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Analysing age-related trends in routine data through transmission modelling during seasonal malaria chemoprevention in Burkina Faso

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Age-related variations in routine data can be attributed to non-malarial fevers and treatment-seeking behaviours, which mask the impact of seasonal malaria chemoprevention.

Introduction

Seasonal malaria chemoprevention (SMC) prevents approximately 75 percent of clinical malaria cases in trial settings. Regular monitoring of its impact is important to identify issues related to implementation, coverage and resistance. In Burkina Faso, the impact of SMC on malaria prevalence aligns with modeled simulations.[1,2,3] However, data from the Health Management Information System (HMIS) indicate an increase in cases among children 3–59 months since 2013, despite a decrease in prevalence in the same age group.[4] In this study, we use a mathematical model to investigate the impact of SMC by analysing the age distribution in HMIS cases.

Methods

- We calibrated a malaria transmission model to fit to microscopy-confirmed prevalence in 62 districts of Burkina Faso based on data from the Demographic Health Survey Programme (DHS) from 2010–2018. Calibration was conducted using the maximum likelihood by varying mosquito density. Factors included in the model were rainfall, mosquito net use (sourced from the Malaria Atlas Project) and treatment (based on DHS data).
- We simulated the impact of SMC with 70 percent coverage in children 3–59 months and compared the modelled predictions of clinical cases to HMIS data showing the number of children with malaria that was confirmed by a rapid diagnostic test.
- We estimated the relative treatment-seeking rate in those over five years old by calibrating the model to the pre-SMC age distribution.
- In the model, we included non-malarial fevers that might be counted as malaria cases in HMIS due to incidental asymptomatic *parasitaemia*. This inclusion was based on data regarding the background rate of non-malarial fevers[5] and the prevalence of asymptomatic infection by age.

Results

- Before the introduction of SMC, there were unexpected seasonal shifts in the age distribution of cases, which increased along with the malaria burden. This occurred without any age-targeted seasonal prevention measures or other age-specific seasonal changes.
- We successfully replicated these results in modelled outputs before SMC introduction by: 1) Including lower rates of non-malarial fevers but higher levels of asymptomatic cases among those over five; 2) Factoring a 40 percent reduction in treatment-seeking behaviour in over-fives compared to children five and under; and 3) Accounting for a 52 percent increase in cases due to children five and under seeking care at the facility after the elimination of user fees in 2016 (Figure 1) (correlation coefficient=0.34 [Figure 2]).
- However, the model predicted larger reductions in cases among children five and under than what was observed in the HMIS data (correlation coefficient=-0.016 [Figure 2]). It is unclear if this is due to varying coverage and/or adherence or whether treatment-seeking behaviours during programme implementation are influencing trends in the data.

Results

Figure 1: Model predictions and estimates from HMIS data showing the proportion of cases in children five and under among all children 15 and under by month (district-level and median) in high burden districts (70-90% baseline prevalence) that introduced SMC in 2016 and 2017

