

An Observational Analysis of the Geographical Shift in IRS Operations Mali

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Introduction

- Mali has successfully implemented indoor residual spraying (IRS) as part of its malaria control strategy since 2008 through a collaboration between the National Malaria Control Program (NMCP) and the US President's Malaria Initiative (PMI) Africa Indoor Residual Spraying (AIRS) program.
- Analysis of routine data from Ségou region has shown that recent IRS campaigns, which utilized non-pyrethroid insecticides to control pyrethroid resistant *Anopheles gambiae* s.s., were particularly effective from 2012 to 2015.¹
 - More than 500,000 people protected for four years for < \$7 USD per year
 - Almost 300,000 cases of malaria prevented at the health facility level
- In 2015, national survey data showed that Mopti region had the highest under 5-year-old (u5) malaria prevalence at 53.4% – nearly twice the national average and significantly greater than Ségou (21.9%) – despite having high access to long-lasting insecticidal nets (LLINs) and seasonal malaria chemoprevention (SMC).²
- Accordingly, in 2016 a decision to shift IRS activities from Ségou to Mopti was made
- To help understand the impact of shifting IRS operations within a dynamic malaria control program, we present:
 - A retrospective analysis of the impact of suspending IRS operations in 2015 in the Bla district of Ségou
 - An outline of similar work that is planned to evaluate 2016 and 2017 data to describe the effect of (1) introducing IRS into three previously unsprayed districts in Mopti and (2) suspending IRS operations in the rest of Ségou

Approach

Table 1. Summary of the malaria control landscape in Ségou and Mopti, 2016 - 2017

Region	District	2016				2017			
		IRS	AI	Coverage Estimate ¹	LLINs Distributed	SMC ²	IRS	AI	Coverage Estimate ¹
Ségou	Barouéli	Actellic® 300CS	98%	ANC/EPI	68%	none	none	ANC/EPI	>80%
	Bla	none	-	ANC/EPI	99%	none	none	ANC/EPI	>80%
	Macina	none	-	ANC/EPI	100%	none	none	ANC/EPI	>80%
	Segou	none	-	ANC/EPI	87%	none	none	ANC/EPI	>80%
	Niono	none	-	ANC/EPI	93%	none	none	ANC/EPI	>80%
	San	none	-	ANC/EPI	81%	none	none	ANC/EPI	>80%
Mopti	Tominian	none	-	ANC/EPI	97%	none	none	ANC/EPI	>80%
	Bandiagara	none	-	ANC/EPI	99%	Actellic® 300CS	95%	Universal	>80%
	Bankass	none	-	ANC/EPI	100%	Actellic® 300CS	96%	Universal	>80%
	Djenné	none	-	ANC/EPI	83%	Actellic® 300CS	97%	Universal	>80%
	Douentza	none	-	ANC/EPI	60%	none	-	Universal	>80%
	Koro	none	-	ANC/EPI	100%	none	-	Universal	>80%
	Mopti	none	-	ANC/EPI	80%	Actellic® 300CS	93%	Universal	>80%
	Ténenkou	none	-	ANC/EPI	100%	none	-	Universal	>80%
	Youwarou	none	-	ANC/EPI	100%	none	-	Universal	>80%

¹ % of structures targeted for IRS that were sprayed
² % of target population receiving at 4 courses of SMC with SP+A; 2017 data awaiting final confirmation

A set of retrospective, observational (ecological), time-series analyses will be performed using RDT-confirmed cases of malaria reported by routine health systems (DHIS2) from January 2016 to December 2017.

- Monthly reports from 359 community health centers across Ségou and Mopti
- Community health center catchment area population estimates obtained from the Ministry of Health
- Health center incidence rates per 10,000 person-months are calculated and stratified by IRS status for comparative analyses
- A difference-in-differences approach is used to evaluate the impact of changing IRS status on health facility RDT+ incidence rates across years

Preliminary Results – Bla in 2015 ¹

Prior to the 2015 transmission season, IRS operations were withdrawn from Bla district but continued in Barouéli. The seasonal changes in malaria incidence are shown by health facility in these districts in figure 2. Incidence rates were consistent across years in Barouéli, but increased significantly by 70% in Bla. This represented an extra 1,386 cases of u5 malaria reporting to health facilities in Bla.

