

# An Observational Analysis of the Impact of Indoor Residual Spraying in the Northern region of Ghana: 2014 - 2016

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## Introduction

Ghana has seen a steady decline in malaria prevalence nationally since 2011, particularly in the northern savannah. In Ghana, insecticide resistance concerns prompted a switch from pyrethroids to a microencapsulated formulation of pirimiphos-methyl (PM CS) starting in 2012. Entomological surveillance has tracked the effect of IRS and the introduction of this next generation IRS product on vector indicators, but there is a need to strengthen evidence demonstrating epidemiological impact as well. To address this gap, we conducted a retrospective, observational analysis of the epidemiological impact of IRS operations in the Northern Region of Ghana from 2014 - 2016, using routine epidemiological data comparing malaria incidence rates from IRS and non-IRS districts in northern Ghana.

## IRS Implementation

The US President's Malaria Initiative's Africa Indoor Residual Spray (AIRS) has been the main implementer of IRS in Northern Region, Ghana. Summary data below is from PMI End of Spray Reports<sup>1</sup>

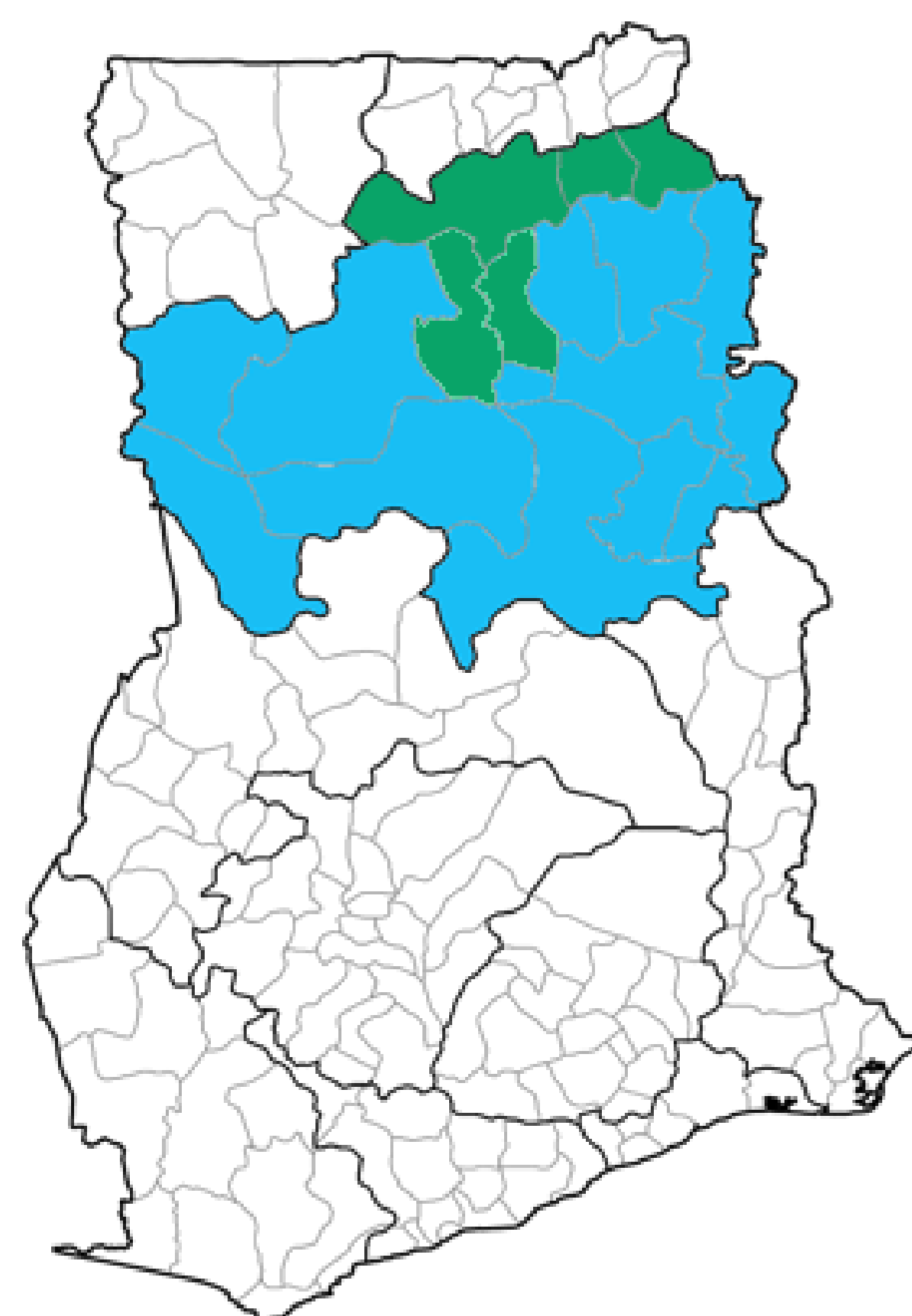


Fig. 1. IRS Landscape in Northern Region from 2014 – 2016. Here, district level malaria incidence rates were aggregated and stratified by IRS status. Blue districts represent matched control districts with No-IRS, while green shows the PMI AIRS districts.

Table 1. Summary of IRS intervention coverages in Northern Region, 2014 – 2016.

District	2014			2015			2016					
