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SENSITIVITY ANALYSES OF VACCINATION, TREATMENT AND DISEASE RELAPSE ON THE TRANSMISSION DYNAMICS OF TUBERCULOSIS

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It is estimated that one-third of the world's population are infected with latent Tuberculosis (TB). This research presents an exhaustive deterministic model for the transmission and control dynamics of TB. This model incorporates significant parameters such as vaccination, treatment, disease relapse after recovery, vaccination wane, progression rate from latent to active TB, among others. The model was shown to possess a positive and bounded solution region. Furthermore, by employing the next generation matrix approach and the Routh Hurwitz Stability criteria, it was obtained that there exists a locally stable disease-free equilibrium point for the model whenever the effective reproduction number, R_e, is less than unity and a unique endemic equilibrium point whenever $R_e > 1$. Sensitivity analysis of R_e was performed using the forward index sensitivity approach. It was obtained that the recruitment rate into the susceptible population and the disease transmission rate have a unitary sensitivity indices. Rates of loss of immunity after vaccination and progression from latent to active TB exhibit a direct variation with R_e while vaccination, treatment, natural and disease induced death rates exhibit an indirect variation with R_e. Numerical simulation was performed on the model by implementing the fourth order Runge Kutta numerical computation method on MATLAB subroutine. Every parameter sensitive to R_e was varied and the effects of these parameters on the spread and eradication of TB was discussed.

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