RESEARCH REVIEW JOURNALS
Volume-05
Issue-05
May-2020

ISSN: 2455-3085 (Online)
RESEARCH REVIEW International Journal of Multidisciplinary
www.rrjournals.com[Peer Reviewed Journal]
DOI: https://doi.org/10.31305/rrijm.2020.v05.i05.010

Detailed Study of Covid-19 Outbreak in India and West Bengal

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ARTICLE DETAILS

Article History
Published Online: 15 May 2020

Keywords
Covid-19, Asansol, SARS, Mutation.

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ABSTRACT

In this article, first we have provided some basic information related to COVID-19 (e.g. its pathogen, its structure etc). In the phylogenetics portion under this section we have tried to discuss over the possibility of one proposed claim of the evolution of the virus. Next, we have presented a detailed statistical picture of the spread in India (up to 10th April) and West Bengal (Up to 9th April) and analyzed the data extensively. In this section, we've discussed whether the spread is in exponential phase or not and what is the rate of spreading. Also, we have presented a discussion over whether we're beating the disease in India as well as in West Bengal or not and presented two graphs by analyzing the data. Thereafter, we have made our inferences and predicted some results about the total number of affected people in future. Finally, we've discussed about the future problems and scope of India in medical field and gave some simple suggestions to people and ended the article.

1. Introduction

As of now, we all have been familiar with the term 'COVID-19', that has proven itself to be a serious challenge to the world not only in terms of Healthcare, Medical Science but also in Socio-economic aspect worldwide. It seems as if the world has paused suddenly and is still finding its way out to come out of this sudden pause and restore its own rhythm and pace. In spite of this grave situation, there is something that looks certainly optimistic and that is the pace of science. It seems suddenly research has shifted to fourth gear and the whole world now, despite of all the cultural and geological diversities, is looking forward to those researches to find a way out of this pandemic. The structure of the virus, the viral genome, its mutations have already been revealed and based on that genetic data and structural data of the virus, researches are going on in different parts of the world to find an infallible vaccine of this disease. Also, many experiments are being conducted to find an immediate potent medicine for the disease. Statisticians are studying and analysing the nature of the spreading of this pandemic and suggesting us how to slow down or completely eradicate the disease. In this article, we have tried to analyse the data of India and West Bengal in a comparative basis from various view points and tried to discuss every single detail related to it.Initially, we have provided the details of the virus (SARS-CoV-2 or, 2019-nCov) – its structure, genome, mutations, phylogenetics and taxonomy etc. In my view, these things are mandatory details so, we decided to mention them. There, in the Mutation and Phylogenetics section, we have provided a critical discussion about the evolution of the virus. Though, we are not a virologist and that is solely my analysis over some logical ground but still we think that this should have been presented in this article. After that, we have entered into rigorous details about the subject (i.e. – comparative study of COVID-19 in West Bengal and India). There we have presented the data we collected, and have analysed the data mathematically with all details. This part covers the nature of this pandemic in India and West Bengal and also there is a comparison between the two. Finally, there has been an inference of the analysis and a brief but important discussion over the Medical System and Medical Science in India. Also, we have added a section in which, we tried to discuss the measures that should be taken by the local people as of now as well as in long term basis in future in this regard. In short, this is what we have covered in our paper.

2. Material and Methods

2.1. Name of the pathogen

COVID-19 is a viral fever and the virus that is causing the disease is named as Severe Acute Respiratory Syndrome CoronaVirus – 2 (in short SARS-CoV-2) [1]. Before the nomenclature it has been provisionally called as '2019 Novel CoronaVirus' (2019-NCoV)[2].

2.2 Taxonomy of sars-CoV-2

SARS-CoV-2 is a particular strain of virus that belongs to the huge family of virus named as Corona virus (it is a beta corona virus (a particular genus of the family))[3]. It is the 7th infectious virus of this family just after the SARS-CoV (which caused SARS) [4]. Other infectious corona virus causes respiratory infection or diseases mostly during seasonal change, but some strains also cause severe diseases like MERS (Middle East Respiratory Syndrome) and SARS (Severe Acute Respiratory Syndrome). COVID-19 is one new name in the list of severe diseases caused by this family of virus.

