

# Rapid reduction of malaria transmission after introducing a third generation indoor residual spraying product in previously unsprayed districts of Mopti Region, Mali in 2017

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## Introduction

- Mali's National Malaria Control Program (NMCP), working with the US President's Malaria Initiative (PMI) Africa Indoor Residual Spraying and VectorLink programs, has had success decreasing malaria transmission using 3rd generation IRS (3GIRS) products in areas with documented pyrethroid resistance, primarily in Ségou and Koulikoro regions.
- Analysis of routine data showed IRS campaigns from 2012 to 2015, which utilized non-pyrethroid insecticides to control resistant *Anopheles gambiae* s.s., were particularly effective in Ségou region:<sup>1</sup>
  - More than 500,000 people protected for four years for < \$7 USD per year
  - Almost 300,000 cases of all-ages 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; 87.9% of households with at least 1 LLIN) and expanding access to seasonal malaria chemoprevention (SMC).<sup>2</sup>
- Migrations of displaced people to Mopti region from northern Mali, where malaria transmission is substantially lower and acquired immunity is thought to be low, has further complicated the transmission landscape in Mopti.
- Accordingly, in 2017 NMCP, PMI, and other stakeholders shifted IRS activities in Mali from Ségou to Mopti region.**
- Here, we present observational analyses of the impact of this switch using routine malaria indicators.

## Approach

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

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

<sup>1</sup>% of structures targeted for IRS that were sprayed

<sup>2</sup>% of target population receiving at 4 courses of SMC with SP+AQ; 2017 data awaiting final confirmation

A set of retrospective, observational (ecological), time-series analyses were 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 centers are stratified by IRS status and RDT+ incidence rates per 10,000 person-months at risk are calculated for comparative analyses
- A difference-in-differences approach is used to evaluate the impact of introducing or suspending IRS on health facility incidence rates from year to year

