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A Study of Two Disease Models: With and Without Incubation Period

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Abstract : The incubation period is defined as the time from infection with a microorganism to development of symptoms. In this research, two disease models: one with incubation period and another without incubation period were studied. The study involves the use of a mathematical model with a single incubation period. The test for the existence and stability of the disease free and the endemic equilibrium states for both models were carried out. The fourth order Runge-Kutta method was used to solve both models numerically. Finally, a computer program in MATLAB was developed to run the numerical experiments. From the results, we are able to show that the endemic equilibrium state of the model with incubation period is locally asymptotically stable whereas the endemic equilibrium state of the model without incubation period is unstable under certain conditions on the given model parameters. It was also established that the disease free equilibrium states of the model with and without incubation period are locally asymptotically stable. Furthermore, results from numerical experiments using empirical data obtained from Nigeria Centre for Disease Control (NCDC) showed that the overall population of the infected people for the model with incubation period is higher than that without incubation period. We also established from the results obtained that as the transmission rate from susceptible to infected population increases, the peak values of the infected population for the model with incubation period decrease and are always less than those for the model without incubation period.

Keywords : asymptotic stability, Hartman-Grobman stability criterion, incubation period, Routh-Hurwitz criterion, Runge-Kutta method

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