Abstract

The emergence of Lassa fever, particularly in West Africa has critically threatened a wide spread outbreak of substantial health, social and economic implications. Irrespective of efforts, the persistence of Lassa fever remains a challenging hazard. It is necessary to have comprehensive understanding of its transmission patterns and risk factors to control this disease.In this thesis, we design transmission model as lens to inspect complicated dynamics of Lassa fever. This involves meticulous description of understanding of disease with special emphasis to its modes of transmission and crucial risk factors.

We take initiative by inspecting intrinsic attributes and then move forward with numerical simulation. In the orbit of analytical analysis, to ensure reliability and validity of model, we demonstrate boundedness and positivity of solutions. The basic reproduction number is obtained by using Next Generation method, which is further used to analyze the stability. We then formulate fractional model by using Caputo type fractional derivative (modified version). We again demonstrate the non-negativity of proposed fractional model. We show conclusively that proposed Caputo type fractional transmission model exhibits a fixed point that is unique, ensuring a unique solution. Then we construct approximation equations by using modified form of Predictor-Corrector scheme.

Furthermore, to ensure the credibility of the findings we evaluate stability of the method. We verify our results by performing the graphical simulation of proposed fractional model. We further investigate memory effects and saturation incidence effect to understand the long term dynamics of transmission of Lassa fever and to improve predictions of future outbreaks.

To effectively mitigate the disease, we employe optimal control strategy. In this context, we develop optimal control problem and inspect it after implementing Pontryagin's Maximum Principle (PMP). Our study yields innovative insights into the dynamics of Lassa fever and examines the utilization of fractional derivatives in this mathematical modeling.