Dynamic of S-I-R-S cholera model with an Allee Effect on bacterial population

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April 27, 2020

Abstract

\par We formulated a generic S-I-R-S (Susceptible-Infected-Recovered-Susceptible) epidemic model of cholera that incorporate three key features: an Allee Effect on bacteria dynamic, the loss of immunity of recovered individuals and infection force to cholera regulated by the contact and logistic dose-reponse of bacteria. These assumptions are built into a simple model which yields surprisingly rich dynamics. Having three different disease-free equilibriums $\mathsf{Q_{0}}$, $\mathsf{Q_{\rho}}$ and $\mathsf{Q_{\theta}}$, the dynamic of the model is essentially characterized by a threshold quantity $\mathcal R^{0}_{0}$ which represents the basic reproduction number of the disease-free equilibrium $\mathsf{Q_{0}}$. The model supports the possibility of bi-stability, backward bifurcation and forward bifurcation. The sensibility analysis of the model and theoretical results supported by numerical simulations suggest that an efficient control strategy would be to increase the value of θ (Allee threshold bacterial population) which is equivalent to increasing unfavorable conditions for bacteria growth. These conditions are generally: regular environmental consolidation measures, compliance with hygiene rules and unfavorable climatic factors.

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