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Commentary

Role of Vaccination in a Two-Strain COVID-19 Model

Huaqing Liu*

Department of Microbiology, Illinois University, Chicago, USA

ABOUT THE STUDY

There is a risk that the SARS coronavirus that is present in bats could evolve and infect people. The Sars-CoV-2 virus, which causes the deadly COVID-19 disease, has been continuously transmitting from person to person since December 2019, when Wuhan, China, reported the first instance of the new virus. COVID-19 has a general mortality rate of 5%, with an average of 2.3%, but elderly populations are at higher risk, with mortality rates of 8% for those between 70 and 79 years old and 14.8% for those over 80. Although the mortality rate may appear to be low, there are a lot of hospitalizations, which puts a strain on global health and poses a significant challenge to healthcare systems everywhere.

Inhaling respiratory droplets from both symptomatic and infectious people can spread COVID-19 from one person to another as well as direct contact with contaminated objects or surfaces. In addition to posing a serious threat to the health of millions of people and having serious economic repercussions as a result of lock-down measures, the 2019 COVID-19 outbreak continues to affect communities all over the world. In fact, it was discovered that when the recruitment rate of immigrants falls below a specific threshold value, lowering the inflow of immigrants could significantly contribute to a decline in the number of infected people. The possibility of stopping the pandemic is given hope by the availability of COVID-19 vaccinations.

As we now face a very different epidemiological landscape from the early pandemic, vaccines provide a crucial pharmacological measure in the fight against the COVID-19 pandemic. This allows us to explore real-world scenarios that combine the effects of both therapeutic and non-therapeutic public health interventions, such as mass vaccination campaigns and treatment, as well as non-pharmaceutical public health interventions like face masks and hand washing. A number of disease outbreaks evolutions have been studied using compartmental models in a big way. In order to examine several important aspects of the transmission, management, and mitigation of the disease, numerous research efforts based on compartmental-like epidemic models have been done since the COVID-19 outbreak.

According to each person's health condition, the population is divided into compartments in deterministic compartmental disease transmission models. While studies on the dynamics of two viral infections have taken cross-immunity and co-infection into consideration, others have discussed the consequences of two competing strains that are cross-immune. Our suggested model is an exact replica of the two-strain flu model with a single vaccination, modified to take into account the power of infection in both infected compartments and to broaden the incidence function. Because immunization against strain 1 may not provide any protection against the second and more virulent strain 2, we included illnesses from people who had received both strain 1 and strain 2 vaccinations in our analysis using the COVID-19 criteria.

The impact of more infectious strains on the transmission dynamics of the COVID-19 pandemic was examined; however vaccination was not taken into account because variant strains had the ability to significantly modify transmission dynamics and vaccine efficacy. They came to the conclusion that a novel variety with a greater propensity for transmission would have more catastrophic effects on the population. To our knowledge, no COVID-19 modeling study has taken into account strain 1 vaccination with the risk of infection with strain 1 even when vaccinated, as well as strain 2 infections for which strain 1 vaccination may not provide any protection. We develop a deterministic compartmental epidemic model of COVID-19 transmission dynamics in a population with homogeneously mixed racial and ethnic composition. This model is focused on the mathematical model's well-posedness, the calculation of its equilibrium, the fundamental reproduction number, and the analysis of the model's dynamics using the dynamic systems theory.

Correspondence to: Huaqing Liu, Department of Microbiology, Illinois University, Chicago, USA, E-mail: huaqingliu@iit.edu

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