Applied Mathematics & Information Sciences
An International Journal

http://dx.doi.org/10.18576/amis/170612

Impact of Covid-19 third wave Omicron in India

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Received: 13 May 2023, Revised: 3 Oct. 2023, Accepted: 7 Oct. 2023
Published online: 1 Nov. 2023

Abstract: The new Covid-19 variant omicron remains a cause of concern as India is seeing a sudden spike in the number of cases related to the highly transmissible coronavirus variant that has fuelled record outbreaks in various countries in the world.Day by day the cases increases reported by union Ministry of Health and family Welfare at the end of 2021. In this study we came to a approach that omicron variant is not severe and less harmful effect in comparison of second wave in India and there is no need for more hospitalization and lockdown for this with the fact knowing that we got 80 % vaccination.

Keywords: Covid-19; Omicron; Delta; National Covid-19 Supermodel Comittee; Mathematical Modelling.

1 Introduction

It is well known that COVID-19 is declared pandemic all over the world. Starting from China it spreads over whole world. The website of worldometer [2] provides all of the necessary facts regarding the spread of this pandemic.

A mathematical model for this epidemic is proposed by Cherniha [12] and the most popular pandemic model is the SIR (susceptible-infectious-Recovered) model, which incorporates three ODE's[10]. Figure 1 shows a dynamic chart of the behaviour. D. Effimov et al. followed this model[4] gives the SEIR model for the outbreak of COVID-19 with the appropriate parameters as shown in Figure 2.

D. Baleanu [5]also proposed a fractional differential equation model using Caputo-fabrizio derivative for covid transmission. M. Akash [20] also formulated a mathematical model of COVID-19 with partially and completely vaccinated people categories. Similarly for the effect of double vaccination O.J. Peter and H.S. Panigoro gave the analysis in their paper[21].

In the continuation of getting the approximate solutions of COVID-19 model L. Pang et.al. [19] studied Susceptible-Exposed-Infectious-Quarantine-Recovered-Death model (SEIQDR) with a more generalization of types of infected people. A. Anirudh [24] reported the results and difficulties of the models used to examine the behaviour of corona instances that were mentioned above.

The Omicron variant, first symptoms was found in November in South Africa , has since spread out quickly in the worldwide scenario, nearly 25 to 31 Dec 2021. On the concern of this variant after WHO report, India and many other countries have imposed travel restrictions. Former studies published in the UK and South Africa shows that less people infected with Omicron wants hospital treatment compared with other variants. On the other hand experts still advise serious caution as the infectious nature of the variant could lead to a surge in cases. In Ernakulam Medical College in south India Dr A Fathahudeen states that even there are not serious cases in India of this variant but the number of infectious patients(need to hospitalized) could increase. It is found that approx. 100 million adults haven't completed a single dose of vaccine although 90% of total population of India partially vaccinated.

Bhatter and Jangid proposed the new fractional mathematical model shows the better effects of vaccination for the outbreak of this pandemic[22], for the quarantine period and after than vaccination effect I. Haq and N. Ullah [23] also proposed a mathematical model.

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According to experts scientific projections forecast the third wave of covid which is said to be omicron variant will not such huge serious impact as first and second wave because it is assume that the life cycle of this wave is very short term. The National Covid-19 Supermodel Committee estimated that the third wave is expected to peak early next year since it is the approx time when Omicron starts replacing Delta as the dominant variant. This happened true as the peak of this varient came in the starting of Feb 2022 and slow down quickly where a 44% jump in daily cases appeared in December 2021. In India the highest cases in single day of omicron variant was found in 31 Dec 2021 in the high populated metropolitan cities like Delhi, Mumbai and kolkata.

Utilising information on the number of vulnerable individuals, the number under surveillance, the number of infected, the number of cures, and the number of virus-related deaths in India, numerical simulations of the dynamics of the virus were run. The Republic of India's Ministry of Health provided these data. Based on the collected data, it was determined that the stability simulation model hit a critical point after a very lengthy period of time. Therefore, in order to minimise the dynamics of COVID-19, medication or vaccinations are required.

