Usage of Mathematical tools in covid-19

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ABSTRACT

In 2019, a deadly COVID-19 outbreak engulfed the world, killing thousands and the world need solution for this problem and then mathematicians all over the world are helping to understand the Covid-19 epidemic by collaborating with experts such as microbiologists and virologists on mathematical methods that account for the different situations in different countries. Mathematical functions can be used to capture the behavior of how infectious diseases spread among humans. Mathematical modeling creates a visual representation of the disease's dynamics in the form of graphs, charts, and comparative tables. Covid-19 show us to prepare socioeconomic structures for future shocks, a resilience-based systems approach is proposed which is possible by mathematics. In this paper we discuss about the usage of mathematics to identify the behavior of virus, spreading of virus, vaccination, best tools to assess the data and prediction of the situation in corona virus pandemic.

Keyword: covid-19, mathematical tools, use of mathematics.

Introduction: The outbreak of the corona virus sickness has caused a great deal of suffering around the world**.** It had rapidly escalated into a pandemic, with an estimated 475 million instances of illness and more than 6.1 million deaths globally. Since the onset of COVID-19 transmission in late January, mathematical modeling seems to be at the core of guiding decisions about non-pharmaceutical actions to limit the virus' spread in the UK. Mathematical modeling is a great way to understand Covid-19 transmission and experimenting with different scenarios. However, rather than concentrating on which model is valid, we must accept that "one model cannot answer all questions." Mathematical modeling allows researchers to analyze the effects of these therapies and develop successful COVID-19 containment strategies. Researchers from India's Indian Institute of Science (IISc.) and Australia's Queensland Brain Institute (QBI) have developed a mathematical model that predicts how COVID-19 vaccination antibodies confer protection from symptomatic illnesses. Nature Computational Science published the research.

Geometry points to corona virus drug target:

It is critical to get knowledge into the virus's evolution and pathology in order to curb the continuing COVID-19 epidemic. When a virus infects your cells, your body undergoes changes. The pathogen, on the other hand, changes form in the process. A new mathematical model suggests the sites on the virus where shape-shifting occurs, giving a new technique to locate treatment and vaccination targets. The novel math-based method has already discovered potential targets in the COVID-19-causing corona virus. Primary virus- and host-based targets that can lead medicinal chemistry research to find novel treatments for this deadly disease and these targets has been discovered from the shape of the virus. Geometry was used to find the information about the virus. Carl Friedrich Gauss, a German mathematician, demonstrated in the 19th century that any unique rotation of three-dimensional space can be described by stating the axis around which it rotates and the quantity by which it rotates, each rotation represents vector. These arrows form a 3-D ball when combined. However, previously unknown locations found using this technology may prove to be attractive therapeutic targets. By these type of methods we conclude the target for vaccine to get effective results.

Math of social distancing:

It may appear that only a mathematician would be interested in sphere packing. Who wouldn't be captivated by the notion of working out the optimum way to arrange circles in space or spheres in the plane? After Covid -19, individuals adopted a new way of life known as social distance. The first line of defense for limiting an infectious disease like COVID-19 is social distance, which is defined as steps made to reduce physical contact. In the early stages of a pandemic, social distancing treatments are critical since they are the only measure assured to be available against a novel variant of influenza. Simulations were utilized in one study to evaluate the scope and timeframe of social distancing necessary measures to avert a pandemic. In social

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Measures	Impact
1. Closing of school and colleges	Teachers and students were at their homes
2. Closing of cinema hall and restaurants	Reduction in community contact
3. Work at home	Individual reduction of physical contact

Table 1

What's obvious is that social distancing was more successful when adopted quickly—the final sickness attack rate increased the fastest after the third week. These results are similar to the visualizations in today's info graphic, which highlight how quickly an illness can spread. The second way is to implement the social distancing (i.e. 2m apart from each other) after lockdowns. Maintaining social distance while working in the same places was a challenge for everyone and the answer to this challenge was geometry. Usage of geometry varies according to the shape and requirement of the situation.

Data Assessing by mathematical tools:

"Data scientists are increasingly doing more epidemiology work than doctors," Laxminarayan says. In the early stages of an outbreak, most viruses are expected to triple rapidly and grow exponentially. Pandemic curves can be mathematically examined in this way, and the trajectory of the increasing infection can be sketched based on the number of cases in time units like days, weeks, or months. The logistic function curve corresponds to the pandemic's progression through time, with an initial exponential spike and subsequent flattening as the population obtains herd immunity. Infectious disease epidemiology has become more reliant on these models, which extrapolate from existing data to forecast the evolution of an outbreak. To handle a simple optimal growth problem, the Verhulst–Pearl equation is a legitimate and useful method. Unlike complicated mathematical models that improve accuracy, this equation simplifies the analysis for a layperson. The formula's accuracy in long-term forecasts is debatable in verhulst equation, while SIR model was more relatable for long term forecasts.

