

Results from impact evaluations of IRS and PBO ITNs: Ethiopia and Sierra Leone

Emily Hilton
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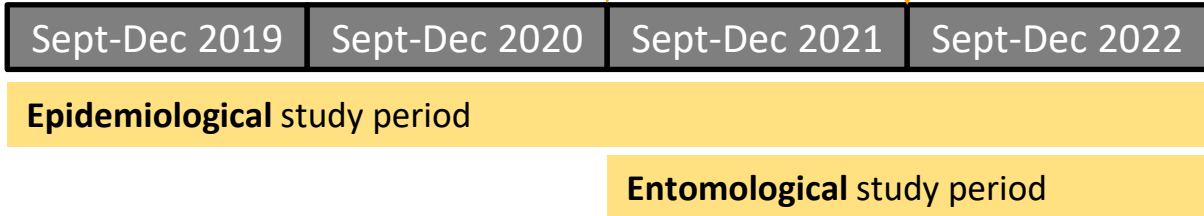
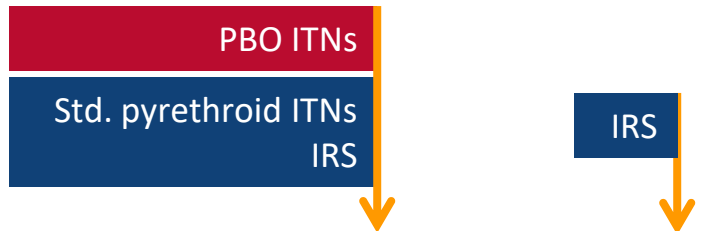
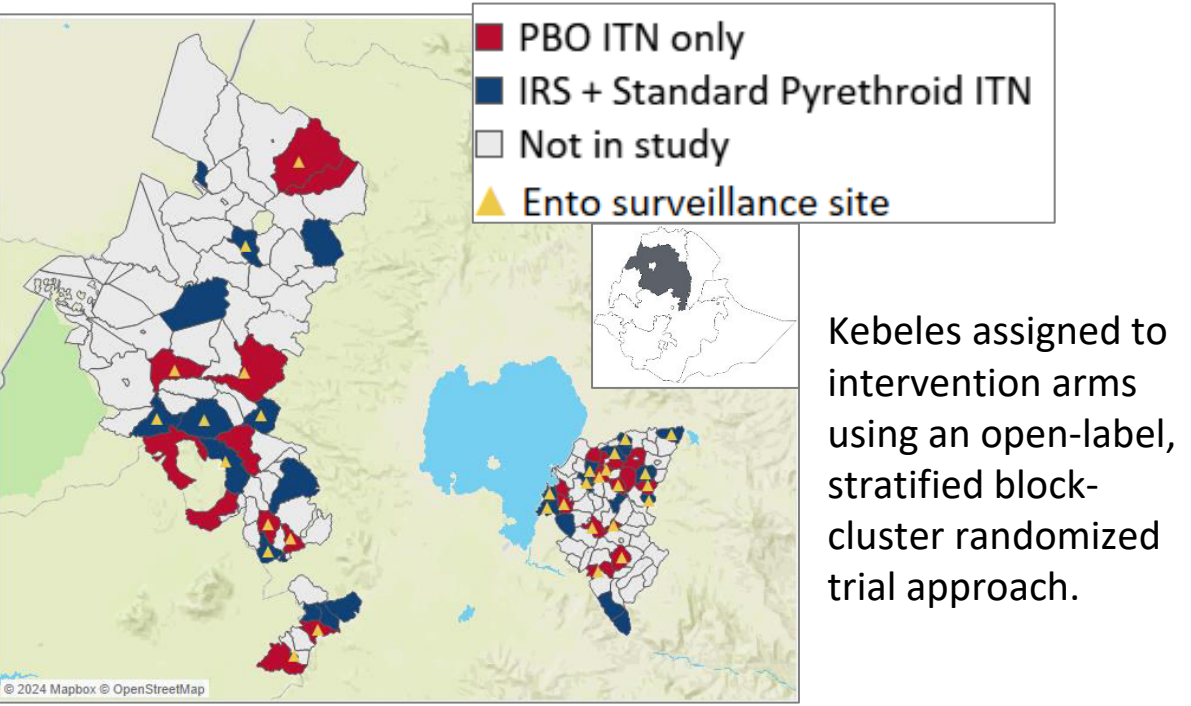
PMI Evolve

