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Analysis, predicting, and controlling the COVID-19 pandemic in Iraq through SIR model

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ABSTRACT

Using the standard SIR model with three unknown biological parameters, the COVID-19 pandemic in Iraq has been studied. The least squares method and real data on confirmed infections, deaths, and recoveries over a long time (455 days) were used to estimate these parameters. In this regards, first, we find the basic reproductive number R_0 is 0.9422661124 which indicates and predicts that the COVID-19 pandemic in Iraq will gradually subside until it is eradicated permanently with time. Additionally, we develop an optimal vaccination strategy with the goal of reducing COVID-19 infections and preventing their spread in Iraq, thereby putting a clear picture of control this pandemic.

1. Introduction

Since its emergence over two years ago, the COVID-19 pandemic has overtaxed the ability of healthcare organizations throughout much of the world, affecting virtually every aspect of daily life. In fact, the last days of 2019 brought an unwelcome surprise: the first pandemic of the century. Wuhan, the capital of the Chinese province of Hubei, was the first place that COVID-19 appeared, and then it spread from Wuhan to around the world. This necessitated pooling all of the world's resources to combat the looming pandemic and halt its spread in any way possible, as most countries closed their borders and airports and prohibited citizens from roaming freely for fear of the disease spreading further. During this time, major pharmaceutical companies worldwide rushed to produce vaccines, and the FDA approved some vaccines for emergency use, including those manufactured by Pfizer, Moderna, and AstraZeneca [1].

In recent years, the mathematical modeling of infectious diseases has become an active and important area of research being carried out. Because infectious diseases have dynamic behaviors, mathematical epidemiology can help scientists to better understand how they behave and what they can expect in the future. In fact, mathematical models are usually implemented to compare and evaluate various detection, prevention, therapy, and control programs, as well as to plan, implement, evaluate, and optimize these programmers throughout their lifecycle. In this vein, many studies have been published in recent years that have been adopted for the creation and evaluation of epidemiological models, and many of these contain significant findings [2–4]. Since the new pandemic's emergence, a slew of mathematical models has given health officials in many countries some useful insights into the most effective ways to stop the disease from spreading [5–9].

Recently, the mathematical models provide future insight into the qualitative behavior of COVID-19 and give a prediction of how this disease will behave [5,10–15]. Some scholars in Ontario, Canada, offered a mathematical model to examine the impact of a variety of public interventions on COVID-19 behavior and how to reduce it [16]. Depending on nonlinear differential equations, Fanelli and Piazza have discussed the temporal models for COVID-19 infection in three countries: China, Italy, and France, based on the real dates of certain days [17]. While Khan and Atangana used the COVID-19 confirmed infection reports in Wuhan to develop

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