Statistics and Probabilities:

In this global pandemic, statistics and probabilities were essential tools for identifying the issue and forecasting the response. Probability played an important role in estimating the result of the situation, for example, if we talk about the number of cases increasing per day and find the probability of increasing numbers of cases then we could get ready for the situation. Proper tables and graphs gave us clear idea about the current situation which helps to predict the probabilities to make us ready for the consequences. The various crises—a health crisis, an economic collapse, and a drop in commodity prices—were estimated using data, which interacted in intricate ways. By the help of statistics we conclude that GDP of many countries have been dropped drastically as shown in table 2.

S.no	Country	GDP growth in % in 2020
1.	China	2.27
2.	Pakistan	-0.38
3.	South Korea	-0.95
4.	Nepal	-1.87
5.	Australia	-2.43
6.	Russia	-3.05
7.	Japan	-4.83
8.	India	-7.96

Table 2

Over 170 countries per capita income is expected to decline. In 2021, advanced economies, as well as emerging market and developing economies, are likely to recover to some extent. It does, however, illustrate the magnitude of anticipated global economic suffering, particularly for developing countries and their possible need for aid.

Vaccination:

In the present pandemic, Covid-19 vaccinations have proven a game-changer. Several vaccine candidates have shown to provide significant levels of protection in clinical trials, with some reducing the number of symptomatic infections by more than 95%. India is home to a whopping 17.7% (139 billion) of the world's population, making vaccine manufacture and vaccination a difficult task in the country. Finally, the Indian government must develop efficient public health measures for mass immunization and avoid crowding people into health-care facilities for vaccination by mathematical models. Figure 1 depicts the model, non vaccinated and vaccinated sub populations are depicted in the top and bottom portions of the picture, respectively. The compartments are represented by boxes, and the arrows show flows between distinct stages of the infection's clinical course. The following are the compartments: Non - infected (U);

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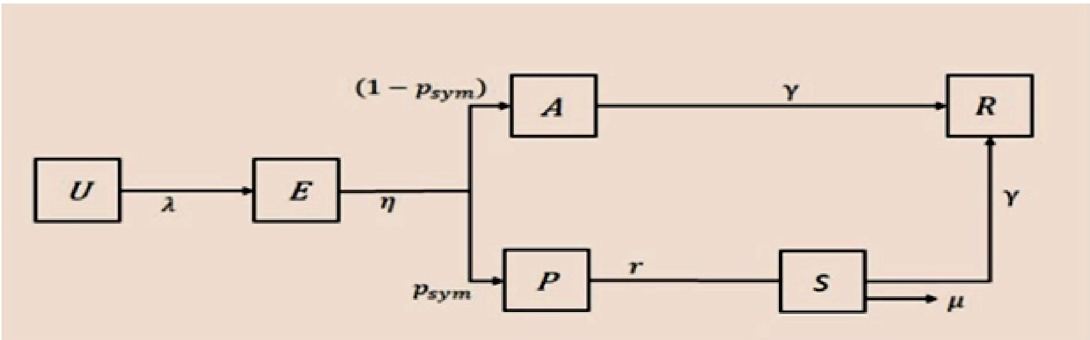
Exposing (E); infectious with no symptoms (A); presence of illness before symptoms (P); symptomatic (S); recovery and immunity (R). The terms c1, c2 denote the efficiency of an infection-preventive and symptomatic disease-preventive vaccination, respectively. The model is stratified by age groups (less than 24 years, 24 to 60 years, and >60 years), as well as complications (diabetes and/or hypertension) and vaccination status as shown in figure 1.



Conclusion:

Math seems to be in the forefront in over the last year as the Covid-19 outbreak has spread is becoming well-known, and a single node can lead to massive infection networks over the world, causing widespread devastation. Mathematics learners will be able to discuss the significance of maths in the current crisis after things have returned to normal, emphasizing the importance of mathematical modeling in government choices. Our methodology, which has been expanded to measure the reduction in transmission owing to the deployment of an unique antiviral nano-coating technology, may be modified to any other high-risk area, which is a significant advantage. It is the best assess tool to implement on the Covid-19 data. Improved accurate disease spread models, as well as ones that are simple to use, are required to establish appropriate responses. From assessing the behavior and geometry to the immunization procedure, a model was applied. Therefore, we conclude that without mathematical models, it was difficult to predict, control and vaccinate people in this pandemic.

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