An Observational Analysis of the Impact of IRS in the Northern and Upper East regions of Ghana: 2015 – 2017

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Introduction

The prevalence of malaria in Ghana in under 5s has decreased from 27.5% (2011) to 20.4% (2016). The heaviest burden is in the Northern Savanah – Upper West, Upper East and Northern regions. With the goal of reducing the malaria burden by 75% by 2020, compared to a 2008 baseline, the country has implemented a package of malaria control activities, including vector control with indoor residual spraying (IRS).

Due to financial and operational considerations, there have been shifts in active ingredients as well as geographic focus, resulting in changes in the IRS status of several districts in the north of Ghana between 2014 and 2017. These changes provided an opportunity to conduct an observational study to better describe the public health impact of IRS with a third-generation IRS (3GIRS*) product. We compared the impact of IRS with non-IRS districts in Northern Region and investigated the introduction of IRS into previously unsprayed districts in Upper East and Northern Regions.

* A 3GIRS product is one that is effective against pyrethroid-resistant mosquitos and has a minimum residual efficacy of six months.

IRS implementation and study location

IRS operations in Upper East Region were led by the AngloGold Ashanti Malaria Control Programme Limited (AGAMal); in Northern Region, operations were led by PMI/AIRS. AGAMal began activities in 2006 and the PMI/AIRS program in 2008.
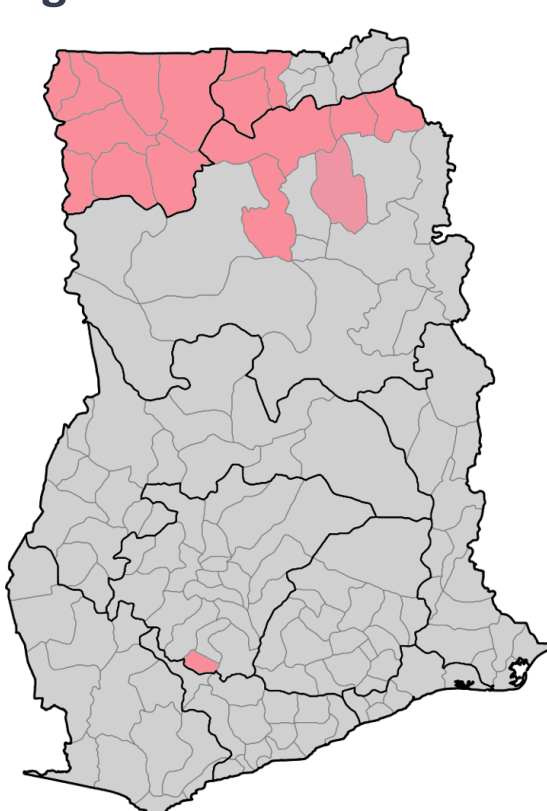
Fig 1. Ghana IRS Districts in 2017

Table 1. The IRS Implementation Landscape in Upper East and Northern Regions, 2014 – 2017.

Region	District	2014	2015	2016	2017
UPPER EAST	Builsa	p	x	x	p
	Bolgatanga	p	x	x	x
	Kassena Nankana	p	x	x	p
	Talensi Nabdam	p	x	x	x
	Bawku West	p	x	x	x
	Bongo	p	x	x	x
	Bawku Municipal	p	x	x	x
	Garu Tempane	p	x	x	x
NORTHERN*	Chereponi	x	x	x	x
	Saboba	x	x	x	x
	Gushiegu	x	x	x	p
	Karaga	x	x	x	p
	Savelugu Nanton	p	x	x	x
	Bunkpurugu-Yunyoo	p	p	p	p
	East Mamprusi	p	p	p	p
	Kumbungu	x	p	p	p
	West Mamprusi	p	p	p	p
	Mamprugu Moaduri		p	p	p

P (pirimiphos-methyl), an organo-phosphate

Upper East Region – In 2014, IRS was implemented in all districts of Upper East Region. However, operations were suspended in 2015 and 2016, but reintroduced in selected districts in 2017.

