The Role of Supplementary Immunization Activity Scheduling on Measles Incidence in Nigeria

Kurt Frey

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IDM Disease Modeling Symposium

Measles 2

Overview

- Introduction to Measles Burden in Nigeria

- Results from Spatially Homogeneous Simulations of Nigeria
  - Incidence, age-at-infection; inputs to EMOD simulation software

- Differences in Pre- and Post- Supplementary Immunization Eras
  - SIAs have created a regularity in measles incidence

- Consequences of SIA Scheduling
  - Opportunities for burden reduction through timing interventions

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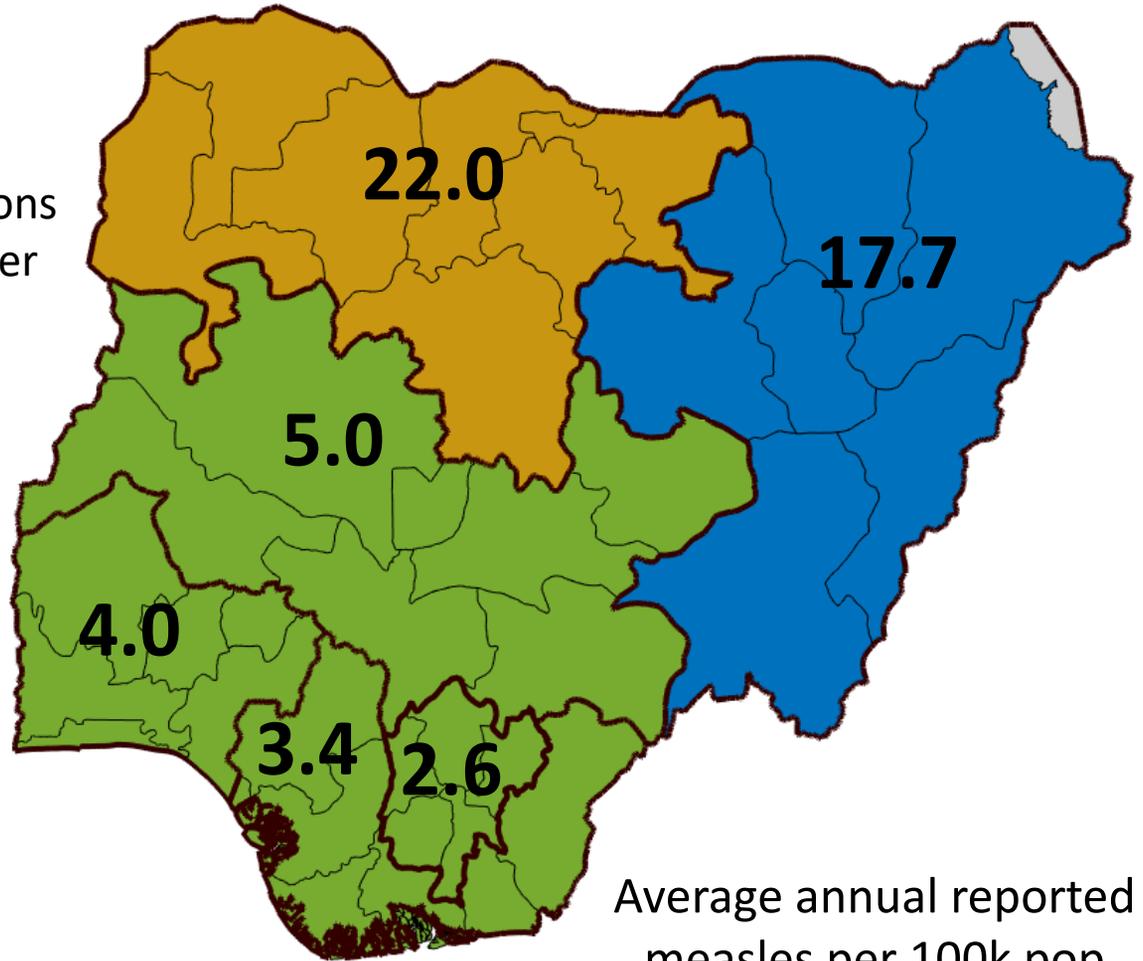INTELLECTUAL VENTURES®

Measles in Nigeria
2007-2016

Major groupings indicate DHS regions with reported measles incidence per total population.