	IRS Active Ingredient <sup>1</sup> (Structures)	IRS Coverage (Pop)	IRS Coverage (Pop)	IRS Active Ingredient (Structures)	IRS Coverage (Pop)	IRS Coverage (Pop)	IRS Active Ingredient (Structures)	IRS Coverage (Pop)	IRS Coverage (Pop)			
Savelugu Nanton	PM CS 68%	33,573	78%	97,775	none	-	none	-	-			
Bunkpurugu-Yunyoo	PM CS 93%	49,370	95%	120,755	PM CS 95%	50,417	97%	124,592	PM CS 96%	50,742	97%	125,903
East Mamprusi	PM CS 87%	58,245	92%	167,401	PM CS 91%	60,283	95%	167,149	PM CS 93%	63,057	96%	173,736
Kumbungu	none	-	-	PM CS 93%	31,333	96%	82,614	PM CS 93%	31,333	96%	82,614	
West Mamprusi - West Mamprusi	PM CS 88%	45,424	92%	129,583	PM CS 88%	45,424	92%	129,583	PM CS 88%	46,785	93%	133,120
West Mamprusi - Mamprugu Moaduri <sup>2</sup>	PM CS 85%	64,042	90%	184,641	PM CS 91%	18,478	90%	50,016	PM CS 92%	18,767	95%	51,534

<sup>1</sup> PM CS = Microencapsulated Pirimiphos Methyl

<sup>2</sup> West Mamprusi and Mamprugu Moaduri were parts of the same district until 2015

## Approach

A retrospective, observational, time-series analysis was conducted using the incidence of malaria cases treated with artemisinin-based combination therapy (ACT) as reported in the District Health Information Management System (DHIMS2) from January 2014 to February 2017.

District-level incidence rates were stratified by district IRS status for comparative analyses.

The data reviewed and analyzed consisted of 2,658,442 total cases of suspected malaria

- 988 monthly reports from 26 different districts in Northern Region
- Cases represent suspected malaria with fever seeking treatment
- District population estimates from the most recent Ghana Statistical Service 2010 Census Report

