



**malaria
consortium**

disease control, better health

Assessing the impact of seasonal malaria chemoprevention on suspected and confirmed malaria cases in Chad using routine clinical data, 2013–2018

Sol Richardson

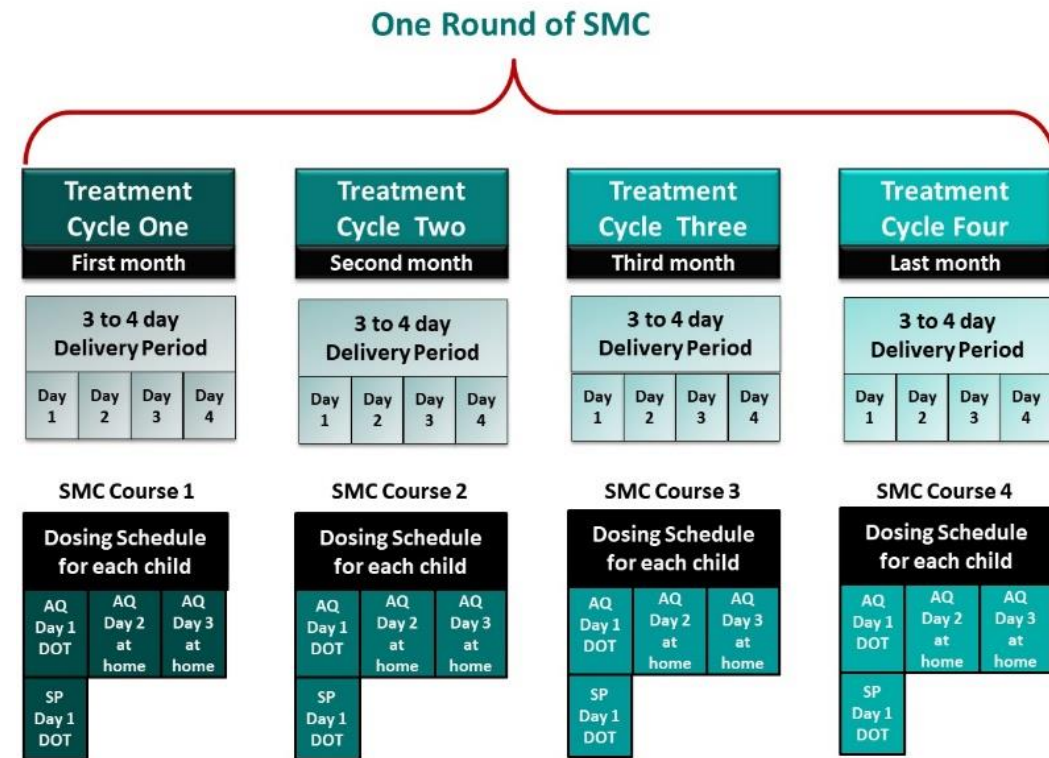
2020 Annual Meeting of the American Society of Tropical Medicine & Hygiene



Introduction

Seasonal malaria chemoprevention

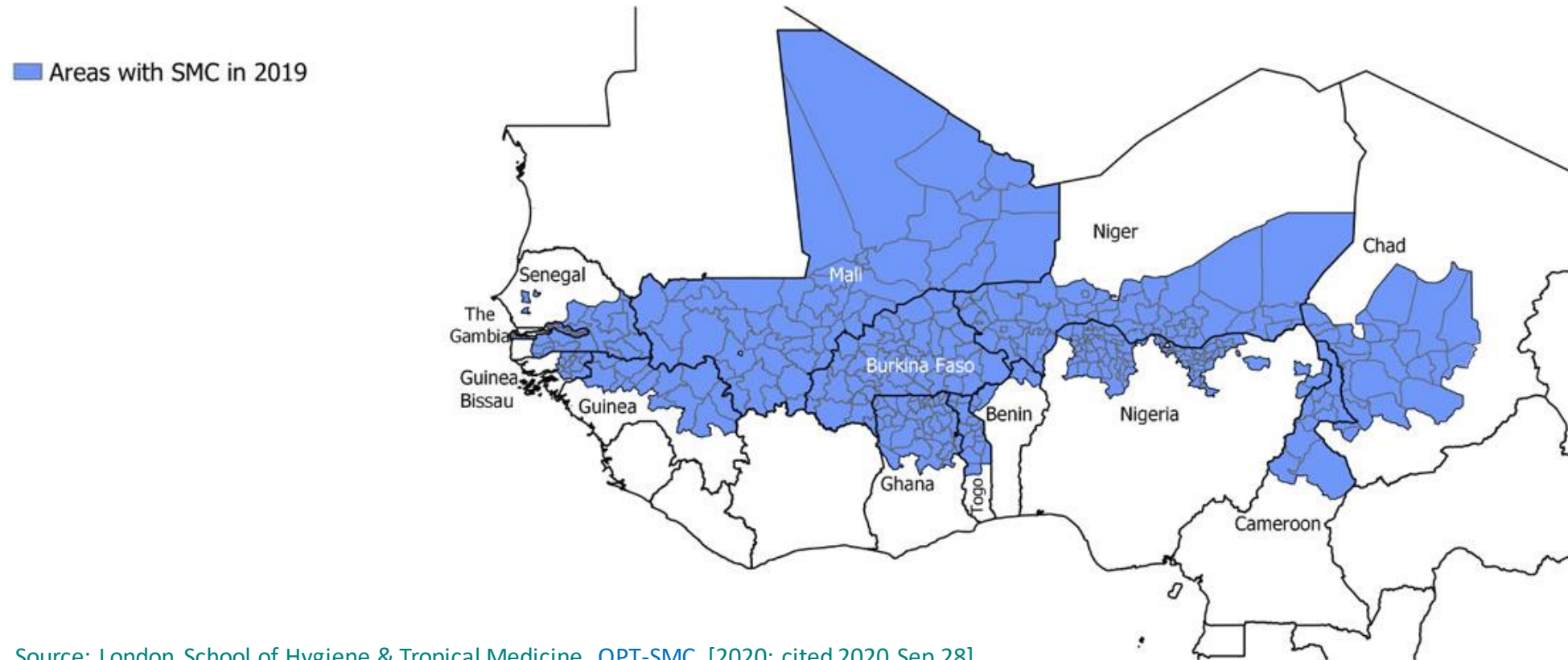
- Malaria Consortium supports SMC administration using sulfadoxine-pyrimethamine plus amodiaquine to children 3–59 months at monthly intervals to provide protection against *Plasmodium falciparum* malaria during the annual high-transmission season.
- Recommended by the World Health Organization in areas of highly seasonal transmission and low prevalence of resistance alleles.
- Randomised controlled trials suggest preventive efficacy is ~74 percent.^[1]



Typical four-cycle SMC treatment round

[1] Meremikwu MM et al. Intermittent preventive treatment for malaria in children living in areas with seasonal transmission. Cochrane Database of Systematic Reviews, 2012; 2:003756.

SMC in the Sahel (2019)



Source: London School of Hygiene & Tropical Medicine. [OPT-SMC](#). [2020; cited 2020 Sep 28].

SMC in eligible districts of Chad (2013–2018)

SMC implementers in Chad by year and number of districts supported

Year	Chadian NMCP	ACCES-SMC	Malaria Consortium	UNICEF	Global Fund	Croix Rouge
2013	4					
2014				1		
2015		6				2
2016		15		4	3	
2017		14			14	
2018			15	4	14	

ACCESS-SMC: Achieving Catalytic Expansion of Seasonal Malaria Chemoprevention in the Sahel (with support from Malaria Consortium)

NCMP: National Malaria Control Programme

UNICEF: United Nations International Children's Emergency Fund

SMC in Chad (2018 to present)

- Using philanthropic funding, Malaria Consortium has continued to support SMC since 2018.
- In 2020, Malaria Consortium-supported SMC campaigns targeted treatment of 960,000 eligible children 3–59 months across 20 health districts.
- SMC in Chad received continuing support from the Global Fund and UNICEF since 2018.