All the data can be found by the study of National Covid-19 Supermodel Committee[29]
The different works related to these concerns are cited [13,6,3,7,9,11,28].

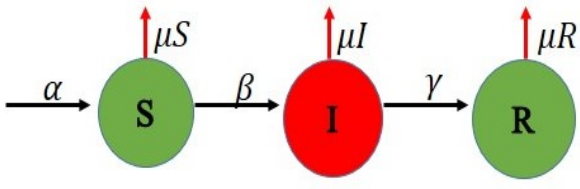


Fig. 1: The progression of dynamic of SIR Model

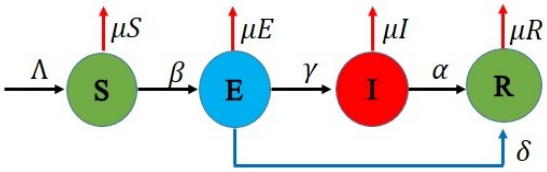


Fig. 2: The progression of dynamic of SEIR Model

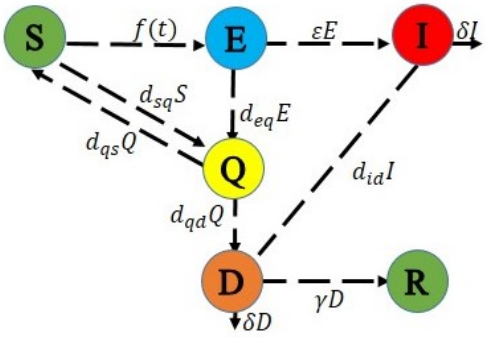


Fig. 3: The progression of dynamic of SEIQDR Model

2 The mathematical models for analysis of covid-19

There are some mathematical models which came into highlight for the study and analysis of the dynamics of the covid 19.
From which SIR, SEIR, SEIQDR, SEIQRF and many more.The Progression of that models in the study of covid-19 are given in the following figures.

3 The SUTRA Model

Two IIT's professor Manindra Agarwal IIT Kanpur and M Vidyasagar IIT Hyderabad Proposed the SUTRA (Suspected, Undetected, Tested (positive) and Recovered Approach) for the prediction of Omicron varient of Covid-19 third wave in India. The both are also the member of National COVID-19 Supermodel Commitee.[29]
In which Manindra agarwal played a major role in the study of behaviour of omicron variant in recent few days.

Padma Shri awardee Manindra Agarwal has said omicron variant is spreading rapidly primarily due to significant loss of immunity and not due to increased infectivity. By applying his mathematical model, SUTRA, Professor Agarwal said that the peak in South Africa, where the new COVID-19 variant was first detected, came as per his assessment based on the 'super model' initiative [25]

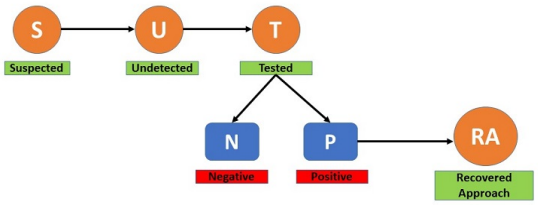


Fig. 4: Flow chart of SUTRA model

Dr. Agarwal said that the severity of the third wave, in terms of numbers, would, however, be half than what India saw during the second wave of the pandemic, it may be recalled that in May 2021, when India was experiencing the peak of the second wave of the Covid-19 pandemic the daily cases had crossed the 4 lakh mark. So as per Dr Agarwal, tough the third wave is inevitable it will be far less impactful than the second wave, which had hit India with an intensity that was perhaps unforeseeable. This definitely comes as a breather for the people of the country.

Speaking about the hospitalisation requirements during the third wave, Professor Manindra Agarwal has further estimated that approximately 2 lakh beds will be required when the third wave is at its peak in the month of March. He said that during the Delta wave, about 1 in 5 reported cases required hospitalization in India whereas during the omicron variant driven Covid third wave it can be assumed that 1 in 10 cases may require hospitalization in India.

