

Evaluating the Epidemiological Impact of Shifting IRS Operations in Northern Ghana, 2012 - 2016: Correlations with Entomological Indicators

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Introduction

The indoor residual spraying (IRS) of insecticides has contributed substantially to recent successes in malaria control. In Ghana, insecticide resistance concerns prompted a switch in IRS active ingredients from pyrethroids to a third generation IRS product (3GIRS)^a, a microencapsulated formulation of pirimiphos-methyl (PM CS), starting in 2012. Previous reports^{1,2} have shown that this switch was associated with significant reductions in entomological indicators of malaria transmission, including reduced entomological inoculation rates (EIR), in four districts of the Northern Region in Ghana.

To supplement these entomological analyses, we conducted a preliminary, retrospective, observational analysis of the epidemiological impact of these IRS campaigns using routine health facility data to compare malaria incidence trends in the same districts before and after IRS. Results are triangulated with the previous entomological analyses to further our understanding of the impact of IRS with PM CS in a region with documented pyrethroid resistance.

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

Study Location

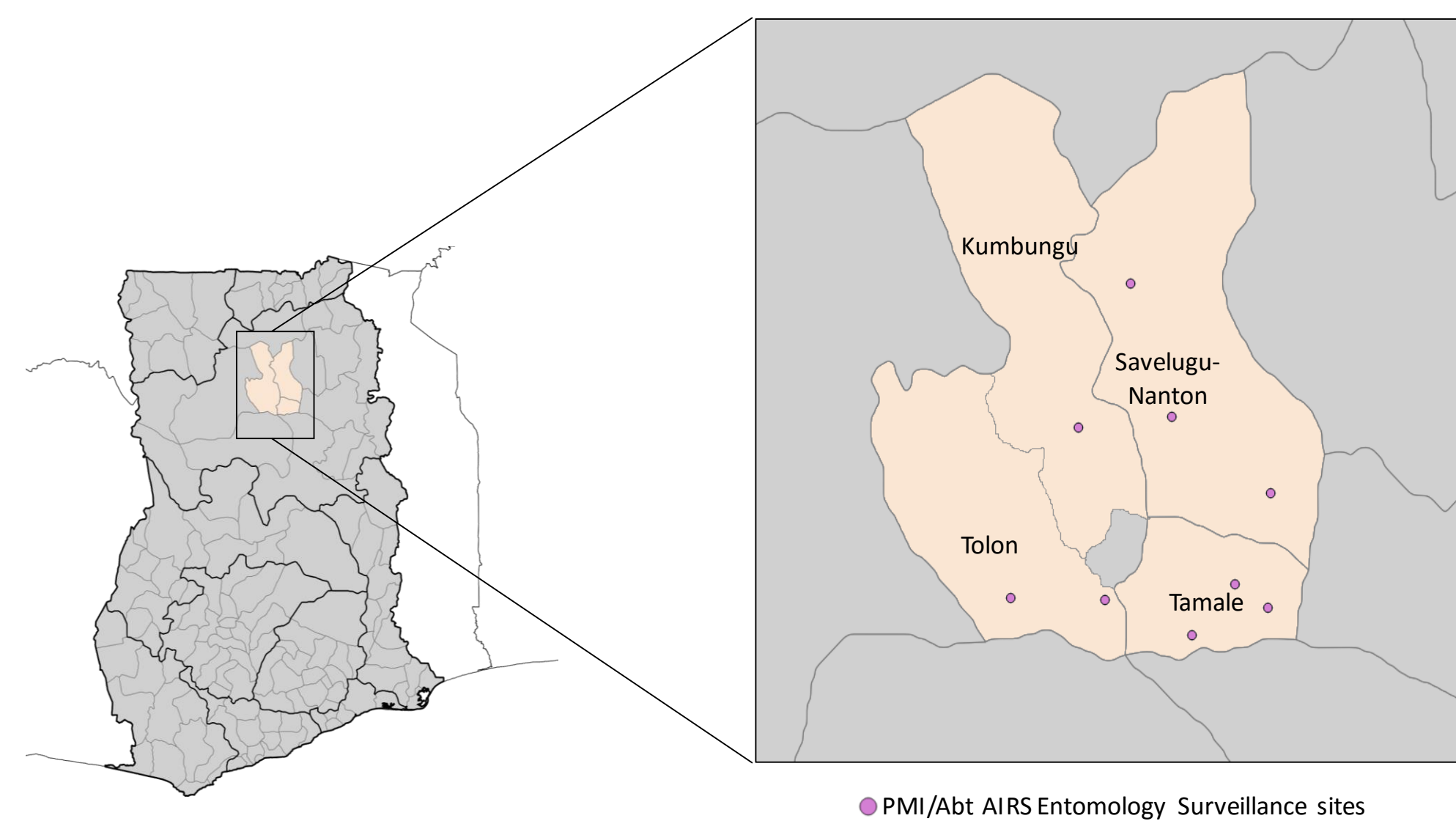


Fig. 1. The districts of Kumbungu, Savelugu-Nanton, Tolon, and Tamale in Northern Ghana. For this descriptive analysis of the impact of IRS operations in the region, district-level EIR estimates from PMI AIRS Entomological surveillance activities are overlaid with passive disease surveillance trends from the corresponding districts.

Table 1. The IRS landscape in the focus districts from 2012 – 2016.

