

Modeling and Reviewing Analysis of the COVID-19 Epidemic in Algeria with Diagnostic Shadow

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Abstract. In this paper, we formulate a special epidemic dynamic model to describe the transmission of COVID-19 in Algeria. We derive the threshold parameter control reproduction number (\mathcal{R}_c^0), and present the effective control reproduction number ($\mathcal{R}_c(t)$) as a real-time index for evaluating the epidemic under different control strategies. Due to the limitation of the reported data, we redefine the number of accumulative confirmed cases with diagnostic shadow and then use the processed data to do the optimal numerical simulations. According to the control measures, we divide the whole research period into six stages. And then the corresponding medical resource estimations and the average effective control reproduction numbers for each stage are given. Meanwhile, we use the parameter values which are obtained from the optimal numerical simulations to forecast the whole epidemic tendency under different control strategies.

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1 Introduction

Plague appears everywhere in human history and it always brings grave misery into society. In another word, the struggling against diseases play an important role in the establishment of mankind's civilization. With the fast development of medical and pharmaceutical industry, some lethal infectious diseases can be cured completely, even the smallpox which plagued mankind for server centuries has been vanished. In recent years, there are small outbreaks in some areas all over the world which are not causing serious global outbreak. Nowadays, people think that we have already built up strong health system and developed high level of medical care.

However, at the end of 2019, everything changed. The first confirmed COVID-19 case was reported in Wuhan City, China [1]. At that time, because of the cognition limitation, it was called as an unknown infectious disease. The clinical symptoms are very similar with viral pneumonia [2,3]. Within one month, it spreads rapidly in Wuhan City and causes many death. The serious anomaly quickly attracted the attention of Chinese government, strict isolation and lockdown strategies were implemented immediately [4]. The warning from China does not get enough attention by other countries. After a short period, the disease spreads all over the world, it has become a global outbreak. People have to stop nearly all kinds of human activities, due to the sudden pandemic causes by the COVID-19, which is an infectious disease of coronavirus.

People have to face the new infectious disease, it seems that the health system and quick drug research which we are proud of are not as effective as before. Unlike other plague happened in the past years, the COVID-19 has many different characteristics. The spread ability of the COVID-19 is really strong, the 2019-nCoV trimeric spike protein binds at least 10 times more tightly than the corresponding spike protein of SARS-CoV to their common host cell receptor [5]. In the initial stage, researchers believe that it is a kind of viral pneumonia, with more and more clinical cases, the lung is not the only damaged organ [6,7]. According to the clinical studies, the COVID-19 attacks various organs of the body, including cardiac, gastrointestinal, hepatic, renal, neurologic, olfactory, gustatory, ocular, cutaneous and haematologic symptoms [8,9]. The virus is very insidious, the incubation period is very complex and flexible. It may be latent in human body for several days or even several weeks, and more than half of people with positive nucleic acid test don't show any typical clinical symptoms at all [10]. But the asymptomatic patients also have the ability to spread the disease [11]. A more severe problem is that, the structure of SARS-CoV-2 is enveloped, positive-sense single-stranded virus ((+)ssRNA virus) [12], the virus mutates in very fast speed [13], it makes great difficult in the developing of specific medicine, even worse, the vaccine may not be effective enough forever.

With the great challenge, people seem to come back to the Middle Ages, the most effective strategy is to protect the susceptible population. Social activities will increase the risk of exposure to SARS-CoV-2 and almost all countries published a series of lockdown strategies to prevent the disease from rapidly spreading. At first, in the view of traditional epidemiological experience, we just need to keep isolation for a few incubation