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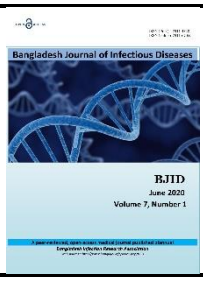


# A Data Driven Model for Prediction of COVID-19 Outbreak in Bangladesh

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## Abstract

COVID-19 disease due to Corona virus of type SARS-CoV-2 has emerged from Wuhan, China in December 2019 and now it has expanded through infection all over the world. Now-a-days, this is a disaster pandemic for almost every nation in the earth. Such novel Corona virus impacts on every country in the world without regarding country's race, nationality and economic status. In this study, an attempt has been made to propose a data driven model to know the present and future Corona virus situation of Bangladesh. It also predicts the cumulative infected people, disease propagation, doubling time and new cases of COVID-19 patients. The result shows that more than two lakh fifty thousand people will be infected by Corona virus and its effect will start to decrease by the mid of July and decline to disappear by the end of August. This study will help policy makers to take plan for healthcare system and management of various aspects related to the control and prevention of Corona virus outspread in Bangladesh. [*Bangladesh Journal of Infectious Diseases, June 2020;7(1):22-26*]

**Keywords:** Covid-19; pandemic; mathematical model

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## Introduction

A new virus introduced in December 2019, is known as the severe acute respiratory syndrome Corona virus 2 (SARS-CoV-2) causing a disease outbreak in China[1]. Such virus SARS-CoV-2 infects people throughout the world and World Health Organization named due to such virus infection a disease called Covid-19. It was first discovered in the city of Wuhan, the provincial

capital of Hupei province in central China, in the middle of 27 December[2]. The Corona virus spreads first Wuhan to great extent in December 2019 and January 2020, then, this terrible Corona virus infection has spread one region to another region, one country to another country since February and now-a-days, it has spread to most of the countries in the world resulting in the ongoing Corona virus pandemics.

Evidence suggests that Corona virus can be transmitted from person to person and has spread people of those countries around the world sharply. Touching hands with eyes, nose and mouth should be avoided, because the virus present in the environment can be touched by touch and can enter the body through the open space of the nose, mouth, eyes[3]. Spitting cannot be done on the streets and in places, because the virus can spread from the spit. This virus can remain dormant for 2 to 7 days after being infected in the body and can be infected with another person's body during this time. For most of the cases, Corona virus infection will cause mild illness like fever, cough and shortness of breath[4]. Other common symptoms may be fatigue, muscle pain, diarrhea, sore throat, loss of smell and abdominal pain[5]. It can make some people very ill and it can be in its worst condition case which is known as fatal. The spread of Covid-19 virus infected all aged people over the world. Generally, the elderly as well as those people who are suffering from pre-existing medical conditions such as cardiovascular disease, diabetes or chronic respiratory diseases are most at risk for severe disease[6]. The harmful effects of the virus have been seen in the elderly and the mortality rate of the people in this group is highest worldwide.

In Bangladesh, the first Corona virus cases were detected on 8 March and then, IEDCR ensured first three Corona virus cases in this country through a press conference[7]. There were two men and one woman, who were aged between 20 and 35 years. Those men were from Italy returnees and woman was a family member of one of them. Again, this country detected three more cases of COVID-19 on March 16, taking the total number of infected people to 8. The first death has been recognized due to Corona virus on March 18.

Due to catastrophe virus spreading pandemic, Bangladesh forced at the same time with other countries take up several measures like compulsory lockdowns, home quarantine, social distancing and local or international flight bans etc. for slowing down the spread. This followed shutting down schools and colleges on March 18 and one week later from March 26, the all offices remain close resulting national lockdown except emergency services. As of April 14, the number of COVID-19 infections was 1012 and that has already spread in 38 districts of 64 districts[5]. Again, the lock down extended up to 30 April. After that all 64 districts have been infected by Corona virus. Due to spread of infection rapidly increased, the lockdown again increased to 30 May considering emergency services as well as limited government offices open. According to Worldometer on 27 May, the total infected cases are 5,709,551 and deaths are 352,753 in the world. In Bangladesh, the infected Corona virus cases are 38,292 and deaths are 544.

However, WHO advised that this transmissible COVID-19 viral disease is currently a significant threat to developing and impoverished country[8]. The reproduction level of this Corona virus is faster in the developing and impoverished countries like Bangladesh. In a study, Imperial College of London model, a projection report says that in Bangladesh, the Corona pandemic can be infected with a total of eight million[9]. From BRAC's research model, it is found that their research model projects Corona virus can kill 5 million people in Bangladesh[10]. Without inventing vaccination or proper treatment, how we control the transmission of the COVID-19 is one of the most admitted burning questions with that people are facing right now. Until such treatments are developed, some policies termed as isolation, quarantine, lockdown, and social distancing would give a stunning direction to control the epidemic outbreak[11].

