

Observational Evidence of a Complementary Effect of Combining Next Generation Indoor Residual Spraying and Seasonal Malaria Chemoprevention in the Ségou Region of Mali

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Introduction

By 2014, concerns about pyrethroid resistance in the Ségou Region of Mali had prompted a shift in indoor residual spraying (IRS) products to a micro-encapsulated formulation of the organophosphate insecticide pirimiphos-methyl (Actellic® 300CS@300 CS; Syngenta AG). Also in 2014, Ségou was in the midst of expanding a pilot program to provide seasonal malaria chemoprevention (SMC) to children aged 3 to 59 months in select districts. The timing of these decisions presented a unique opportunity to analyze the impact of both interventions, deployed individually and in combination, using quality-assured passive surveillance data.

Study Location

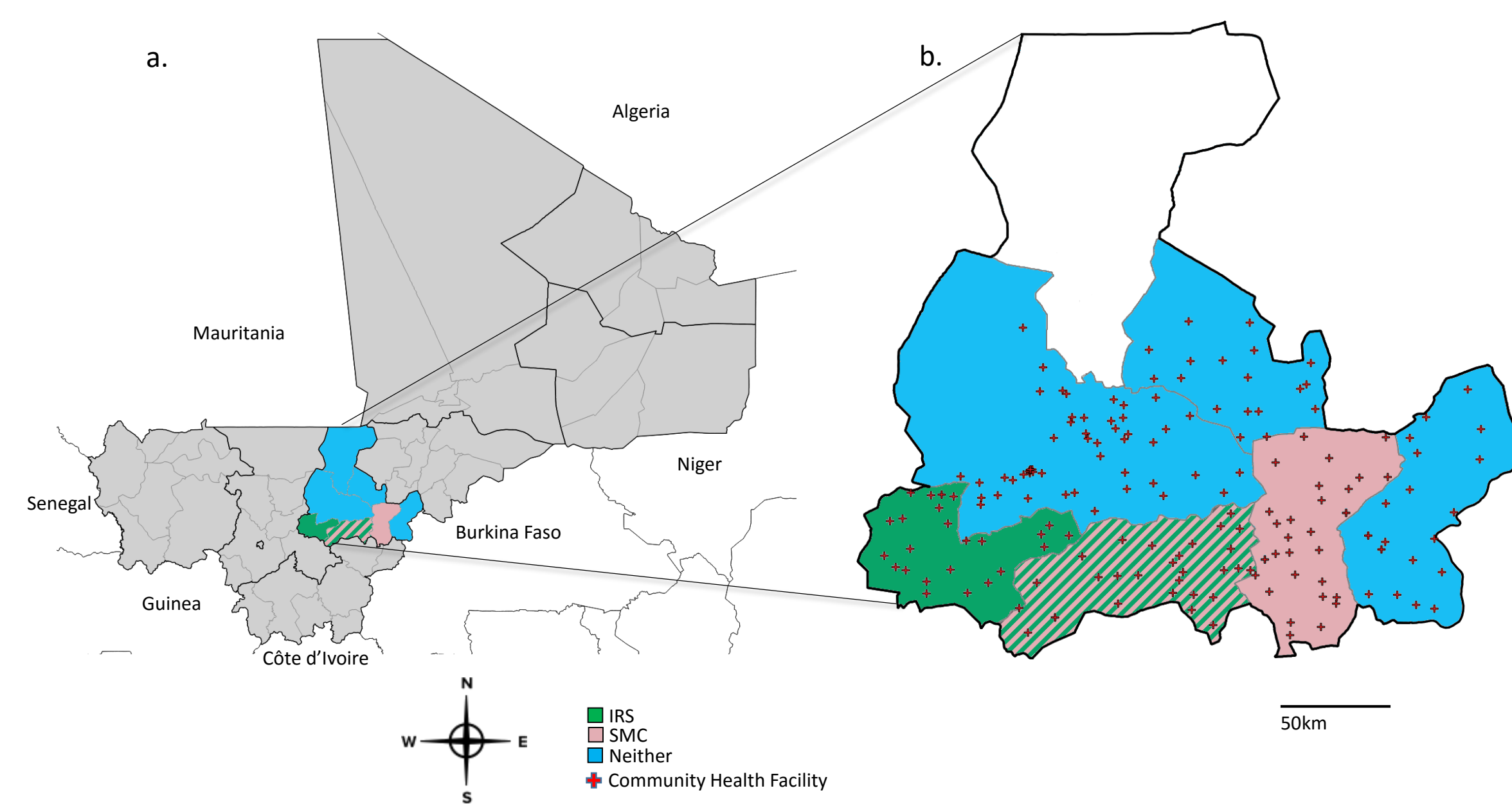


Fig. 1. (a) The location of Mali in West Africa, with Ségou Region highlighted. (b) The locations of the community health facilities in Ségou that reported malaria rapid diagnostic test results during the months analyzed here (Jan - Dec 2014), with the IRS and SMC status of each district indicated.

Ségou Region in 2014

- 2013 under 5-years old (u5) malaria prevalence = 56%²
- Malaria transmission highly seasonal, typically highest June - October
- Primary vectors are *Anopheles gambiae* s.s.
- High levels of pyrethroid and DDT resistance widely reported^{3,4}
- High access to and use of LLINs²
 - 90% of households with at least 1 LLIN
 - 60% of total population report sleeping under the LLIN
- Scale up of seasonal malaria chemoprevention (SMC) began in 2013
