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Cost-effectiveness of malaria control measures: A cluster-randomized control trial of IRS and LLINs in Mozambique

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Introduction

Malaria endemic countries face challenging decisions regarding the choice and financing of vector control interventions to prevent malaria, especially in light of growing concerns about the impact of pyrethroid resistance on the efficacy of standard insecticide treated bed net (LLIN) and indoor residual spray (IRS) tools. Whether looking to maintain recent gains in malaria control or accelerate towards elimination, **the need to shift to newer insecticide active ingredients and formulations that are effective against pyrethroid-resistant vectors is widely recognized – but more robust evidence of the efficacy and cost-effectiveness of newer interventions, and combinations of interventions, is needed[1].**

In order to help address this information gap, and ultimately to inform national vector control strategies, the partners under the NgenIRS project* have designed a cluster-randomized controlled trial (CRT) to evaluate the efficacy and cost-effectiveness of IRS with the organophosphate insecticide pirimiphos-methyl (PM) (Actellic® 300CS: Syngenta AG, Basel, Switzerland), in the context of high coverage of LLINs, in the Mopeia District of Zambezia Province, Central Mozambique.

Study Design

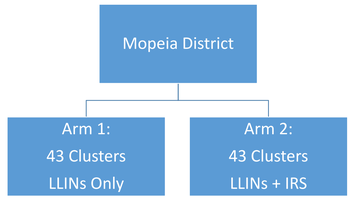


Fig. 2 Study schematic.

Intervention timing

- 2016 – IRS with Actellic
- 2017 – IRS with Actellic + mass distribution of new LLINs scheduled for entire district

Two years of follow up, to include

Active Cohort Surveillance

- 18 children per cluster (774 per arm)
- Monthly follow up
  - → True U5 incidence
  - → Health behavior & household spending

Enhanced Passive Surveillance

- Continual, at local health facilities
  - → Incidence of symptomatic cases seeking treatment
  - → Health Systems Costs

Cross Sectional Surveys

- April 2017 & April 2018
- 385 Surveys per arm
  - → Community prevalence
  - → Health behavior & household spending

Goal & Primary Aims

The main study aim is to evaluate **the cost-effectiveness of IRS with PM**, used in addition to LLINs, in an area of high transmission and evidence of emerging pyrethroid resistance. The main indicators for analysis will be:

- True malaria incidence observed in the active sentinel cohorts of children 5 years of age and under
- Health facility malaria incidence via passive surveillance of symptomatic cases presenting to local health clinics and community health workers in control and intervention clusters
- Malaria point prevalence across intervention and control clusters via cross sectional surveys in 2017 and 2018

Cost-effectiveness Evaluation:

An ingredients approach from a provider perspective will be used to calculate incremental cost of IRS per case averted based on spray campaign net costs and health systems savings from reduced case burdens observed at local health facilities. Additional analyses will utilize individual household malaria expenditures and reductions in active cohort incidence to consider cost-effectiveness from a societal perspective.

Entomological Impact:

Routine entomological surveillance in a sub-sample of 5 clusters from each study arm will estimate the impact of the intervention on vector density, entomological inoculation rates, measures of indoor/outdoor biting behaviors and insecticide resistance patterns.

Study Location

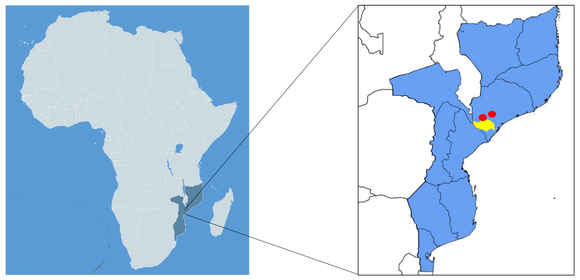


Fig. 1 Mopeia District (yellow) in Central Mozambique. The red dots indicate the locations of neighboring districts where pyrethroid resistance had been documented (see below).

