How Vaccination Coverage Level Impact Cases Observed During Ebola Outbreak in Guinea, Sierra Leone, and Liberia

African Institute for Mathematical Sciences SOUTH AFRICA

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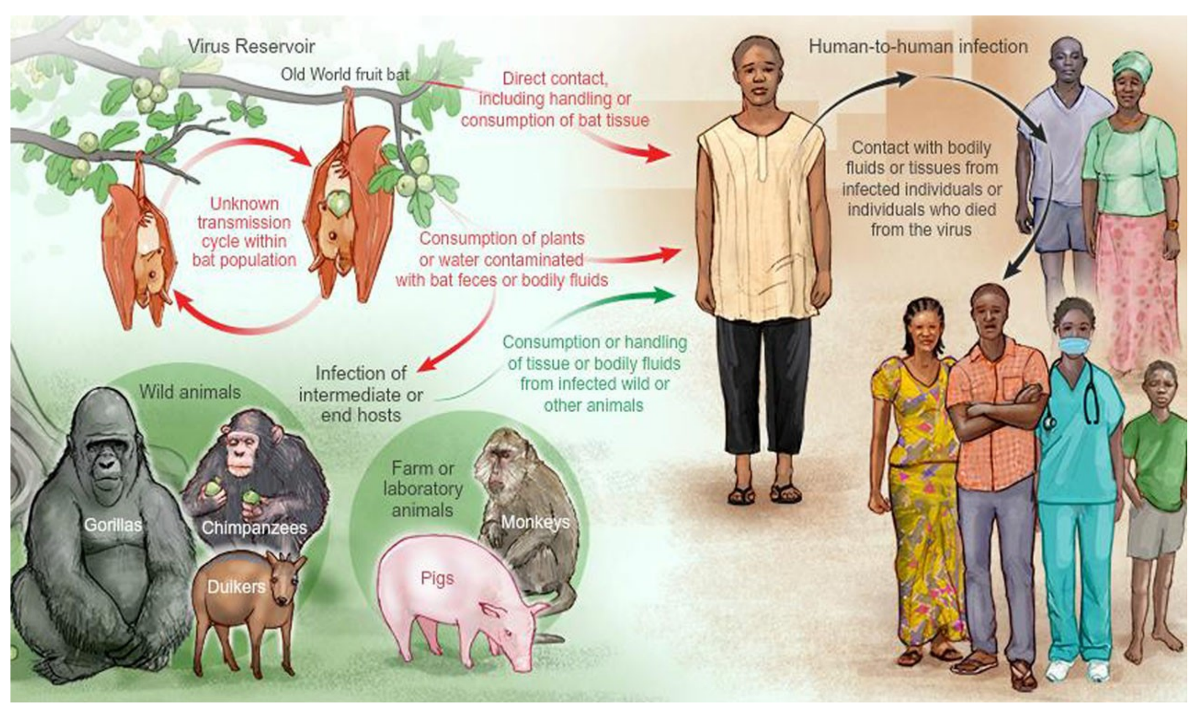
Introduction

Background

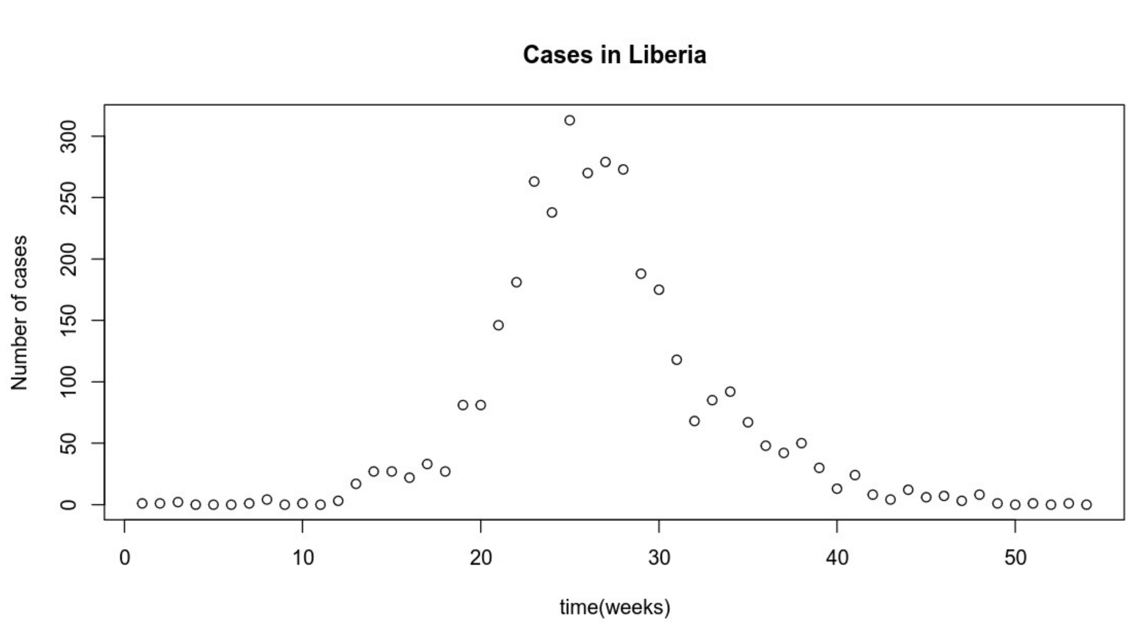
This report explores how vaccination coverage influenced the 2014-2016 Ebola outbreak in Guinea, Sierra Leone, and Liberia.