Total Reported Cases:
Northwest: 55%
Northeast: 25%
Elsewhere: 20%

Estimated 2015 Population:
Northwest: 25%   (48M)
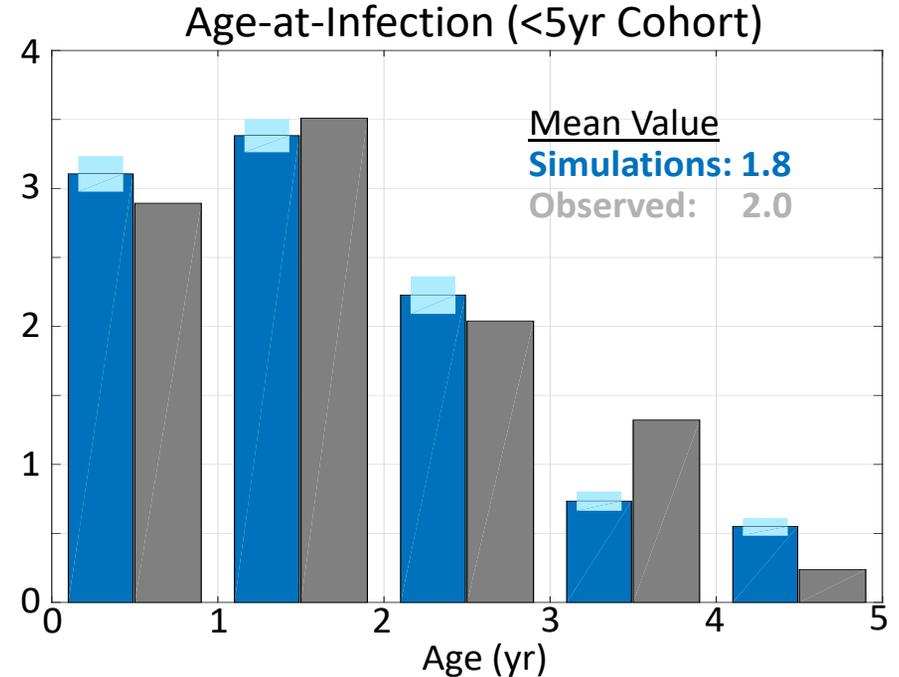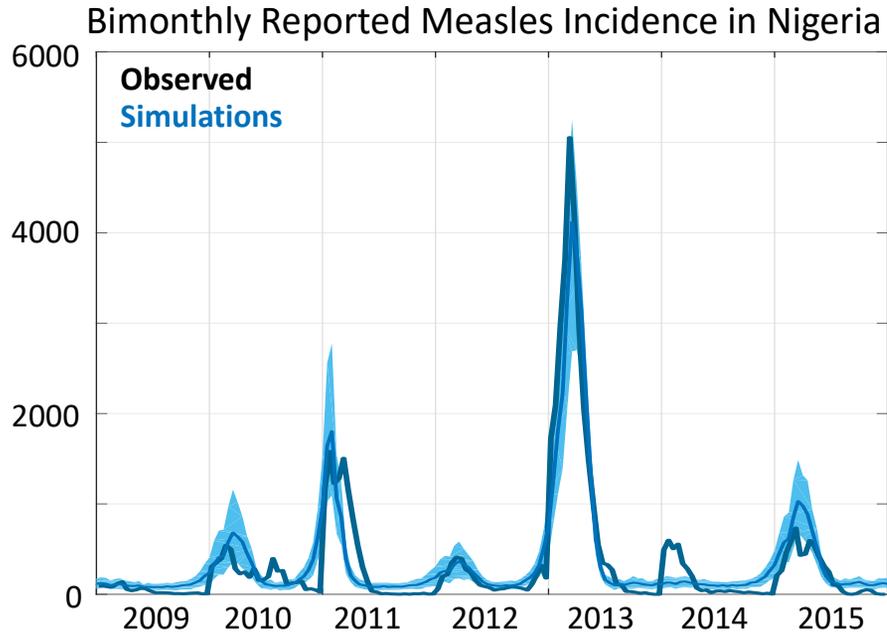Northeast: 14%   (26M)
Elsewhere: 61%   (115M)

22.0

17.7

5.0

4.0

3.4

2.6

Average annual reported measles per 100k pop

Spatially Homogeneous Simulations
Calculated and Observed Incidence

Case-based incidence reports of measles have been used to estimate measles infectivity-related descriptors in IDM's Epidemiological Modeling software (EMOD).

Bimonthly Reported Measles Incidence in Nigeria

Observed
Simulations

Age-at-Infection (<5yr Cohort)

Mean Value
Simulations: 1.8
Observed: 2.0

Age (yr)

EMOD Specifications

Simulations were focused entirely on the under-five cohort; this cohort encompasses 17% of the total population, and 80% of the total measles burden.

This iteration of the model represents the entire country as a single, well-mixed population, using overall averages for demographic parameters.
- Raw birthrate of 40/1000; seasonal birthrate forcing of around 30%
- Age dependent non-disease mortality (i.e., neo-natal, infant, etc.)

Disease descriptors:
- 10 ± 2 day incubation period
- 8 ± 2 day infectious period
- No disease-specific deaths

Maternal immunity:

