

IMPLEMENTATION OF NON-PHARMACEUTICAL INTERVENTIONS TO MINIMISE THE INFECTION DURING THE OUTBREAK OF COVID-19 EPIDEMIC IN SRI LANKA

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By accounting for Sri Lanka's limited healthcare resources and economic production in the absence of a vaccine, this study aims to manage an epidemic outbreak while balancing its sanitary and economic effects. The World Health Organization (WHO) proposed to implement certain Non-Pharmaceutical Interventions (NPIs) to mitigate and investigate the dynamics of the spread of COVID-19. Accordingly, successful use of NPIs, including public health campaigns, washing hands with sanitizers, social distancing, travel bans, public gathering bans, quarantine regulations, and complete lockdowns were enforced to suppress the outbreak in Sri Lanka. In addition to being economically costly, lockdowns cause political instability, societal weariness, and annoyance. NPIs' stringency has, on one hand, reduced the spread of COVID-19, but on the other, it has had a negative impact on both the public and private sectors, which has slowed economic growth and had a significant negative influence on people's mental health. We thoroughly examined the Sri Lankan scenario and proposed an optimisation model that empowers the nation's policymakers to ascertain the severity budget that the nation can afford to reduce the spread of infection. Given the limited health care resources in the nation, this study aims to reduce the number of infections within the several budgetary possibilities. A Mixed Integer Non-Linear Programming epidemic model is developed to determine the optimal sequence of NPIs for each of the 25 districts over varying planning horizon. By linearising quadratic constraints, this Mixed Integer Non-Linear Programming model was later transformed into a Mixed Integer Linear Programming model. Consequently, this Mixed Integer Linear Programming model is transformed into an Integer Linear Programming model by utilising the Decreasing Severity Property of the NPI sequence. For each of the 25 districts, three plans-Plan A, Plan B, and Plan C are taken into consideration. Plan A has no lockdown limitations; however, the total number of lockdown weeks in plan B and consecutive weeks of lockdown in plan C are restricted, and by changing the budget and planning time horizon, the infection levels were obtained. The non-zero binary decision variables in the objective function are identified by solving the developed Mixed Integer Linear Programming model in IBM ILOG Optimisation Studio using the Branch-and-Cut algorithm. The results are analysed and hence determined which NPI sequence should implement for which district during the planning horizon to minimise the infection. Furthermore, the infected number obtained in Plan B is incompatible with the official statistics of the Sri Lankan government.

Keywords: COVID-19, IBM ILOG Optimisation Studio, Mixed Integer Linear Programming, Non-pharmaceutical interventions