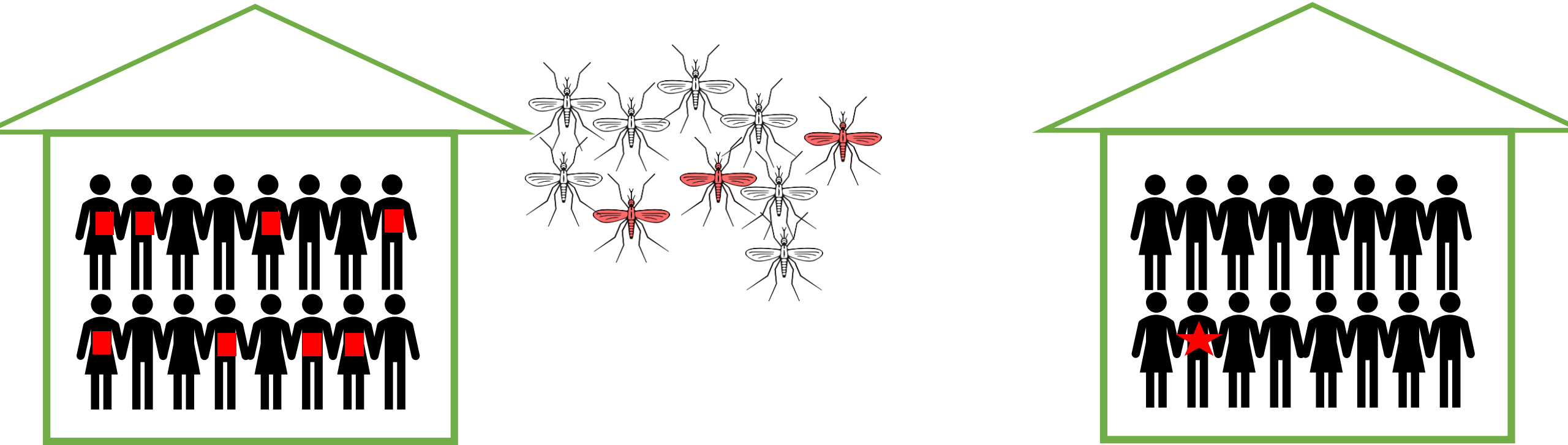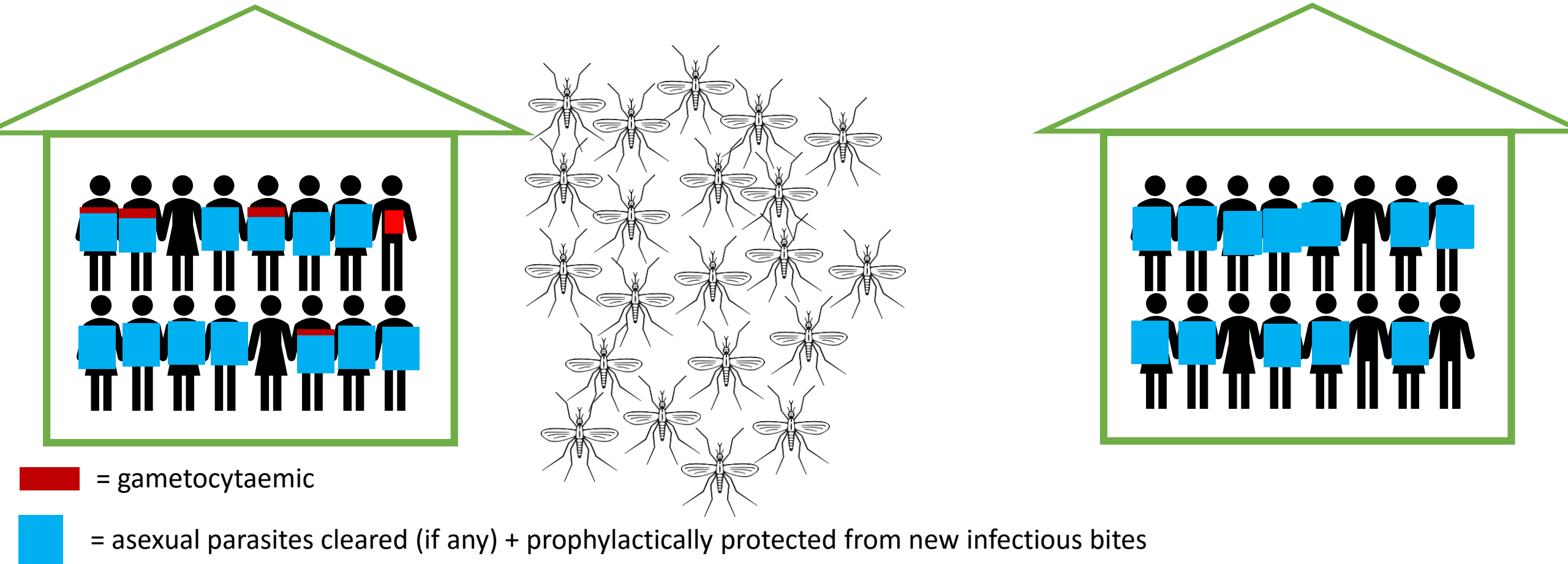