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Commentary

Short commentary on fractional model for Middle East Respiratory Syndrome Coronavirus on a complex heterogeneous network

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About the Study

Middle East Respiratory Syndrome caused by one of the viruses of the Corona family is among the most dangerous diseases that have spread recently, with an estimated death rate of approximately 36%. Humanity has not been exposed to this type of epidemic since the spread of influenza A in 1918. It is also characterized by the presence of a host that hosts the virus and helps in the process of mutation and spread from the animal source to the human. And it is considered the first recorded outbreak of Middle East Respiratory Syndrome, which occurred in the Kingdom of Saudi Arabia in particular, and then to the Gulf region. Camels are the main host of this virus, as it is widely spread in the Gulf region. Camels has its place, especially among the Gulf residents, and dealing with it is direct and continuous [1-5]. Epidemiological models of various patterns (SIS, SIR, etc.) have an effective role in summarizing and predicting the epidemiological situation, especially fractional models [6-13].

The goal of creating this fractional mathematical model is to create an effective image from which we can obtain results, after conducting mathematical analysis, that help control the epidemiological situation and the effect of various precautionary measures.

We formed a fractional mathematical model that describes this epidemiological situation, which relied in its formation on imposing an epidemiological network for camels and another epidemiological network for humans. The interaction between the two networks expresses the dynamic of spreading from camels to humans as a result of direct interaction between them. The impact of the extent of adherence to health protection instructions during direct interaction with camels has also been taken into consideration [6].

After the analytical study of the model, we were able to identify three positions in which stabilization of the epidemiological situation might occur. These positions represented, in turn, the natural stages of propagation, which are [6]

- The virus does not spread within the epidemiological network of the host, as well as the human network (free communities of the virus).
- The spread of the virus within the epidemiological network of both humans and camels.
- The spread of the virus within the epidemiological network of humans only, and the host network is completely free of infection.

We also determined the infection prevalence threshold within each community, whose value depends on the values of the parameters used in the mathematical model, as well as the shape of the network that represents the camel community and also the network that represents the human community. The pattern of network configuration influences the value of the infection spread threshold. We also proved during the analytical study the type of stability for each of the three

positions of equilibrium [6-11]. And there is a fourth position, but it does not represent a stable position for the model, which is the spread of infection within the animal community only without transmission to the human community, and this means that as long as infection occurs within any animal community of a virus capable of mutating and human interaction with this animal community, it must and inevitably from the transmission of infection to human society, and this has been proven in another work, see [6,9].

The study concluded with numerical simulations that establish the validity of the theories reached, and those examples expressed the three stability positions with the condition of each of them occurring. In addition to showing the importance of using fractional order in differentiation because it is characterized by generalization and obtaining different cases of curves that would not have appeared in the case of using the integer order [6].

We also put some examples that show the importance of the parameter ω (rate of commitment to preventive measures), which was used to express the extent of human commitment to health protection instructions while dealing with camels directly. It was found that it does not affect the stability conditions, but it does affect the numbers at which the system stabilizes. It also appears in all examples the role of using heterogeneous networks in describing the model and the extent of the effect of the degree of each element on the infected numbers [6].

The aforementioned model shows the powerful role of combining the use of fractional models and complex networks, which helped in predicting the future numbers that we might reach, as well as studying the impact of some factors. Among them, organizations responsible for combating epidemics can use these results and studies to determine appropriate methods to control the spread of infection. And take appropriate measures that are most effective to prevent the spread and that are commensurate with the financial capabilities of each country.

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