District	2012			2013			2014			2015			2016		
	IRS Active Ingredient ¹	IRS Coverage (Structures)	IRS Coverage (Pop)	IRS Active Ingredient	IRS Coverage (Structures)	IRS Coverage (Pop)	IRS Active Ingredient	IRS Coverage (Structures)	IRS Coverage (Pop)	IRS Active Ingredient	IRS Coverage (Structures)	IRS Coverage (Pop)	IRS Active Ingredient	IRS Coverage (Structures)	IRS Coverage (Pop)
Tamale	none	-	-	none	-	-	none	-	-	none	-	-	none	-	-
Savelugu-Nanton	PM CS	90%	39,014 93%	102,646	PM CS	91%	41,020 94%	113,068	PM CS	68%	33,573 78%	97,775	none	-	-
Tolon ²	Alpha	92%	75,307 95%	187,799	none	-	-	-	none	-	-	-	none	-	-
Kumbungu ²	Alpha	92%	75,307 95%	187,799	PM CS	93%	31,333 96%	82,614	PM CS	94%	31,932 96%	86,578	PM CS	94%	31,932 96%

¹ PM CS = Microencapsulated Pirimiphos Methyl; Alpha = Alphacypermethrin
² Kumbungu-Tolon was administered as one district until 2014

Approach

Monthly trends in district-specific entomological inoculation rates (EIR) from 2012 – 2014 have been previously published as part of a comprehensive assessment by Coleman, et al¹. Those from subsequent years (2015 – 2016), in which the same PMI AIRS entomological surveillance procedures were followed, are from annual PMI AIRS Entomological Monitoring Reports².

Trends in monthly incidence rates of suspected malaria cases by district were analyzed with an observational time-series approach using 664,838 total cases of suspected malaria from 109 health facilities across the four focus districts that were reported in the District Health Information Management System II (DHIMS2) from January 2012 to December 2016.

- Cases represent suspected malaria with fever seeking treatment
- District population estimates from the most recent Ghana Statistical Service 2010 Census Report