Study aim and objectives

- **Aim:** to generate evidence on the impact of SMC at scale.
- **Objectives:** to investigate associations between SMC and
 - district-level rates of suspected malaria cases in eligible children
 - district-level rates of confirmed malaria cases in eligible children.



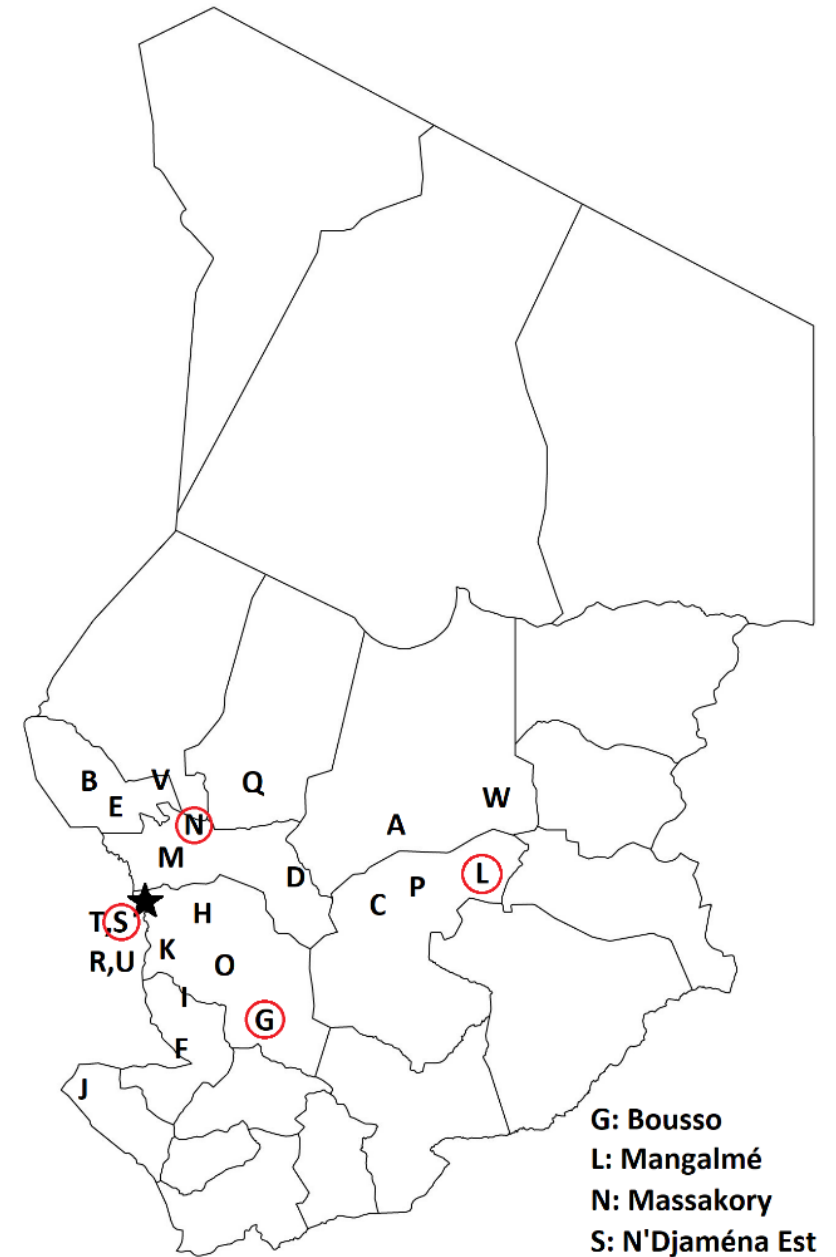
Methods

Data sources

- Chadian Health Management Information System (HMIS) (2013–2018), compiled by the Chadian NMCP
- 2019 district-level population projections provided by the Chadian Ministry of Health's Department of Health Statistics
- Climatic data provided by the Chadian National Meteorological Agency, and the Demographic and Health Survey (DHS) (2014) not employed in analysis.

SMC administration in Chad

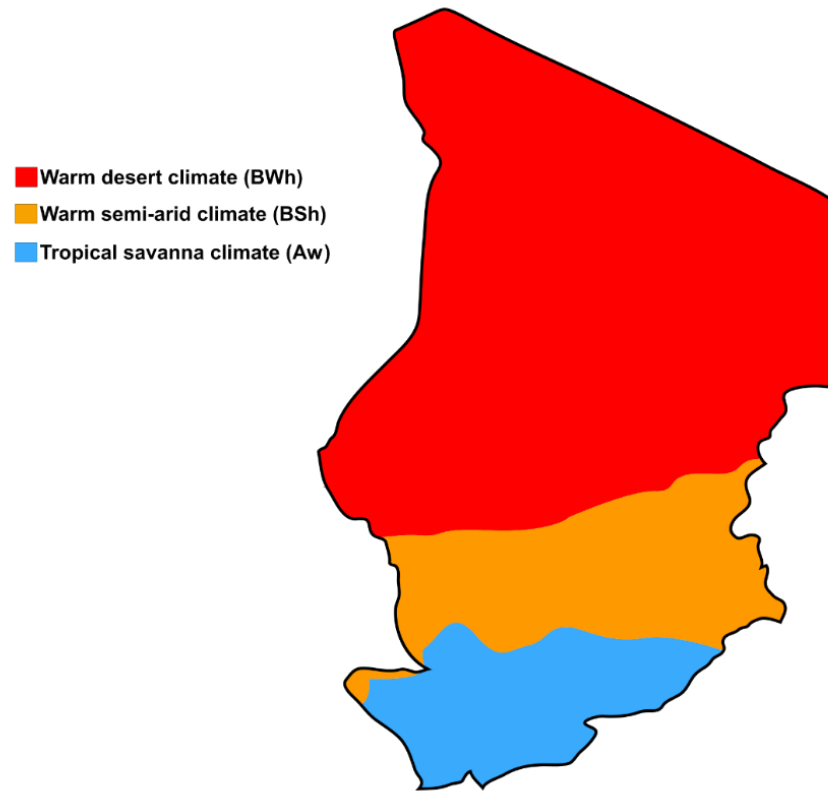
- In 2013, 44 of 72 health districts in Chad were eligible for SMC.
- During 2015–2018, larger districts were subdivided, resulting in a total of 118 districts (of which 75 were eligible and 43 non-eligible).
- SMC was implemented in at least one season in 23 of 44 eligible (2013) health districts across Chad during 2013–2018.
 - Total 2013 population of children 0–59 months: 1.03 million.



Map of health districts with SMC campaigns, 2013–2018

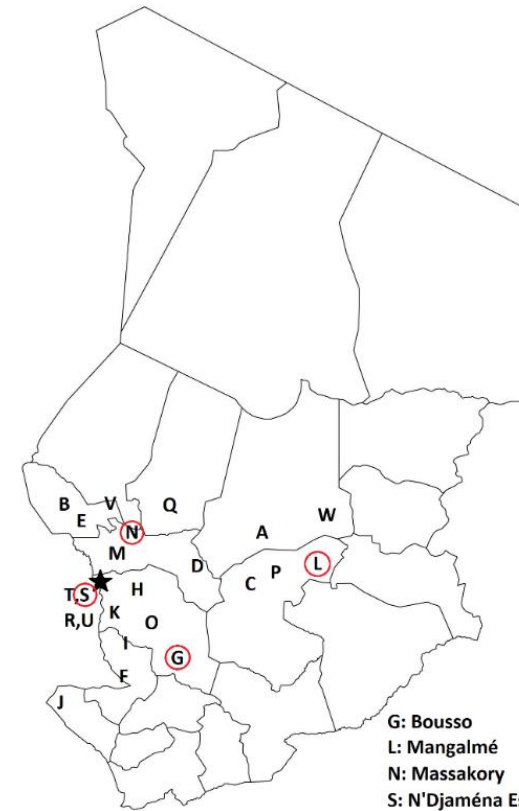
Climate and seasonality of sampled districts

Chad map of Köppen climate classification



Map of health districts with SMC campaigns, 2013–2018

Source: [Wikimedia Commons](#). [2016; cited 2020 Sep 29].



