

INTISARI

ANALISIS DAN KENDALI OPTIMAL MODEL MATEMATIKA PENULARAN CACAR MONYET ANTAR MANUSIA DENGAN REINFEKSI

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Cacar monyet merupakan penyakit zoonotik yang disebabkan oleh virus Monkeypox (MPXV). Pada tesis ini, dibahas mengenai model matematika cacar monyet. Selanjutnya, ditentukan titik ekuilibrium bebas penyakit dan endemik serta bilangan reproduksi dasar dari model. Kemudian dilakukan analisis kestabilan lokal dan global dari titik ekuilibrium serta dilakukan analisis sensitivitas dari bilangan reproduksi dasar (\mathcal{R}_0). Lebih lanjut, dibahas mengenai masalah kendali optimal model cacar monyet menggunakan Prinsip Minimum Pontryagin. Kendali yang digunakan berupa vaksinasi. Simulasi numerik juga dilakukan untuk memverifikasi hasil analisis secara analitik. Hasil penelitian menunjukkan bahwa titik ekuilibrium bebas penyakit stabil asimtotik lokal dan global ketika $\mathcal{R}_0 < 1$, sedangkan titik ekuilibrium endemik stabil asimtotik global bersyarat. Penerapan kendali optimal terbukti mampu menurunkan jumlah individu terinfeksi secara signifikan dibandingkan dengan kondisi tanpa kendali.

Kata Kunci: Model Matematika, Cacar Monyet, Reinfeksi, Kendali Optimal

ABSTRACT

ANALYSIS AND OPTIMAL CONTROL OF A MATHEMATICAL MODEL FOR HUMAN-TO-HUMAN MONKEYPOX TRANSMISSION WITH REINFECTION

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Monkeypox is a zoonotic disease caused by the Monkeypox virus (MPXV). This thesis discusses the mathematical model of monkeypox. Furthermore, the disease-free and endemic equilibrium points and the basic reproduction number of the model are determined. Then, the local and global stability of the equilibrium points are analyzed and the sensitivity of the basic reproduction number (\mathcal{R}_0) is analyzed. Furthermore, the optimal control problem of the monkeypox model using Pontryagin's Minimum Principle is discussed. The control used is vaccination. Numerical simulations were also conducted to verify the analytical results. The results show that the disease-free equilibrium is locally and globally asymptotically stable when $\mathcal{R}_0 < 1$, whereas the endemic equilibrium is conditionally globally asymptotically stable. Furthermore, the application of optimal control is shown to significantly reduce the number of infected individuals compared to the uncontrolled case.

Keywords: Mathematical Model, Monkeypox, Reinfection, Optimal Control