Age (Month)			
0 - 3	5	7	9
100%	51%	26%	13%

Vaccination immunity results from a 40% rate of routine immunization, and SIA campaign schedules / coverages as reported by the WHO for the period 2005 – 2015.
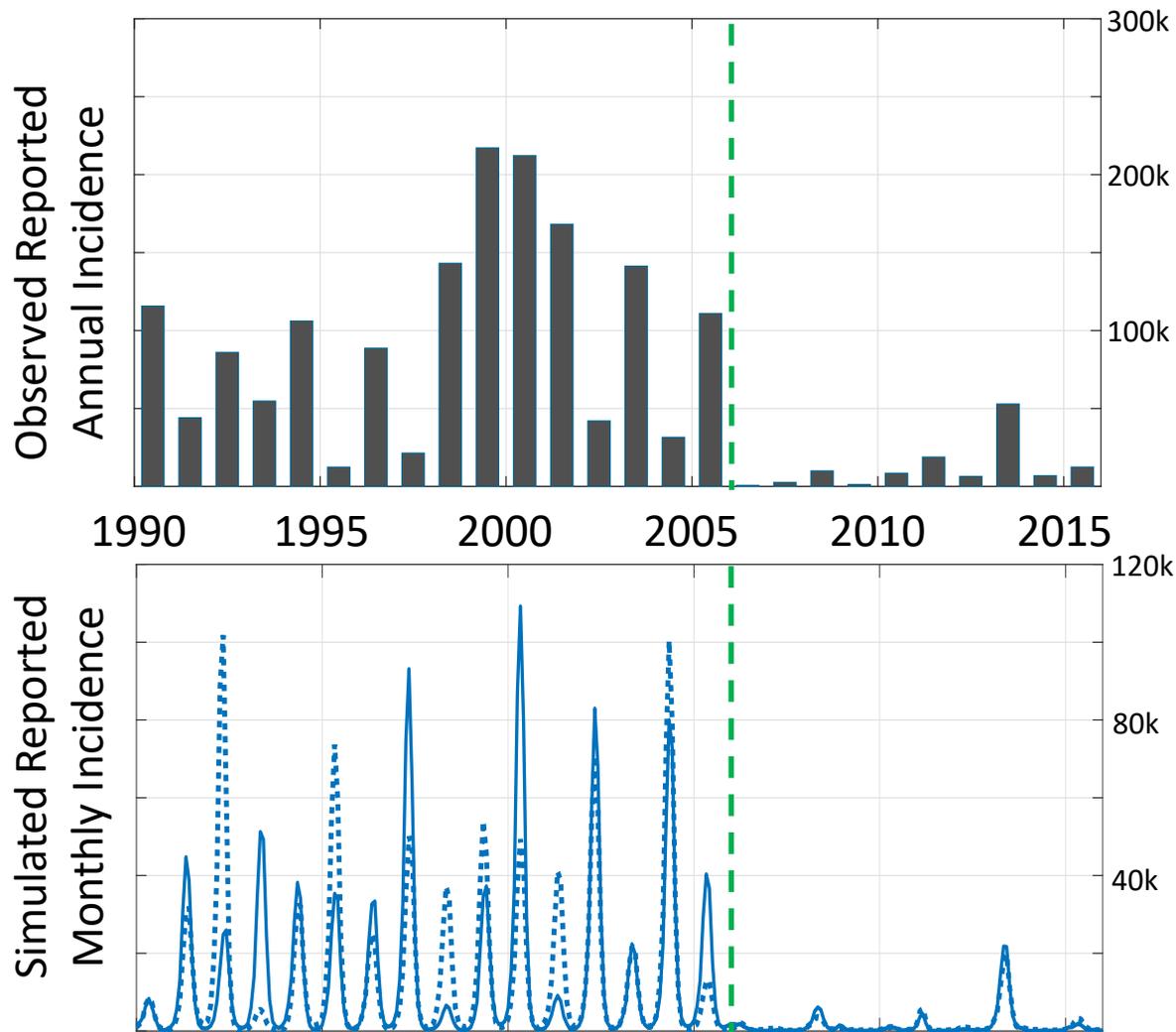
SIA Era
2006-Present

Regular follow-up campaigns of supplementary immunizations have created a corresponding regularity to the intensity of measles outbreaks in Nigeria.

Outbreaks in the current era can either be self-limited (from a depletion of susceptibles), or seasonally-limited (from an annual decrease in infectivity).
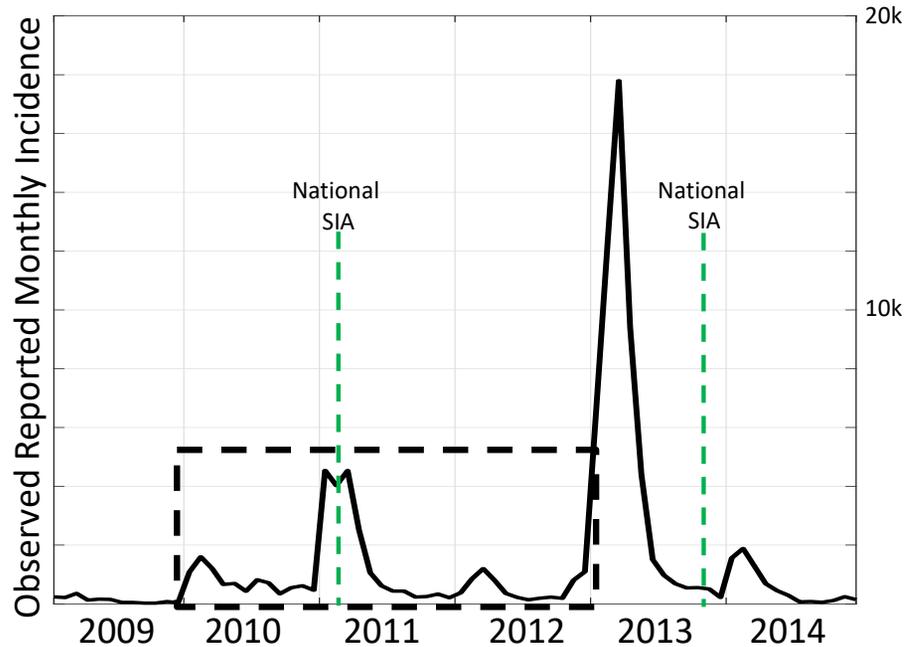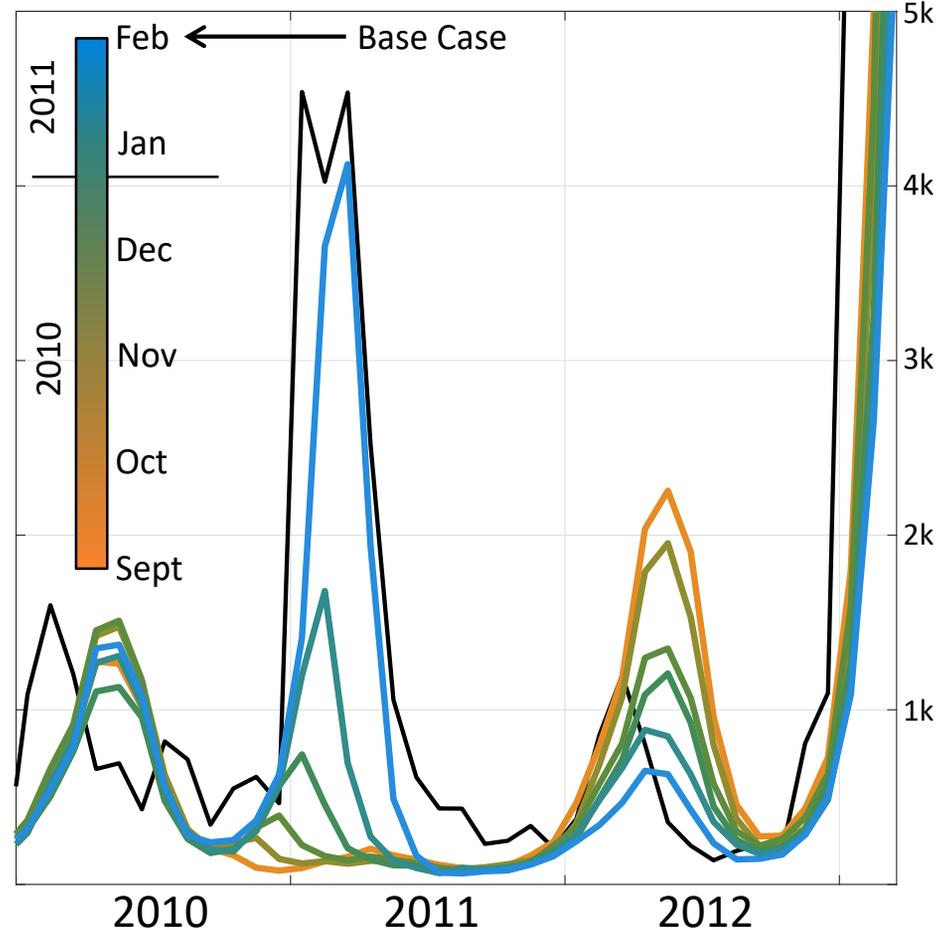
Note:
   Infectivity = Disease * Mixing