Chad Köppen climate classification map

Outcome measures

- We used monthly district-level HMIS data on malaria cases among children 0–59 months in health districts with SMC administration, in at least one high-transmission season.
- Two models were fitted:
 1. Suspected cases (in primary care facilities)
 2. Confirmed cases (in primary care facilities, by rapid diagnostic testing or microscopy).

Model specification

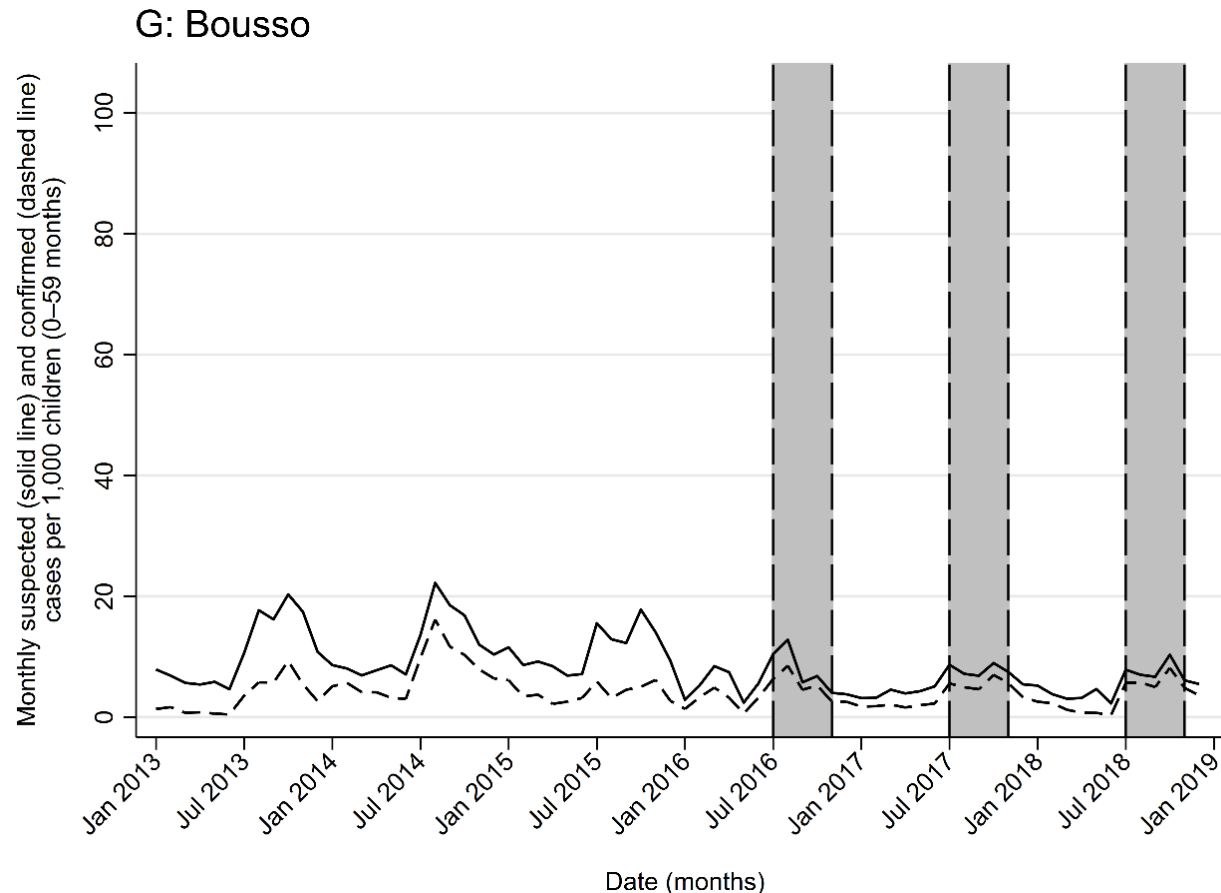
- We fitted generalised additive mixed models using a quasi-Poisson link function for count outcomes (cases/month).
- Year and (2013) health districts were fitted as random effects (with years nested within health districts).
- Cyclic cubic spline terms were fitted individually by health district on month to adjust for seasonality of malaria cases.
 - Estimated degrees of freedom and p values were calculated.

- Models used a log-transformed offset term to account for district-level population change and proportion of clinics reporting suspected and confirmed cases.
- The primary exposure, SMC administration, was fitted as a binary variable with '1' corresponding to the expected period of protection (July–October inclusive).
- Results were expressed as rate ratios (RR) for monthly cases.