Northern Region – In 2015 and 2016, 5 of 26 districts benefitted from IRS. In 2017, operations were expanded to 2 additional districts of the region.

*Only 11 of 26 districts in the Northern Region are included in this analysis. These 11 districts are in the north-eastern part of the region and have been sprayed at some point in earlier years (2008-2014) before the switch to 3GIRS products.
**One district was split into 2 districts: West Mamprusi became West Mamprusi and Mamprugu Moaduri

Approach

We conducted a set of retrospective, observational time-series analyses on confirmed malaria cases reported in the national District Health Information Management System II (DHIMS2) from January 2015 to December 2017. The following data sets were compiled, cleaned and analyzed:

- Monthly reports from all 13 districts in Upper East Region (~3.9M confirmed cases)
- Monthly reports from 11 old and current PMI IRS districts (of 26 districts total) in Northern Region (~2.8M confirmed cases)
- District population estimates from the most recent Ghana Statistical Service 2010 Census Report, adjusted for yearly population growth estimates

Cases were represented by suspected malaria with fevers which tested positive by RDT and/or microscopy. District confirmed-case incidence rates were stratified by district IRS status for comparative analyses.

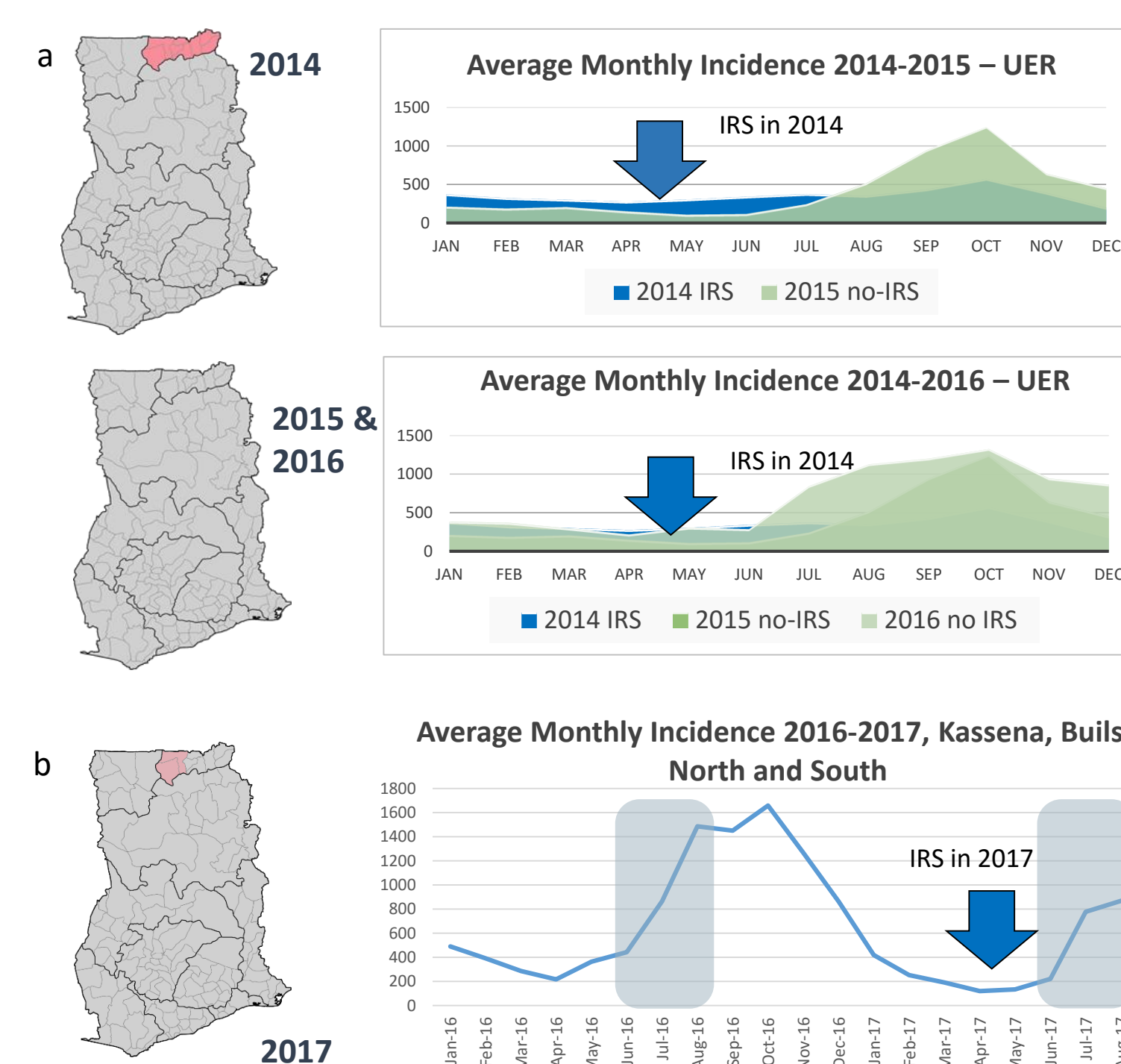## Upper East Results: Removal of IRS after 2014 campaign and reintroduction in 2017