## Study Location

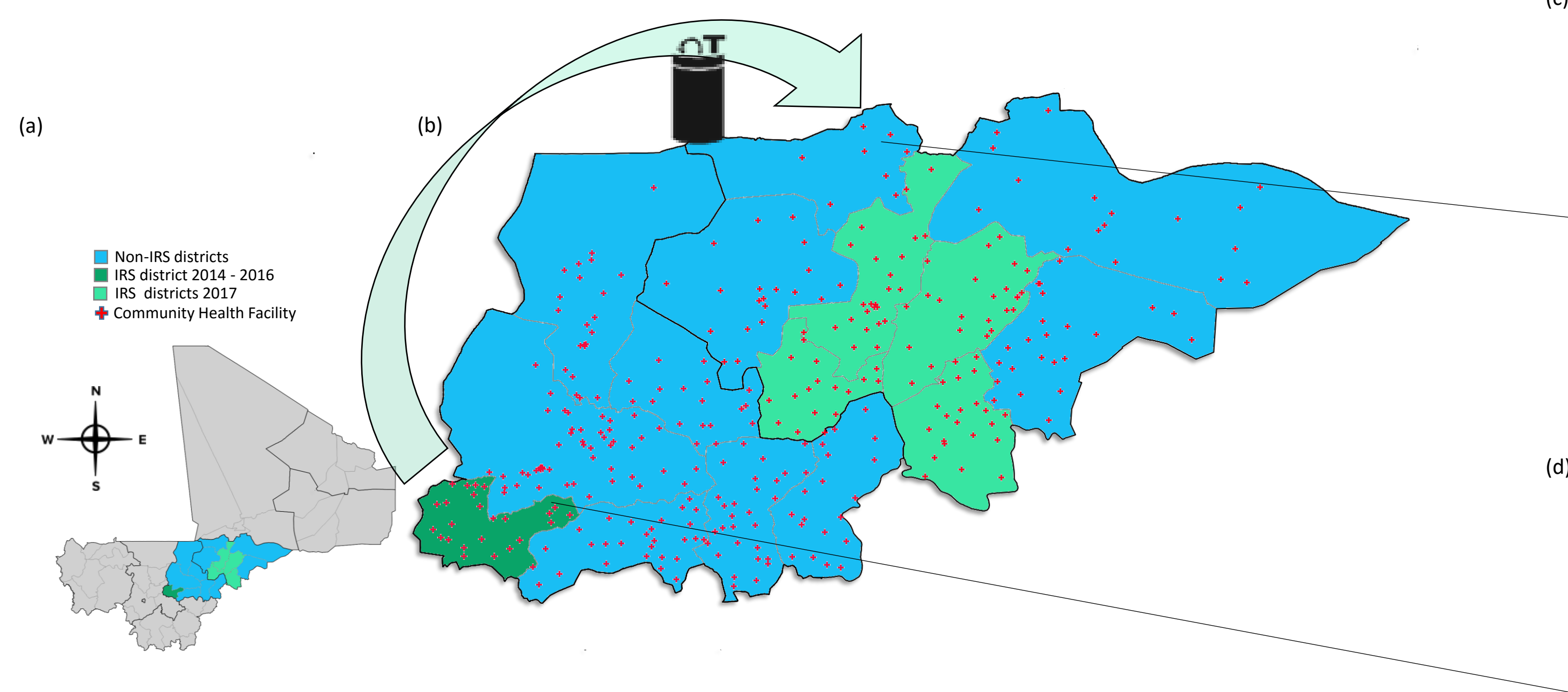


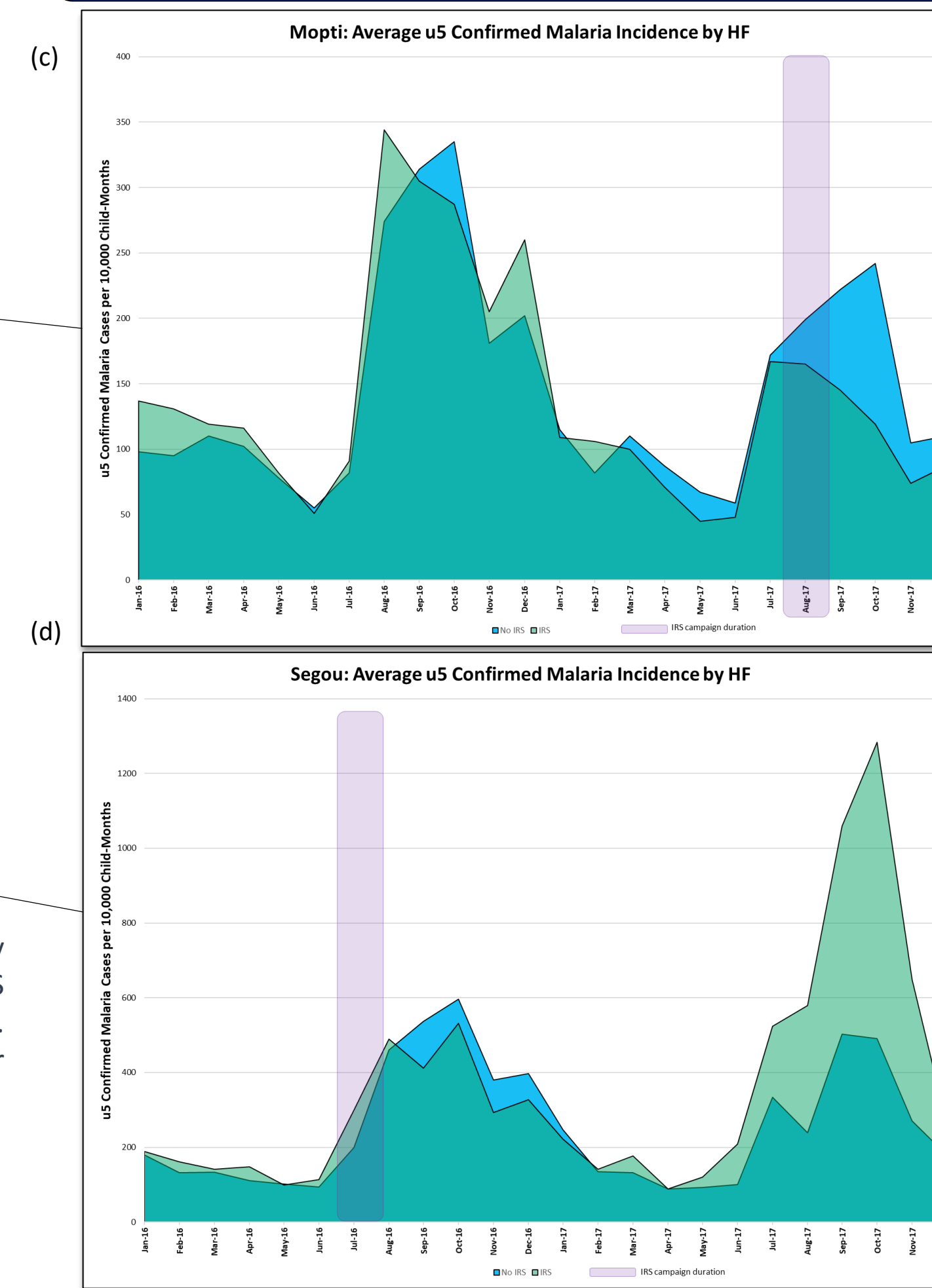
Fig. 1. (a) The location of Mali in West Africa, with Ségou and Mopti regions highlighted. (b) The locations of the regional community health facilities that reported malaria rapid diagnostic test results during the months analyzed here (Jan 2016 to Dec 2017). The IRS districts are shown in various shades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

