# Model Matematika Pengaruh Kebijakan Dua Tahap Vaksinasi dalam Pengendalian COVID-19 di DKI Jakarta = Mathematical Model of the Effect of Two Stages Vaccination Policy in Controlling COVID-19 in DKI Jakarta

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Abstrak

Coronavirus Disease 2019 (COVID-19) merupakan penyakit menular yang disebabkan oleh virus SARS-CoV-2. Sejak ditemukannya COVID-19 di DKI Jakarta hingga 31 Desember 2021, sudah tercatat total kasus terinfeksi sebanyak 865,415 dan total kematian sebanyak 13,588 kasus. Pemerintah telah melakukan berbagai kebijakan dalam menghentikan penyebaran COVID-19, salah satunya adalah melakukan vaksinasi. Oleh karena itu, pada penelitian ini dikonstruksi model matematika pengaruh kebijakan dua tahap vaksinasi dalam pengendalian COVID-19 di DKI Jakarta. Model matematika dikonstruksi menggunakan sistem persamaan diferensial biasa nonlinier berdimensi sebelas. Lebih lanjut, dilakukan analisis secara analitik maupun numerik serta interpretasi hasil terhadap model matematika yang dikonstruksi. Kajian analitik meliputi analisis eksistensi dan kestabilan titik keseimbangan bebas penyakit (DFE) serta pembentukan basic reproduction number (R0). Kajian numerik meliputi penaksiran parameter, analisis elastisitas dan sensitivitas terhadap R0, dan simulasi numerik. Berdasarkan kajian numerik, memberikan vaksin dengan efikasi yang tinggi menyebabkan kasus positif harian COVID-19 yang rendah. Selain itu, peningkatan laju vaksinasi disertai dengan pelonggaran pembatasan sosial yang mengakibatkan peningkatan laju penularan COVID-19 dapat mempercepat hilangnya COVID-19 seiring berjalannya waktu. Data yang digunakan pada penelitian merupakan data kasus positif harian COVID-19 di DKI Jakarta sejak tanggal 1 Maret 2020 hingga 31 Desember 2021.

......Coronavirus Disease 2019 (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus. Since the discovery of COVID-19 in DKI Jakarta until December 31, 2021, there have been 865,415 infected cases and 13,588 deaths. The government has implemented various policies to stop the spread of COVID-19, one of which is vaccination. Therefore, this study constructed a mathematical model of the effect of the two-stage vaccination policy in controlling COVID-19 in DKI Jakarta. The mathematical model is constructed by an eleven-dimensional nonlinear ordinary differential equation system. Furthermore, analytical and numerical analysis was carried out, and the results of the constructed mathematical model were interpreted. Analytical studies include analysis of the existence and stability of the disease-free equilibrium (DFE) and the formation of the basic reproduction number (R0). Numerical studies include parameter estimation, elasticity, and sensitivity analysis of R0, and numerical simulation. Based on numerical studies, administering a vaccine with high efficacy leads to low daily positive cases of COVID-19. In addition, an increase in vaccination rates accompanied by an easing of social distancing increasing the transmission rate of COVID-19 could accelerate the disappearance of COVID-19 over time. The data used in this study is daily positive case data for COVID-19 in DKI Jakarta from March 1, 2020, to December 31, 2021.