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# ROLE OF OPTIMAL SCREENING AND TREATMENT ON INFECTIOUS DISEASES

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## ABSTRACT

Sudden outbreaks of infectious diseases not only pose challenges on human survival but also place a high economic loss on communities across the world. The economic losses include expenditures on care, diagnosis and medical treatment etc. apart from productivity loss due to high morbidity and mortality during the course of epidemic. For example, in 2003, the total economic loss was 50 billion dollars due to SARS worldwide. Thus the control of disease transmission and its prevalence becomes utmost important. Further, when outbreaks take place, information of disease prevalence spreads and influences the human behaviour to adapt protective measures. In [1, 2] authors studied impact of different control interventions on disease dynamics. In this work, we study the dynamics of an infectious disease under two types of control interventions: pharmaceutical (screening and treatment) and non-pharmaceutical (information induced self-protection).

First, a nonlinear compartmental model is formulated and analysed that accounts for the effect of screening and limited treatment on disease dynamics. A controlling aspect 'information induced self-protection' has also been coined that induces healthy individuals to abate the infection. Model analysis has been performed via stability and bifurcation analysis when basic reproduction number varies. Further the model is extended to corresponding control problem and analytically optimal control paths are obtained. A control strategy may be, to use a single control intervention or multiple control interventions. In case of multiple control interventions, it is important to understand that in what ratio and for what time periods such controls should be applied. Comparative study has been performed for three control strategies as: execution of only screening, only treatment and combination of both. To vet the criticality and cost-effectiveness of applied control policies, numerical experimentations have been accomplished to

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find the optimal strategy that minimizes disease and economic burden during the outbreaks.

Our study accentuates that limitation or saturation on medical resources causes backward bifurcation when basic reproduction number is below unity. Thus the condition of disease eradication, basic reproduction number below unity, is not enough to eliminate the disease. Numerically, we recognize that combination of screening and treatment is highly effective and economically profitable than any single strategy. In addition, a significant role of screening is observed in absence of treatment and also it is more effective in disease elimination than treatment. Moreover, information induced self-protection plays a crucial role in suppressing the count of infective along with minimum potential controls. Time distributions of optimal controls and costs are also obtained. Thus combined effect of screening and treatment not only reduces disease burden but also minimizes obtained economic loss during the course of epidemic.

## References

[1] SM Kassa and A Ouhinou (2015) *The impact of self-protective measures in the optimal interventions for controlling infectious diseases of human population*, Journal of Mathematical Biology, 70 **(1-2)**, pp. 213–236.

[2] S Lee, G Chowell, and C Castillo-Chávez (2010) *Optimal control for pandemic influenza: the role of limited antiviral treatment and isolation*, Journal of Theoretical Biology, 265 **(2)**, pp. 136–150.

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