Motivation

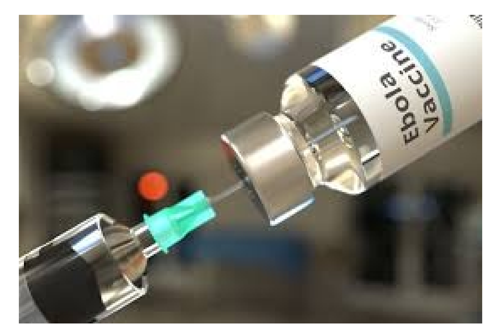
From 2014-2015 that data indicates that

- The number of infected people in Liberia over a span of 50 weeks
- The peak number of cases in the 25^{th} week.
- The gradual decline in cases indicates the impact of interventions like vaccination.



Research Question

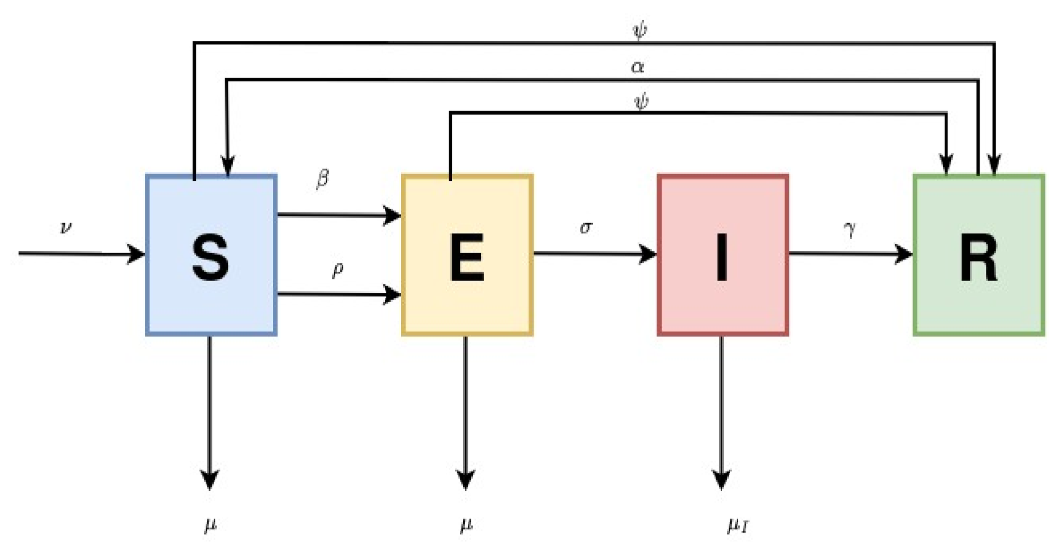
How does implementing the same vaccination program in different settings impact infection rates and the spread of Ebola?



Approach

Modeling framework

SEIR Model



Parameter	Description	Values
β	Transmission Rate	0.710
ρ	Transmission rate due to contact with dead infected	0.089
σ	Infectious Rate	0.083
γ	Recovery Rate	0.1
ν	Birth Rate	1.7
μ	Death Rate	0.073
α	Rate of losing Immunity	2.57
ψ	Vaccination Rate	0.5
μ_I	Death Rate due to the Infection	0.1

