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Second Wave on Indian Covid-19 Pandemic Vaccination Strategy Outbreak and Oxygen Crisis with Mathematical Models

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ABSTRACT

The second wave spread on Indian COVID-19 pandemic with vaccination current strategy and Oxygen crisis little bit is identified. We discussed some basic ideas of Mathematical models in COVID-19. We focused Mathematical modeling of COVID-19 in current situation and four COVID-19 model examples are given in this paper. It’s very helpful for mathematical modeling in biology and other researchers for COVID-19.

Keywords: COVID-19, Nonlinear ODE, Mathematical Models, Vaccination control, Oxygen Crisis.

1. INTRODUCTION

Infectious diseases are common to affect the humans and animals. Many of the disease are

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spread from animal to human, like Cholera, Anthrax, Malaria and Blake. Also with use of respiratory droplets many disease may be transfer directly from person to person [1]. In particular the respiratory system is good in our body then we may be away from the cause of virus. Commonly main virus spreader in the world is Mosquitoes, s Malaria and Cholera are seasonable diseases for humans [2]. But some of the diseases are controlled by vaccine, antiviral drug, and antibiotics. We consider some control strategies for a particular disease like Corona virus disease (COVID-19), since the control strategies are essential to know the features. Mathematical modeling is very useful to find out the control strategy of possible disease for humans and also the important aspects of disease are focused [3]. Here the basic reproduction number R_0 is the very important threshold quantity. We have two main compartments such as, infected and susceptible [4]. Where the infected individuals has disease but the susceptible individuals are in healthy and may be they have a disease. So the particular disease depends on many variables then we find out the value of R_0. We mainly discussed that how we find out the basic reproduction number R_0 in different ways and how we find another reproduction number may be used in control strategy [5].

The new Corona virus is identified in China at January 2019, it spread in Wuhan, Hubei province, China [6]. The Chinese scientists and experiences in medical department are identifying the Corona virus disease (COVID19) on January 2019. They declared, this is the most dangerous virus and it is more than Severe Acute Respiratory Syndrome (SARS), Middle East Respiratory Syndrome (MERS) [7]. The main problem of this virus is strictly invisible virus. Since SARS affected humans are may cause of kidney failure and even death but Corona virus disease (COVID19) affected a human we unable to identify since the cause is most common for all like throat infection, breathing [8]. The spread of Corona virus disease (COVID-19) is from human to human is common, but it takes some time‘t’ days. So that more than 1.6 billion peoples are affected otherwise the whole world will be an empty that is without humans because of this virus [9]. Such as a quarantine time period we try to control the spread of the virus from an infected person to a person. The spread of this virus is very high in high populated countries [10]. In this case the infectious disease is appropriate so we use the boiler model and we discuss the local stability of the disease free model and in endemic equilibrium then we test the global stability of the model [11].

We know all the transformable disease are endemic there for we use an compartment model

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to find the basic reproduction number R_0 [12]. The basic reproduction number R_0 will decide the death of humans and animals. In this mathematical model, we have studied the $R_0<1$, $R_0>1$, and $R_0=1$ [13]. We discuss the three category and we try to reduce the death of human. We study a detailed and in depth of reproduction number R_0. Optimally control the Malaria with use of asymptotic if the infection is heavy. In the entire epidemic model the R_0 may play a main role in global stability analysis [14].

A mathematical model in MERS – Corona virus in control strategy with stability analysis and also we use study a optimal control of this model [15]. The abstain strategies in the epidemic disease model for Ebola virus in stability analysis [16]. The spread of an epidemic model is control then transmission is less in human to human. So the social epidemic model is optimally controlled one [17]. In the entire epidemic model the novelty is important so that we discuss the novelty in our model in the emergency situation of COVID-19. The most of the deaths are confirms due to the new Corona virus disease (COVID-19) in India and all other countries in the world [18].