- 6 ecologically similar⁵ administrative districts (*cercles*) analyzed here:
 - **San** (408K total population)¹ received 3 rounds of SMC in 2014
 - Children aged 3 to 59 months
 - Monthly dose of SP+A beginning in August
 - **Barouéli** (248K total population) received IRS in 2014
 - Actellic® 300CS@300 CS; Syngenta AG)
 - **Bla** (347K total population) received both IRS and SMC interventions
 - **Ségou** (852K total population), **Tominian** (270K total population), & **Macina** (289K total population) received neither intervention in 2014

Approach

Table 1. Summary of IRS and SMC intervention coverages in Ségou Region, 2014. Each district participated in an LLIN mass distribution campaign in 2012.

Intervention	District	IRS Implementer	IRS Coverage (Structures)	IRS Coverage (Pop)	SMC Implementer	SMC 1 Coverage ^a (children)	SMC 2 Coverage ^a (children)	SMC 3 Coverage (children)
IRS	Barouéli	PMI	97%	61,234	93%	279,441	-	-
SMC	San	-	-	-	UNICEF	99%	79,124	93% 74,391
IRS + SMC	Bla	PMI	98%	96,229	95%	334,115	102%	81,343
neither	Macina	-	-	-	NMCP	102%	69,132	-
neither	Niono	-	-	-	-	-	-	-
neither	Ségou	-	-	-	-	-	-	-

^a SMC 1 = Round 1: August; SMC 2 = Round 2: September; SMC 3 = Round 3: October

A retrospective, observational, time-series analysis was performed using 472,046 RDT-confirmed cases of malaria reported by the routine health system (Système Numérique d'Information Sanitaire Intégré/SNISI) from January 2014 to March 2015.

- 2,712 monthly reports from 164 community health centers in the six districts
- Community health center catchment areas population estimates obtained from the Ministry of Health
- Health center incidence rates were stratified by intervention status for comparative analyses