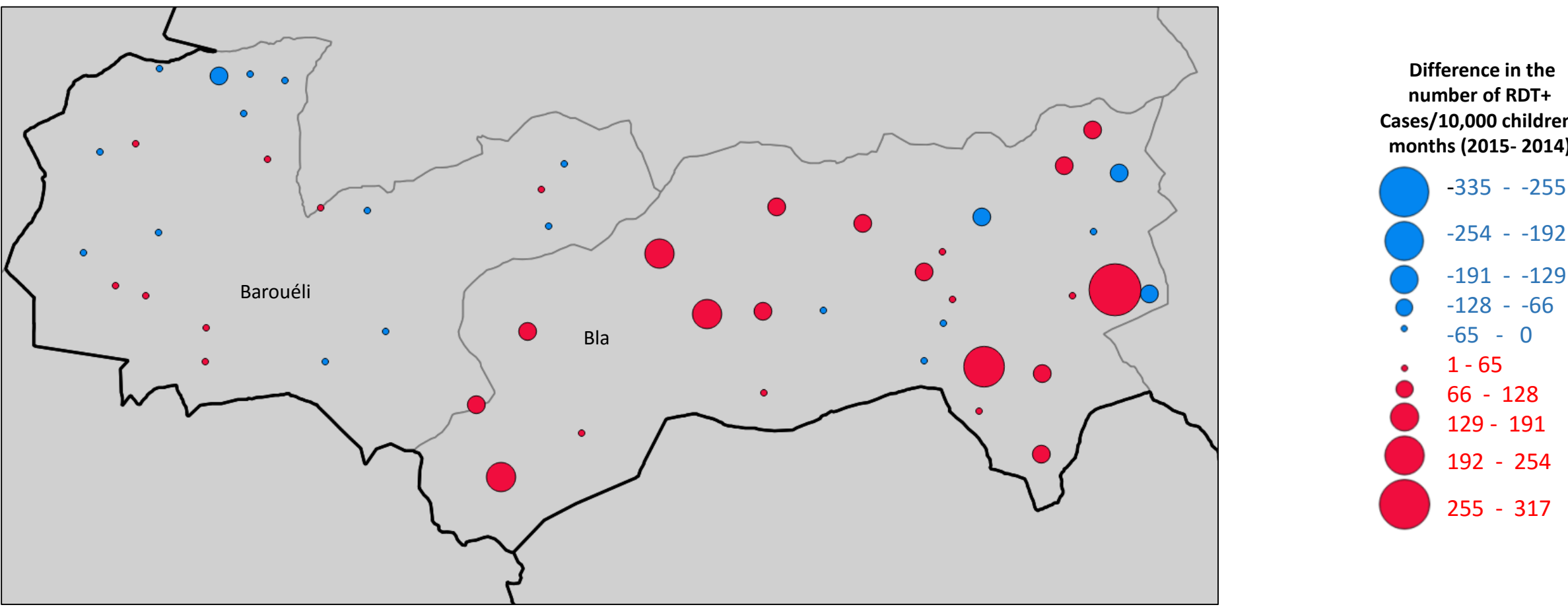


Fig. 2. Changes in u5 malaria incidence (2014–2015) by health facility in Barouéli and Bla Districts. At each health facility location on the map, the color blue represents a decrease in malaria rates from year to year while the color red represents an increase in malaria rates. The magnitude of the change is represented by the size of the marker. Aggregated by district, malaria rates were the same from year to year in Barouéli, where IRS with operations were consistent, but increased by 202 cases/10,000 (1,386 total extra cases) in Bla, where IRS operations were suspended after 2014.

