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IMPACT OF INFORMATION ON TREATMENT AS WELL AS ON DISEASE DYNAMICS

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In this work we shall highlight the impact of control interventions: information of the disease (non-pharmaceutical) and treatment (pharmaceutical) on the infectious disease dynamics. With improvement of medical facilities and technology, it is important to use the available resources to their maximum and achieve the best output. Also, it has been also observed that due to presence and spread of a disease, the information about disease spreads via media in the population. This information induces behavioral changes in susceptible population which take protective measures (such as use of masks, sanitizer, protections etc.) to avoid contracting infection. Hence this information induced behavioural change can be used as a control intervention [1]. The question is how can we use this control intervention to reduce load on treatment, which is usually limited? For this, we propose and analyse compartment models which highlight impact of information on treatment and disease dynamics. We perform stability analysis of infection free and infected equilibria. Global stability of infected equilibrium is established under certain parametric conditions. We also note that the system undergoes backward and hopf bifurcation and there is possibility of existence of multiple equilibria, which employs that system consists of rich and complex dynamics. We further develop an optimal control problem and find the optimal profiles of control interventions using Pontryagin Maximum Principle [2]. We observe that the effect of information is significant during initial phase of disease spread and reduces the peak of infective even in absence of any other control. The treatment on the other hand not only reduces the peak of infective but also the infectivity period. We numerically discuss various optimal control scenarios for certain set of parameters. We also perform cost analysis and find that a suitable combination of both the control interventions is economically most viable option and does not only reduce disease prevalence but also minimize total cost.

References

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