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# Can Meningitis A be Eliminated in Ghana?: Insights from a Stochastic Model Considering the Possibility of Re- introduction.

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# Context

- Meningitis, a serious infection of the brain, affects more than 2.5 million people across the globe each year (MRF 2024)
- 10% case fatality rate and 1/4 of its survivors suffer from sequelae including brain loss and hearing impairment.
- The African meningitis belt, which includes Ghana, has experienced irregular but periodic epidemics of meningitis, primarily due to *Neisseria meningitidis* for over a hundred years.
- Many countries including Ghana have successfully introduced a vaccine (MenAfriVac) against the predominant cause, meningococcal serogroup A (MenA), since 2012. There have been no cases of MenA since 2017.



Source: *Control of epidemic meningococcal disease, WHO practical guidelines, World Health Organization, 1998, 2nd edition, WHO/EMC/BAC/98.3*

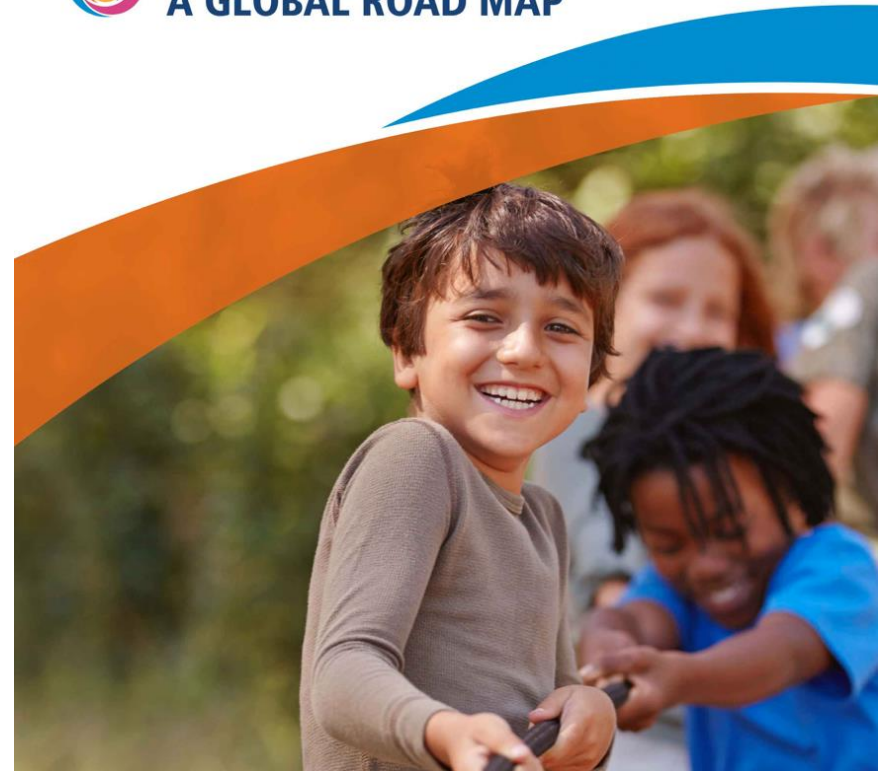
**Figure 1.** The African meningitis belt. These sub-Saharan countries are at high epidemic risk for meningococcal meningitis.

# Rationale

- A new multivalent meningococcal conjugate vaccine (MMCV) targeting serogroups A,C,W, X and Y has recently been licensed.
- The WHO Strategic Advisory Group on Immunization (SAGE) recommends targeting 1 to 19-year-olds for a catch-up, and routine vaccination for high-burden countries/regions including Ghana.
- Previous modelling used a **deterministic approach**, which predicts a long honeymoon period and resurgence.
- Given the evidence of the continued absence of MenA, I developed a **stochastic model** to investigate the potential for the elimination of MenA.