## Results

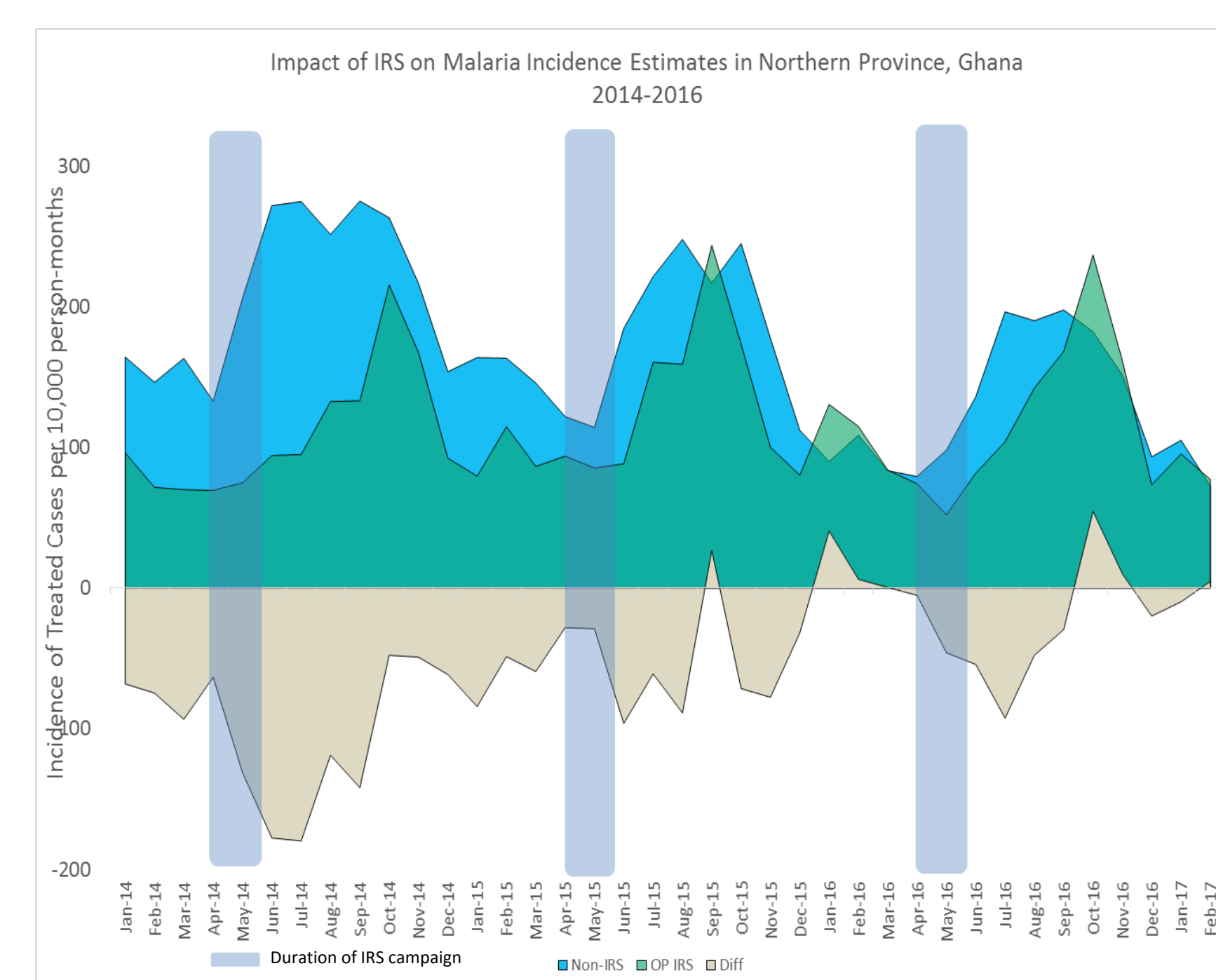


Fig. 2. Epidemiological curves showing the monthly incidence of ACT Treated malaria cases from IRS and non-IRS districts of Northern Region, 2014 - 2016. The area of the tan curve shows the difference between the incidence rates observed in the IRS districts (green) relative to the higher incidence rates observed in the neighboring non-IRS districts (Blue). Also shown is the timing and duration of each year's IRS campaign.