Table 2: Parameter values for Ebola model

- The values of the parameters used on the model were found by Oduro et al. (2016)

$$R_0 = \frac{\sigma\beta}{(\gamma+\mu_I)(\sigma+\mu+\psi)}$$

$$\beta = \frac{R_0(\gamma+\mu_I)(\sigma+\mu+\psi)}{\sigma}$$

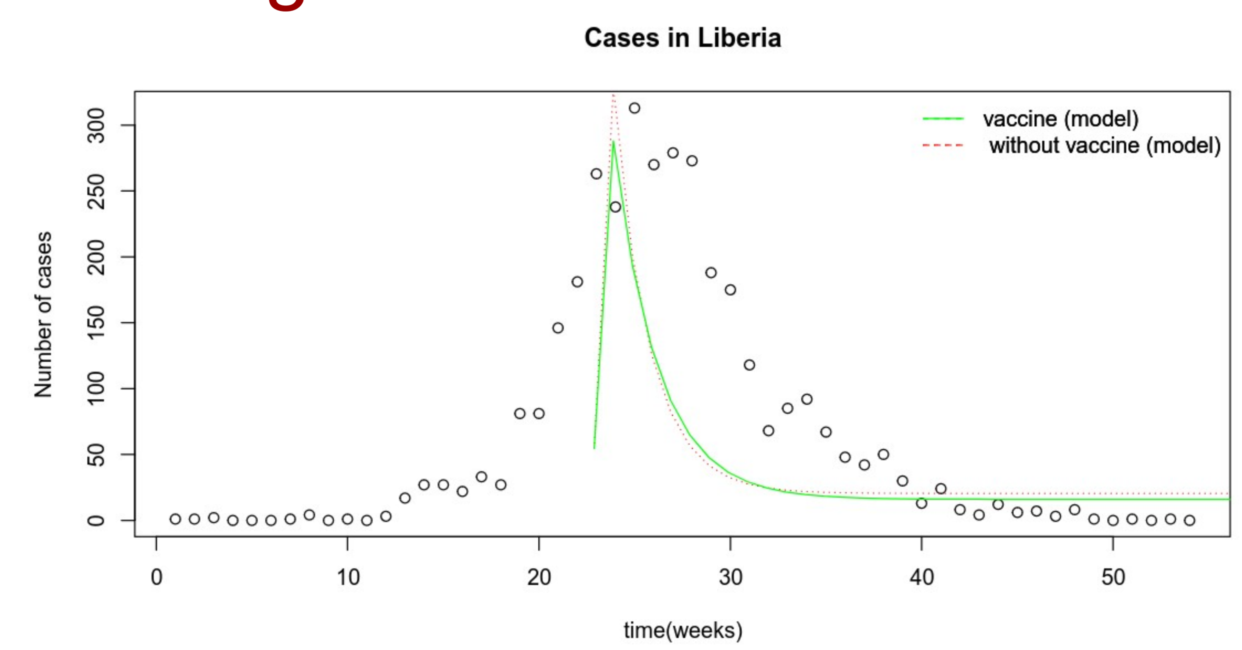
Countries	R_0
Guinea	1.71
Liberia	1.83
Sierra Leone	2.02

