The Seasonal and Climatic Determinants of Access to Care: Implications for Measles Outbreak Risk in Madagascar

C Jessica E Metcalf, Keitly Mensah, Amy P Wesolowski, Amy K Winter, B Ramamonjiharisoa, Saki Takahashi, A Randriamanan tena, Richter Razandratsimandresy, Jean-Michel Heraud
Seasonality is ubiquitous

Births are seasonal

Data from the 2008 DHS, Madagascar
Seasonality is ubiquitous

Births are seasonal

Data from the 2008 DHS, Madagascar

Transmission is seasonal

Fever-rash surveillance, 2004-2015, Madagascar
Seasonality is ubiquitous

Births are seasonal
Data from the 2008 DHS, Madagascar

Transmission is seasonal
Fever-rash surveillance, 2004-2015, Madagascar

Vaccination is seasonal
Data from the 2008 DHS, Madagascar
Seasonality shapes measles dynamics

Births are seasonal
Data from the 2008 DHS, Madagascar

Transmission is seasonal
Fever-rash surveillance, 2004-2015, Madagascar

Vaccination is seasonal
Data from the 2008 DHS, Madagascar
Seasonality shapes measles dynamics

Births are seasonal
- Data from the 2008 DHS, Madagascar

Transmission is seasonal
- Fever-rash surveillance, 2004-2015, Madagascar

Vaccination is seasonal
- Data from the 2008 DHS, Madagascar

\[
\begin{align*}
\text{births} & \rightarrow S \\
& \rightarrow I \\
& \rightarrow R \\
\end{align*}
\]
Vaccination timing is shaped by climate

Cyclone Enawo

Births → Vaccination

Transmission → Recovery
Vaccination timing is shaped by climate
Identifying windows of vulnerability

Seasonal births

(age)

(age)
Identifying windows of vulnerability

Seasonal births

Seasonal vaccination

8 months
11 months
Identifying windows of vulnerability

Seasonal births

Seasonal vaccination

8 months

11 months

Children missed by vaccination weeks
Identifying windows of vulnerability

Seasonal births

Seasonal vaccination

Relative number of susceptibles

Increase upper age

Upper age limit, months
Low cost interventions.

A simple interim measure to mitigate the current design is to open up the age window of eligibility.

Ultimately, routine vaccination is likely to be essential; but time-lines to strengthening routine vaccination are likely to be long.
Adding spatial context

Urban

Routine

Routine

Jul
Dec
Jun

Leverage data streams

Rural

Adding spatial context

Urban

Routine

Routine

Jul
Dec
Jun

Leverage data streams

Rural
How do we optimise for access to care around changes in cyclone frequency and timing in a changing world?

Keitly Mensah
How do we optimise for access to care around changes in cyclone frequency and timing in a changing world?

**Co-authors:** Keitly Mensah, Amy P Wesolowski, Amy K Winter, B Ramamonjiharisoa, Saki Takahashi, A Randriamanantena, Richter Razandratsimandresy, Jean-Michel Heraud

**Co-Is:** Caroline Buckee; Andy Tatem; Elena Shevliakova

Thank-you.
Reports on age at last vaccination

Fever-rash surveillance, 2004-2015, Madagascar

Reports on age of measles vaccination

Data from the 2008 DHS, Madagascar