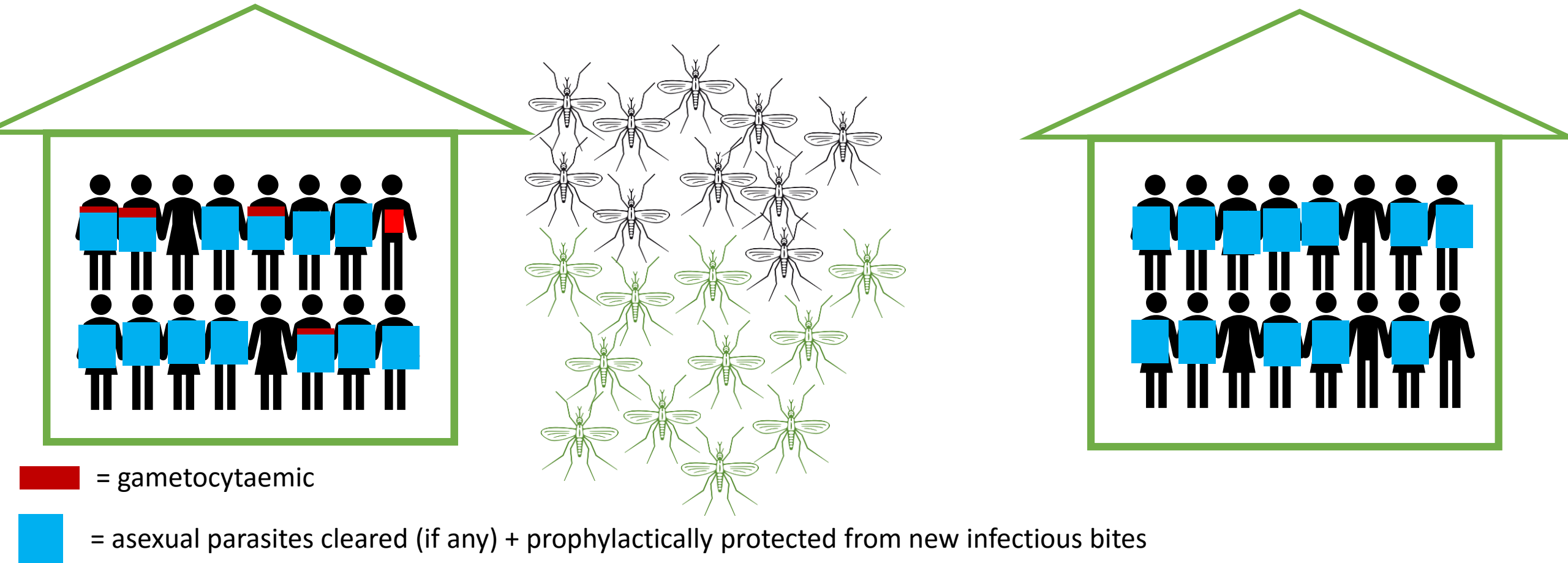
Rationale for adding MDA to IRS

