Review of: "The Spherical Horse and COVID-19"

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Potential competing interests: No potential competing interests to declare.

Summary of the Work

This work aims to highlight that the celebrated SIRD model is too ideal and does not describe the spread of COVID-19 realistically (to this end, the author recalled the popular "*spherical horse*" joke). The author proposed the model sketched in Figure 2. mentioning that it will be analyzed elsewhere.

General Remarks

There are several aspects of the SIRD model that, in my opinion, deserve to be recalled.

1) First of all, this model satisfies the conservation law between the various compartments, i.e.$dS/dt+dI/dt+dR/dt+dD/dt=0$ (or $S+I+R+D=N$=Total number of population).

2) While it is true that this model is ideal, it is also true that it can be easily generalized by adding appropriate terms. For Instance, we can explain the intrinsic fluctuations to which compartments are subject by adding stochastic terms whose magnitude can be determined from statistical mechanics (see, for example,

[1] G. Sonnino, P. Peeters, and P. Nardone, *Modelling the Spread of SARS-CoV2 and its variants. Comparison with Real Data. Relations that have to be Satisfied to Achieve the Total Regression of the SARS-CoV2 Infection*, European Society of Medicine (ESMED), **10**(7) (2022).

[2] G. Sonnino G., F. Mora, and P. Nardone P,*A Stochastic Kinetic Type Reactions Model for COVID-19*, MDPI-Mathematics: Math Mod and Ana in Bio and Med, **9**(11), 1221 (2021). https://doi.org/10.3390/math9111221

3) Furthermore, the SIRD model can be easily generalized in such a way that the dynamics take into account both the delay (an infected person today will recover or die after a certain period of time) and the spatial diffusion (in this case the dynamics is governed from partial differential equations). See, for example,

[3] G. Sonnino, P. Peeters, and P. Nardone, *Modeling the spreading of the SARS-CoV-2 in the presence of the lockdown and quarantine measures by a kinetic-type reactions approach*, Oxford University Press. Mathematical Medicine and Biology: A Journal of the IMA, **39**(2), (2022).

Comments

4) As regards the model proposed by the author and illustrated in Figure 2., it is not evident that the conservation law

referred to in the above point **1)** is respected.

5) Even if the author prefers to publish the analysis of his model elsewhere, he should at least show that his model in Figure 2. admits a stable stationary solution. Indeed, if we express the author's model in the form of differential equations, we note that there are some feedback terms that can make the dynamics unstable (consider, for example, the effects of the feedbacks deriving from I_{hd} => S and from S => r_{SQ} => Q and Q => r_{QS} => S).

Conclusions

To convince the reader, it is desirable that the author takes into account the above suggestions and, above all, demonstrates the added value of his model with respect to the vast literature in this research area. In particular, in my opinion, it is important to take into account that while it is true that the SIRD model (and its variants) is an idealized model, it is also true that it is possible to make it more realistic by integrating it with additional terms suitable for studying the impact of specific factors (such as the role of the intrinsic fluctuations, of the delay, etc.).