Mopeia District

- 7. 614 km^2
- 160,000 total population[2]
- 17,500 children under 5 years old (U5)
- U5 malaria prevalence = 54%[3]
- 1 District Hospital and 11 local Health Facilities
- *An. gambiae* s.l. & *An. funestus* s.l. are the dominant vectors[4]
- 175,000 LLINs distributed in 2014/15 (usage rates estimated ~40% in U5's) [3,5]
- IRS with Deltamethrin in 2014
- Pyrethroid resistance detected in neighboring Mocuba & Morrumbala districts in 2015[4]

Progress to Date

A ground census of 190 villages in Mopeia was conducted to inform cluster definition and randomization for IRS by the PMI Africa Indoor Residual Spraying Project (AIRS):

- Houses enumerated & geolocated
- Village names & boundaries clarified
- Number of residents/household
- Number of residents under 5 years of age

Clusters Defined (146)

- Stratified by number of households: Large (>125), Med (71 - 125), Small (<70)
- Randomized 1:1 to either IRS or no IRS arms
- 43 spray clusters will be designated for active data collection (intervention)
- 43 non-spray clusters will be designated for active data collection (control)

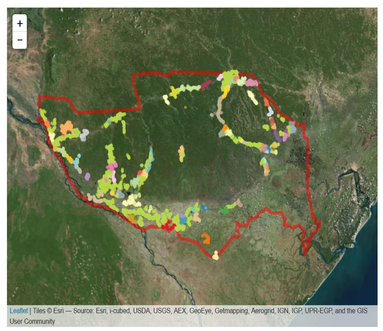


Fig. 3 Enumerated houses with preliminary cluster designations shown by color. Figure courtesy Joe Brew, Charfudin Sacoor, Carlos Chaccour, and Francisco Saute of CISM

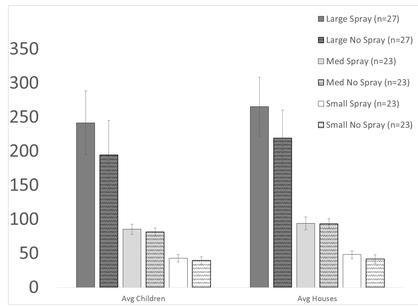
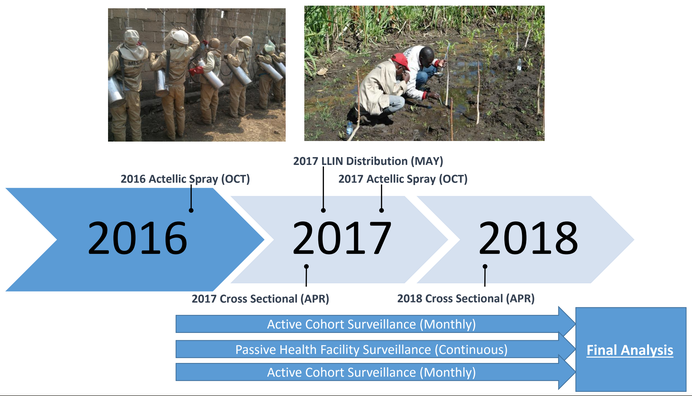


Fig. 4 Baseline Cluster Similarity. Across clusters randomized to either the spray or no-spray arms, there are no significant differences in the numbers of houses or in the <5 populations.



Study Partners

*The NgenIRS (Next Generation IRS) project is a partnership, led by IVCC, that includes the US President's Malaria Initiative, Abt Associates, and PATH. NgenIRS works in close collaboration with leading insecticide manufacturers, national malaria control programs, the Global Fund, and other stakeholders to save lives and protect health by reducing transmission of malaria through affordable indoor residual spraying of long lasting, non-pyrethroid insecticides. It is funded by UNITAID. For more information please visit www.ngenirs.com or email David McGuire (david.mcguire@ivcc.com).

References

[1] WHO Guidance for countries on combining IRS and LLINs, March 2014
[2] National Institute for Statistics, Maputo, Mozambique
[3] 2012 DHS Final Report
[4] PMI|AIRS Mozambique Report, Sept. 2015
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