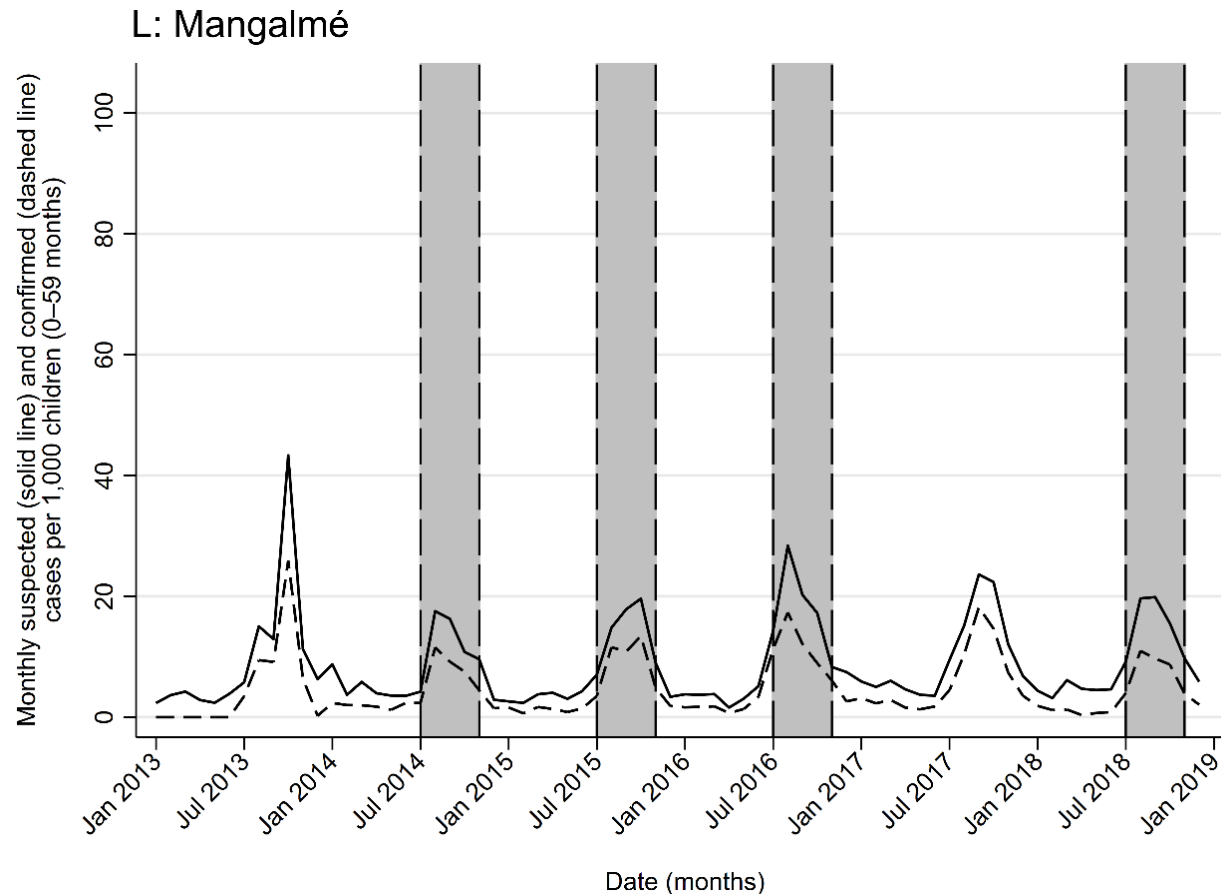
Results and discussion

Bouso district: Suspected and confirmed cases per 1,000 children 0–59 months (2013–2018)

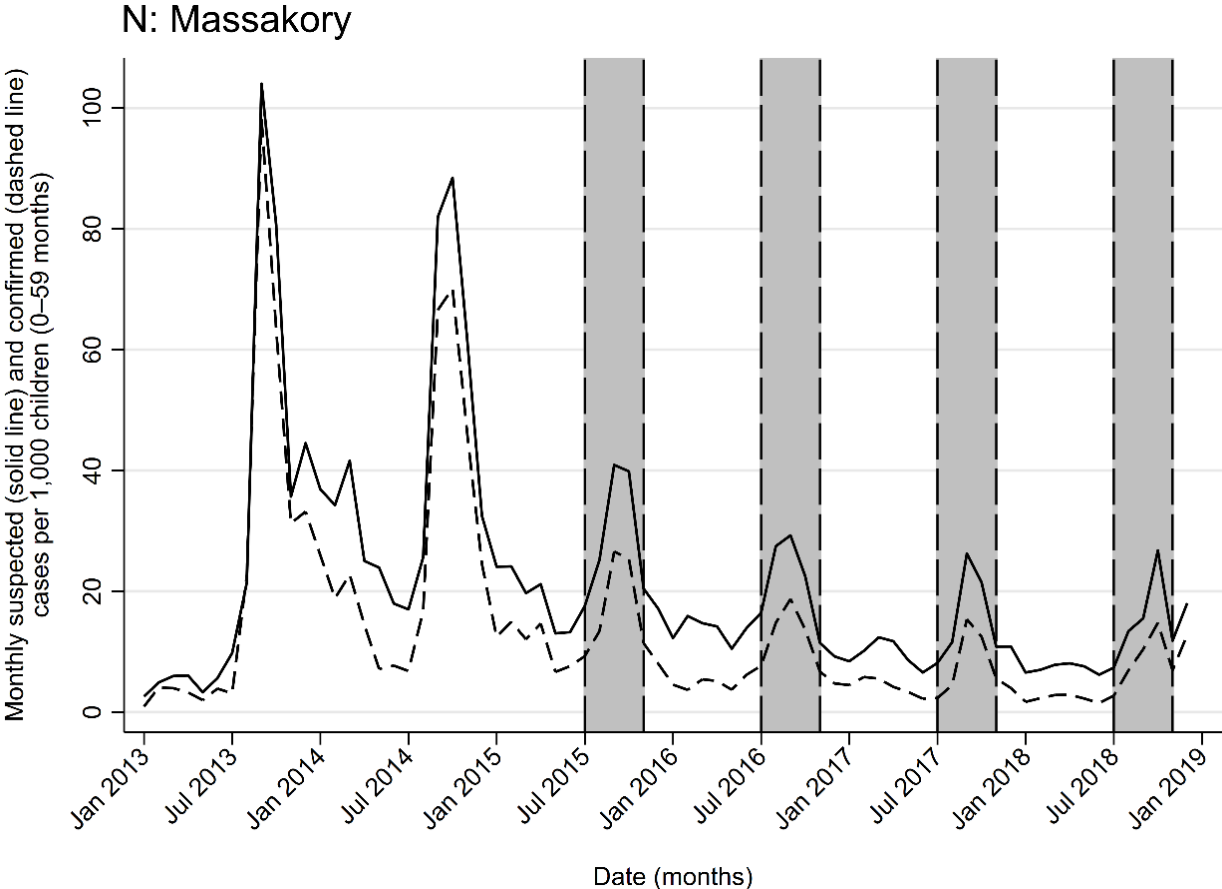


- Grey: Protective period of SMC administration
- Solid line: Monthly suspected cases per 1,000
- Dashed line: Monthly confirmed cases per 1,000

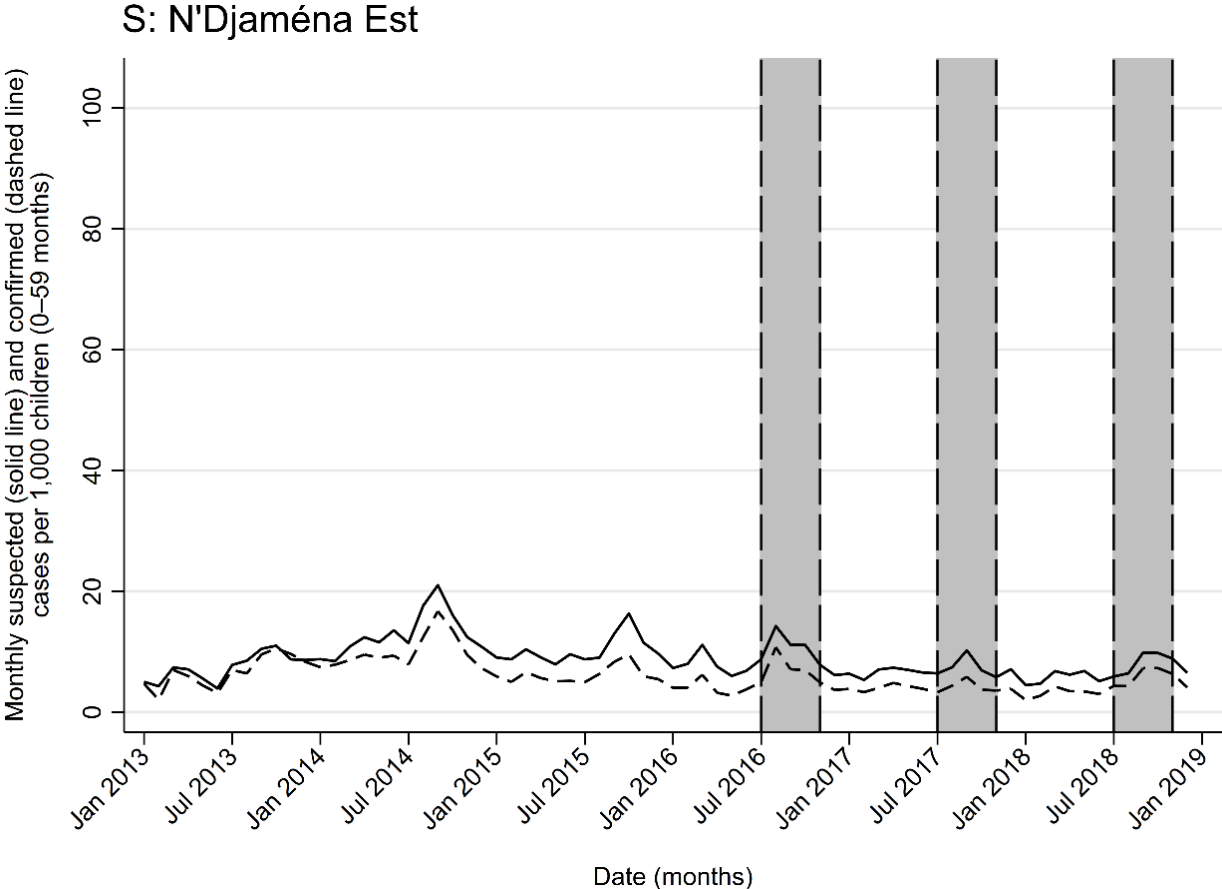
Mangalmé district: Suspected and confirmed cases per 1,000 children 0–59 months (2013–2018)



