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Mathematical model of measles epidemiology with control strategies

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Measles remains a significant public health challenge, particularly in regions with low immunization rates. This paper presents a mathematical model to assess the impact of vaccination on measles control, incorporating additional measures such as quarantine and public health education. The model categorizes the population into five key compartments: susceptible, vaccinated, exposed, infectious, and recovered.

We employ Partial Rank Correlation Coefficient (PRCC) analysis to identify critical parameters influencing measles transmission dynamics, including vaccine efficacy, coverage, and the duration of immunity. Our simulations evaluate the effectiveness of various vaccination strategies, such as booster doses, mass immunization campaigns, and targeted interventions in high-risk populations. The results indicate that high vaccination coverage and efficacy, coupled with timely quarantine measures and robust public health education, can significantly reduce measles incidence and prevalence.

The PRCC analysis reveals that the rate of progression from exposure to infection and the waning of immunity are pivotal in determining the success of these control strategies. We advocate for comprehensive immunization programs, particularly in vulnerable areas, combined with aggressive public health interventions to enhance measles control. The study emphasizes the need for continued research into developing vaccines with higher efficacy and longer-lasting immunity, as well as effective educational campaigns, to further curb the spread of measles.

These findings provide valuable insights for policymakers and public health officials, highlighting the critical role of vaccination and complementary measures in comprehensive measles control programs. By integrating these strategies into public health policies, governments can more effectively combat the measles epidemic and improve health outcomes in affected communities.

Keywords: mathematical model, PRCC analysis, public health epidemiology, vaccine efficacy, health policy

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