He further stated that, unlike South Africa, the omicron variant does not appear to have much of an impact on India at the moment. There is no indication of a lock down. However, a complete assessment can be established only after the variant spreads widely in India. Speaking about the rapid spread of the omicron variant which has pushed the UK into a state of emergency, Dr Agarwal was of the opinion that in the United Kingdom, though there is more vaccination (mainly mRNA vaccine) in terms of numbers, the seropositivity is lower. While in India, vaccination rates have risen, so has the seropositivity. He said that apart from vaccination, natural immunity has also developed in many people. In such a scenario, though India will experience the third wave, it will be less frightening than the delta variant driven second wave. It may be noted that earlier, Prof Agarwal had predicted that the omicron wave in South Africa would peak anywhere between 18 to 23 December. He had, however, advised waiting a few more days.

It may be recalled that in August Prof Agarwal had said that the third wave of coronavirus would arrive in a highly unlikely scenario that is only if a new virus strain emerges. Besides, by applying his mathematical model, SUTRA, Prof Agarwal had predicted the trajectory of the second surge in infections. He had predicted that the situation would worsen in May 2021, and rightly so, the second wave of Covid was at its worst during May this year with India recording its highest-ever surge of 4.14 lakh Covid cases in a single day.

4 The Night Cerfew

4.1 Uttar Pradesh

From December 25, 2021, through January 1, 2022, the state of Uttar Pradesh was under a nighttime curfew from 11 p.m. to 5 a.m. Numerous other limits, such as the number of guests allowed at weddings and the location of gatherings, are also in place to stop the spread of variants. This was a crucial step in the fight against the omicron virus.

4.2 Assam

Himanta Biswa Sarma-led Assam government also imposed night curfew. Government also applied curfew on all the business work places, commercial places, offline food delivery systems, Hotels, Mall, restras, coachings and many other places.

4.3 Maharashtra

Maharashtra govenment also revised the guidelines and imposed night curfew on the concern of severe cases appeared in the state, which was a really effective way to prevent and outbreak the chain of virus in such a overpopulated state. Although it was a tough decision but night curfew and weekends off builds the state again on line.

4.4 Rajasthan

The Rajasthan government also took action and imposed curfew from 11 pm to morning 5 am. The total cases reached 1100 on Dec 4, 2022 in which 745 are of Jaipur only .

The public awareness and uses of masks is also essential for breaking the chain.Also if lock down is applied than it should be in small gaps.

5 The Progression of SUTRA model

We develop equations guiding the pandemic's evolution based on the aforementioned categories. Additionally, by dividing all categories by the population of the area under study, all values fall within the satisfying range of 0 and 1:

$$S+U+T+R_U+R_T=1 \tag{1}$$

The last term A for SUTRA stands for Approach.

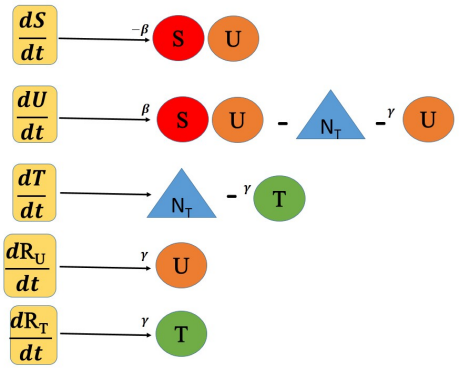


Fig. 5: The progression of SUTRA model

The governing equations for the pandemic [29] are:

$$\frac{dS}{dt}=-\beta SU \tag{2}$$

$$\frac{dU}{dt}=\beta SU-N_T-\gamma U \tag{3}$$

$$\frac{dT}{dt}=N_T-\gamma T \tag{4}$$

$$\frac{dR_U}{dt}=\gamma U \tag{5}$$

$$\frac{dR_I}{dt}=\gamma T \tag{6}$$

where γ is the average clearance rate and β is the typical likelihood that an infected person will spread the disease to another, setting $N_T=\varepsilon\beta SU$