Massakory district: Suspected and confirmed cases per 1,000 children 0–59 months (2013–2018)

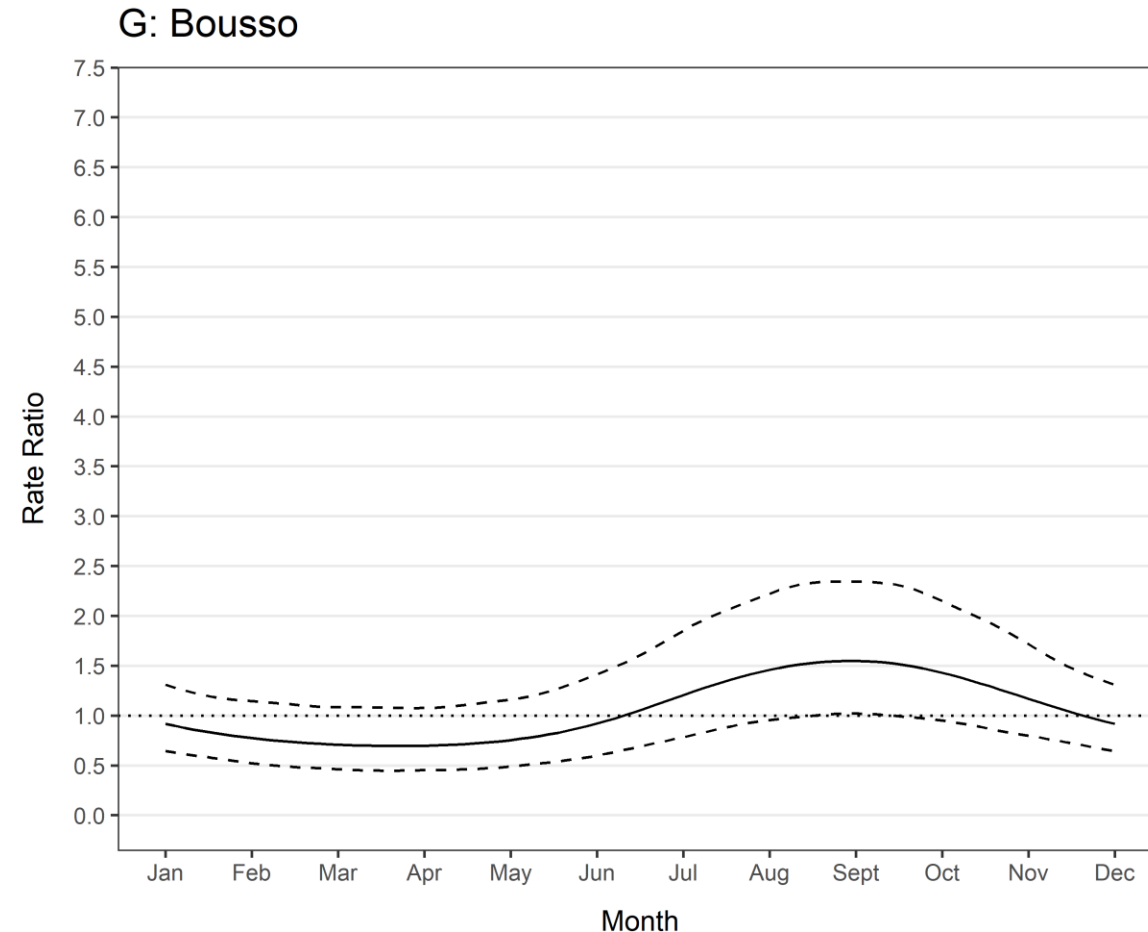


N'Djaména Est district: Suspected and confirmed cases per 1,000 children 0–59 months (2013–2018)



Bouso district: Suspected cases, plot of smooth term

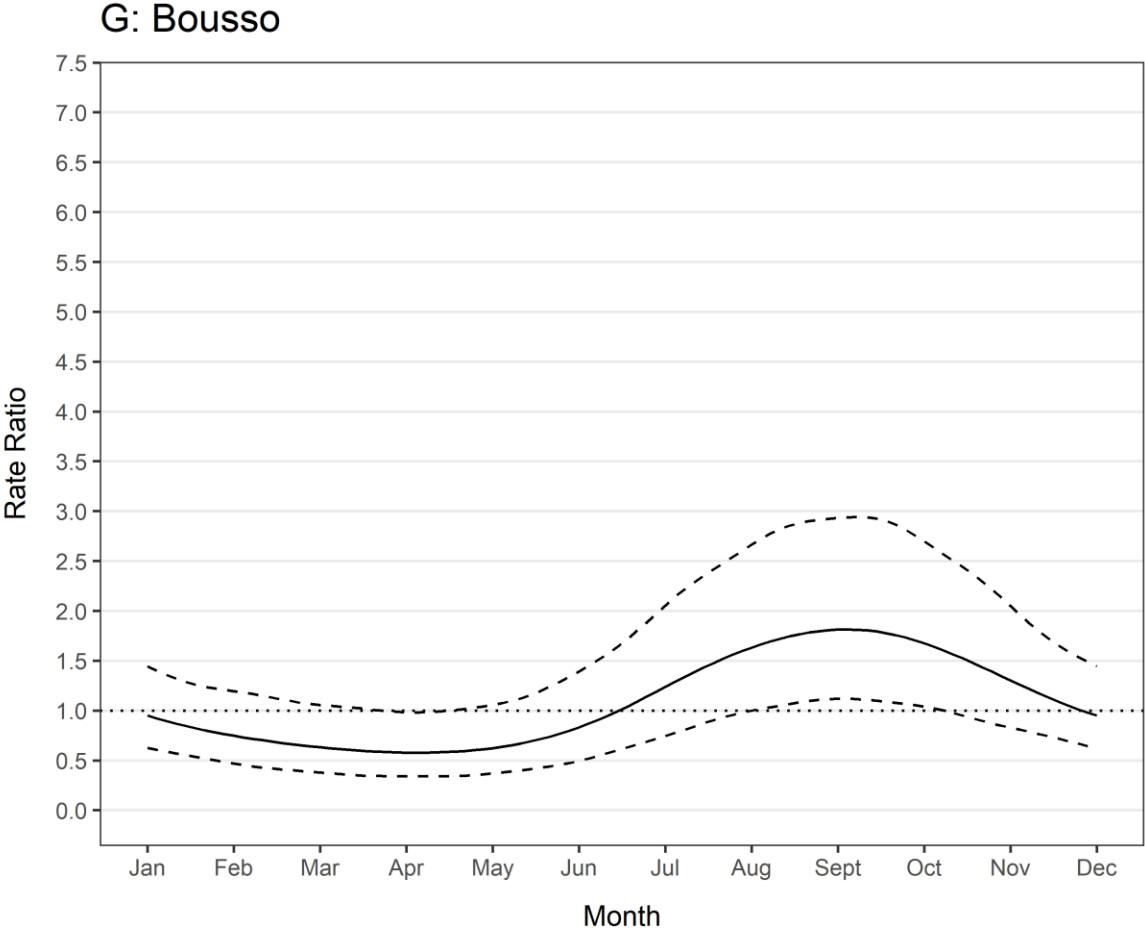
Estimated degrees of freedom (EDF)=2.45
p=0.024