Study Location

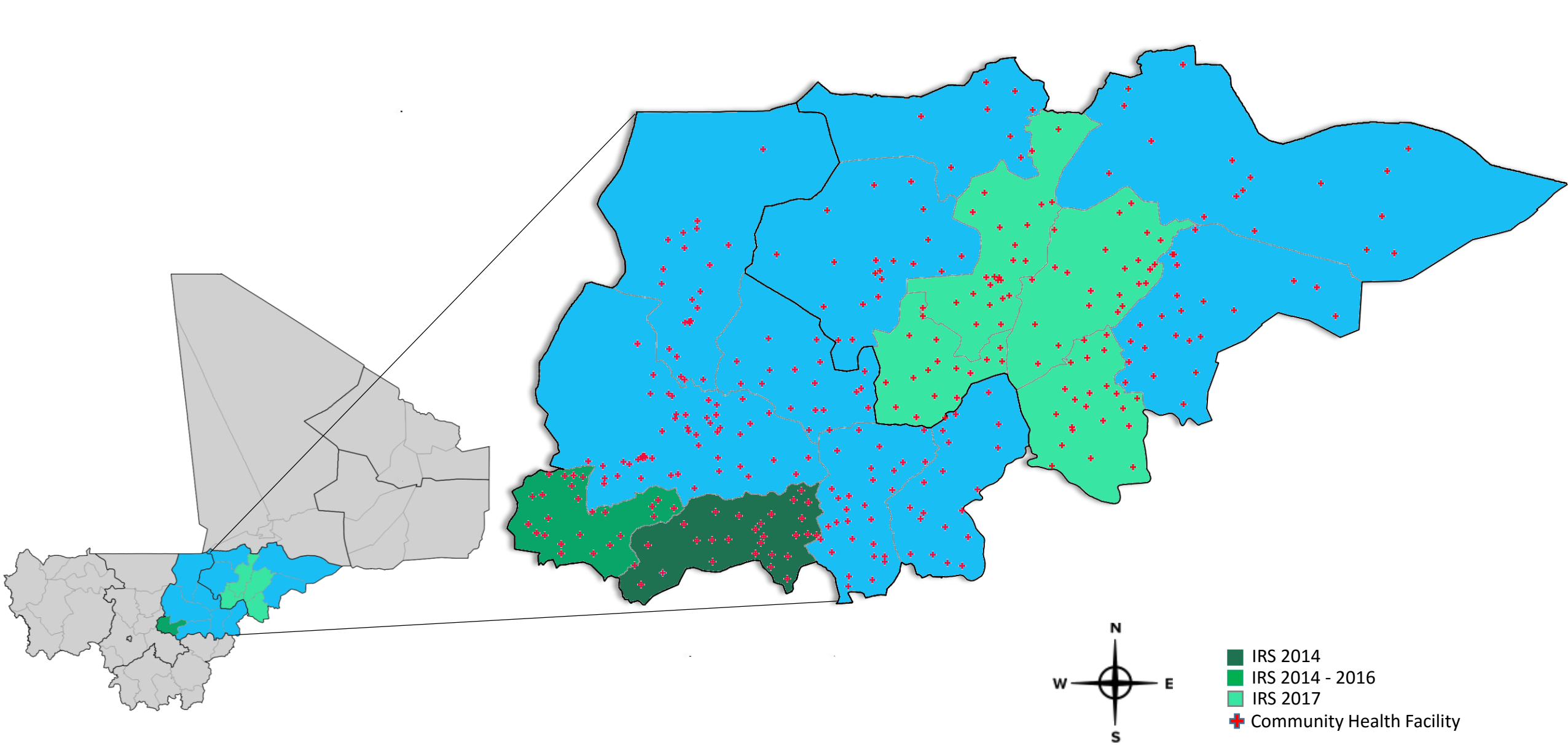


Fig. 1. (a) The location of Mali in West Africa, with Ségou and Mopti regions highlighted. (b) The locations of the regional community health facilities that reported malaria rapid diagnostic test results during the months to be analyzed (Jan 2016 to Dec 2017). The IRS districts are shown in various shades of green according to the year they were sprayed; non-IRS comparator districts are shown in blue.

Ségou and Mopti Regions

- Total population ~ 5.8 million; u5 population ~ 1.05 million ³
- Primary vector species is *An. gambiae* s.s.⁴
- Pyrethroid and DDT resistance are high in Ségou and Mopti regions.^{4,5}
- Malaria transmission is highly seasonal; highest June – October
- 16 total administrative districts, highly similar in terms of ⁶
 - Population density
 - Rainfall patterns
 - Malaria transmission seasonality
- PMI AIRS Mali-supported IRS in select districts (Figure 1) using a third generation IRS product (3GIRS) effective against pyrethroid resistant mosquitoes
 - Pirimiphos-methyl CS (Actellic® 300CS®300 CS; Syngenta AG)



Future Directions

The difference-in-differences approach used previously to evaluate the effect of withdrawing IRS operations from Bla district in 2015 will be repeated using routine surveillance data from 2016 and 2017 to describe the impact of:

- Introducing IRS into four previously unsprayed districts in Mopti
- Suspending IRS operations in previously sprayed districts in Ségou and Koulikoro

This approach will permit the evaluation of the impact of Introducing IRS with a third generation IRS product (3GIRS) into a malaria control package that also includes high coverage with SMC and a universal coverage LLIN distribution campaign.

Entomological surveillance data will also be included in the analyses, so that the impact of the geographical shift in IRS operations in Mali on local vector populations can also be evaluated.

Project 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).



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