Evaluating Public Health Responses: A Comparative Study of Ebola Management in Sierra Leone, Guinea, and Liberia

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Abstract

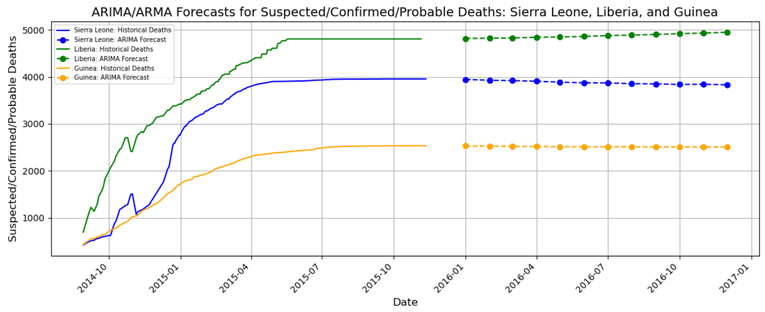
- The Ebola virus causes fever, aches, fatigue, memory loss, and many other debilitating symptoms
- The largest and most widespread Ebola outbreak occurred from 2014-2016 in West Africa where over 28,000 cases and 11,000 deaths were reported
- This project examines the epidemics progression with a focus on Sierra Leone, Guinea, and Liberia
- This project applies time series analysis, survival analysis, and intervention analysis to understand the pattern of suspected cases and deaths
- This project considers public health measures to understand their impact towards the number of reported cases and deaths
- The outcome of this study will be utilized to provide policy recommendations for other advancing economies that are vulnerable to Ebola epidemics

Introduction

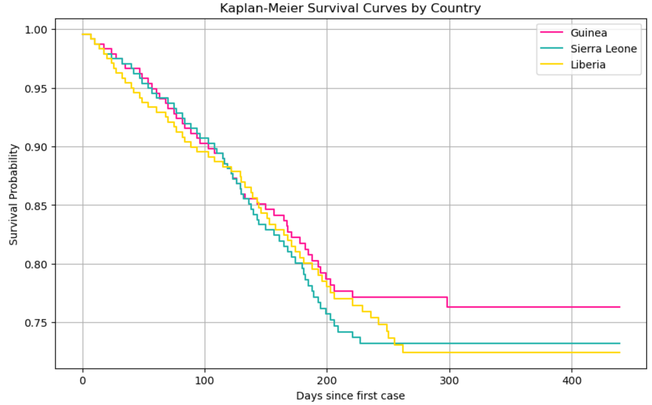
- Transmission occurs through contact with bodily fluid such as infected blood or saliva
- Outbreaks have occurred primarily in sub-Saharan Africa
- The Ebola Virus has proved to be unpredictable and fatal without proper treatment but can be survived with proper policies set in place
- Countries should adopt community engagement, early case detection/diagnosis, contact tracing, prompt patient isolation, and safe burial measures to reduce the spread
- Strong financial backing is needed to support such public health needs
- interventions such as safe and dignified burial and contact tracing have been studied but need to be more accessible
- This project aims to address to predict unexpected disease outbreaks and evaluate public health interventions

Results

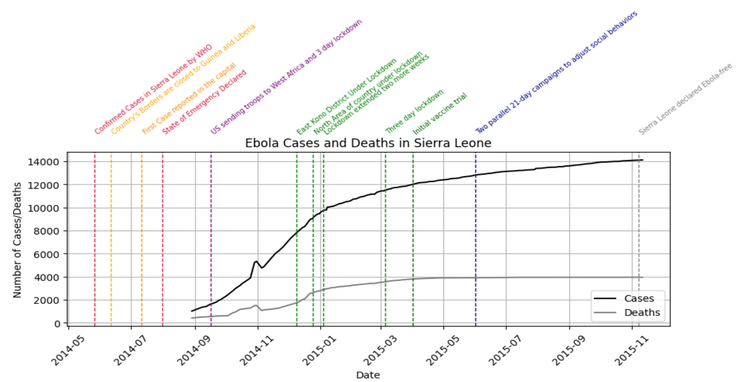
Time Series Analysis



Survival Analysis



Action, Event, and Intervention Analysis



Data

- The project utilizes the weekly Ebola outbreak reports from the WHO that have been reformatting into a concise dataset
- Every week, cases are reported as suspected/probable/confirmed and deaths are in the same format
- The values reported are the rolling total number of cases and deaths in that country since the beginning of the epidemic (i.e. the observed deaths for a particular week can be observed as the difference in the current total number of deaths and the previous weeks number of deaths)
- The Liberia data was updated with new reports towards the end of 2015 and into 2016 where the new number of cases/deaths per week reported instead of adding them to the rolling total
- Any duplicate entries were removed and reports after November 2015 were removed due to the inconsistent reports
- The cleaned dataset includes weekly reports from August 2014 to November 2015, during which the epidemic hit its peak

Methods/Algorithms

- For the time series analysis, AR and ARIMA are chosen due to their ability to capture patterns in the data over time, including trends and seasonality.
- Auto-regressor (AR) is a statistical model used to predict a variable based on its own past results
- ARIMA extends AR by integrating differentiation and moving averages to provide a more comprehensive analysis
- The purpose of using ARIMA is to predict to the spread of the epidemic using past collected data
- For the survival analysis, this project utilizes the Kaplan-Meier estimator which is a non-parametric statistic that estimates the survival function of a time-series data
- The survival analysis constructs a survival curve from the collected data without assuming an underlying distribution
- The purpose of using the Kaplan-Meier metric is to show the probability of survival as the epidemic progresses
- For the intervention analysis, this project collected media sources that defined actions taken/observed during the epidemic in the three countries
- News articles, reports, timeline articles, public health organizations and government organization records were utilized to mark the time actions were taken
- The purpose of using media data is to show how actions taken effected the spread of the epidemic and to provide insight on how such interventions can help future Ebola and other epidemics