2) Adding MDA to IRS
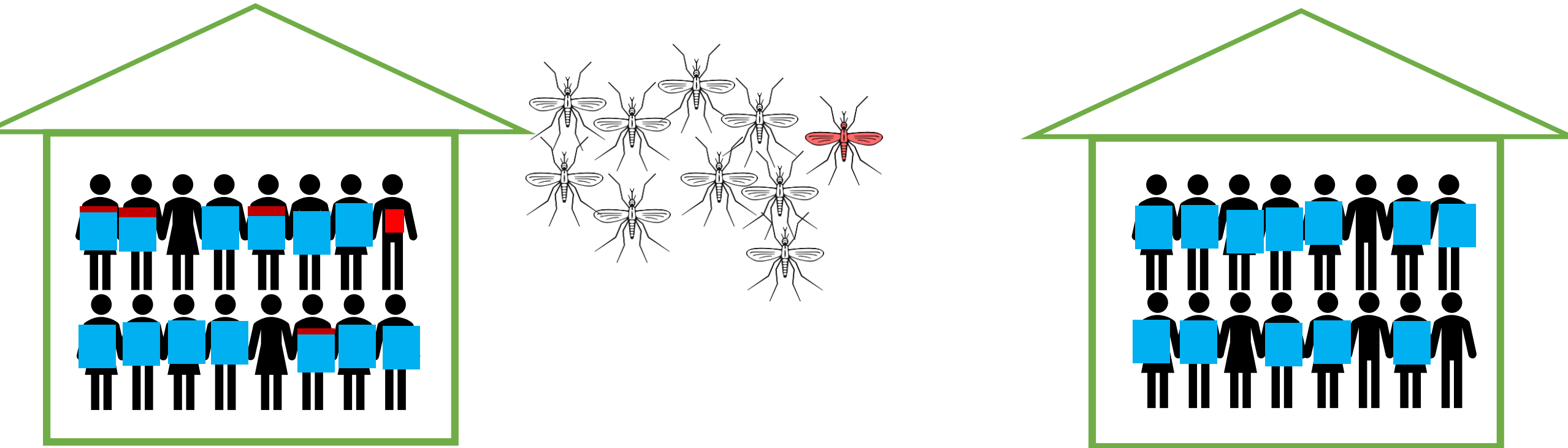
NO NEW INFECTIONS

Would you expect to see a 'less than additive' impact of combining these two interventions?

- Use malaria transmission model to simulate the impact of MDA + IRS

  - Seasonal transmission setting with moderate transmission (based on Western Province, Zambia)

  - IRS coverage set at 20% pre-intervention, and increased to 60% during the intervention and has efficacy and duration based on Actellic

  - MDA coverage is 70%, 3 rounds are conducted starting at the end of the dry season and spaced 1 month apart, and drug given is DHA-P