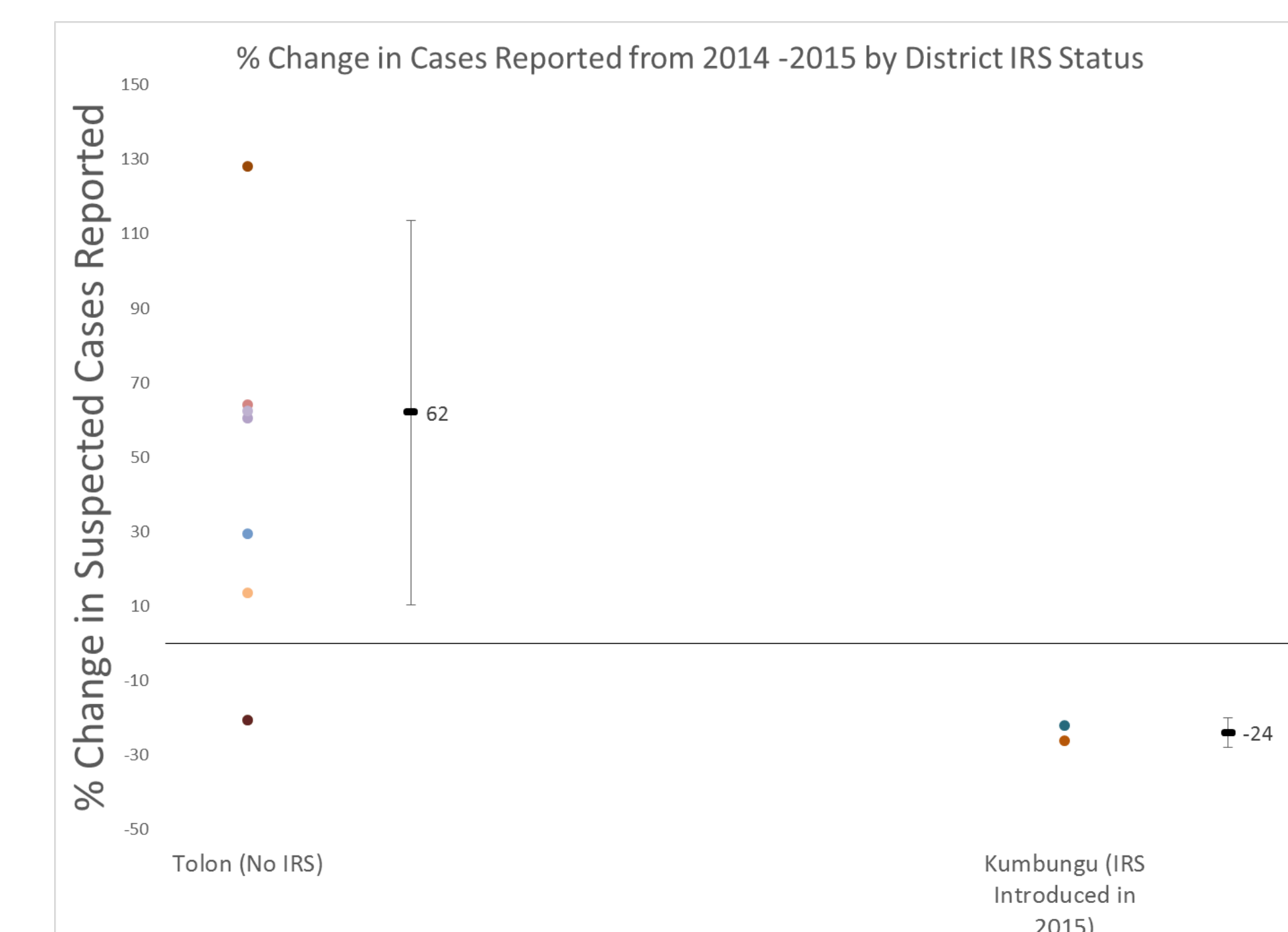
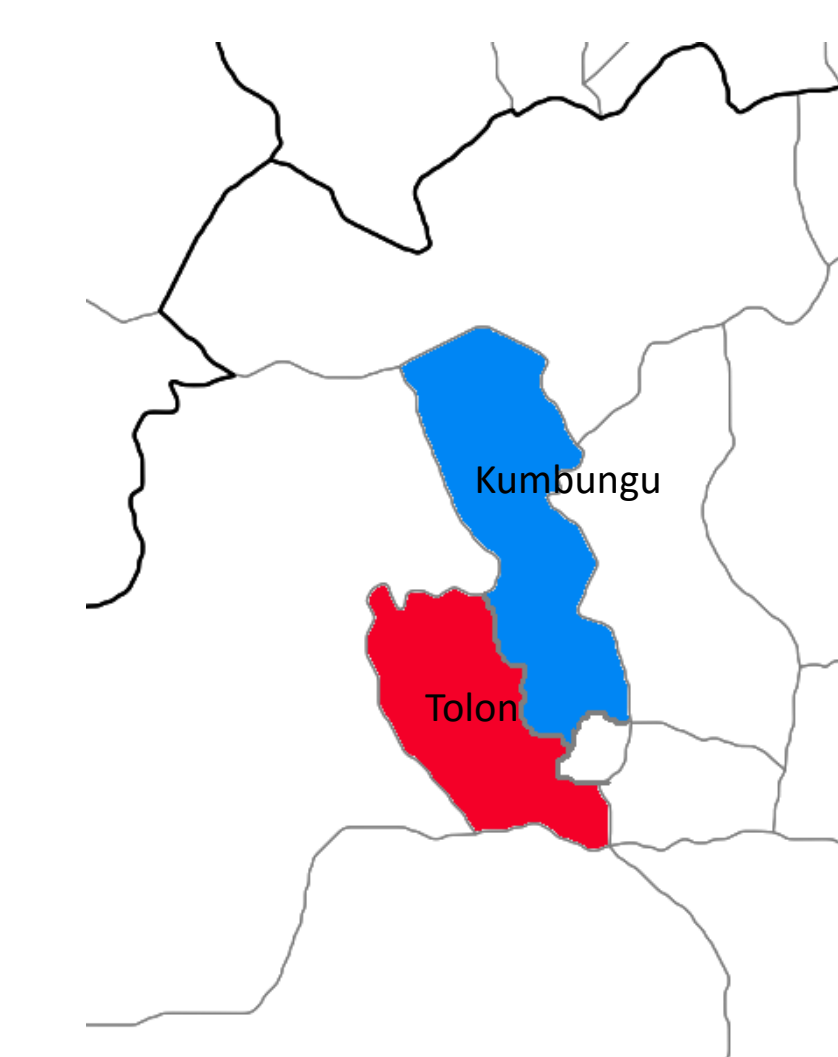