Letting $I=U+T, R=R_U+R_T$, the model becomes the standard SIR model.
Compare equations for U and T, we get

$$\frac{dU_I}{dt}+\gamma U=\beta(1-\varepsilon)SU \tag{7}$$

$$\frac{dT_I}{dt}+\gamma T=\beta\varepsilon SU \tag{8}$$

The last two equations are linear differential equation and their solutions are given by

$$\frac{d(T-\varepsilon U)}{dt}=-\gamma(T-\varepsilon' U), \varepsilon'=\frac{\varepsilon}{1-\varepsilon} \tag{9}$$

Therefore

$$T=\varepsilon' U+\alpha e^{-\gamma T} \tag{10}$$

In the similar manner, we can get

$$U+R_U=\frac{1}{\varepsilon'(T+R_T)}+c \tag{11}$$

Hence the solutions for N_T is given by

$$N_T=\beta\varepsilon SU \tag{12}$$

$$=\beta(1-\varepsilon)ST \tag{13}$$

$$=\beta(1-\varepsilon)(1-U-T-R_U-R_T)T \tag{14}$$

$$=\beta(1-\varepsilon)(1-c-\frac{T+R_T}{\varepsilon})T \tag{15}$$

$$=\beta(1-\varepsilon)(1-c)T-\beta(1-\varepsilon)\frac{T+R_T}{\varepsilon}T \tag{16}$$

Which finally concluded the fundamental form of SUTRA model as

$$T'=\frac{1}{\beta(1-\varepsilon)(1-c)}N_T'+\frac{1}{\varepsilon\rho(1-c)P_0}(T'+R_T')T' \tag{17}$$

$$T'=bN_T'+\frac{e}{P_0}(T'+R_T')T' \tag{18}$$

where $b=\frac{1}{\beta(1-\varepsilon)(1-c)}$ and $e=\frac{1}{\varepsilon\rho(1-c)}$.
The values of the used parameters according as [29] are given below:

Table 1: Meaning of parameters

Parameters	Meaning	value
β	Contact rate, governs speed at which people get infected	0.33
γ	Removal rate, governs speed at which infected people get removed	0.1
η	Mortality rate	0.0012
ε	Ratio of detected to total infections	0.027
c	Constant connecting R_T to R_U	0.5
ρ	Reach of the pandemic	89.5

5.1 Iterations

The iteration of the governing equations are as:

$$(\frac{dS}{dt})_n = -\beta S_{n-1} U_{n-1} \tag{19}$$

$$(\frac{dU}{dt})_n = \beta S_{n-1} U_{n-1} - N_{T_{(n-1)}} - \gamma U_{n-1} \tag{20}$$

$$(\frac{dT}{dt})_n = N_{T_{(n-1)}} - \gamma T_{n-1} \tag{21}$$

$$(\frac{dR_U}{dt})_n = \gamma U_{n-1} \tag{22}$$

$$(\frac{dR_I}{dt})_n = \gamma T_{n-1} \tag{23}$$

And the solution range is given by

$$T_n = \varepsilon' U_{n-1} + \alpha e^{-\gamma T_{n-1}} \tag{24}$$

$$U_n + R_{U_n} = \frac{1}{\varepsilon'(T_{n-1} + R_{T_{(n-1)}})} + c \tag{25}$$

and the fundamental form is given by

$$T'_n = bN_{T'_{(n-1)}} + \frac{e}{P_0}(T'_{n-1} + R_{T'_{(n-1)}})T'_{n-1} \tag{26}$$