Fig 2. Impact of the changing IRS landscape in Upper East Region from 2014 to 2017. (a) In 2014, all districts in UE were sprayed with Actellic® 300CS, while none were sprayed in 2015 or 2016. Monthly incidence of malaria cases recorded from UE in the District Health Information Management System 2 from 2014 to 2016. The 2014 IRS campaign is indicated with the blue arrow. (b) IRS was reintroduced in 3 districts of UER in 2017, Kassena, Builsa North and Builsa South.

In Upper East, health facility-level analysis of monthly reporting trends from 2014, when Actellic® 300CS was sprayed, show a low incidence of confirmed malaria cases from June to November – 6-month post IRS campaign. In 2015, from June to November – there was a 50% increase in cases and double the number of cases in 2016 compared to 2014.

With available resources, IRS was reintroduced in three districts (Kassena, Builsa North and Builsa South) in 2017. Health facility-level analysis of monthly reporting trends from 2016-2017, in the three IRS districts show a 36% reduction (815 fewer cases per 10,000-person months) in the incidence of confirmed malaria cases in June-August 2017, 3-month post IRS campaign compared to the same period in 2016; against a 16% reduction in non-IRS districts (335 fewer cases per 10,000-person months).

Northern Region Results: IRS vs. Non-IRS incidence and expansion in 2017
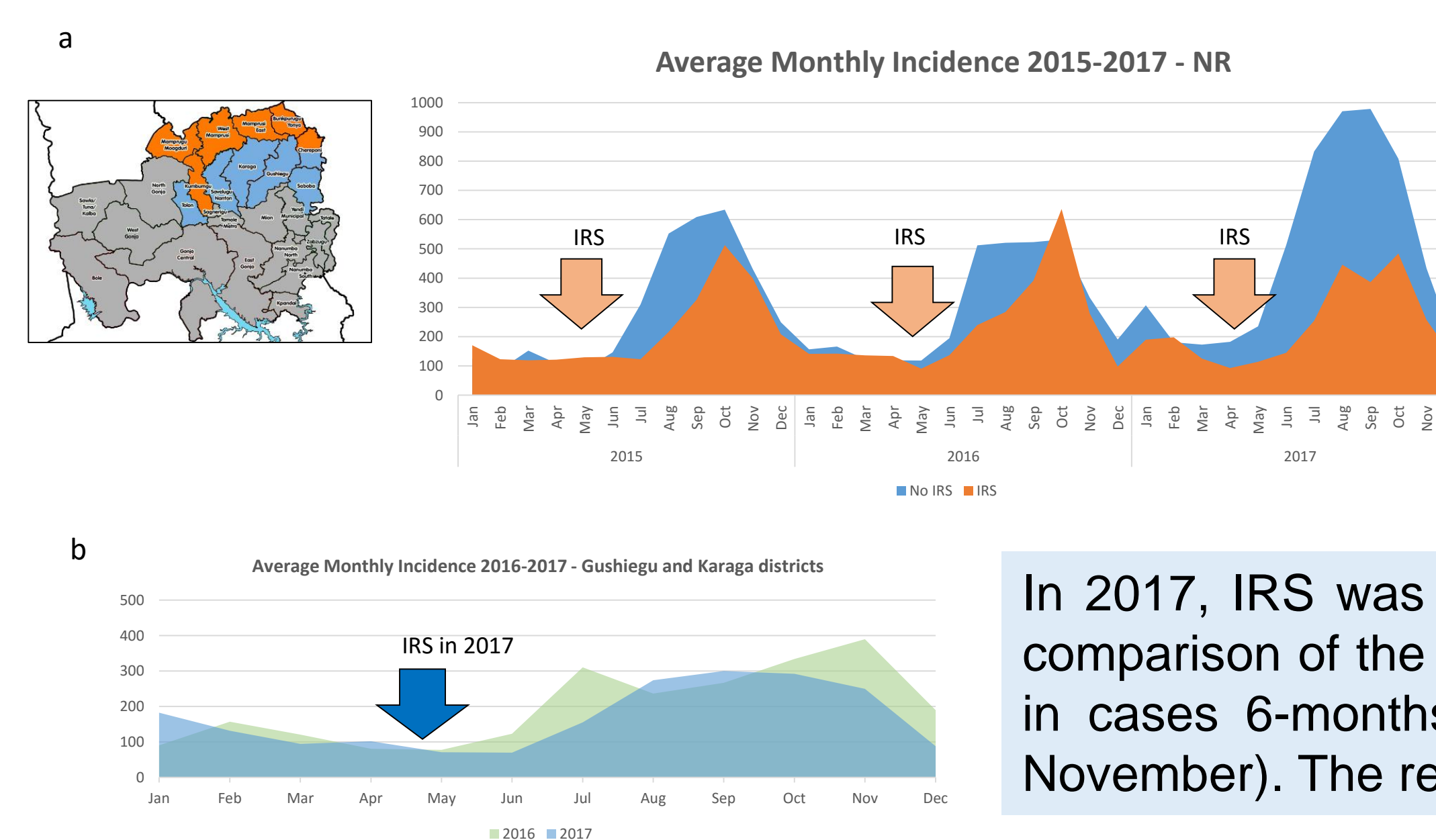
