A Mathematical Model of the Ebola Virus in Guinea

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The Ebola virus has infected over 30,000 people, killing almost 13,000 in Africa since its discovery in 1976. Since then, outbreaks occur on average every 1.5 years. A mathematical model of the Guinean outbreak that began in December 2013 was created to gain a better understanding of how it spreads and what interventions can be most effective. Using a logistic curve, the phases of the outbreak are easily distinguishable. Spreadsheet modeling and difference equations are created and applied to model the pattern of transmission and to estimate the effects of various interventions on cases and deaths. This model estimates behavioral parameters that affect the spread of the disease and accurately reproduces the cumulative case and death counts throughout the outbreak. The data obtained from this model shows that a vaccine is almost doubly effective on cases and deaths when implemented prior to rather than during an outbreak. According to the model, if 10% of the Guinean population had been vaccinated prior to the latest outbreak, 85% less people would have died. If 10% of the Guinean population had been vaccinated throughout the course of the outbreak, with 2000 new inoculations per day, 45% less people would have died. In addition, treatments that reduce mortality rate even slightly have a substantial effect on cases and deaths. A 5% reduction in mortality rate could have resulted in 64% of the deaths without said treatment. The mathematical model created shows numerically the benefits of treatments and vaccines on case and death load while also suggesting a method for vaccination distribution.

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