Scheduling SIAs

Heuristics suggest scheduling interventions several months prior to peak infectivity.

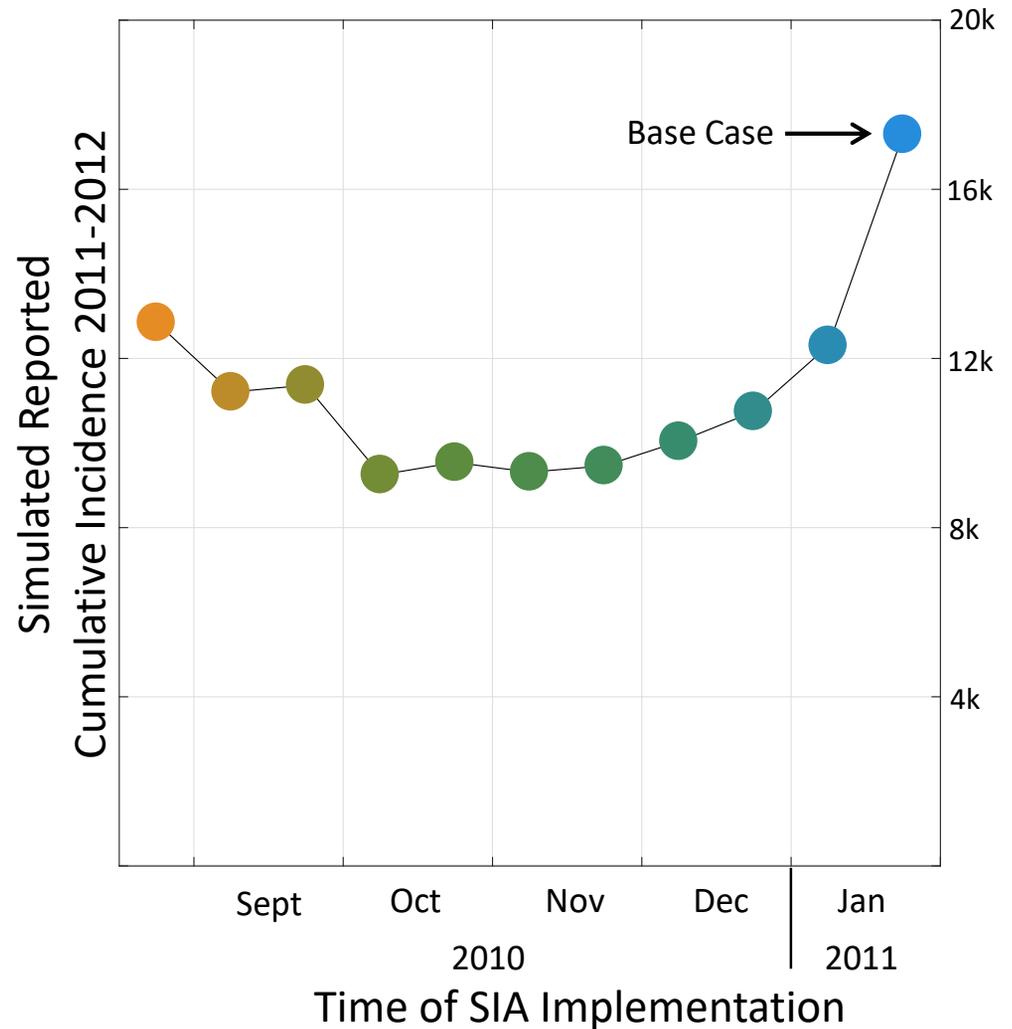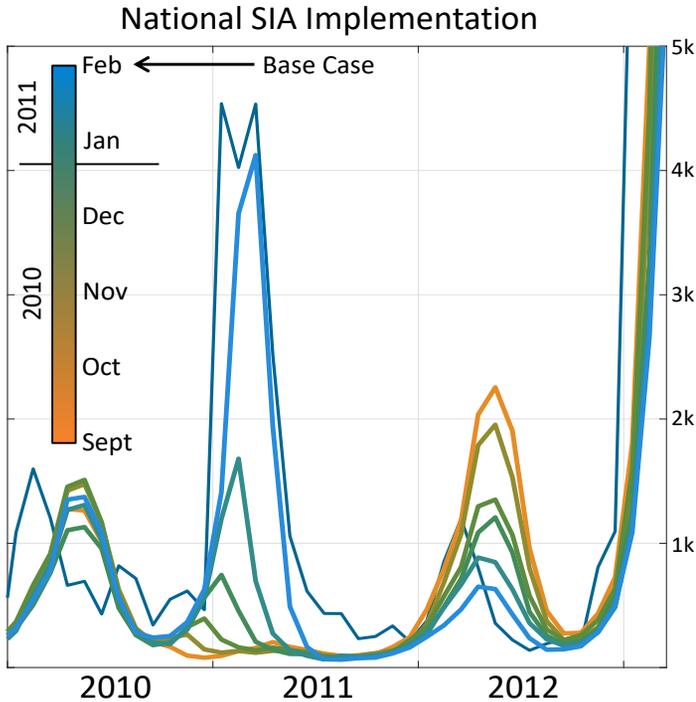Logistic challenges sometimes result in delays (e.g., 2010 and 2015).