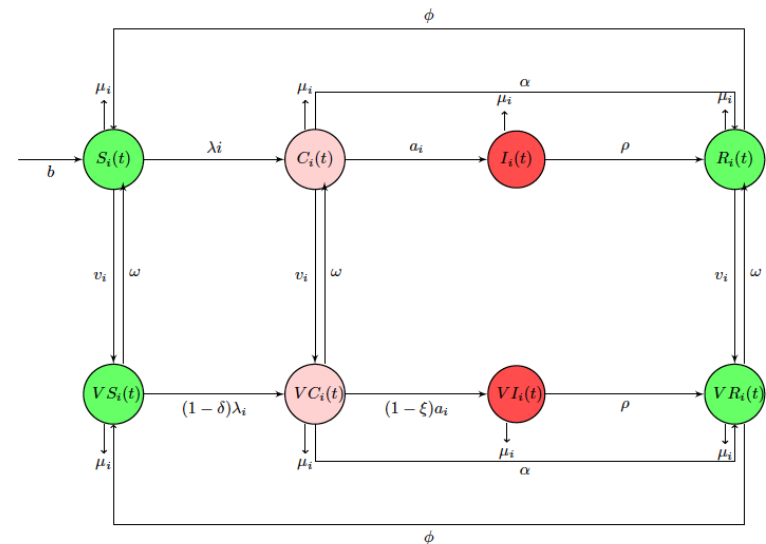


**DEFEATING MENINGITIS BY 2030**  
**A GLOBAL ROAD MAP**



# Methods

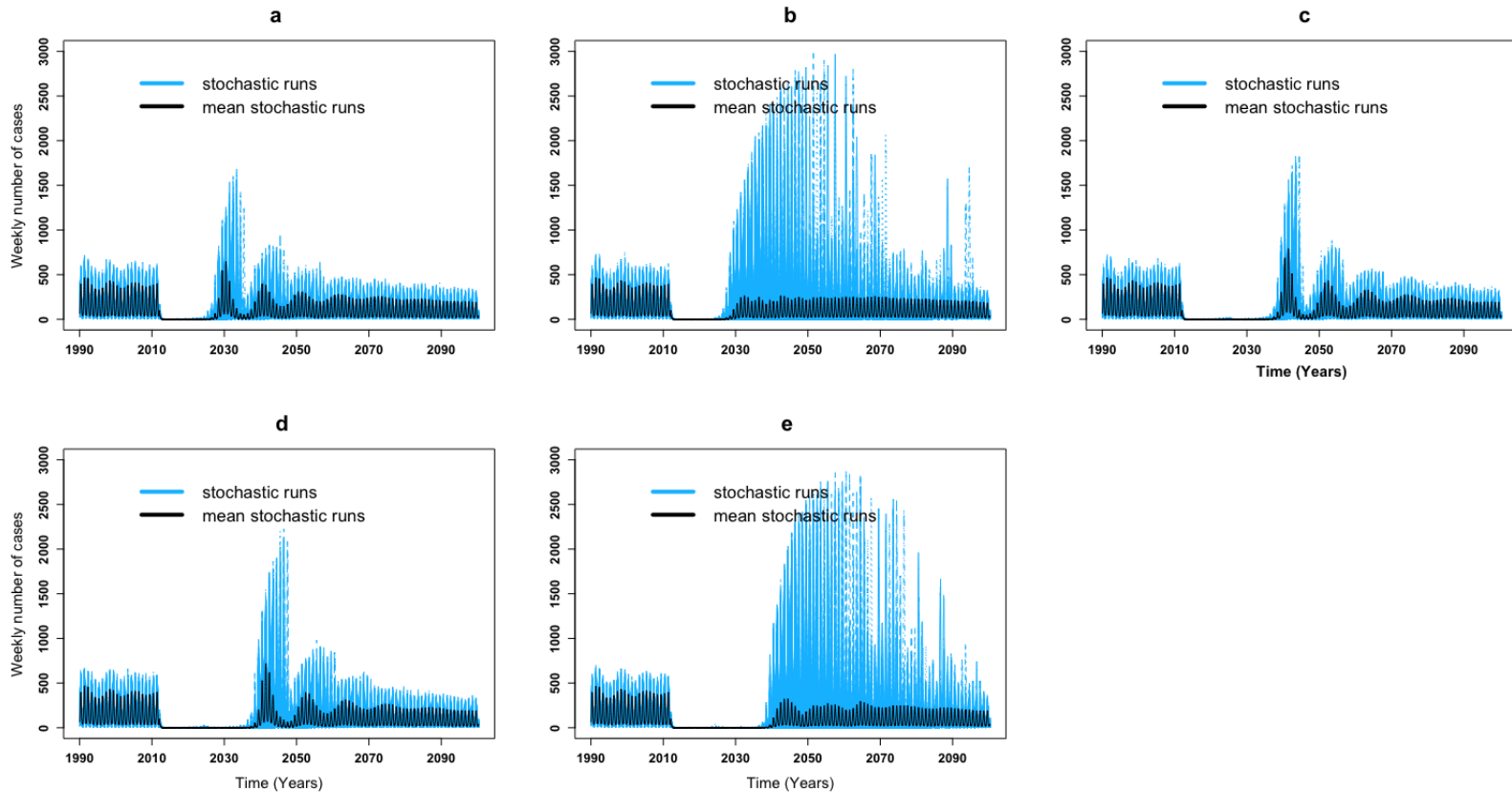
- I used a SCIRS model and adopted Odin stochastic package.
- A key feature of this model is that it includes an external force of infection.
- It also allows MenA to die out when there is less than one carrier in the population.
- Elimination is defined as 5 consecutive years with no case.
- I explored a range of assumptions about the external force of infection.