Impact on prevalence of combining IRS and MDA
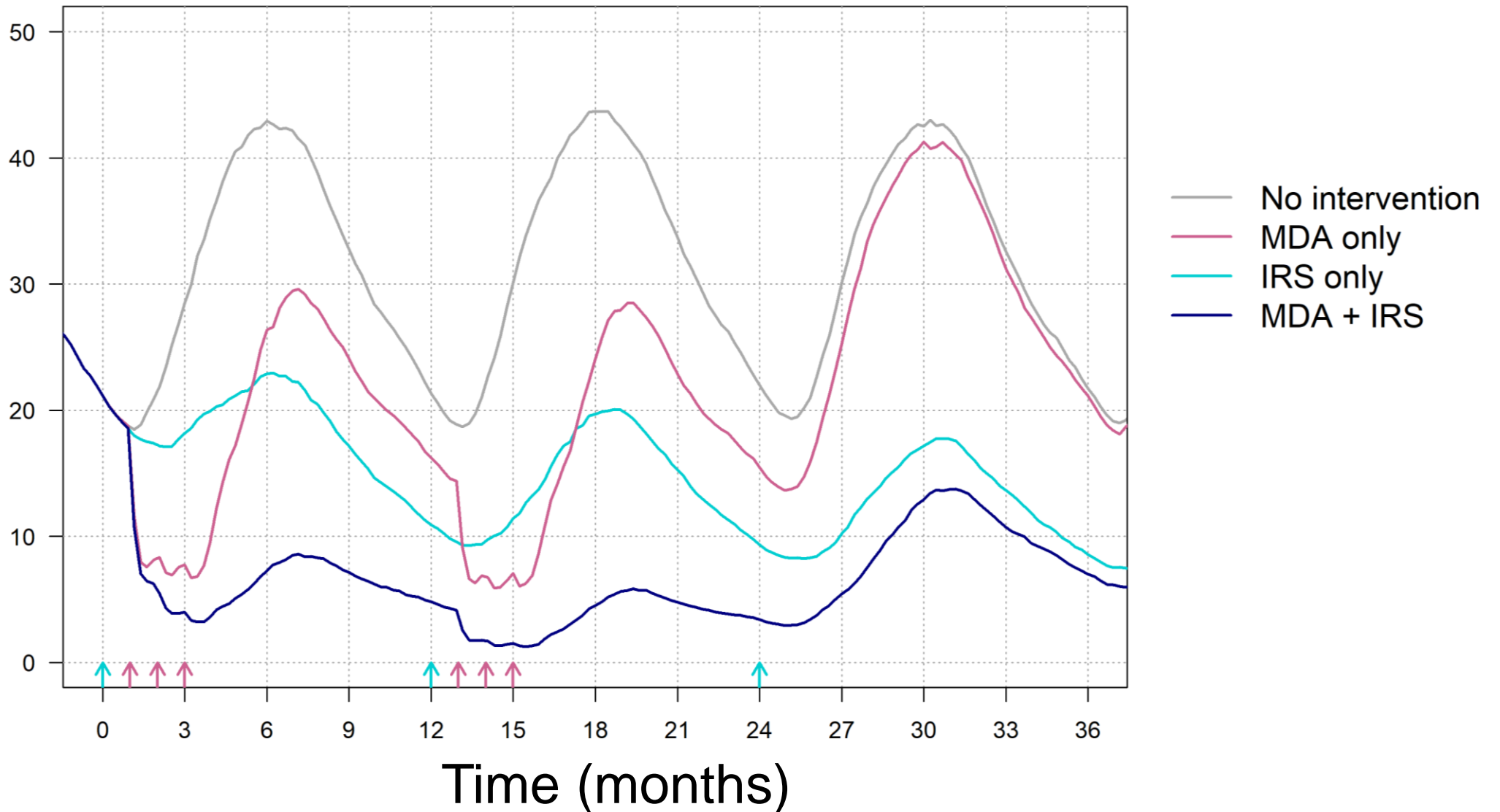
Impact on mean prevalence in 2 years after start of intervention

	Mean slide prevalence in 2-10yr olds	Percentage reduction compared to no intervention	Percentage reduction compared to IRS only
No Intervention	32%	-	-
IRS only	16%	49%	-
MDA only	18%	43%	-
MDA + IRS	6%	85%	66%

Impact on treated clinical cases in 2 years after start of intervention

	Mean treated clinical cases per 1,000 per year	Percentage reduction compared to no intervention	Percentage reduction compared to IRS only
No Intervention	179	-	-
IRS only	40	78%	-
MDA only	87	51%	-
MDA + IRS	12	93%	71%

Impact is lower and more transient in a setting with high and perennial transmission (i.e. Uganda, Dorothy Echodu)

Impact of combining these two interventions depends on (amongst many factors):