Fig. 3. A difference in differences analysis of the change in the number of suspected malaria cases reported from 2014 to 2015 at health facilities from Tolon and Kumbungu Districts. In Tolon District (Red), where there was no IRS in either year, health facilities reported an average increase of 62% in suspected malaria cases from year to year. In Kumbungu District (Blue), there was an average 24% decrease in the number of suspected malaria cases reported following the introduction of IRS in 2015.

District-level comparative analysis (Fig. 2) indicates that there were fewer malaria cases observed in districts that received IRS than districts that did not for almost all months from January 2014 to January 2017. Also, each year the maximum reduced incidence was observed during peak transmission months of June – September, corresponding to the four months following the conclusion of each IRS campaign.

An additional difference in differences analysis (Fig. 3) is possible during this timeframe, as in 2015 IRS operations were expanded to include Kumbungu District but not its neighboring district Tolon. After the IRS campaign of 2015 health facilities in Kumbungu reported 24% (±4%) fewer suspected malaria cases than the year before, while in Tolon the number of suspected cases reported increased by an average of 62% (±51%).

## Conclusion

These preliminary results from the retrospective analysis of passively reported malaria surveillance data from Northern District, Ghana, illustrate the positive contribution of next generation IRS products to malaria control programs in an area of widespread pyrethroid resistance<sup>2,3</sup>. In addition, data from the US President's Malaria Initiative/Africa Indoor Residual Spraying (AIRS) project routine entomological surveillance have shown lower indoor resting vector densities between IRS and non-IRS sentinel sites as well as overall lower entomological inoculation rates. Ongoing work is aiming to disaggregate the surveillance data to sub-district levels to allow further data cleaning and more quantitative analyses.

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



**References**  
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 [3] Fuseini, et al. 2011. *J Med Ent* 48(2): 437  
 [4] Dadzie, et al. 2017. *Malaria J* 16:342