Now as the omicron cases arises in the month of Dec 2021, the syudy of the dynamics of various models like SIR, SEIR, SEIQDR with the comparison of SUTRA models in terms of positive cases found and recovered in India are given in the figure from Dec 2021 to Feb 2022. From time period Dec 2021 to Feb 2022, the values of these parameters and the initial values $S_0 = 445963$, $U_0 = 398563$, $T_0 = 12653$ according to [29].
On putting these values in the fundamental form, we get$b = -0.168$ and $e = 0.00058$ and drift time perioud for 3 months so

$$T'_n = (-0.168)N_{T'_{(n-1)}} + \frac{0.00058}{3}(T'_{n-1} + R_{T'_{(n-1)}})T'_{n-1} \tag{27}$$

This gets the fundamental form of SUTRA model as any iteration with the solution range for first iteration is given as

$$T_1 = \varepsilon' U_0 + \alpha e^{-\gamma T_0} \tag{28}$$

$$U_1 + R_{U_1} = \frac{1}{\varepsilon'(T_0 + R_{T_0})} + 0.5 \tag{29}$$

which obviously shows that $0 < |T_n| < 1$, as n is taken large, so it gives less and less error than the dynamics results of SIR, SAIR, SEIR and SEIQDR models as the parameters taken to the drift time period. Basically SUTRA model gives more approx results in the study of the dynamics comparison to other models. Probably this is the first model that can estimate values of all parameters only from daily reported infections and deaths data and also provide an excellent understanding of the past and future projections up to medium term, assuming that parameters do not change significantly. So its very significant to the contemporary zone.

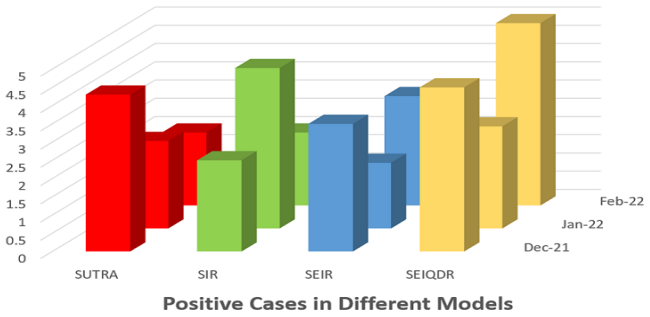
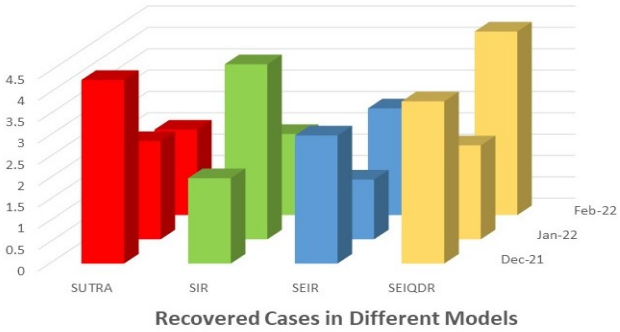


Fig. 6: Comparison of different models for Positive cases



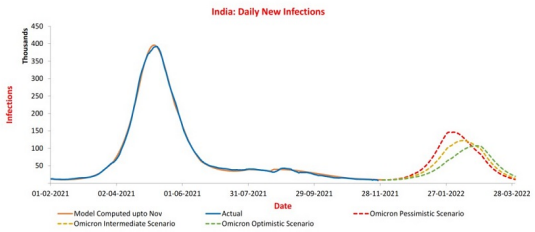


Fig. 8: India Omicron data

6 Conclusion

We can infer that the Omicron variant is less damaging for Indians assuming the convergences stated above have taken place. The numbers also show how well the

SUTRA model predicts original data in contrast to other fundamental models. The graph of the total rise and decay of this variety in India is shown. The reasons are simple since this varient came to India after the completion of 80% of vaccination, and till that, people got immunised, as well as after the second wave, people understood and followed the hygiene.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Acknowledgement

This study is supported via funding from Prince Sattam bin Abdulaziz University Project number (PSAU/2023/R/1444). The authors are thankful to the Deanship of Scientific Research at University of Bisha for supporting this work through the Fast-Track Research Support Program.

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