National SIA Implementation

Scheduling SIAs

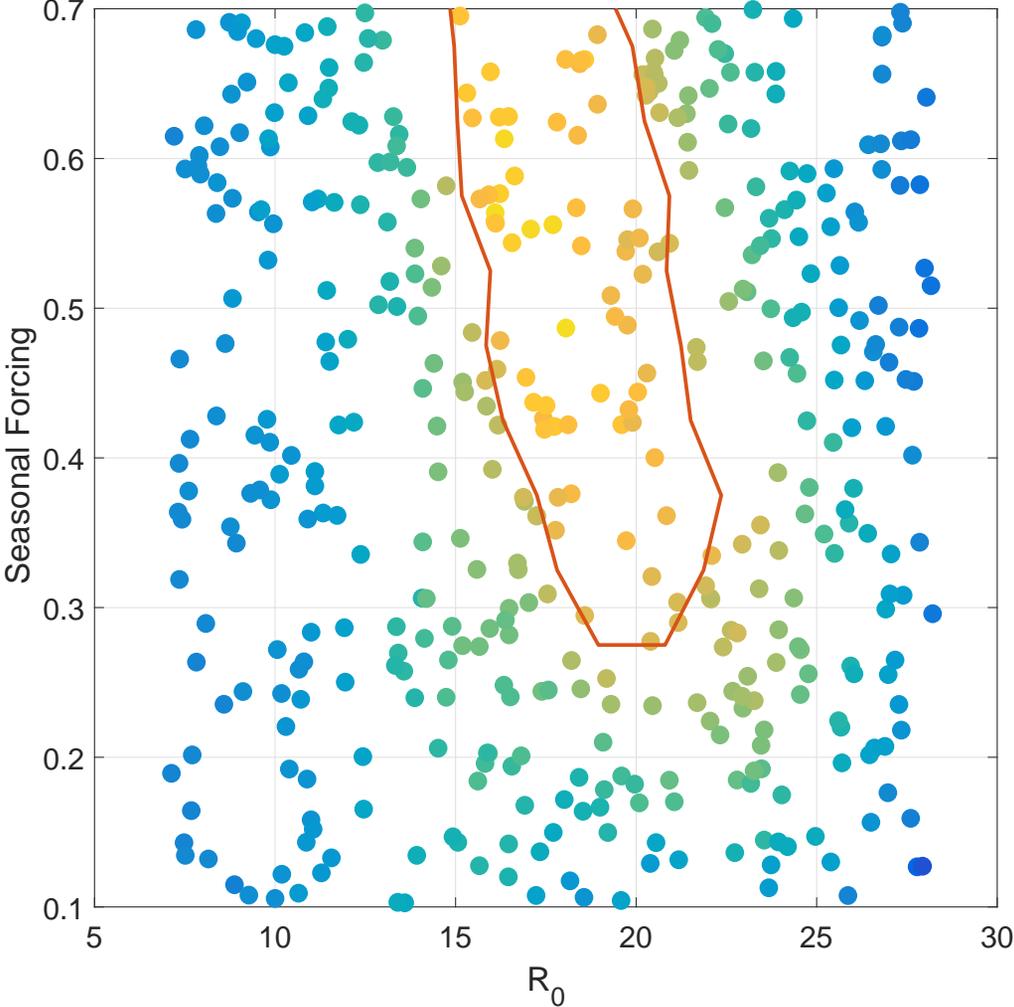With a 2-year time window, targeting an SIA for October or November provides the greatest burden reduction.

National SIA Implementation

Next Steps

- Evaluate the time horizon needed to establish an equilibrium for biennial SIAs

- Explore the trade-offs involved with annual SIAs
  - Contrast with expanded age-range SIAs