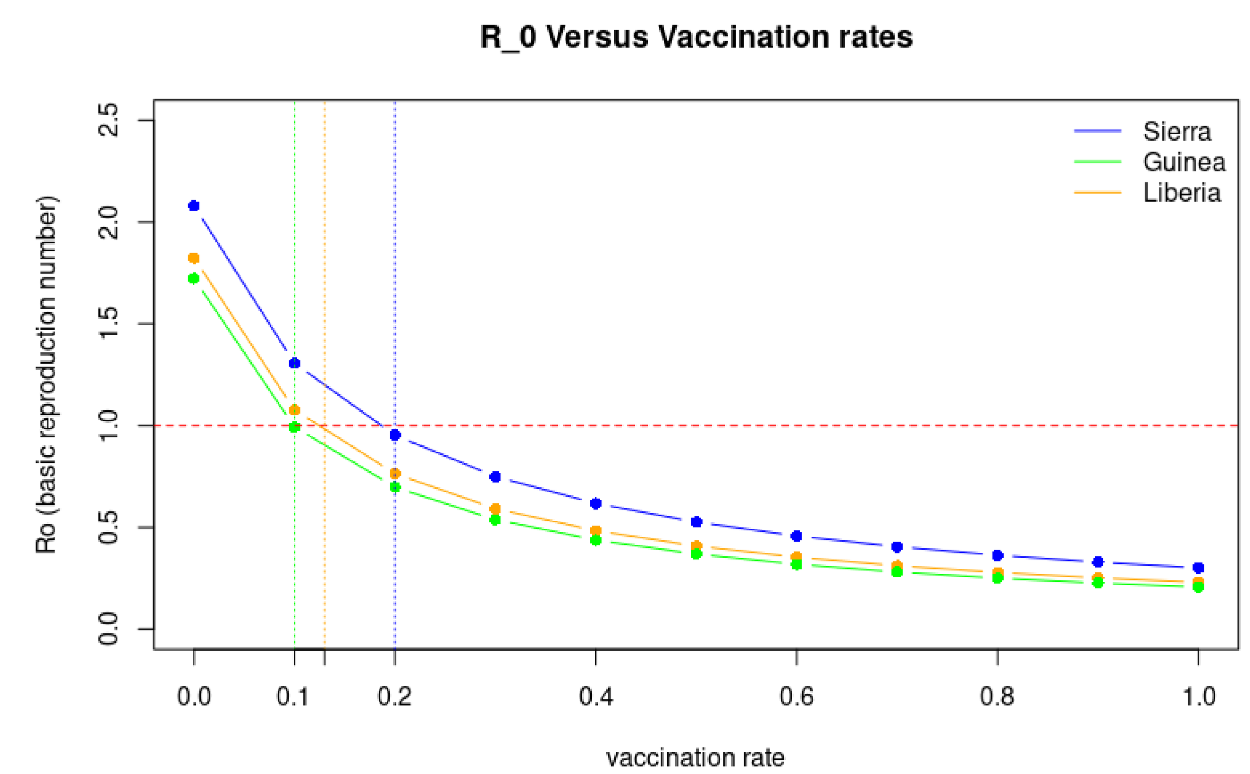
Table 2: R_0 Values

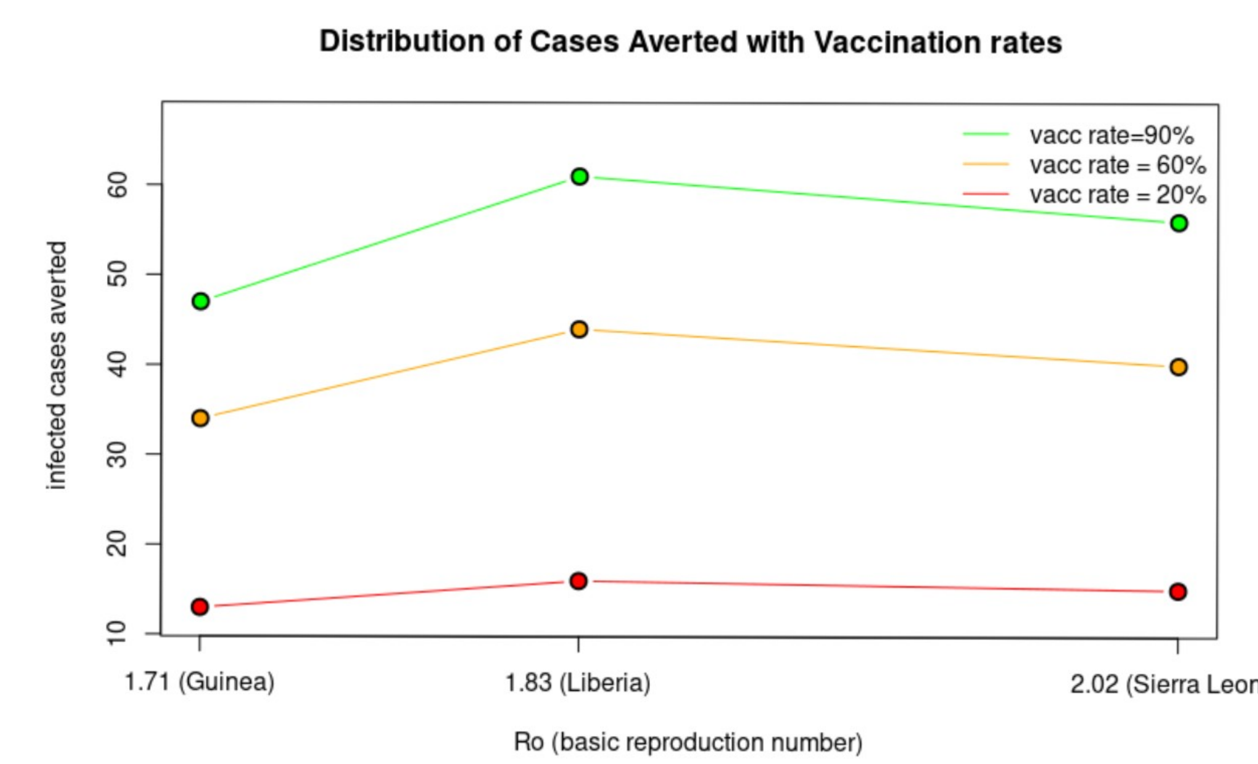
- The transmission rate were calculated for the different countries using their Basic reproductive number.
- The equation of the model were solved using the deSolve and tidyverse library in R.

Results

Findings so far







- The Basic reproductive number decrease as the vaccination rate varies.
- Increase in vaccination rate increases the number of cases averted for each country.

Results (cont'd)

Conclusions

A constant vaccination rate across the three countries shows an increase the number of averted cases.

- This shows that vaccination is an important intervention method to control the spread of Ebola in the three countries.

Further questions

- What is the impact of additional public health interventions, when combined with vaccination, on controlling Ebola outbreaks?

References

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