Fig 3. Impact of the changing IRS landscape in Northern Region from 2015 to 2017. (a) In 2015 and 2016, the districts shown in green were sprayed with Actellic® 300CS, while districts in blue received no IRS. In 2017, IRS operations expanded to include 2 additional districts in Northern Region. (b) Monthly incidence of confirmed malaria cases recorded from Northern in the District Health Information Management System 2 from 2015 to 2017. (c) Monthly incidence of confirmed malaria case in Gushiegu and Karaga, where IRS was introduced in 2017.

In Northern Region of Ghana, district-level analysis of monthly reporting trends from 2015 to 2017 show that over these 3 years, districts where Actellic® 300CS was sprayed had ~4,200 fewer cases per 10,000 person-months at risk than in the districts with no IRS in the 6 months that followed spraying.

In 2017, IRS was expanded to 2 additional districts in the eastern part of Northern Region, Gushiegu and Karaga. The comparison of the confirmed malaria incidence in these districts from 2016 (no IRS) to 2017, shows a very small reduction in cases 6-months post spray in 2017 (~306 less confirmed malaria cases per 10,000 person-months from June to November). The reduction in these two new cannot be attributed to IRS, since malaria incidence varies from year to year.

Conclusion

These preliminary analyses show clear correlations in time and space with the indoor residual spraying of a 3GIRS product and reduced incidence of confirmed malaria cases from routine surveillance systems in the north of Ghana, where pyrethroid resistance is widely reported. Additional analyses are underway to further disaggregate epidemiological surveillance data to sub-district levels and align results with entomological surveillance and expanded ecological datasets to allow for more robust conclusions.

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