Results

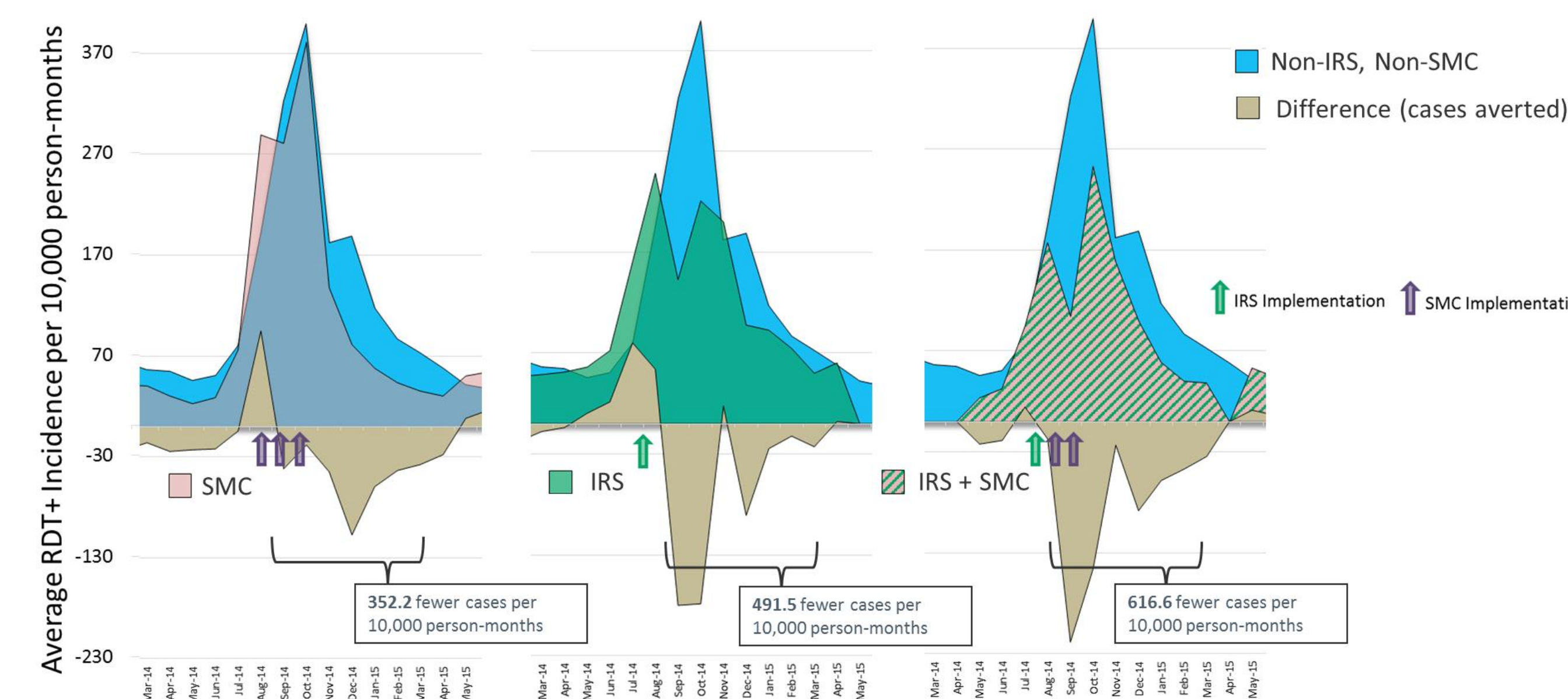


Fig. 2. Epidemiological curves showing the monthly incidence of RDT+ confirmed malaria cases in the districts of San (SMC only), Barouéli (IRS only), and Bla (IRS + SMC), 2014. The area of the tan curves represents the differences between the incidence rates observed in each district relative to the neighboring districts that received neither intervention in 2014.

Also shown are the cumulative incidence reductions observed in the intervention districts, relative to the comparator non-intervention districts, during the 6 months that followed each year's IRS campaign.

District-level comparative analysis (Fig. 2) shows that during peak malaria transmission season (Sep–Mar) in 2014: SMC in San corresponded to 352 fewer cases per 10,000 person-months at risk, IRS in Barouéli corresponded to 491 fewer cases per 10,000 person-months at risk, and the combined IRS+SMC in Bla corresponded to 617 fewer cases per 10,000 person-months at risk. Looking at the protective effect of each intervention by month (Fig. 3) is useful for describing the magnitude and timing of the impact - this analysis suggests that the SMC only intervention had a more moderate effect initially (24% fewer cases in the first month) that lasted for a longer duration (at least 6 months) while the IRS only intervention had a rapid, comparatively large impact (55% fewer cases) of shorter duration (4 months). The impact of the combined intervention was both rapid (68% fewer cases in the first month) and of longer duration (at least 6 months).

