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Seasonal RSV Projections in Alberta: A Mathematical Modeling Study

Respiratory Syncytial Virus (RSV) has become a significant global concern, causing respiratory illness in infants, children, older adults, and immunocompromised individuals. According to the WHO, RSV causes 3.6 million hospitalizations and 100,000 deaths annually worldwide in children under five. My research aimed to develop a mathematical model to analyze RSV transmission dynamics. It also assessed whether such models could accurately predict the magnitude, duration, timing, and intensity of RSV infection peaks during the respiratory viral season. A five-age-group model based on the SIR framework was developed to capture the complex transmission dynamics of RSV, incorporating heterogeneous contacts across the population. The model was calibrated using a Bayesian inference framework with Diffusive Nested Sampling algorithm implemented in MATLAB. Key challenges included non-identifiability and computational complexity arising from a high-dimensional system of equations and parameters. We used advanced calibration algorithms, multiple data sets, and informed parameter priors to address these challenges. RSV case counts for Alberta in the 2024–2025 season were projected using the model and validated against observed data to enhance accuracy and reliability. The model projected the peak week of RSV cases with a magnitude that closely aligned with confirmed cases. It precisely captured the rising trajectory leading to the peak, with the peak's timing falling within the predicted range. Model results aid health authorities in planning for seasonal RSV surges by anticipating the timing and intensity of cases. It also supports resource allocation and informs targeted prevention and response strategies to minimize the impact of RSV on vulnerable populations.