### Ségou and Mopti Regions

- Total population ~ 5.8 million <sup>4</sup> (2.7m in Mopti; 3.1m in Ségou)
- u5 population ~ 1.05 million <sup>4</sup> (488k in Mopti; 560k in Ségou)
- Primary vector species is *An. gambiae* s.s.<sup>5</sup>
- Pyrethroid and DDT resistance are high in Ségou and Mopti regions.<sup>5,6</sup>
- Malaria transmission is highly seasonal; highest June – October
- 16 total administrative districts, highly similar in terms of <sup>7</sup>
  - Population density
  - Malaria transmission seasonality
  - Rainfall patterns
  - LLIN access and use <sup>2</sup>
- 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®300 CS; Syngenta AG)

**\*Ségou and Mopti have dramatically different health service utilization rates (based on out-patient visits/capita): a resident of Mopti is about 50% less likely to visit a health center during the year than a resident of Ségou - This makes direct comparisons of health facility case numbers between districts difficult to interpret from a population perspective**

## Results



After introducing IRS into 4 districts of Mopti in 2017, RDT+ confirmed malaria rates fell 37% compared to similar unsprayed districts: **3,800 health facility cases averted from September to December\***

After suspending IRS in Ségou district in 2017, RDT+ confirmed malaria rates rose 125% compared to similar unsprayed districts: **6,400 health facility cases more than expected from September to December\***