Furthermore, Bangladesh is the eight most densely populated country in the world, for such high densities, it is difficult task to maintain social distancing, despite closing of educational institutes, offices and markets may contribute considerably to reducing spread, while commuting in crowded public transport.

There is uncertainty when the outbreak of dangerous Corona virus infection will finish as well as lockdown. Needless to say, it is terrible and dangerous and dangerous for Bangladesh in terms of economy, health and social sector. Besides, public healthcare system in Bangladesh is not sufficient, rather is overburdened. In this context, this study proposes a model for outbreak of the growth of COVID-19 Corona virus that fits the real data more perfectly, to understand the growth pattern scenario for the cases and predicts the stability of infected Corona virus cases in Bangladesh.

## Methodology

In this study, the real data in Bangladesh have been extracted from Worldometer. For the analysis of Corona virus in Bangladesh data, we have proposed logarithmic model for projection of the Corona positive case. The equations for the model are given below:

$$Y = bLn(t) + a$$

Here $Y$ is $\left(\frac{n_t}{n_{t-1}}\right)$, $n_t$ is Corona positive cases on $t^{th}$ day and $n_{t-1}$ is Corona positive cases on $(t-1)^{th}$ day and $t$ is the day. When $n_t$ and $n_{t-1}$ are equal then $Y$ will become one. If this value of $Y$ will continue some days then we can assume Corona pandemic is disappear now. In the initial face of the disease spread, the $Y$ increases but after sometime when some preventive measure is being taken then it decreases. Therefore, for the analysis purpose, 20 days data (from April, 16th to May 5th) have been taken from worldometers.info.

**Estimation Procedure:** The least square method is used to estimate the parameter of the above model. Let $X = Ln(t)$ is independent variable and $Y$ is depending on $X$, thus the normal equation for estimating coefficients of the linear equation $Y = bX + a$ is given below

$$\Sigma Y = b\Sigma X + na \quad \text{and} \quad \Sigma XY = b\Sigma X^2 + a\Sigma X$$

Solving the above equations for the considered data discussed above, we can get the estimate of $a$ and $b$. The estimate of $b$=-0.04 and $a$=1.198 has been obtained. Therefore the following equation is used to project cumulative number of Corona positive cases in Bangladesh.

$$Y = -0.04Ln(t) + 1.198$$

Also, let us define the disease propagation is as $r_t = \frac{x_t}{\sum_{i=0}^{t} x_i}$, where $x_t$ is the number of confirm cases on $t^{th}$ day. We have calculated $r_t$ and the doubling time of the disease propagation in Bangladesh. The doubling time is calculate as $\frac{Ln2}{r_t} = \frac{0.693}{r_t}$

## Results and Prediction

Bangladesh is one of the countries who have passed the threshold of 1000 confirmed cases, with many more countries. According to the Corona virus infection, Bangladesh ranked the 22nd country and day by day the cases rapidly increase. The infection crossed over the 100 case mark within 27 days on April 4, this was the dangerous alarming pathways that Bangladesh is likely to experience in future. In this study, first, the exponential and power curves have been fitted for the real data (Figure I). It shows increasing trend and far from the observed data. This is unlikely to fit the data appropriately and this is not suitable to predict the data.

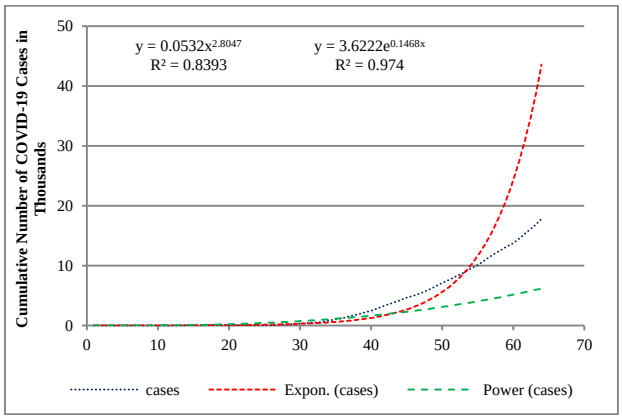


**Figure I: Exponential and Power Curve for the Cumulative Cases of COVID-19**

Now, the proposed logarithmic model has been fitted for the real data for Corona virus cases and it fits well. The observed cases appear very similar to the fitted cases. This model is used for prediction purpose. The result of probable cases for being the onset of COVID-19 was attained based on the ongoing trend of the deadly virus SARS-CoV-2 in Bangladesh. Table 1 shows the observed and the predicted cumulative number of cases and this table also reveals the predicted new cases of COVID-19 up to June, 15th 2020. The model predicts that the total infected people by Corona virus will be more than two lakh and fifty thousand by the end of August, 2020.