Evolving Vector Control to Fight Malaria

Context

- With an **increasing number of vector control tools** available for use alone or in combination, national malaria programs (NMPs) need **timely, local evidence** to guide vector control product choice and deployment decisions.
- With support from PMI Evolve, NMPs in Ethiopia and Sierra Leone conducted **retrospective impact evaluations** to understand the relative impact of different combinations of vector control interventions on **epidemiological and entomological outcomes**.
 - **Ethiopia**: PBO ITNs alone **vs.** Standard Pyrethroid ITNs + pirimiphos-methyl-based IRS
 - **Sierra Leone**: PBO ITNs alone **vs.** PBO ITNs + clothianidin-based IRS

ETHIOPIA | Study Design



	Epidemiological outcomes	Entomological outcomes
Primary outcome	Routinely-reported confirmed malaria cases (all-ages)	Vector density per trap; indoor resting density
Study period	Sept-Dec, 2019-2022	Sept-Dec, 2021-2022
Modeling approach	Negative binomial mixed effects models	Negative binomial mixed effects models
Control variables	Intervention arm, time since intervention, precipitation, enhanced vegetation index (EVI), temperature	Intervention arm, time since intervention, precipitation, EVI, temperature

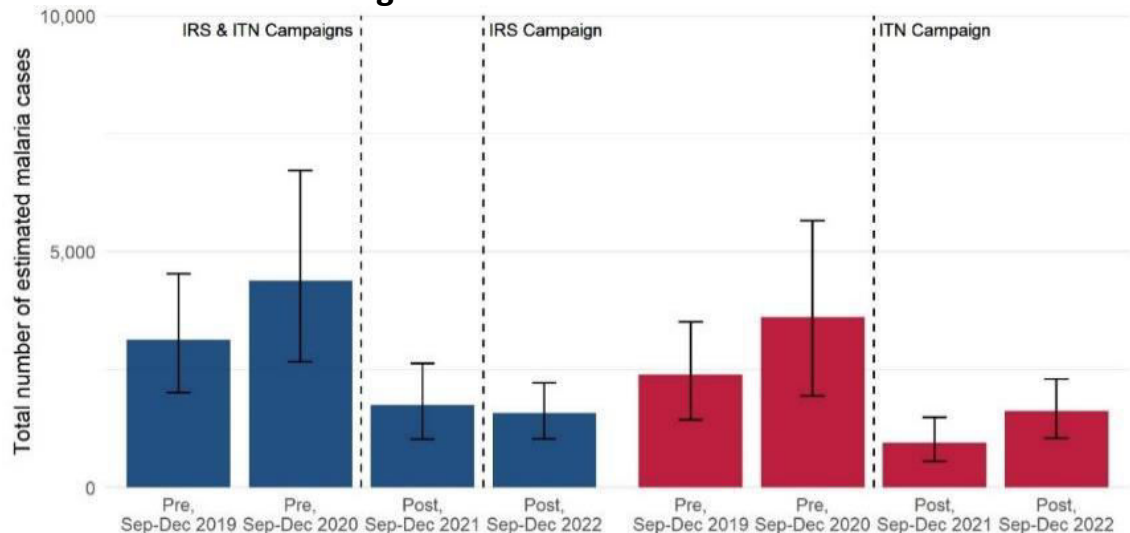
ETHIOPIA | Results

■ PBO ITN only
 ■ IRS + Standard Pyrethroid ITN

*Statistically significant

Epidemiological Outcomes

All-Ages Confirmed Malaria Cases



Overall pre- vs. post-intervention

↓ **53.6% ***

(-72.9%, -29.8%)

Year 2 vs. Year 1 post-intervention

↓ **5.9%**

(-34.3%, 47.2%)

Overall pre- vs. post-intervention

↓ **55.9% ***

(-73.0%, -32.5%)