2.3 Structural Biology

Like all other virus this virus also consists of two parts – capsid and the genetic material. In case of this virus the

genetic material is positive sensed single strand RNA[5]. The RNA strand consists of nearly 30000 base pairs. It is kind of a unique beta corona virus because of the presence of a polybasic cleavage site. This special feature increases the pathogenicity of this virus.[6]On the other hand, its capsid is made up of four kinds of structural proteins – S (Spike), E (Envelope), M (Membrane), N (Nucleocapsid). Out of these four the N protein holds the RNA genome and the other three takes part in building the envelope[7]. Scientists have already revealed the atomic level structure of the spike protein and researches reveal that these spike proteins of this virus have much affinity towards the ACE-2 (Angiotensin Converting Enzyme 2) receptor of human cell so scientists suspected that this receptor may function as a medium for the cell-entry. Later researches from two different team of researchers from China and USA revealed that ACE-2 receptor actually acts as a medium of cell entry[8].

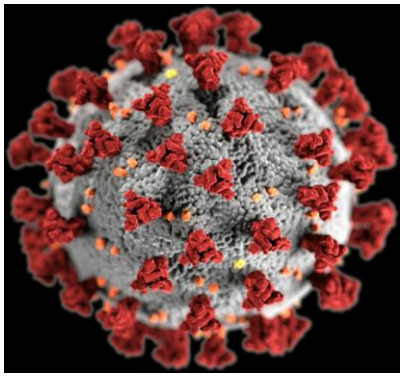

Fig – 01 (schematic diagram of SARS-CoV-2)

2.4 Phylogenetics and Mutation of SARS-CoV-2

Personally, for us this is one of the most interesting parts to discuss about this virus cause when WE first read this part in a site, it caused jaw drop to us. Actually, the virus, which we are calling SARS-CoV-2, have a wide genetic variations among themselves and the number of genomes which has been presently been detected so far (up to the end of the March) is 3160(Up to April 9th)![9](Look at fig – 2) (Although RNA virus is more prone to quick mutation).Well, according to Barsanjit Mazumder (Professor of Cleveland State University), the selection pressure to save the host is one of the main reasons of such mutations. The idea is as follows: Actually, virus can't live without host. So, as soon as the infection spread vigorously a certain population to such an extent that the hospital system of that area gets collapsed and the fatality rate increases suddenly, a huge selection pressure is created on the virus to save the host in order to save itself. Thus, rate of mutation increases. But, according to us this idea is supposed to have two immediate corollaries, as stated below –

If the idea is true, then the places, where the number of cases is quite large as well as the number of casualties is high also, the number of viral genomes present there should also be more.

Well, if you go to the Nextstrain site and check the country-wise data, you will find that this is a true fact (e.g. China, Hong Kong, Italy, USA, UK, Switzerland etc. Also, the notable fact is that Iran is exception)

But at the same time, you will notice in some handful number of places where the infection is not reported to be so much severe yet, also have many variations (e.g. Iceland, Finland etc.).

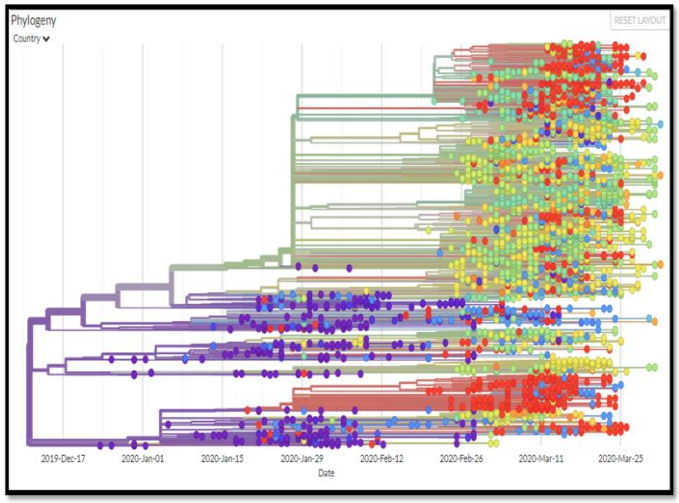

Fig – 2 (the phylogenetic tree of SARS-CoV-2 up to the April 9th)

For those countries, in which the infection rate is still low but number of viral genomes is quite large, We think one possible reason of that may be the inward flow of small number (cause the infection is not severe yet) of affected inhabitants from different parts of the world in their country. The widespread region in which all those genomic variations lie on the phylogenetic tree (i.e., they are phylogenetically not nearer to each; on the contrary quite far from each other in terms of phylogenetics) supports this fact. But still, as WE don't have sufficient data of the inward flow of people in those countries so, WE dare not to come to any clear-cut conclusion. All, WE just want to say, this maybe a reason. Though I'm quite confused about the anomaly in Iran and have no idea to explain this. If the selection pressure to save the host is one of the main reasons for such huge genomic variation then, with the course of time the severity of the infection caused by the new virus should also become weak.