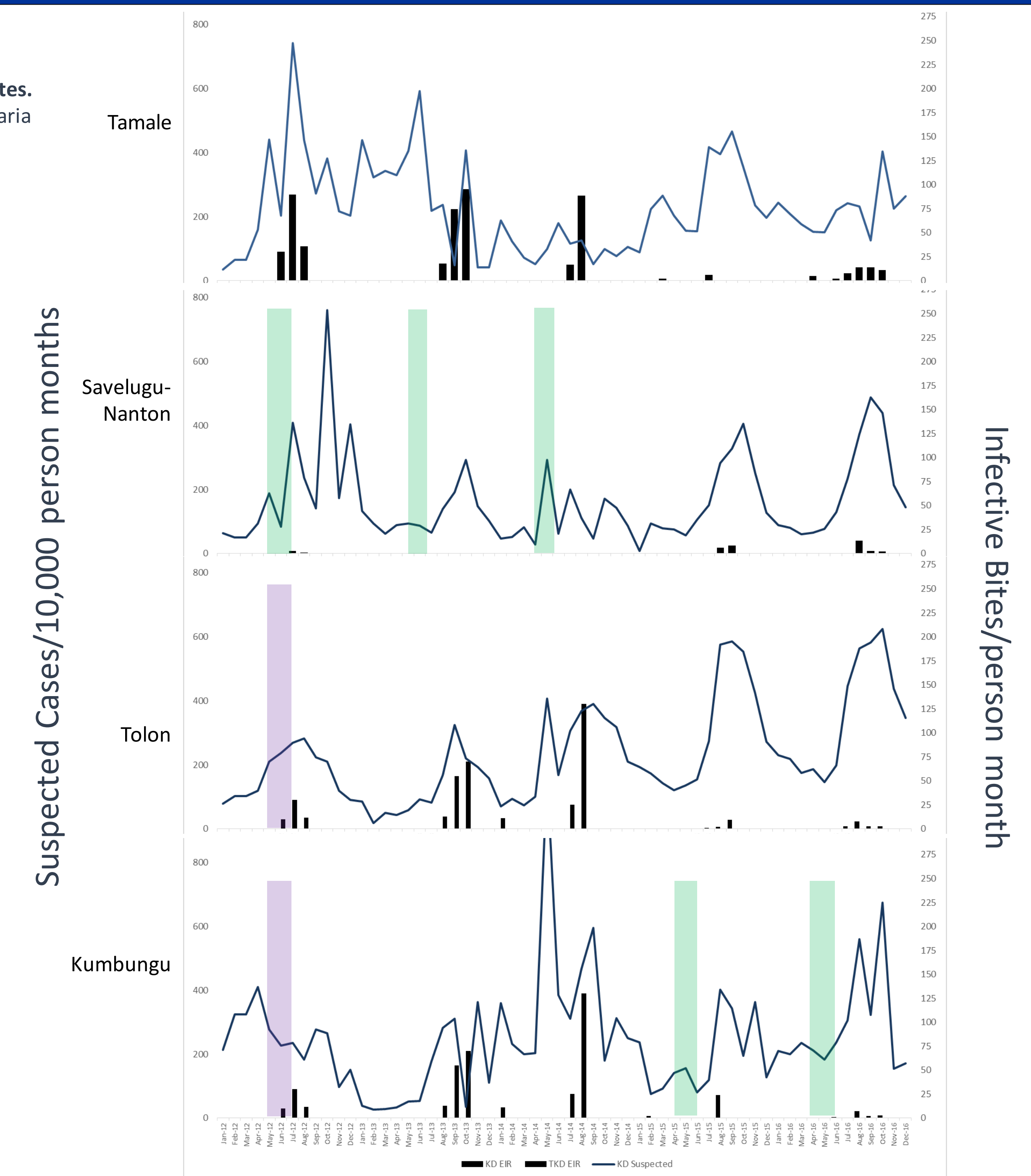
Results:

Fig 3. Overlaying district-specific monthly Entomological Inoculation Rate estimates with the corresponding malaria incidence rates. EIR estimates are from PMI/Abt AIRS entomological surveillance activities^{1,2}. Incidence rates reflect the number of suspected malaria cases reported from the DHIMS2 surveillance system per 10,000 person-months.

This analysis builds on previous work¹ that has shown that IRS operations in these districts of Northern Ghana have had a significant impact on entomological indicators of malaria transmission as assessed by PMI AIRS entomology surveillance activities. Here, it can be seen that changes in EIR are associated in time and space with corresponding changes in the incidence of suspected malaria cases reporting to local health facilities.

This is particularly evident in:

- Savelugu-Nanton district, where EIRs and malaria incidence rates were well controlled by IRS with Actellic in 2012, 2013, and 2014, but increased following suspension of IRS operations in 2015 and 2016
- Tolon and Kumbungu districts, where suspension of pyrethroid IRS in 2013 was followed by increases in both EIR and suspected cases
- Kumbungu district, where re-introduction of Actellic IRS in 2015 is associated with decreases in both entomological and epidemiological indicators of malaria transmission



Conclusion

- These preliminary time-series analyses show clear correlations in time and space with the indoor residual spraying of 3GIRS product and reduced incidence of suspected malaria cases from routine surveillance systems in Northern Ghana, where pyrethroid resistance is widely reported^{3,4}.
- The reduced incidence rates observed here also align with clear reductions in the entomological inoculation rates that have been reported following IRS operations in these districts.
- Further work will attempt to improve the resolution of the epidemiological surveillance data to sub-district levels and align results ecological datasets to allow for more robust, multifactorial 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 or email David McGuire (david.mcguire@ivcc.com).



References
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