- Solid line: Cyclic cubic smoothing term
- Dashed line: 95 percent confidence interval (95 percent CI)
- Horizontal line: District-level mean rate of cases

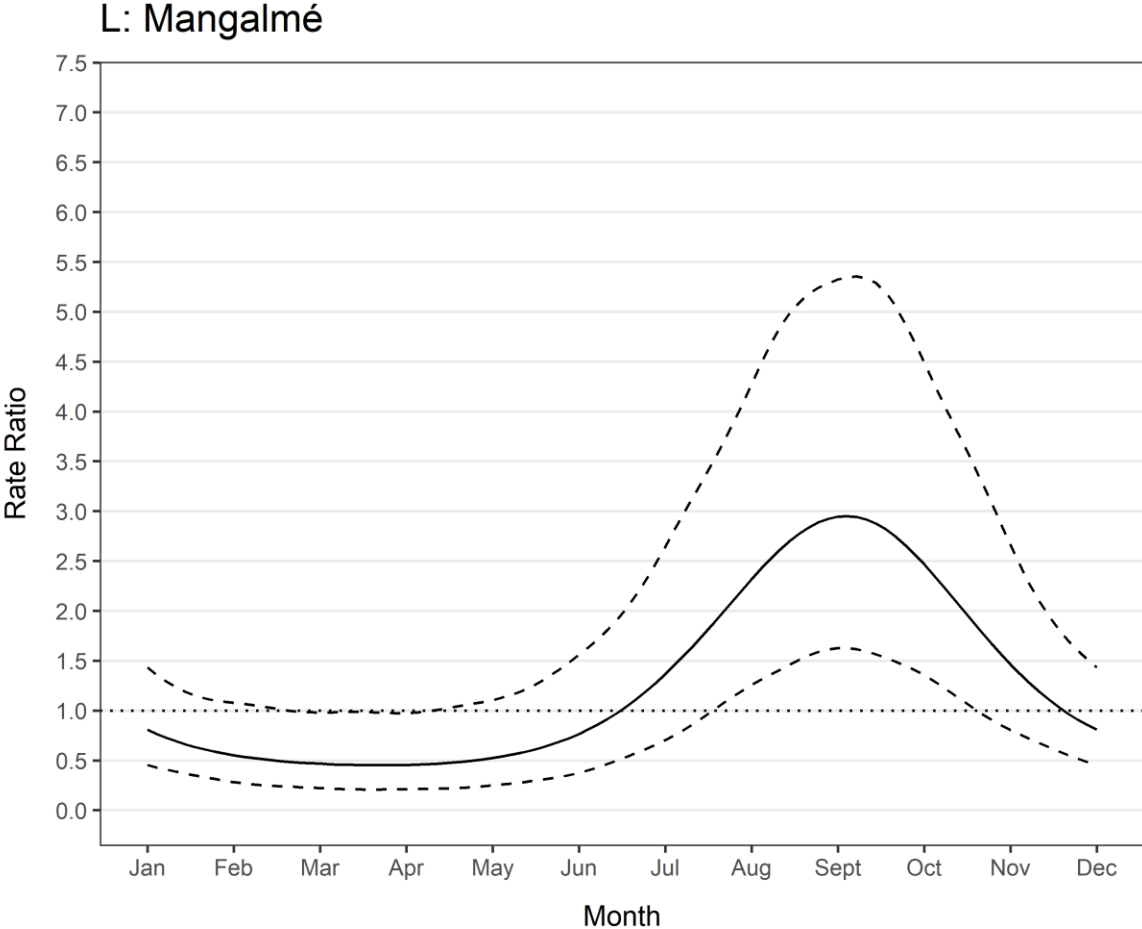
Bouso district: Confirmed cases, plot of smooth term

EDF=2.59
p=0.004



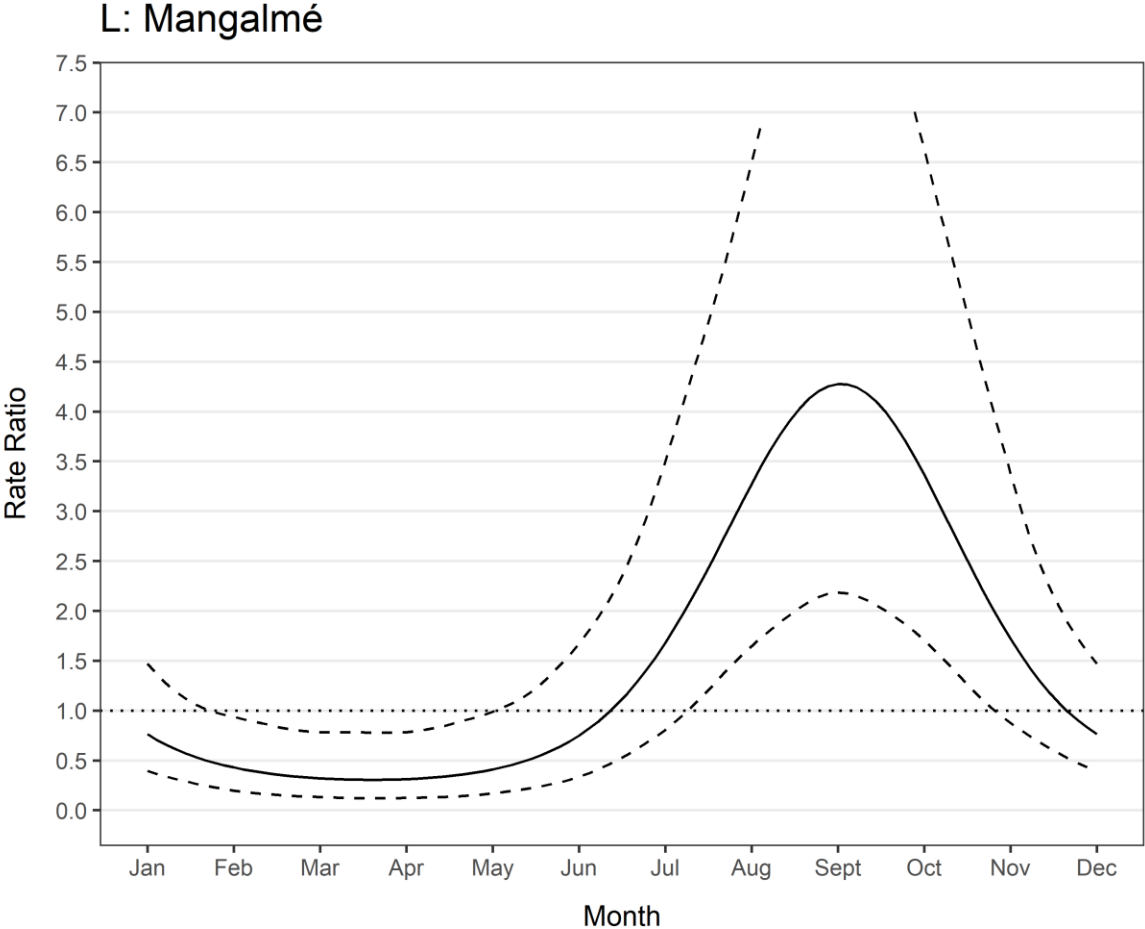
Mangalmé district: Suspected cases, plot of smooth term

