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Dynamics of Covid-19 and Social Distancing: Insights from an Epidemiological SIRSi-Vaccine Model with Forced Limit Cycles

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Abstract

In this study, we present an epidemiological SIRSi-vaccine model that describes the early dynamics of Covid-19. We adjust the model parameters using official public data on confirmed cases and social distancing measures. Our analysis includes the global stability of the endemic and disease-free equilibrium and determines a transcritical bifurcation diagram that depicts the alternation of stability between the two equilibria when the vaccination rate and isolation index are varied.

Furthermore, we found numerical evidence suggesting that small amplitude oscillations observed in the social distancing time series can force stable oscillatory limit cycles in the phase portrait, breaking the endemic equilibrium even in the presence of vaccination measures. This mechanism of inducing forced oscillations in the spread of the disease may contribute to explaining the emergence of consecutive pandemic waves. Our study highlights the importance of effective social distancing measures in controlling the spread of Covid-19 and suggests the need for continued vigilance even with widespread vaccination.

Our findings offer insights into the early dynamics of Covid-19 and the potential impact of vaccination and social distancing measures on controlling the pandemic. This study will be of interest to researchers and policymakers in the fields of epidemiology, public health, and infectious diseases, and non-linear dynamics.

Biography

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