The Corona virus disease (COVID-19) is called a novel Corona virus (2019–nCoV) and also called SARS-CoV [19]. The Corona virus disease (COVID-19) may spread from human to human and may be from animal to human. So we suspect the virus may spread because of bat with outbreak of pneumonia [20]. Corona virus disease (COVID-19) spread and transmission is high in Wuhan, China [21]. So that most of them are infected in Wuhan by Corona virus disease (COVID-19). We study spread of Corona virus disease (COVID-19) in Wuhan is control (or) not. Corona virus disease (COVID-19) is prevented but we try to recover the humans from this infectious Corona virus disease (COVID-19) with use of clinical methodology [22]. Phase based transmission model is help to recover the human from Corona virus disease (COVID-19) [23].

Using ordinary differential equation with fractional derivative operator of a mathematical model, we find the stability analysis of this model with use of numerical methods. In initial stage it means January 2019 the Corona virus disease (COVID-19) widely spread in high populated country [24]. We study a simulation of mathematical model of a pandemic Corona virus is highly spread in Wuhan, China [25]. Fever is a main symptom for Corona virus disease (COVID-19). But we know that the fever may be an ordinary fever a Typhoid fever.

If a person affected by Corona virus disease (COVID-19) and he may be affected by HIV/AIDS. So the transmission of virus from a human to human is complicated. Because he (or) she spreading Corona virus disease (COVID-19) and HIV/AIDS [26].

2. VACCINATION STRATEGY OUTBREAK AND OXYGEN CRISIS

As on date 02.05.2021, totally affected 1186344, 147 persons were died, others in account of 14193. The lots of people lives lost form Oxygen crisis with the supply were disrupted. Here it takes more time those who died. If the failed to supply the 490 metric tons of Oxygens, as per day distribution. As per direction of central government, it is to ensure that NCT of positively given the statement. After that all private hospitals begin Vaccination for COVID-19 at 18+. Nowadays the vaccinations were opened to all above the 18 years old. The death ratio crossed 200000 in COVID-19 cases. It is universal inoculation; vaccination is compulsory who are 18+. Vaccine is equitable and people hit by this pandemic. It is better for the age group between 18 and 44 ages group only. Different prices are fixed the vaccination, like I don’t know, may be 300 to 600 rupees in Indian money. Better it will be decreased the amount for vaccine cost. There are three important points in vaccination, such as, vaccination supply chain, deliver to vaccine, and cost of the vaccine. It is not possible to vaccinate for 700 million people in over0-night.

The people got lots of doubts in vaccination, such as heisted for vaccination, why they pushed to people, vaccine testing results, it is working or not. Unfortunately, vaccine supply was very less. It is not enough for all peoples. The triaging center opened in Chennai. Daily it is capable for 1000 patients to tertiary care hospitals, COVID-19 care centers and home isolation.

Figure 1 COVID-19 Vaccine image-1 from google images

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Figure 2 COVID-19 Vaccine image-2 from google images

Figure 3 COVID-19 Vaccine image-3 from google images

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Figure 4 COVID-19 Oxygen cylinder image-4 from google images

Figure 5 COVID-19 Oxygen cylinder image-5 from google images

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Figure 6 COVID-19 Oxygen mask image-6 from google images

3. MATHEMATICAL MODELING OF COVID-19

The World Health Organization recommended that mathematical modeling can be the best method for providing the right health based decision. Moreover, it has been devised as a timely requirement. Indeed, modeling has given effective understanding to those who are doing the study on COVID-19 such as how this disease gets transmitted and how effectively the number of cases increased during the infectious period [27].

During the course of infection, it's effects is so severe having the extreme power. International mathematical experts have accepted to design mathematical model for the dynamics of transmission and current outbreak of corona virus. Many of the models have been done with different estimated values till today [28].

By using daily based real time data, Biao Tang. et al explored the dynamics transmission model for COVID-19 and re-estimated a reproduction number, by which transmission risk can be assumed. We extend the work of Tian-Mu Chen. Et al. they developed a four

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compartmental network model such as Bats-Hosts-Reservoir-People respectively for simulating the infection source to human infection. They simplified by excluding bats and hosts into RP model to find R_0.