- seasonality
- transmission intensity timing
- frequency of rounds
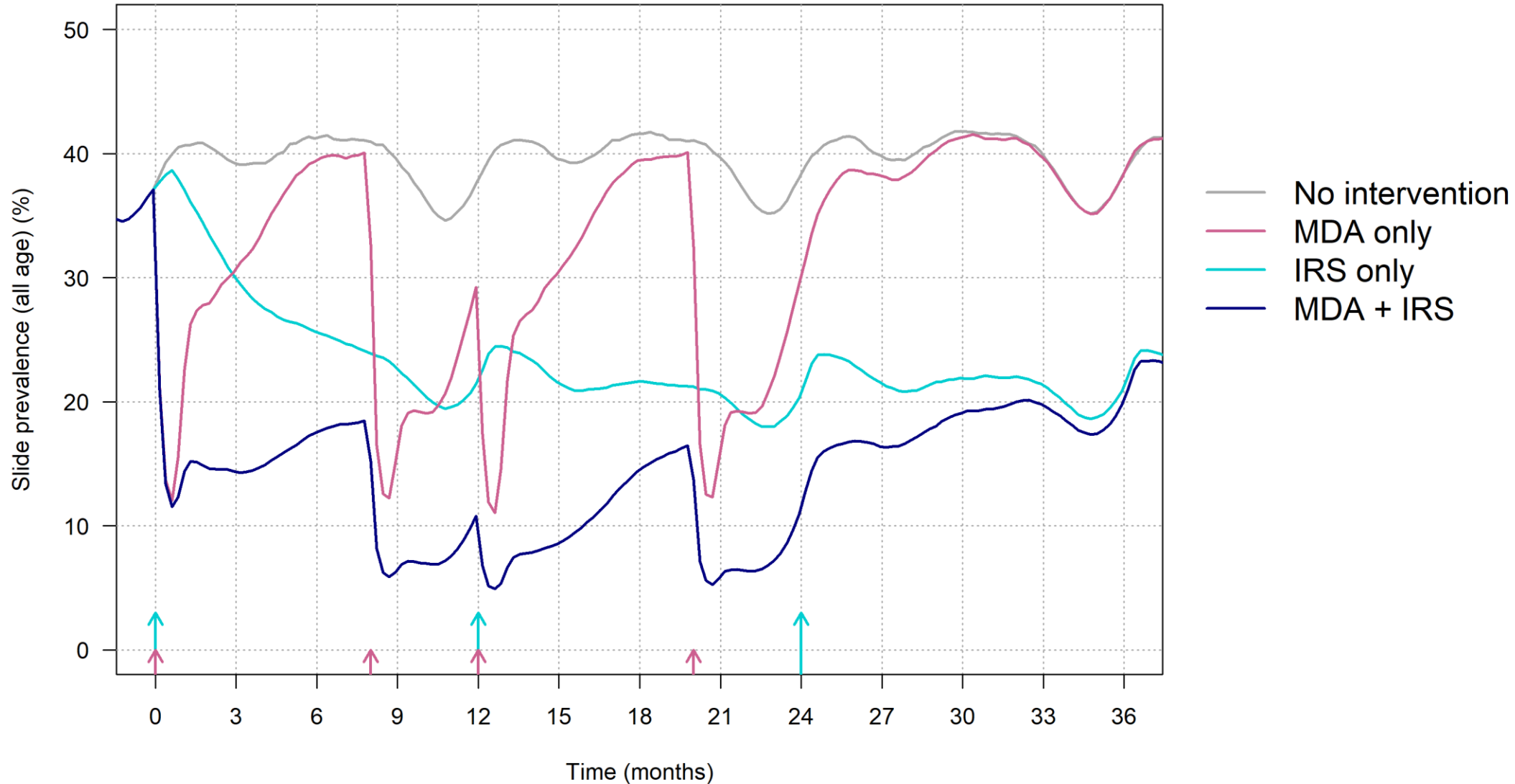
Key observations

- Mosquito populations are resistant to key chemistries – specifically pyrethroids – we need alternatives.

- IRS chemistries provide broader mechanisms of action but differ in performance

- Coupling indoor interventions with MDA has potential

  - ➢ MDA clears parasites in the human population
    - o lower probability that a mosquito will become infected
  - ➢ IRS reduces the vector population
    - o fewer mosquitoes to become infected, and mosquitoes dying before becoming infectious
  - ➢ MDA protects people through the prophylactic properties of the antimalarials
    - o fewer people susceptible to new infections

  = Theoretically sensible complementary interventions

Thank you to the ASTMH and Symposium organisers

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