- Improve spatial resolution
  - Examine subnational regions of Nigeria independently
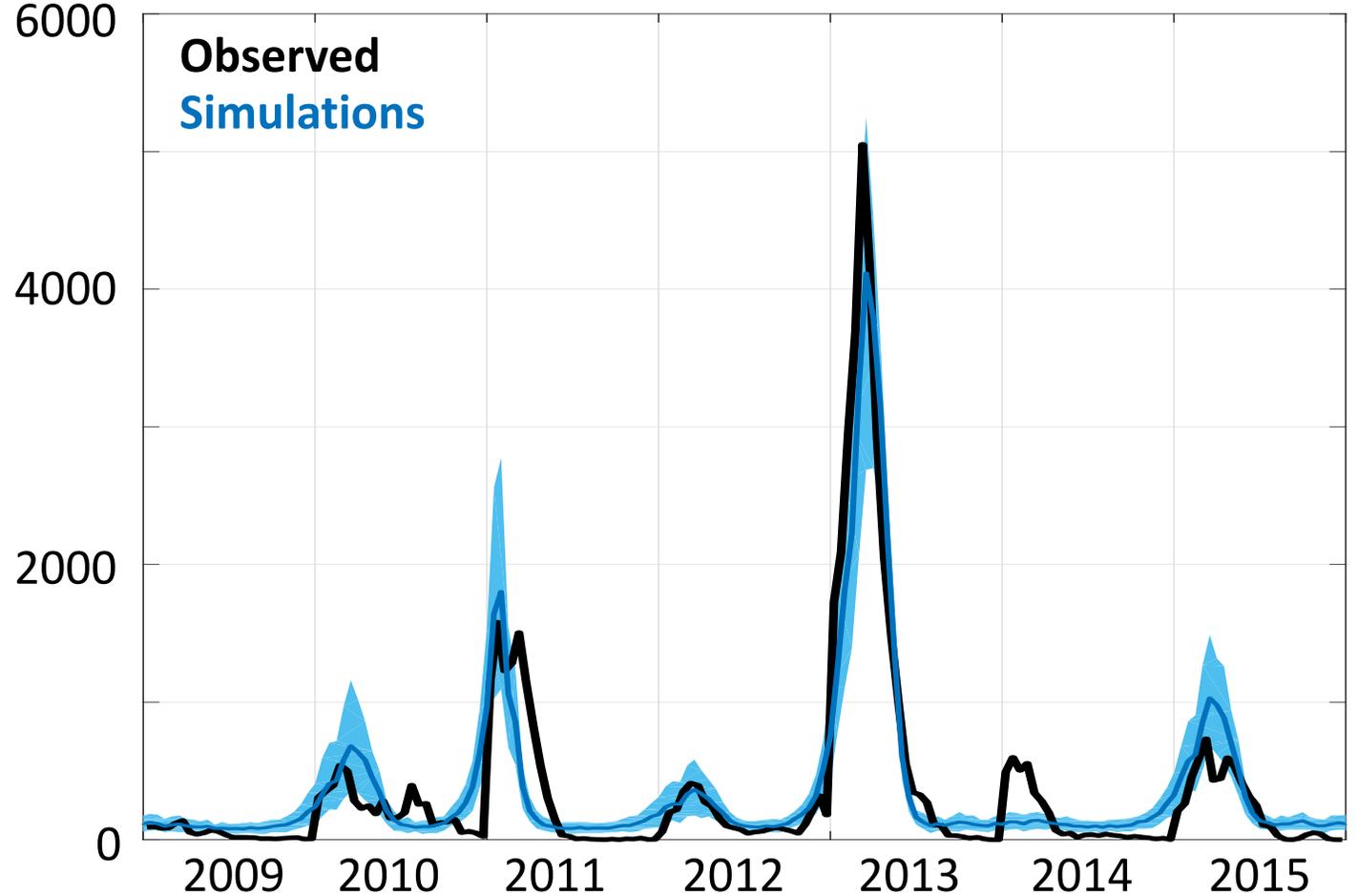