In the BHRP transmission network model, it is assumed that initially, the virus got transferred among the bats, and then, the virus was transferred to strange hosts which are assumed as wild animals [29]. Hunting the assumed wild animals, the hunters brought them to the seafood market which has been defined as the reservoir of the virus. Whoever goes to the market exposed to the risks of the infection?

$$\frac{dS_X}{dt} = \varphi_X - d_X S_X - \beta_X S_X I_X$$

$$\frac{dE_X}{dt} = \beta_X S_X I_X - \mu_X E_X - d_X E_X$$

$$\frac{dI_X}{dt} = \mu_X E_X - \left(\alpha_X + d_X\right) I_X$$

$$\frac{dR_X}{dt} = \alpha_X I_X - d_X R_X$$

$$\frac{dS_Y}{dt} = \varphi_Y - d_Y S_Y - \beta_{XY} S_Y I_X - \beta_Y S_Y I_Y$$

$$\frac{dE_Y}{dt} = \beta_{XY} S_Y I_X + \beta_Y S_Y I_Y - \mu_Y E_Y - d_Y E_Y$$

$$\frac{dI_Y}{dt} = \mu_Y E_Y - \left(\alpha_Y + d_Y\right) I_Y$$

$$\frac{dR_Y}{dt} = \alpha_Y I_Y - d_Y R_Y$$

$$\frac{dS_P}{dt} = \varphi_P - d_P S_P - \beta_P S_P \left(I_P + rF_P\right) - \beta_C S_P C$$

$$\frac{dE_P}{dt} = \beta_P S_P \left(I_P + rF_P\right) + \beta_C S_P C - \left(1 - \gamma_P\right) \mu_P E_P - \delta_P \mu'_P E_P - d_P E_P$$

$$\frac{dI_P}{dt} = \left(1 - \gamma_P\right) \mu_P E_P - \left(\alpha_P + d_P\right) I_P$$

$$\frac{dF_P}{dt} = \gamma_P \mu'_P E_P - \left(\alpha'_P + d_P\right) F_P$$

$$\frac{dR_P}{dt} = \alpha_P I_P + \alpha'_P F_P - d_P R_P$$

$$\frac{dC}{dt} = eC \frac{I_Y}{N_Y} + \rho_P I_P + \rho'_P F_P - \delta C$$

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4. Mathematical Model 1

Based on the model, Infectious Exposed (E) and Infectious (I) are zero in SEIR model. If we apply to the given COVID-19 equation, we get the disease free equilibrium points [30]. Suppose all components are not equal to zero we get the endemic points .we evaluate the Eigen values from the Jacobian matrix and we substitute the equilibrium point in the system. Then all the Eigen values are negative the analysis of the system is globally asymptotically stable. By using the Lyapunov techniques, the local and global stability of equilibrium points are investigated. Also we discuss the sensitive analysis and reproduction number R_o. The numerical solutions are derived to calculate the real life data using MATLAB. Our system of COVID-19 equations is valid (or) not, when we compare the real life data for validates the theoretical outcome. Let us consider the system of non-linear ordinary differential equations is as follows:

$$\frac{\mathrm{dS}}{\mathrm{dt}} = A - \beta \frac{SE}{N} - \mu S$$
$$\frac{\mathrm{dE}}{\mathrm{dt}} = \beta \frac{SE}{N} - (\mu + \alpha + \theta)E$$
$$\frac{\mathrm{dI}}{\mathrm{dt}} = \alpha E - (\mu + \alpha + \delta_1)E$$
$$\frac{\mathrm{dH}}{\mathrm{dt}} = \lambda I - (\mu + \gamma + \delta_2)H$$
$$\frac{\mathrm{dR}}{\mathrm{dt}} = \gamma H + \theta E - \mu R$$

Moreover the analysis of the above equation organized as positivity of the solution and stability analysis of local and global sensitivity analysis of R_0, with Lyapunov function is used to identify the above model is locally asymptotically stable (or) globally asymptotically stable.