The predicted cumulative infected cases were very much resembled with the observed data from May 6, 2020 and onwards (Table 1). The predicted result reveals that the infected new cases will reach highest from beginning of July, 2020 to mid July, 2020. This couple of a week Corona disaster will reach the peak of the graph (Figure II). The infected people with Corona virus will start to decrease after the above estimated time and it disappears

expectedly by the end of August 2020. The maximum number of Corona cases in Bangladesh will be about 3000 per day during the first week of July (Figure II).

The number of predicted cases is very much resembled after a certain time interval with that of the actual number of cases in Bangladesh. The actual prediction gives idea about, "how many people will be affected onset by the following days or the outbreak going to be peak or not in the coming month?" of an epidemic disease from a transmission dynamics based model is quite tough[12]. This is because the transmission dynamics based model is developed foothold on the official clinical surveillance data, which comes through a bureaucratic reporting chain of public health officials and government employees[13] who have to maintain privacy concern owing to geographical resolutions. Moreover, human (host) social behavior[14], potential changes in the pathogen[15] and host-pathogen interaction[16] dominates the epidemic models to a greater extent, while these are continuously change within an epidemic period.

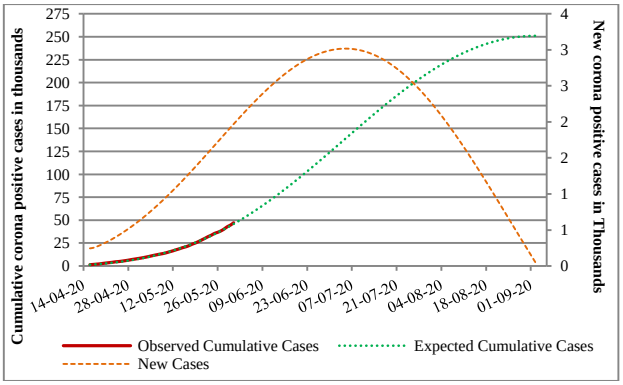


**Figure II: Observed and Expected Number of Cumulative Cases and New Cases of COVID-19**

Another important aspect of this study is that we have calculated disease propagation $r_t$ on the basis of 5 days moving average of daily confirm cases and it is found gradually decreasing in Bangladesh. This indicates the good sign of government attempts to combat this pandemic. Also, we have obtained doubling time of the disease propagation which is increasing (Figure III). These findings indicate that in future the burden of COVID-19 will be expectedly lowering down if the current status remains same.