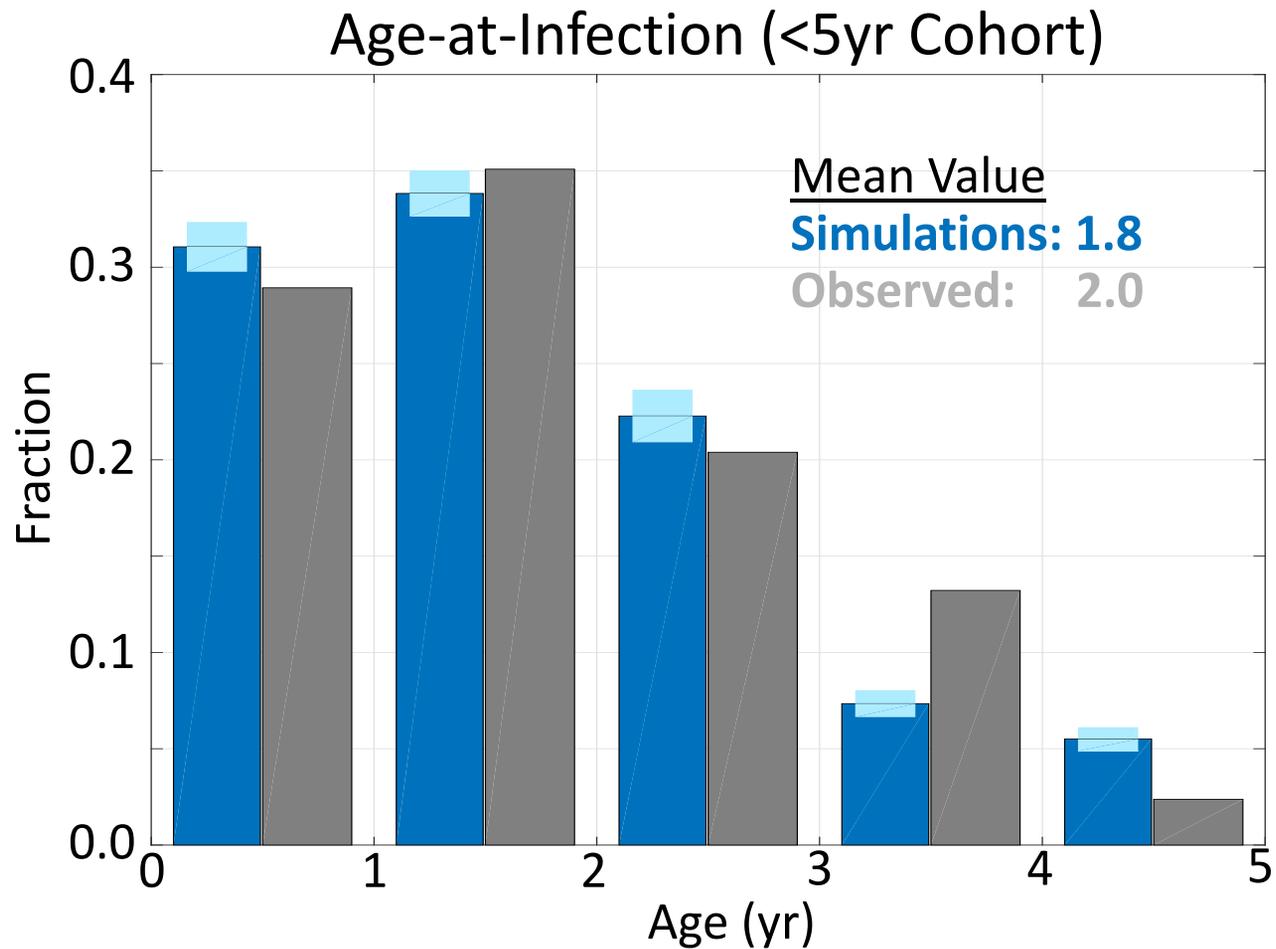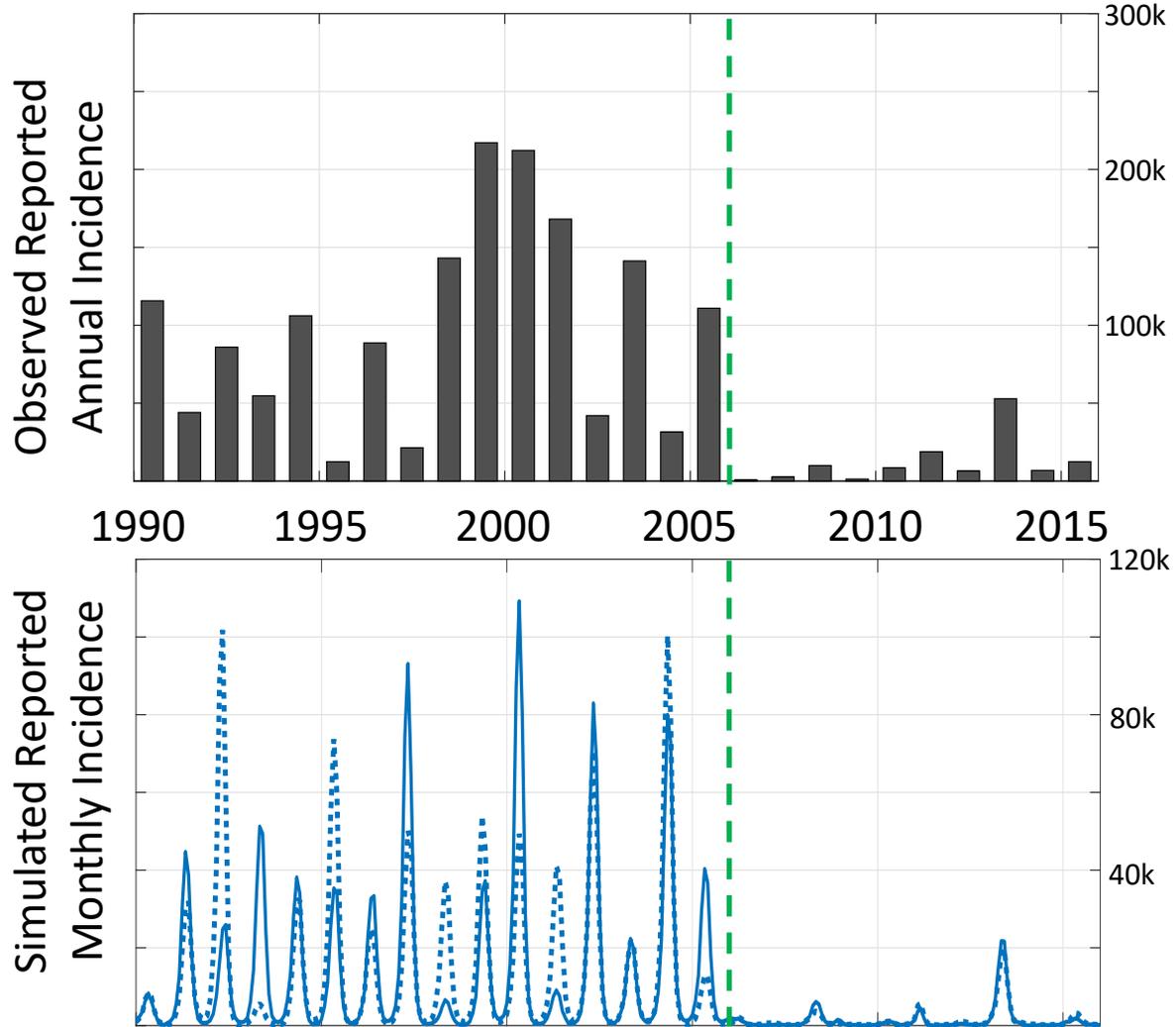 - Investigate heterogeneous SIA scheduling