# Intervention Scenarios

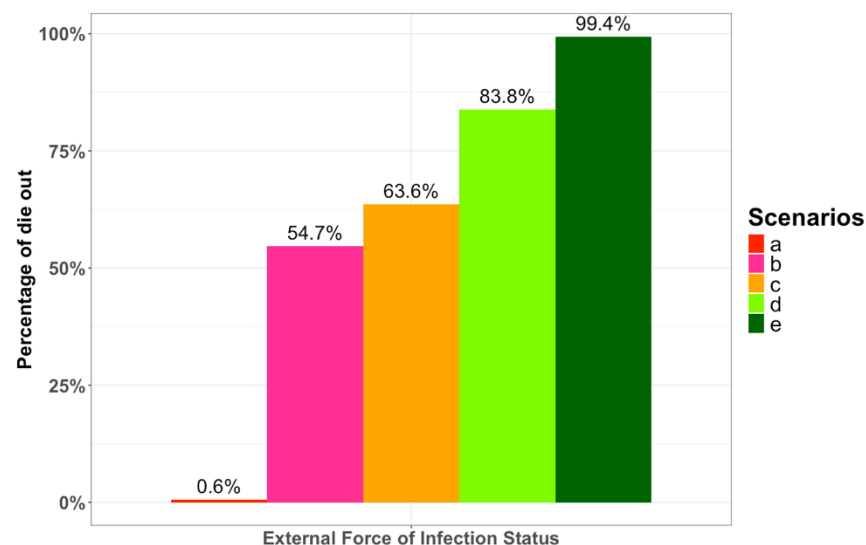
<b>Scenario</b>	<b>Ghana</b>	<b>Neighbouring Countries</b>	<b>External Force of Infection</b>
a	No MMCV	No MMCV	No change
b	No MMCV	MMCV	90% reduction
c	MMCV	No MMCV	No change
d	MMCV	MMCV	40% reduction
e	MMCV	MMCV	90% reduction

# Results: Dynamics of Simulations



# Results: Dynamics of Elimination

- The results show a 99% chance of eliminating MenA if Ghana and the neighbouring countries follow SAGE's recommendations.
- With no additional vaccine intervention, there is a very low chance of eliminating MenA (<1% chance).
- A higher external force of infection reduces the possibility of elimination in Ghana as expected.



# Interpretation

The results mean that:

- The SAGE's recommendation not only provides effective control but also has the potential to eliminate MenA if fully implemented.
- Therefore, countries within the meningitis belt are strongly encouraged to adopt and follow these guidelines as recommended.



# Strengths and Limitations

- This is the first comprehensive stochastic model to study the dynamics of MenA, allowing the possibility of elimination.
- Accounting for the external force of infection adds a necessary complexity to better explore potential barriers for elimination.
- However, due to limited data on this external force, I explored various scenarios to address this uncertainty.

# References

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