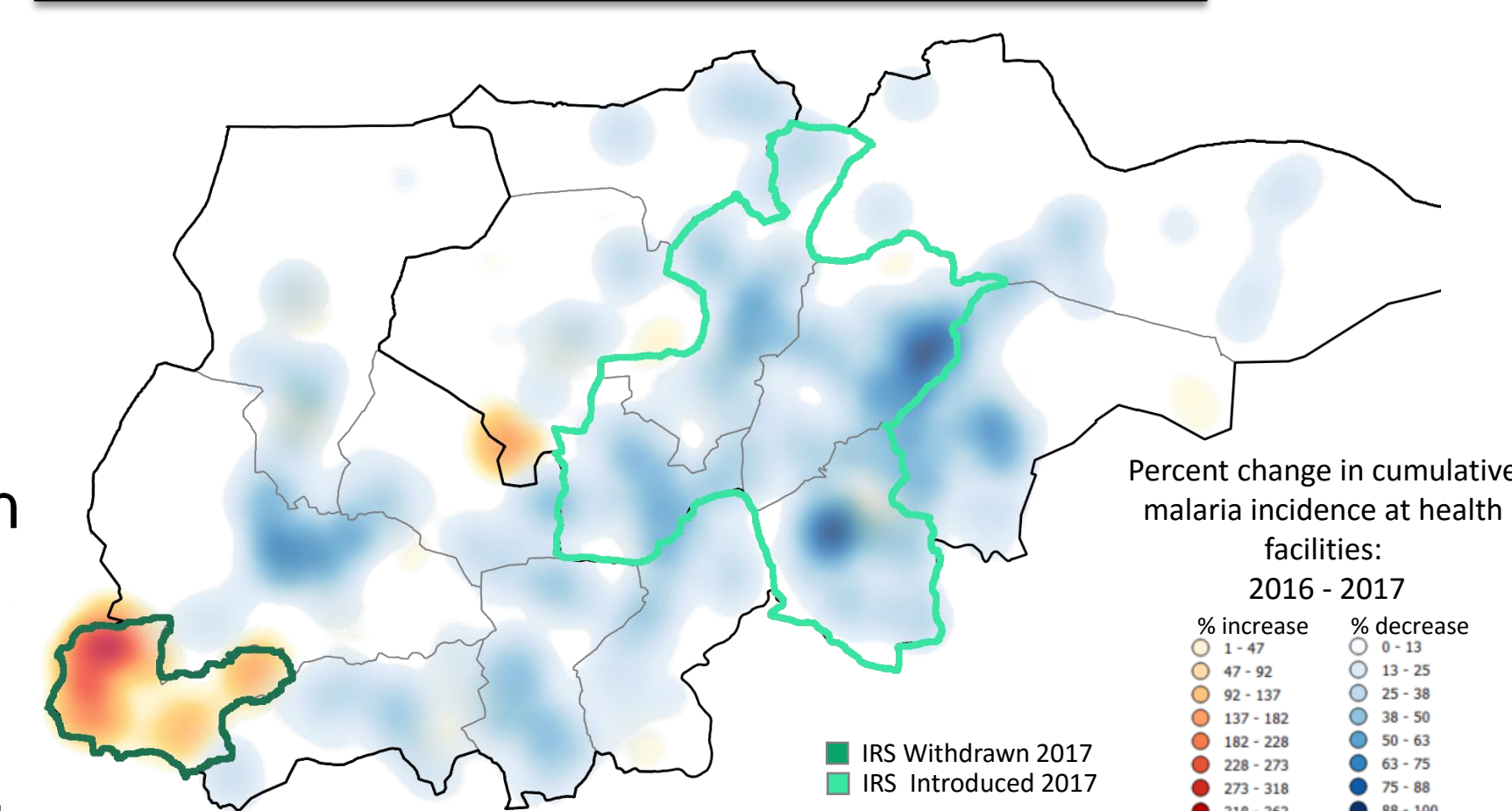
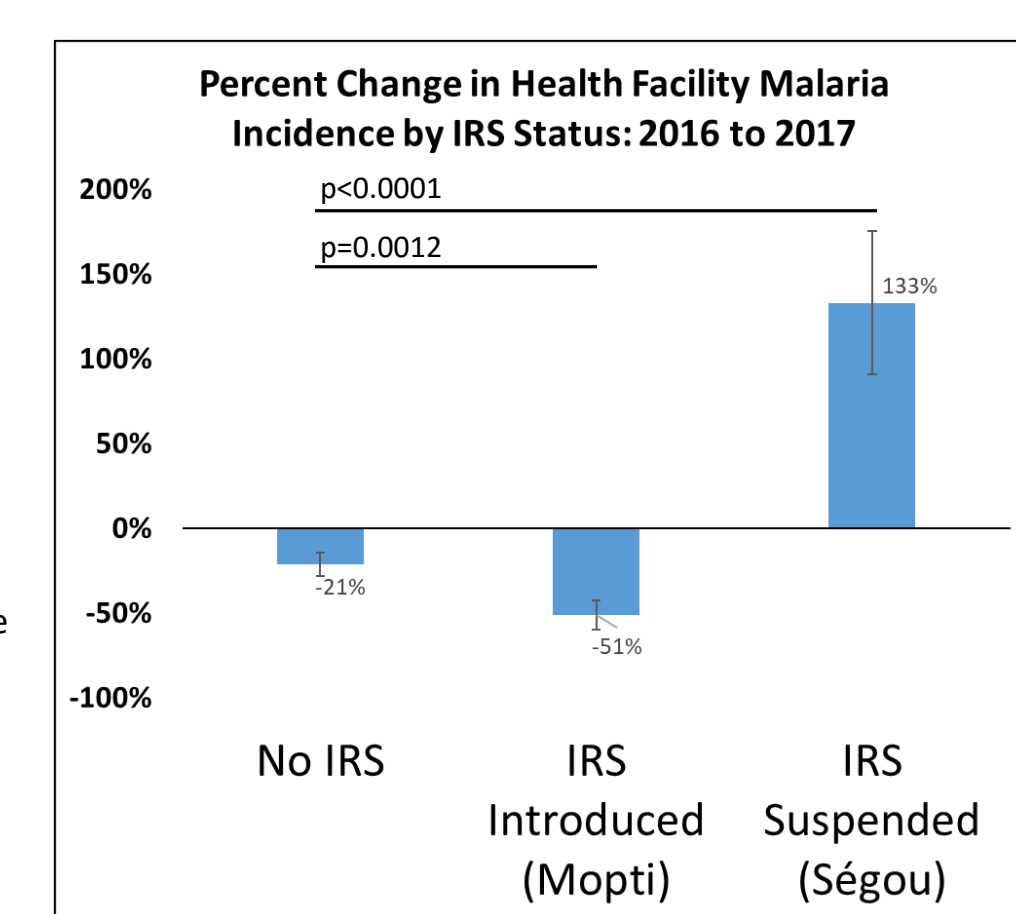


Fig. 2. Changes in u5 malaria incidence (2016–2017) at health facilities in Ségou and Mopti, by IRS status. p-values are from a Student's t-test evaluating the difference in differences between peak incidence rates reported in 2016 and 2017.



## Discussion

- Analysis of routine health data from 2016 and 2017 shows clear trends associating IRS with Pirimiphos-methyl CS with reductions in RDT-confirmed malaria cases reporting to local health facilities in central Mali
- IRS provided significant added protection from malaria to a package that included a concurrent universal LLIN distribution campaign and high SMC coverage**
- While these observations add to the growing evidence that 3GIRS can be a wise public health investment, special considerations should be made when shifting IRS operations out of previously sprayed communities, as increases in malaria incidence rates can be expected**

## 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 <http://www.ivcc.com/ngenirs> or email David McGuire (david.mcguire@ivcc.com).



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