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Questions

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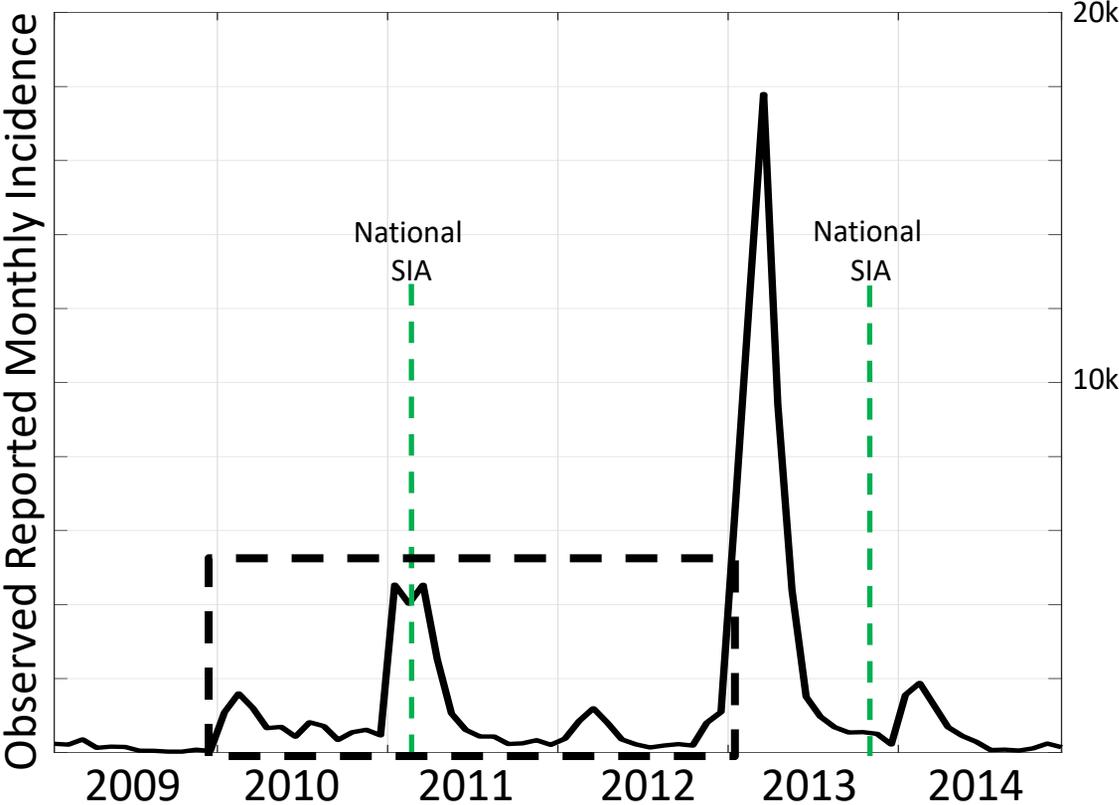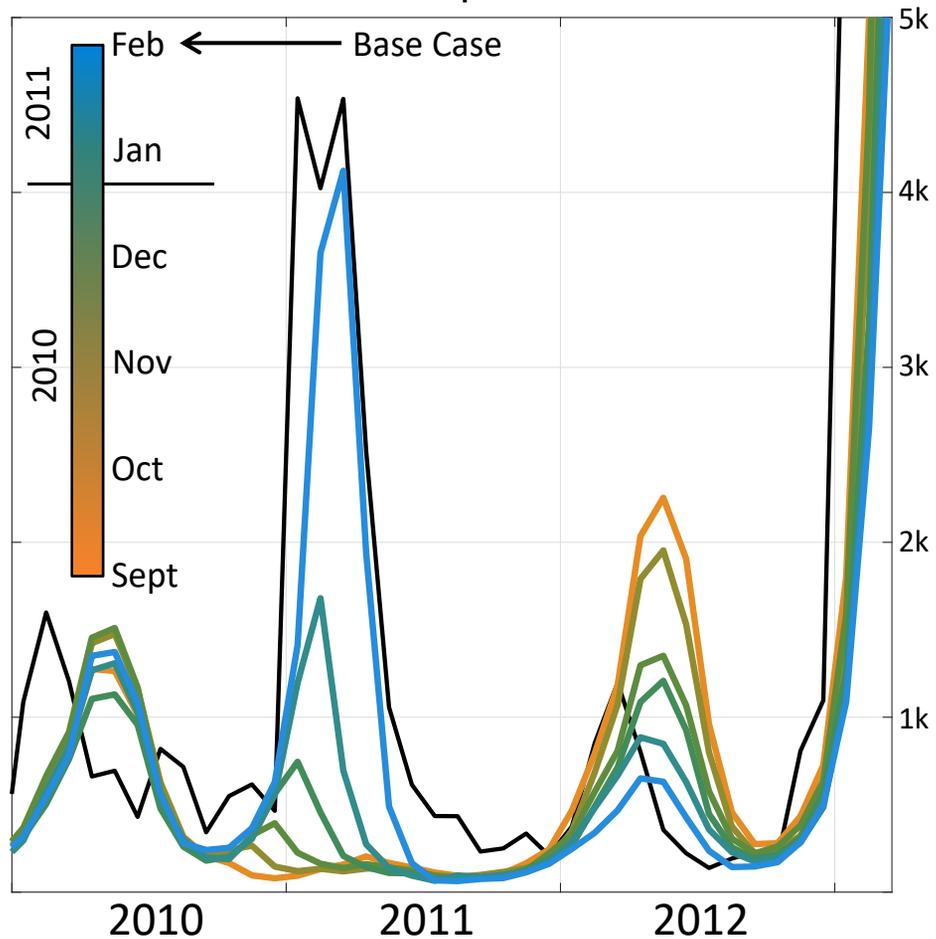

Bimonthly Reported Measles Incidence in Nigeria

Figure

Age-at-Infection (<5yr Cohort)

Figure

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National SIA Implementation

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