EDF=2.96
p<0.001



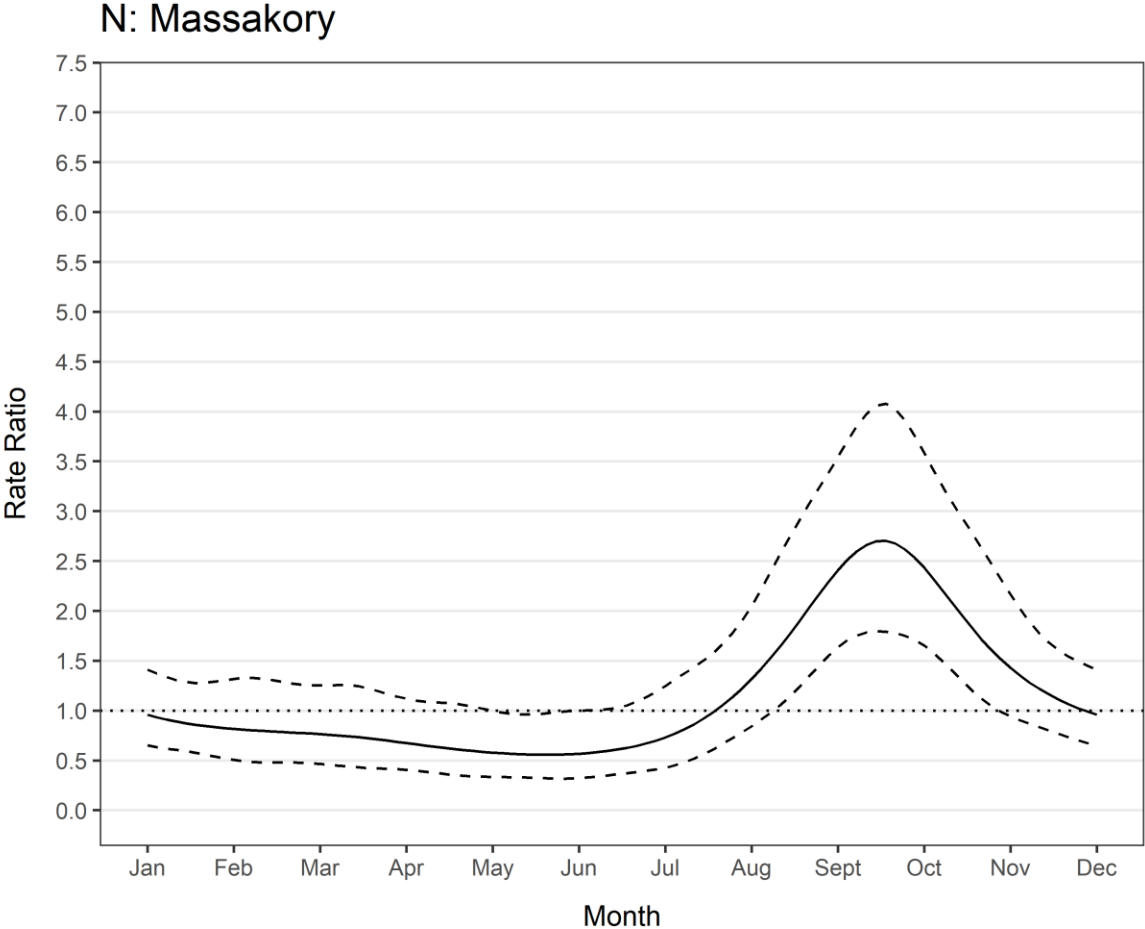
Mangalmé district: Confirmed cases, plot of smooth term

EDF=2.84,
p<0.001



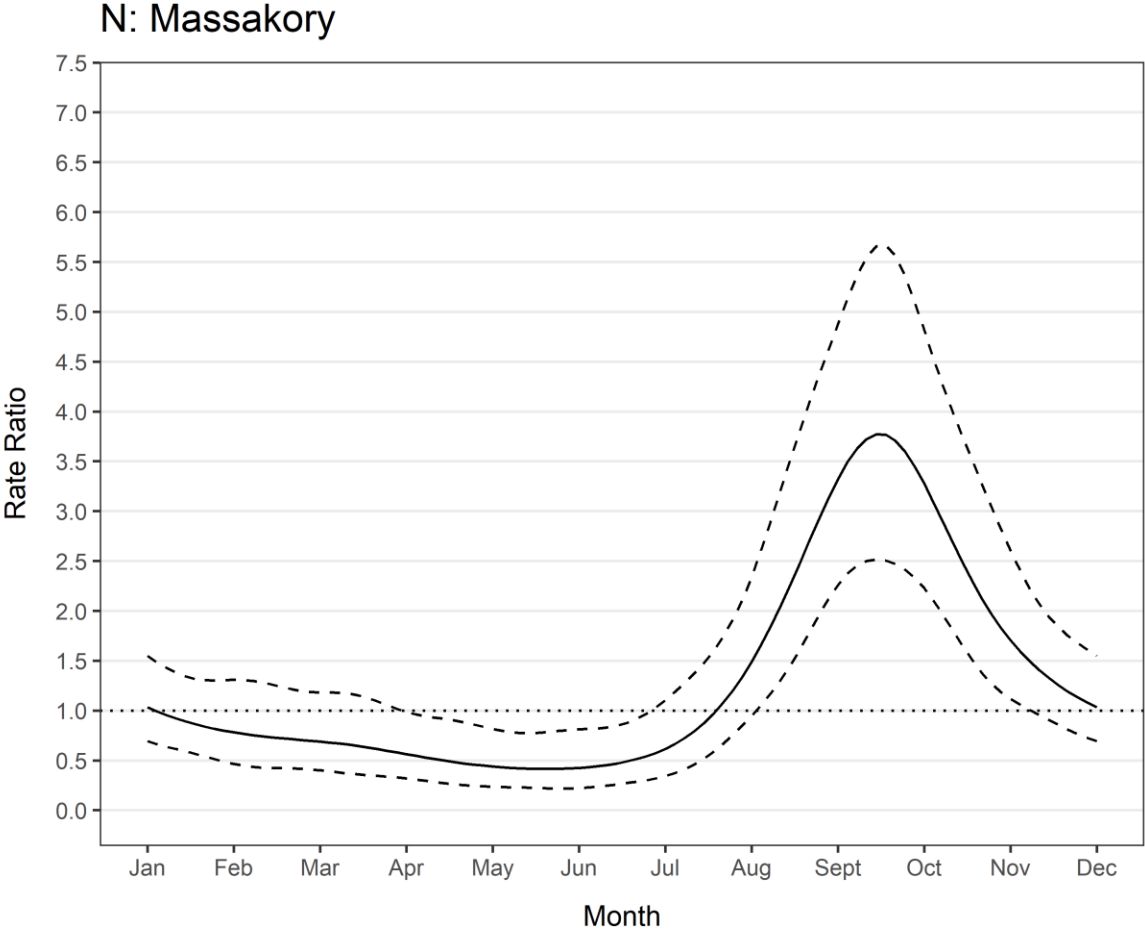
Massakory district: Suspected cases, plot of smooth term

