Chapter 9
Consequences of Parameters Mathematical Modelling of Two Interacting Viruses: Influenza and SARS- COV-2

Dipak Maji
https://orcid.org/0009-0004-9251-3205
Adamas University, India

Adiya Ghosh
Adamas University, India

ABSTRACT

Covid-19 and Influenza both are infectious disease. Covid-19 caused by the virus SARS-COV-2 and Influenza caused by influenza viruses. One interactive model is considered here of influenza and SARS-COV-2 .The model consist of six compartments;the susceptible population by both of the viruses, infected population by both viruses, population which is recovered from one virus but susectable to other virus. The importance of parameters are measured here. The stability analysis was performed for disease free case and co-existing case depending on different value of the parameters. Positivity and Boundedness of the model are also considered.The basic Reproduction number was computed by Next Generation Matrix method. The impact of all parameters towards the Basic Reproduction Number is also taken care of through the Normalised Forward Sensitivity Analysis. The numerical justification is also performed corresponding to these results.

INTRODUCTION

As COVID-19 (Pinky, L., and Dobrovolny, H. M.,2020) is still not over completely, it is changing its nature and appears in different forms. It started in Dec 2019 in Wuhan, China and gradually spread all over the world and so to India. Many patients died, not only in COVID-19 (Pinky, L., and Dobrovolny, H. M.,2020) caused by the virus SARS-COV-2(Pinky, L., and Dobrovolny, H. M.,2020), (Nowak, M. D., Sordillo, E. M., Gitman, M. R., and Paniz, A. E.,2020), (Achdout, H., Vitner, E.B., Politi, B. et

DOI: 10.4018/979-8-3693-2655-8.ch009

al.2021), but especially by another disease which was present along with COVID-19. This incident is known as comorbidity. Starting from May 2020, the highest number of deaths in India and second highest in the world was reached by 5th September 2020 with a case fatality rate of 1.75% (Kim, D., Quinn, J., Pinsky, B., Shah, N. H., and Brown, I.,2020), (Nowak, M. D., Sordillo, E. M., Gitman, M. R., and Paniz, A. E.,2020). Due to the sudden outbreak of COVID-19, the main attack was on the respiratory system(Xing, Q., Li, G-j., Xing, Y-h., Chen, T., Li, W-j., Ni, W., et al.,2020)of a human being and if the person already had any other respiratory problem, those cases became critical. Pneumonia was one of the major diseases for comorbidity along with COVID-19 with an immediate cause of death (around 54%). Dyspnea, fever and cough were also responsible for the same. Vaccination started on 16/01/2021 and at present the following vaccines are used for the same Bharat - Covaxin, Biological E - Corbevax, Gamaleya - Gam-Covid-Vac, Janssen - Ad26.COV 2-S,Moderna - Spikevax, SII - Covishield, SII - Covovax, Zydus - ZyCov-D (Pinky, L., and Dobrovolny, H. M.,2020). The details of vaccination are mentioned as per the following table .

Table 1. Details of vaccination as per 14/08/2022 received from WHO website.

Total vaccination	**2070189438**
Vaccinated 1 Plus dose	1021007522
Vaccinated 1 plus dose per 100	73.986
Persons fully vaccinated	936566863
Persons fully vaccinated per 100	67.867
Persons Booster Dose	112615053
Persons Booster Dose per 100	8.16
Number of vaccines used	8

Sometimes, some viruses can also block the growth of other viruses if they both are residing in the same host(Pinky, L., and Dobrovolny, H. M.,2020). Here we try to see the interaction of SARS-COV-2 with Influenza virus and try to understand the mutual behavior of them and do stability analysis(Rodrigues H.S., Monteiro M.T.T, Tores D.F.M,2013),(Chitnis N., Hyman J.M., Manore C.A.2013),(Hategekimana F., Saha S.,Chaturvedi A.,2013) for the interactive model. One competitive model is considered here by taking SARS-COV-2 and Influenza virus(Nowak, M. D., Sordillo, E. M., Gitman, M. R., and Paniz, A. E.2020),(Andersen V.,LinJ.and Levin S.A1997) and their interactive nature is considered. There are many articles regarding interactive behavior of SARS -COV-2(Blasco, M. L., Buesa, J., Colomina, J., Forner, M. J., Galindo, M. J., Navarro, J., et al., 2020) .The interactive model will be considered here and stability analysis for the model will be performed so that some important result can be found for the interactive mathematical model. It can also be observed that one disease is working as a prevention of another disease and drugs can be provided to boost one virus and that virus can work as a boost for human society.