Abstract

Ebola virus disease, a kind of fever commonly known as Ebola hemorrhagic fever, is one of the deadliest viral infections that has caused a serious global health problem in the known human history. This is rare but severe and is considered to be extremely dangerous. The Ebola virus was first transmitted to humans through domestic and wild animals, called transmitting agents and then the spread was through direct and indirect contacts among individuals. To control this spread has been one of the most challenging aspects of epidemic studies carried out so far.

The purpose of this work is to explore the dynamics of EVD propagation and to illustrate how the Ebola virus maintains its stability in the human population. A reliable and competitive mathematical analysis of different strategies to control Ebola virus transmission is carried out. To understand the profound dynamical behavior of Ebola disease, an SEIR compartmental model consisting of coupled nonlinear ordinary differential equations is considered from the existing literature. The reason of selection of this model is to fill some flaws and gaps in the mathematical analysis performed. The problem is addressed carefully and other aspects of both qualitative & quantitative analysis of the model are included. Afterwards, we have developed and rigorously analyzed two different deterministic mathematical models namely SEQIR model, and SVEIR model based on the dynamics of SEIR epidemic model. To discuss the mode of impact of Ebola virus on the human population, these models will provide a good tool. It is proved that our proposed models help in better understanding of the dynamical behavior of EVD and explains its stability pattern.

To validate our theoretical results, the systems of ODE's are solved by employing three well known numerical techniques such as RK4 method, Euler's method, and the NSFD method. A quantitative analysis of deterministic epidemic models for different vaccination and quarantine coverage levels is presented. We also study the effect of threshold parameter at different vaccination and quarantine coverage levels to draw some useful results. Numerical results drawn using MATLAB validate our claim that EVD could be eradicated faster if a human population adopts proper vaccination and quarantine measures with proper awareness at various coverage levels.

A new nonlinear SVEIR model for the rapidly spreading COVID-19 is also developed, which determines the impact of vaccination strategy on susceptible humans and afterwards exposed and infected humans. A complete mathematical analysis of this model is conducted to predict the dynamics of Corona virus in humans. The study proves the effectiveness of vaccination strategy employed and assists public *health services in controlling or reducing the burden of corona virus pandemic. A quantitative analysis of the model is explored for various coverage levels of voluntary vaccination. It is claimed that COVID-19 could be eradicated more quickly if a human community implements mandatory vaccination measures with proper awareness.*