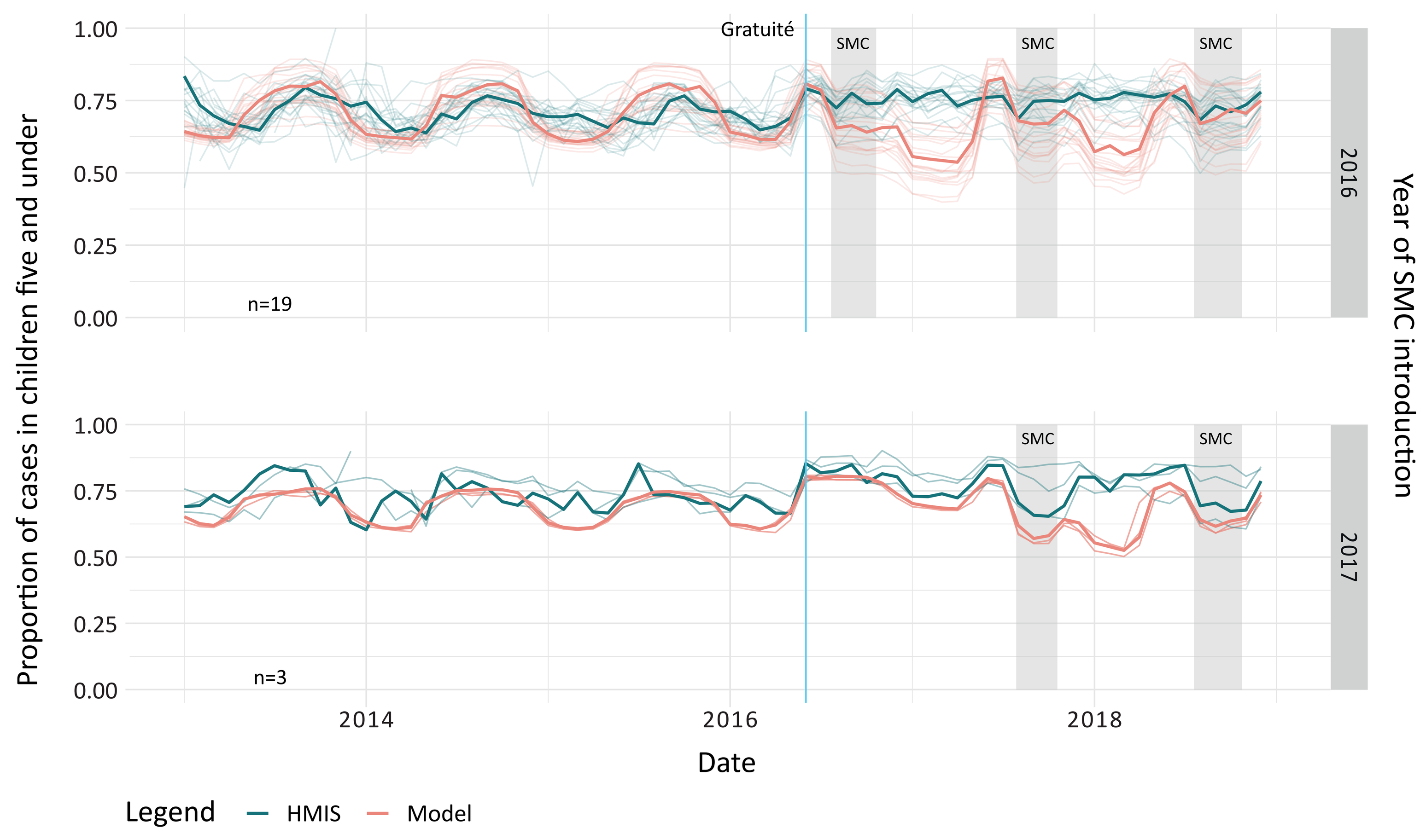
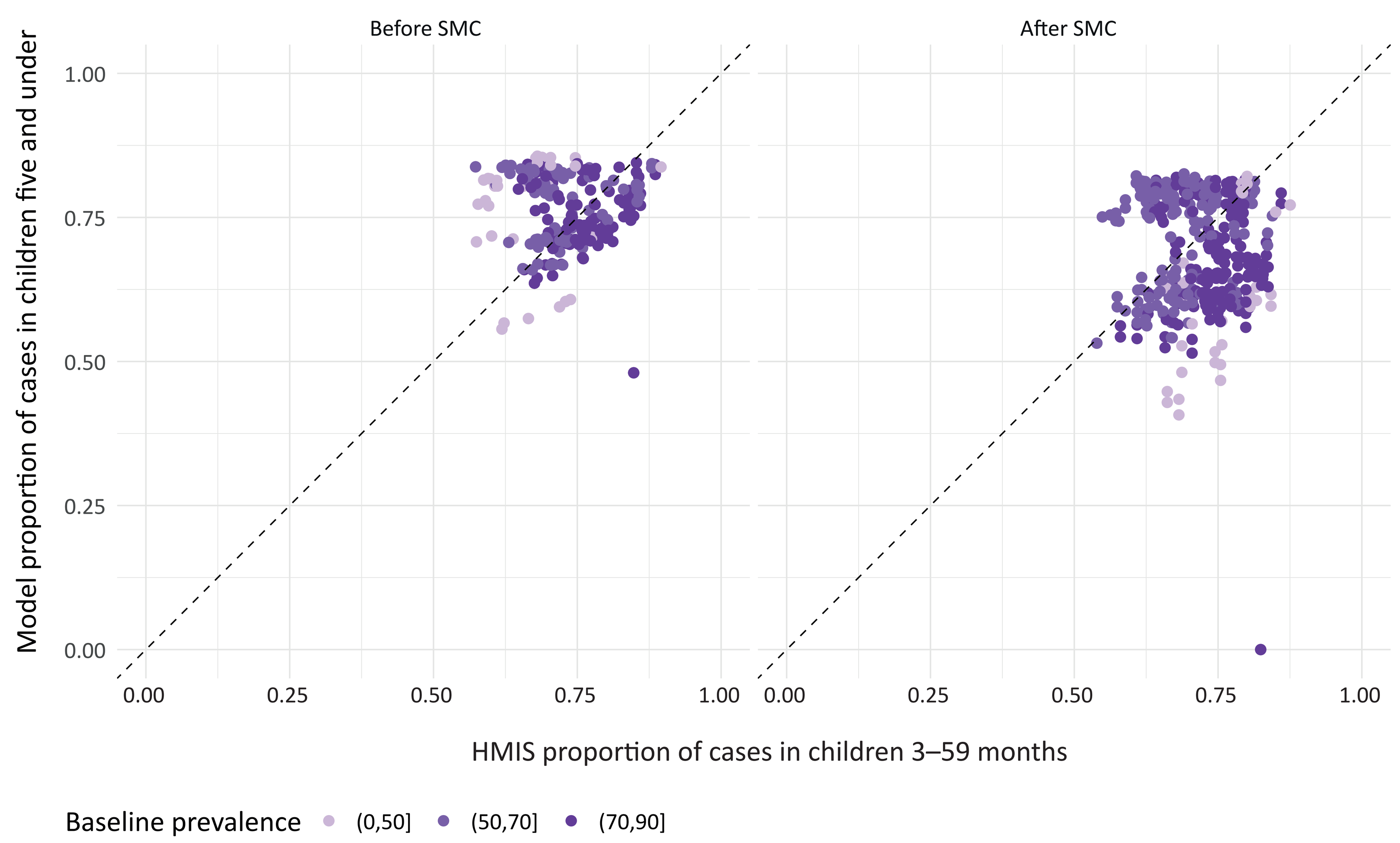


Figure 2: Model predictions of the proportion of cases in children five and under among all children 15 and under compared to estimates from HMIS data by district and year (2013-2018) before and after SMC



Conclusion

Routine data relating to the impact of SMC can be obscured by various factors, including changes in policy, seasonality, treatment-seeking behaviour and other interventions. Accounting for these factors before SMC is introduced will allow for a more accurate estimation of SMC's impact. Future research will further examine whether the model's simulated SMC coverage aligns with observations in routine data over time and across each cycle.

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