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Modeling and Optimal Control of Pneumonia Disease with Cost Effective Strategies

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Abstract : We propose and analyze a non-linear mathematical model for the transmission dynamics of pneumonia disease in a population of varying size. The deterministic compartmental model is studied using stability theory of differential equations. The effective reproduction number is obtained and also the local and global asymptotically stability conditions for the disease free and as well as for the endemic equilibria are established. The model exhibit a backward bifurcation and the sensitivity indices of the basic reproduction number to the key parameters are determined. Using Pontryagin's maximum principle, the optimal control problem is formulated with three control strategies; namely disease prevention through education, treatment and screening. The cost effectiveness analysis of the adopted control strategies revealed that the combination of prevention and treatment is the most cost effective intervention strategies to combat the pneumonia pandemic. Numerical simulation is performed and pertinent results are displayed graphically.

Keywords : cost effectiveness analysis, optimal control, pneumonia dynamics, stability analysis, numerical simulation
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