Year 2 vs. Year 1 post-intervention

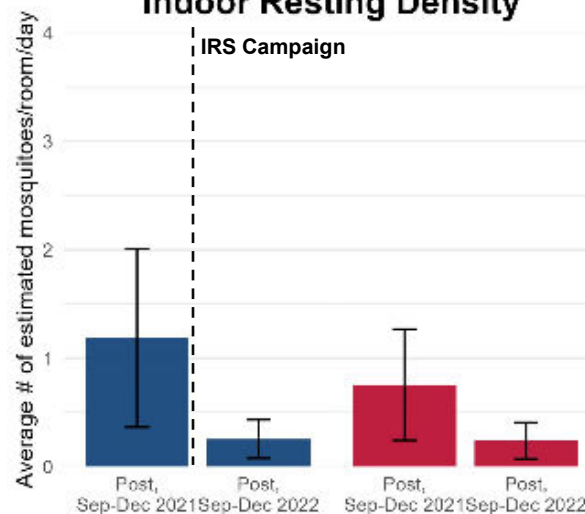
↑ **98.1% ***

(49.5%, 167.3%)

No significant differences between intervention arms.

Entomological Outcomes

Indoor Resting Density



Year 2 vs. Year 1 post-intervention

↓ **71.1% ***

IRR=0.29

95%CI=0.21-0.40

Year 2 vs. Year 1 post-intervention

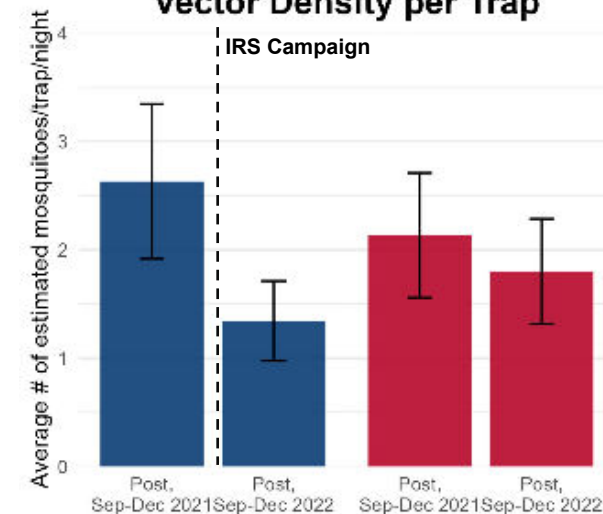
↓ **63.5% ***

IRR=0.37

95%CI=0.26-0.51

Significantly greater decrease in the IRS + Standard ITN arm

Vector Density per Trap



Year 2 vs. Year 1 post-intervention

↓ **51.6% ***

IRR=0.48

95%CI=0.43-0.54

Year 2 vs. Year 1 post-intervention

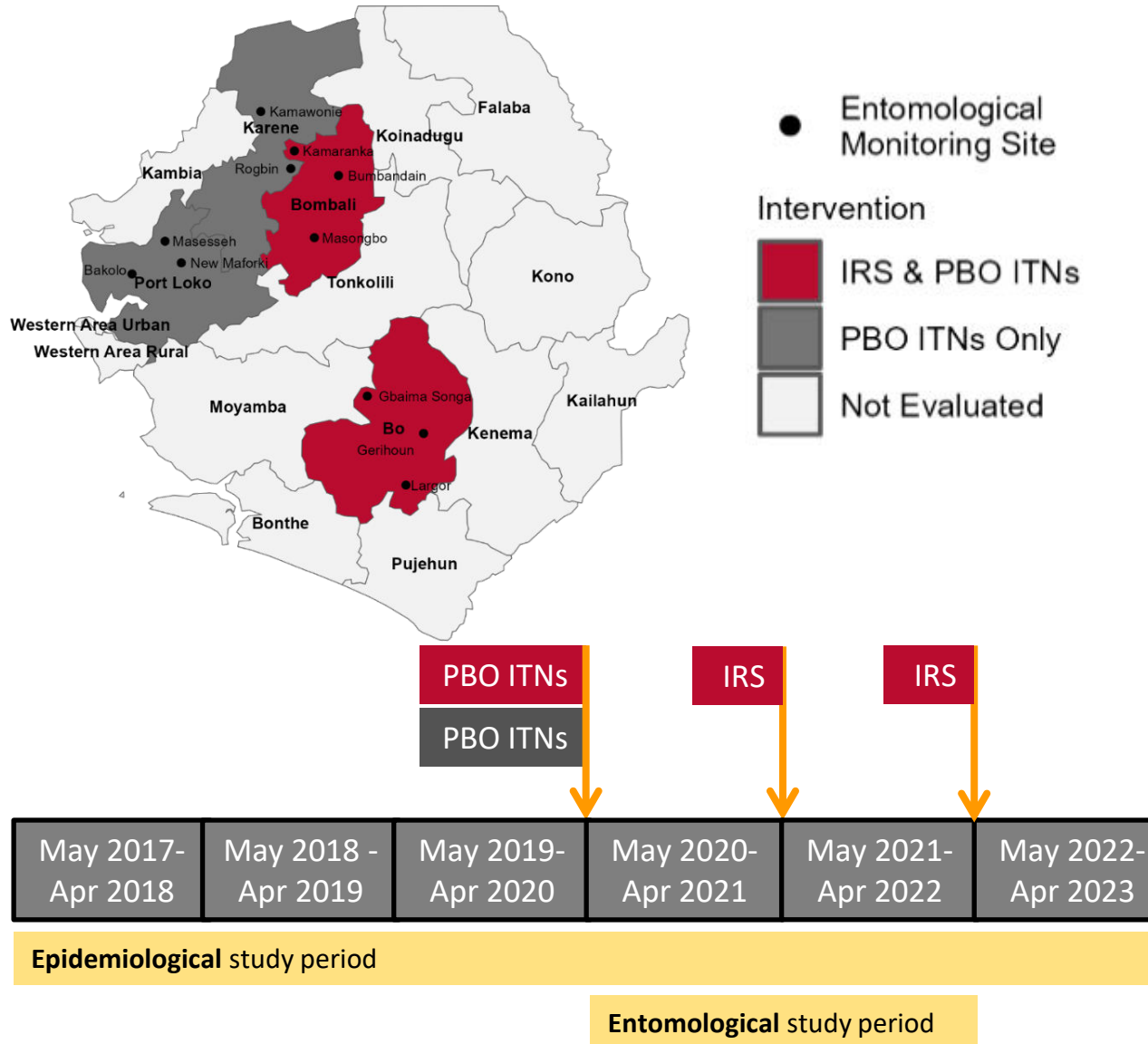
↓ **21.6% ***

IRR=0.78

95%CI=0.69-0.89

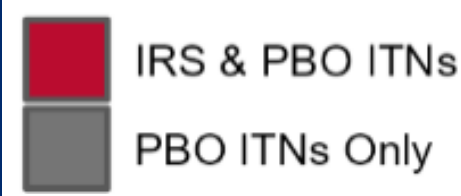
Significantly greater decrease in the IRS + Standard ITN arm

SIERRA LEONE | Study Design



	Epidemiological outcomes	Entomological outcomes
Primary outcome	Routinely-reported all-ages confirmed malaria cases	Human biting rate; indoor resting density
Study period	May 2017 – Apr 2023	Jul 2020 – Apr 2021 ; Jul 2022 – Apr 2022
Modeling approach	Negative binomial mixed effects models	Negative binomial mixed effects models
Control variables	Intervention arm, time since intervention, non-malaria outpatient attendance, community health worker (CHW) reporting	Intervention arm, time since intervention, precipitation, EVI, temperature, transmission season, collection location (HBR only)