EDF=4.66
p<0.001



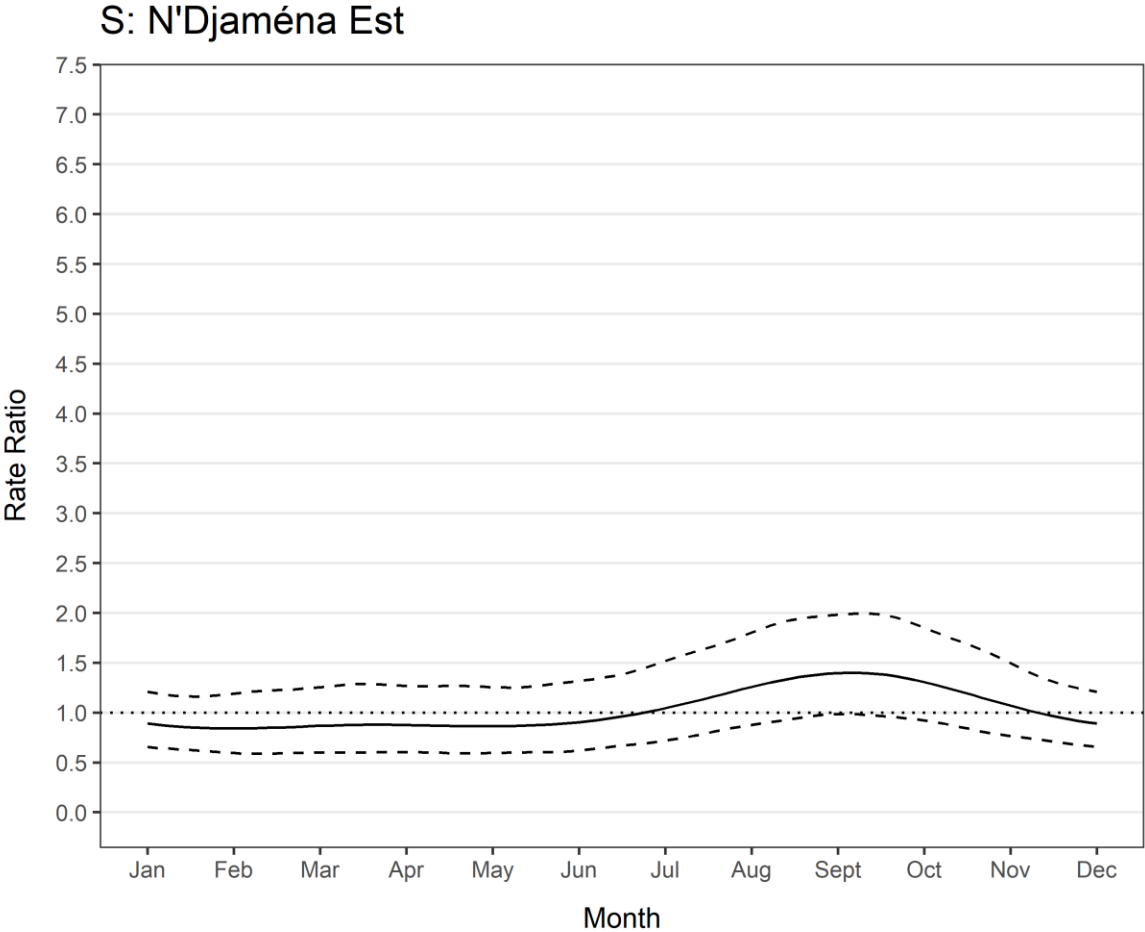
Massakory district: Confirmed cases, plot of smooth term

EDF=4.71
p<0.001



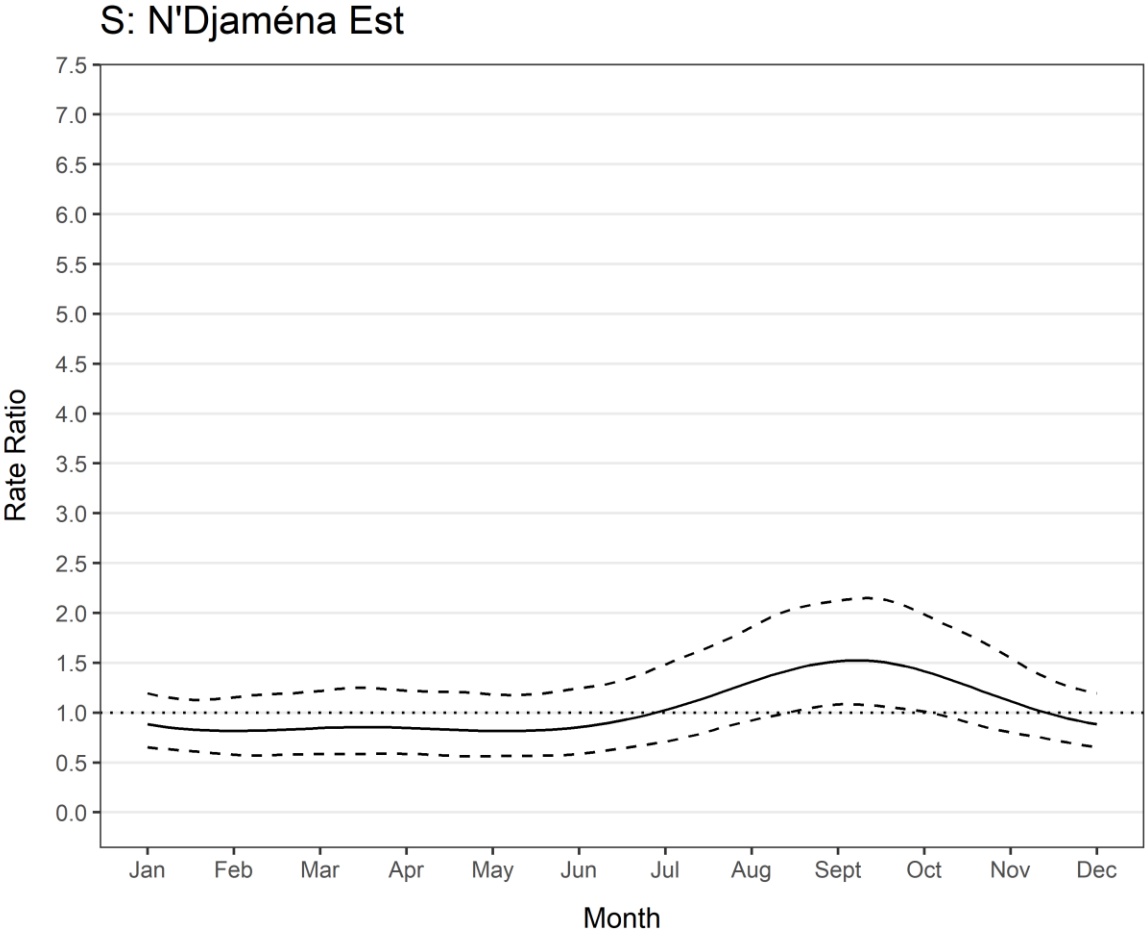
N'Djaména Est district: Suspected cases, plot of smooth term

EDF=3.13
p=0.74



N'Djaména Est district: Confirmed cases, plot of smooth term

EDF=3.32
p=0.11



Model results (SMC administration)

- Model 1 (suspected cases)
 - RR: 0.82, 95% CI: 0.72–0.94, $p=0.006$
 - 18 percent reduction in suspected cases reported at primary health facilities.
- Model 2 (confirmed cases)
 - RR: 0.81, 95% CI: 0.71–0.93, $p=0.003$
 - 19 percent reduction in confirmed cases reported at primary health facilities.

Limitations

- Lack of usable covariate data necessitated the use of random effects and spline terms to account for seasonality.
 - Models explained over 80 percent of variance in the two outcomes.
- Estimated ~20 percent effectiveness (based on RRs) was substantially below the assumed 74 percent efficacy of SMC.
 - Not all malaria cases are reported at primary health facilities.
 - The outcomes related to children 0–59 months; this may have underestimated effect sizes as children 0–2 months were not treated but their cases were included in the outcome.

Issues and next steps

Issues

- data quality
- missing information

Next steps

- sensitivity analyses
- data quality audit
- evidence from other countries (e.g. using a regression discontinuity approach to investigate association of age-specific incidence rate ratios of malaria cases based on routine data in Mozambique).

Acknowledgements

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¹Malaria Consortium Chad

²Malaria Consortium

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