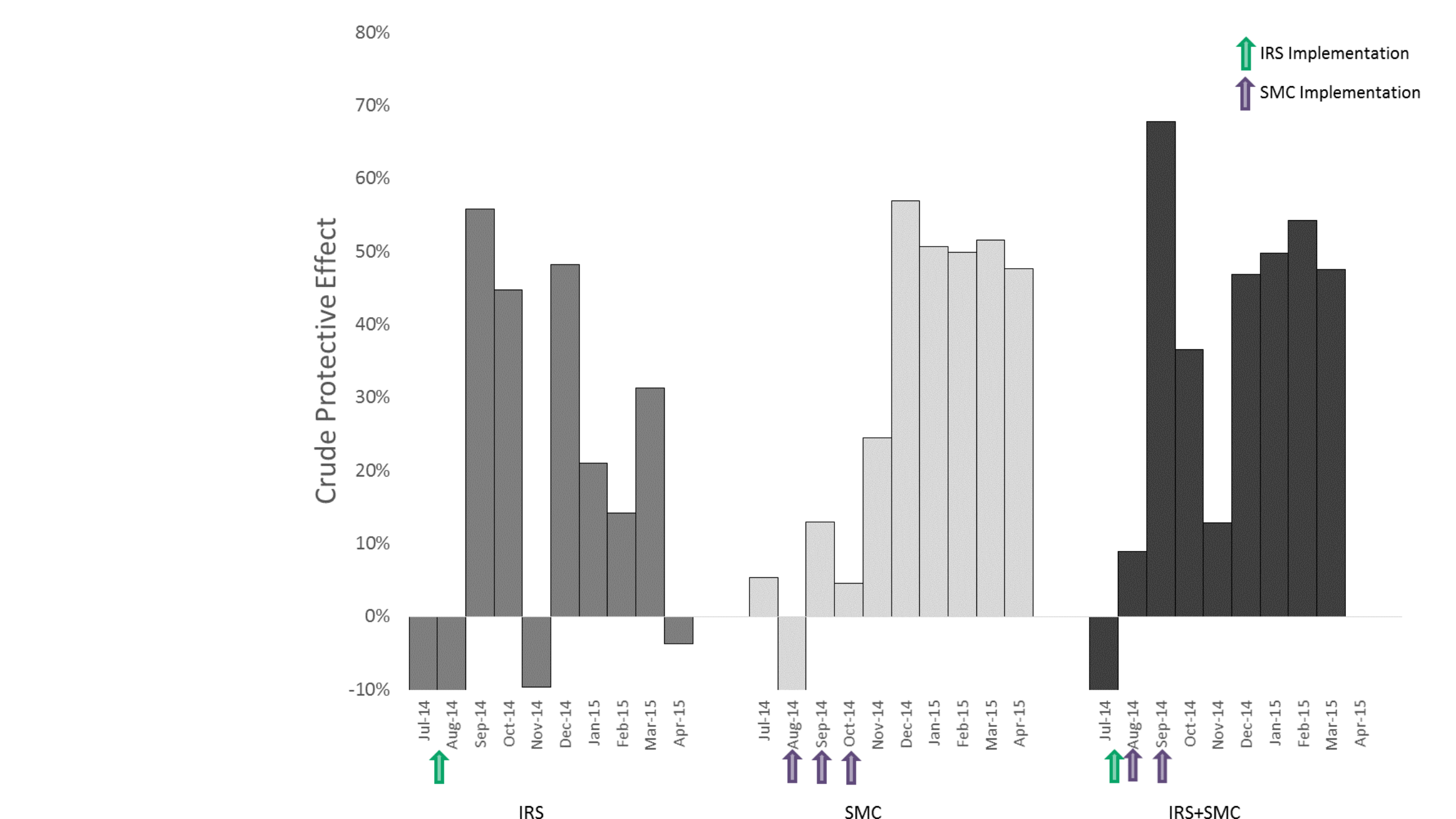


Fig. 3. The monthly protective effect of each intervention type. The protective effect shows the reduced incidence observed in each district as a percentage of the total incidence observed in the non-intervention comparator districts:

$$(\text{Incidence}_{\text{intervention}} - \text{Incidence}_{\text{non-intervention}}) / \text{Incidence}_{\text{non-intervention}} * -100$$

Discussion

Though observational studies should always be interpreted with caution, **these preliminary results suggest a possible combinatorial effect of co-implementation of both IRS and SMC in central Mali.** Current efforts to better understand how the testing and treatment procedures that were part of the SMC campaigns in 2014 may have influenced the numbers of RDT+ cases passively reported in the SNISI surveillance system will inform further analysis and interpretation of the trends observed here. Nonetheless, this work also supports the utility of quality-assured and validated routine surveillance data in rapidly assessing the impact of malaria control interventions in operational settings to empower evidence-based decision making.

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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