

MATHEMATICAL AND SENSITIVITY ANALYSIS OF THE DYNAMICAL SPREAD OF CHOLERA

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ABSTRACT: Sensitivity analysis was performed on the mathematical model of Cholera to determine the influence and importance of each parameter on the basic reproduction number (R_0) in the dynamical spread of Cholera. Basic Reproduction Number (R_0) was obtained using next generation matrix method (NGM). The disease free equilibrium was analyzed for stability and the analysis shows that the disease free equilibrium point is globally asymptotically stable whenever the basic reproduction number is less than unity i.e ($R_0 < 1$). Also, there exist endemic equilibrium points of the model whenever $R_0 > 1$. The relative sensitivity indices of the model with respect to each parameter in the basic reproduction number is calculated in order to find the most sensitive parameter which the medical practitioners and policy health makers should work on in order to reduce the spread of cholera in the society. The result shows that effective contact rate and fraction of individuals with low immunity are the most sensitive parameters in the reproduction number. Numerical simulation was carried out by MAPLE 17 software using Runge-kutta method of order four to show the effects of contact rate and fraction of individuals with low immunity in the dynamical spread of Cholera. This work will allow the health policy makers to know the best control measure to be adopted in order to have disease free environment.

KEYWORDS: Cholera, Reproduction Number, Critical Point, Sensitivity analysis, Stability.

1 INTRODUCTION

Cholera is a deadly disease that is majorly caused by the bacterium called *Vibrio Cholera*. It belongs to a class of water-borne disease which occurs as a result poor sanitation and dirty water. The cholera bacteria release a toxin which makes it difficult for the body system to absorb liquids and makes an infected person to become dehydrated. This dehydration can lead to loss of life within two or three hours if not given medical attention on time [10]. An estimate of 1.4 to 4.3 million cases occurs each year with the total death of 28000 to 142000 worldwide [14].

The bacteria transmission involve two stages which are human and environmental stages which means that cholera transmission could be from environment to human and person to person transmission. Its transmission is common in an area where is no good environmental sanitation and lack of food/personal hygiene which creates avenue for cholera spread. Majorly there are two means of cholera transmission which are water and sea foods that are contaminated by the bacteria [9, 2, 5].

The time frame from the point of exposure to the time of appearance of cholera symptoms (incubation period) ranges between the hours of two to five days. The infected person develops the following symptoms after infection which includes: watery diarrhea, vomiting, loss of skin elasticity, thirst and muscle cramps [3, 14, 15].

Cholera can be treated through the use of antibiotics and fluid replacement therapy as this will reduce the spread and the death due to cholera infection in the environment [15].