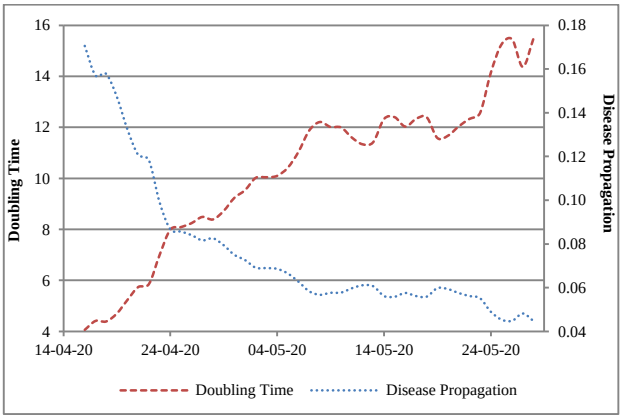


**Figure III: Disease Propagation and Doubling Time in Bangladesh**

**Table 1: Predicted cumulative infected and new infected cases of Covid-19 by date.**

| Date | Cumulative Cases | | Expected New Cases |
|---|---|---|---|
| | Observed | Expected | |
| 16-04-20 | 1572 | 1475 | 244 |
| 17-04-20 | 1838 | 1726 | 251 |
| 18-04-20 | 2144 | 1992 | 266 |
| 19-04-20 | 2456 | 2276 | 284 |
| 20-04-20 | 2923 | 2580 | 304 |
| 21-04-20 | 3382 | 2906 | 326 |
| 22-04-20 | 3772 | 3255 | 349 |
| 23-04-20 | 4186 | 3628 | 374 |
| 24-04-20 | 4689 | 4028 | 400 |
| 25-04-20 | 4998 | 4455 | 427 |
| 26-04-20 | 5416 | 4909 | 455 |
| 27-04-20 | 5913 | 5393 | 484 |
| 28-04-20 | 6462 | 5908 | 515 |
| 29-04-20 | 7103 | 6454 | 546 |
| 30-04-20 | 7667 | 7033 | 579 |
| 01-05-20 | 8238 | 7645 | 613 |
| 02-05-20 | 8790 | 8293 | 647 |
| 03-05-20 | 9455 | 8976 | 683 |
| 04-05-20 | 10143 | 9696 | 720 |
| 05-05-20 | 10929 | 10454 | 758 |
| 06-05-20 | 11719 | 11251 | 797 |
| 07-05-20 | 12425 | 12087 | 837 |
| 08-05-20 | 13134 | 12965 | 877 |
| 09-05-20 | 13770 | 13883 | 919 |
| 10-05-20 | 14657 | 14845 | 961 |
| 11-05-20 | 15691 | 15849 | 1005 |
| 12-05-20 | 16660 | 16898 | 1049 |
| 13-05-20 | 17822 | 17992 | 1094 |
| 14-05-20 | 18863 | 19131 | 1139 |
| 15-05-20 | 20065 | 20316 | 1185 |
| 16-05-20 | 20995 | 21548 | 1232 |
| 17-05-20 | 22268 | 22827 | 1279 |
| 18-05-20 | 23870 | 24154 | 1327 |
| 19-05-20 | 25121 | 25530 | 1375 |

| | | | |
|---|---|---|---|
| 20-05-20 | 26738 | 26954 | 1424 |
| 21-05-20 | 28511 | 28427 | 1473 |
| 22-05-20 | 30205 | 29950 | 1523 |
| 23-05-20 | 32078 | 31522 | 1572 |
| 24-05-20 | 33610 | 33144 | 1622 |
| 25-05-20 | 35585 | 34816 | 1672 |
| 26-05-20 | 36751 | 36538 | 1722 |
| 27-05-20 | 38292 | 38310 | 1772 |
| 28-05-20 | 40321 | 40132 | 1822 |
| 29-05-20 | 42844 | 42003 | 1871 |
| 30-05-20 | 44608 | 43924 | 1921 |
| 31-05-20 | - | 45894 | 1970 |
| 01-06-20 | - | 47913 | 2019 |
| 02-06-20 | - | 49981 | 2068 |
| 03-06-20 | - | 52097 | 2116 |
| 04-06-20 | - | 54260 | 2163 |
| 05-06-20 | - | 56469 | 2210 |
| 06-06-20 | - | 58725 | 2256 |
| 07-06-20 | - | 61027 | 2301 |
| 08-06-20 | - | 63373 | 2346 |
| 09-06-20 | - | 65762 | 2390 |
| 10-06-20 | - | 68194 | 2432 |
| 11-06-20 | - | 70668 | 2474 |
| 12-06-20 | - | 73183 | 2515 |
| 13-06-20 | - | 75737 | 2554 |
| 14-06-20 | - | 78329 | 2592 |
| 15-06-20 | - | 80958 | 2629 |

## Conclusion

At present, the horrific Corona virus caused COVID-19 disease is a serious disaster concern for the outbreak situation in Bangladesh. Day by day, the novel Corona virus is spreading in a huge number of populations in Bangladesh as well. However, Bangladesh has limited resources to face this outbreak. For this reason, it is most important to know when the effect of novel Corona virus is going to start decline and its effect will be negligible. In this context, this study tries to propose a model for the prediction of the total cumulative infected people, new infected people, peak time of disease, declining time, propagation and the time when its effect will be negligible. To know the nature of graph of the study, peak time, declining time of spreading Corona virus, Bangladeshi people should follow WHO guidelines and maintaining social distancing, mask use as well as hand wash after sometimes. People should have the responsibility to make their home as a quarantine place that could decrease spreading the virus rapidly. This strategy can control faster from spreading the virus and protect Bengali nation. This study can help health manager and policy maker to take appropriate policy. Finally, it should be accept that the above observations are a model based observations of the COVID-19 pandemic and the estimates are calculated from available limited information. If several protective measures will not be taken effectively, then this rate may be changed. However, the government of Bangladesh has already taken various protective measures such as lockdown in several areas, make possible quarantine facility to reduce the rate of COVID-19, thus we may hopefully conclude that, Bangladesh will be successful to reduce the rate of this pandemic COVID-19.

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