5. Mathematical Model 2

Let us consider the current COVID-19 model given by below:

$$\frac{dS}{dt} = A - mS - \beta S(I + KA) - \beta SW$$
$$\frac{dE}{dt} = \beta S(I + KA) + \beta SW - (1-\delta)\omega E - \delta\omega E - mE$$
$$\frac{dI}{dt} = (1-\delta)\omega E - (\gamma + m)I$$
$$\frac{dA}{dt} = \delta\omega' E - (\gamma' + m)A$$

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$$\frac{dI}{dt} = \gamma I + \gamma' A - mR$$

$$\frac{dW}{dt} = \mu A + \mu' A - \varepsilon W$$

We derived the above equation such as equilibrium analysis and reproduction number R_0. We obtain phase based transmission model for spreading COVID-19 Pandemic throughout the world. Our model is common to all countries (or) world. It can be extended the same model to other countries, like Indian Pandemic. We estimated highly affected areas Delhi, Karnataka, Maharashtra, Tamil Nadu and Andhra. This model is useful for new researchers of COVID-19 model and society [31]. Finally we decide the system of COVID-19 equation valid (or) not from current real life data in World Health Organization. All data are available in current pandemic situation 2020.

6. Mathematical Model 3

The mathematical model COVID-19 is organized as follows:

$$\dot{S}(t) = -S(t)[\alpha I(t) + \beta D(t)] + \gamma A(t) + \delta R(t)$$

$$\dot{I}(t) = S(t)[\alpha I(t) + \beta D(t)] + \gamma A(t) + \delta R(t) - (\varepsilon + \zeta + \lambda) I(t)$$

$$\dot{D}(t) = \varepsilon I(t) - (\eta + \rho) D(t)$$

$$\dot{A}(t) = \zeta I(t) - (\theta + \mu + \kappa) A(t)$$

$$\dot{R}(t) = \eta D(t) + \theta A(t) - (\nu + \xi) R(t)$$

$$\dot{T}(t) = \mu A(t) + \nu R(t) - (\sigma + \tau) T(t)$$

$$\dot{H}(t) = \lambda I(t) + \rho D(t) + \kappa A(t) + \xi R(t) + \sigma T(t)$$

$$\dot{E}(t) = \tau T(t)$$

In our proposed model has eight non linear differential equation, we use three important compartment in our model, such as susceptible five infected compartment, recovery and death compartment.

7. Mathematical Model 4

The parameter values are estimated from current COVID-19 data for Indian pandemic. Let us consider the COVID-19 equation given as.

$$\frac{d^{\tau}S}{dt^{\tau}} = \Delta - \lambda S - \frac{\alpha S(I+\beta A)}{N} - \gamma SQ$$

$$\frac{d^{\tau}E}{dt^{\tau}} = \frac{\alpha S(I+\beta A)}{N} + \gamma SQ - (1-\phi)\delta E - \phi\mu E - \lambda E$$

$$\frac{d^{\tau}I}{dt^{\tau}} = (1-\phi)\delta E - (\sigma+\lambda)I$$

$$\frac{d^{\tau}A}{dt^{\tau}} = \phi\mu E - (\rho+\lambda)A$$

$$\frac{d^{\tau}R}{dt^{\tau}} = \sigma I + \rho A - \lambda R$$

$$\frac{d^{\tau}Q}{dt^{\tau}} = kI + vA - \eta Q$$

8. CONCLUSION

In this paper, we have to discuss only mathematical modeling of COVID-19 and some four examples are given for other mathematical models of COVID-19. It is very useful mathematical modeling area and other medical research. These types of nonlinear ODE analysis were good for current situation reports and identify the cure rate and disease spread. Also we explained the current vaccine strategy and Oxygen crisis of India.

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