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MODIFIED SEIRD MODEL: A NOVEL SYSTEM DYNAMICS APPROACH IN MODELLING THE SPREAD OF COVID-19 IN MALAYSIA DURING THE PRE-VACCINATION PERIOD

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Abstract

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Abstract

Mathematical modelling is an effective tool for understanding the complex structures and behaviors of natural phenomena, such as coronavirus disease 2019 (COVID-19), which is an infectious disease caused by a life-threatening virus called SARS-CoV-2. It has rapidly spread across the world in the last three years, including Malaysia. Adopting a novel system dynamics approach, this paper aims to explain how mathematics can play a significant role in modelling the COVID-19 spread and suggests practical methods for controlling it. It forecasts the data of infected (I), recovered (R) and death (D) cases for decision-making. This paper proposes a modified Susceptible-Exposed-Infected-Recovered-Death (SEIRD) model with time-varying parameters considering the sporadic cases, the reinfection cases, the implementation of a movement control order, and the percentage of humans abiding by the rules to forecast future growth patterns of COVID-19 in Malaysia and to study the effects of the consideration on the number of forecasted COVID-19 cases, during the pre-vaccination period. This

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study implemented the preliminary stage of forecasting the COVID-19 data using the proposed SEIRD model and highlighted the importance of parameter optimization. The mathematical model is solved numerically using built-in Python function 'odeint' from the Scipy library, which by default uses LSODA algorithm from the Fortran library Odepack that adopts the integration method of non-stiff Adams and stiff Backward Differentiation (BDF) with automatic stiffness detection and switching. This paper suggests that the effects of factors of sporadic cases, reinfection cases, government intervention of movement control order and population behavior are important to be studied through mathematical modelling as it helps in understanding the more complex behavior of COVID-19 transmission dynamics in Malaysia and further helps in decision-making. © 2023, IIUM Engineering Journal. All Rights Reserved.

Author keywords

COVID-19; Malaysia; SEIRD model; simulation; system dynamics; systems thinking approach

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