SIERRA LEONE | Results

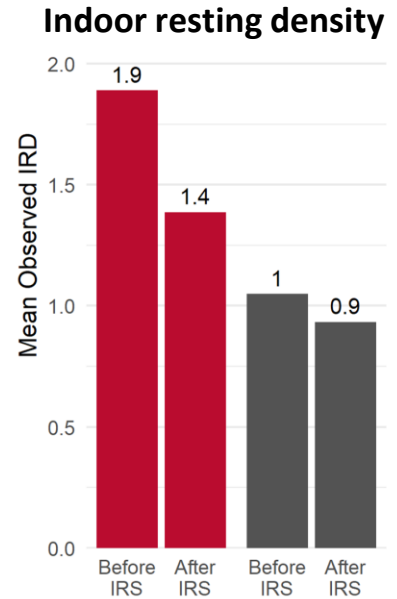


Epidemiological outcomes

Entomological outcomes

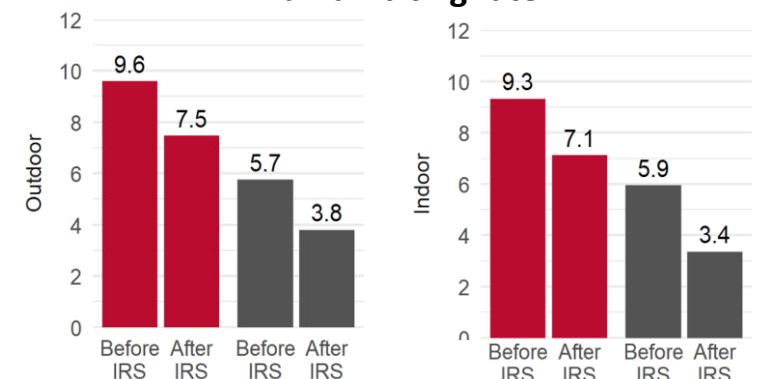
Comparing Year 1 post-ITN/Pre-IRS versus Year 2 post-ITN/Year 1 post-IRS

Indoor resting density: No significant difference in reductions between intervention arms (IRR: 0.95, 95% CI: 0.75-1.21)



Human biting rate

Human biting rate: 10% greater reduction in **IRS + PBO ITN** areas compared to PBO ITN only areas (IRR: 0.90, 95% CI: 0.82-0.99)



Overall Post-Intervention Changes Compared to Baseline

Year-to-Year Annual Changes

Year 1 post-ITN/Pre-IRS

Years 2-3 post-ITN/Years 1-2 post-IRS

Year 2 post-ITN/Year 1 post-IRS

Year 3 post-ITN/Year 2 post-IRS

% Change (95% CI)	Intervention Arm	Overall Post-Intervention Changes Compared to Baseline		Year-to-Year Annual Changes	
		Year 1 post-ITN/Pre-IRS	Years 2-3 post-ITN/Years 1-2 post-IRS	Year 2 post-ITN/Year 1 post-IRS	Year 3 post-ITN/Year 2 post-IRS
* Statistically significant	PBO ITNs only	-32.0% * (-33.2%, -30.0%)	-40.2% * (-41.1%, -39.3%)	-38.5% * (-39.6%, 37.3%)	-41.9% * (-43.0%, -40.8%)
	IRS + PBO ITNs	-28.4% * (-29.6%, -27.2%)	-39.3% * (-40.1%, -38.4%)	-35.3% * (36.4%, 34.1%)	-43.4% * (-44.5%, -42.4%)
Interpretation		Small but greater reduction in PBO ITN only areas (Pre-IRS)	No difference in change between intervention arms	Small but greater reduction in PBO ITN only areas	Small but greater reduction in co-deployment areas

* Statistically significant

Discussion and Limitations

Key Findings

- Both intervention arms were associated with **reduced malaria cases overall** in Ethiopia, although the **effect of PBO ITNs appeared to wane in the second year post-distribution**.
- There was **no significant overall difference** in impact between deploying PBO ITNs alone compared to alongside annual IRS in Sierra Leone.
 - Greater declines in relative impact in the PBO ITN only arm in the 3rd year post-ITN distribution suggest co-deployment with IRS may sustain vector control impact as ITN durability declines.

Using routine data to estimate intervention impact

- Bias in malaria incidence estimates based on routine data can arise from changes in care-seeking, differences in access to parasitological diagnosis, and incomplete registration of patients. However, these biases would not be expected to vary in association with the interventions of interest.
- Routine data are an important source of longitudinal data and can effectively be used to evaluate the impact of new vector control tools.

Thank you to our partners and collaborators

Ethiopia

Malaria and Other Vector-Borne Diseases Prevention and Control Desk

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Bahir Dar University

Jimma University

PMI

PMI Evolve Project

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Sierra Leone

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PMI

PMI Evolve Project

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Thank You!

