Mathematical Modeling on the Control of Measles by Vaccination: Case Study of Kisii County, Kenya

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Abstract

Protection of children from vaccine-preventable diseases, such as measles, is among primary goal for health workers. Since vaccination has turned out to be the most effective method against childhood diseases, developing a framework that would predict an optimal vaccine coverage level needed to control the spread of these diseases is important and essential. In this project, the use of a population with variable size to provide this framework was adopted. It majorly relied on a compartmental model expressed by a set of ordinary (O.D.E) and partial differential equations (P.D.E) based on the dynamics of measles infections. The mathematical model equations, the mathematical analysis and the numerical simulations that followed served to reveal quantitatively as well as qualitatively the consequences of the mathematical modeling on measles vaccination. The numerical and qualitative analyses of the model were performed and different state variables were determined. Qualitative results show that the model has the disease-free equilibrium which is locally asymptotically stable for RO<1 and unstable for RO>1. Simulation of different epidemiological classes revealed that most of the individuals undergoing treatment join the recovered class.

Keywords: Basic Reproduction Ratio, Ro Compartmental Model, Disease-Free Equilibrium, Mathematical Modeling, Measles Herd Immunity, Vaccination

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