Truly to say, We looked a number of articles on the mutation of this virus and its effect, We were unable to find any report or article that suggests that the infection caused by the mutated new virus is weak. Instead all the articles say, that we don't know yet, whether it is weakening or getting more severe. So, We think we still have to wait to verify this corollary. So, now We come to the details of the statistics and its detailed analysis as well as a comparative discussion of this pandemic in West Bengal and India.

2.5 Data collection

For INDIA (from 1st March) the data has been illustrated in the table to be cited as table.01. After 31st March 1st April is denoted as 32nd day and so on. The data is updated up to 10th April.

Slot Number (Date)	No. of affected people	Log of no. of people	No. of newly affected people	log of no. of newly affected people	No. of recoveries	No. of casualty	No. of new recoveries
1	3	0.47712	0		0	0	0
2	6	0.77815	3	0.47712	0	0	0
3	7	0.8451	1	0	0	0	0
4	29	1.4624	22	1.34242	0	0	0
5	30	1.47712	1	0	0	0	0
6	31	1.49136	1	0	0	0	0
7	34	1.53148	3	0.47712	0	0	0
8	40	1.60206	6	0.77815	0	0	0
9	47	1.6721	7	0.8451	1	0	1
10	62	1.79239	15	1.17609	1	0	0
11	62	1.79239	0		1	0	0
12	74	1.86923	12	1.07918	1	1	0
13	82	1.91381	8	0.90309	7	2	6
14	100	2	18	1.25527	7	2	0
15	114	2.0569	14	1.14613	10	2	3
16	129	2.11059	15	1.17609	10	2	0
17	143	2.15534	14	1.14613	11	3	1
18	169	2.22789	26	1.41497	11	3	0
19	194	2.2878	31	1.49136	17	4	6
20	249	2.3962	55	1.74036	20	5	3
21	332	2.52114	83	1.9108	20	5	0
22	396	2.5877	64	1.80618	21	7	1
23	499	2.6981	103	2.01284	31	10	10
24	536	2.72916	37	1.5682	37	10	6
25	657	2.81757	121	2.08279	40	12	3
26	727	2.86153	70	1.8451	42	20	2
27	887	2.94792	160	2.20412	70	20	28
28	987	2.99432	100	2	81	24	11
29	1024	3.0103	37	1.5682	92	27	11
30	1251	3.09726	227	2.35603	99	32	7
31	1397	3.1452	146	2.16435	120	35	21
32	1998	3.3006	601	2.77887	145	58	25
33	2543	3.40535	545	2.7364	188	72	33
34	3108	3.49248	565	2.75205	229	86	41
35	3671	3.56478	563	2.75051	283	99	54
36	4289	3.63236	618	2.79099	328	118	45
37	4778	3.67925	389	2.68931	382	133	54
38	5351	3.72843	573	2.75815	468	160	86
39	5916	3.77203	565	2.75205	565	180	97
40	6729	3.82795	813	2.91009	635	229	70
41	7600	3.88081	871	2.94002	774	249	139

Table -1 For INDIA from 1st March

For WEST BENGAL (From 17th March) the data has been illustrated in the table cited as table. 02 Up to 16th March number of cases in West Bengal was nil.

(March 1st has been taken as 1 and April 1st is taken as 32 and so on. The data is updated up to 9th April)

Slot Number (Date)	No. of affected people	Log of no. of people	No. of newly affected people	log of no. of newly affected people	No. of recoveries	No. of casualties	No. of new recoveries
17	1	0	1	0	0	0	0
18	1	0	0		0	0	0
19	1	0	0		0	0	0
20	2	0.30103	1	0	0	0	0
21	3	0.47712	1	0	0	0	0
22	4	0.60206	1	0	0	0	0
23	7	0.8451	3	0.47712	0	1	0
24	9	0.95424	2	0.30103	0	1	0
25	9	0.95424	0		0	1	0
26	10	1	1	0	0	1	0
27	15	1.17609	5	0.69897	0	1	0
28	17	1.23045	2	0.30103	0	1	0
29	20	1.30103	3	0.47712	0	1	0
30	26	1.41497	6	0.77815	0	3	0
31	27	1.43136	1	0	3	3	3
32	37	1.5682	10	1	3	3	0
33	53	1.72428	16	1.20412	3	6	0
34	63	1.79934	10	1	3	6	0
35	69	1.83885	6	0.77815	3	6	0
36	80	1.90309	11	1.04139	10	6	7
37	80	1.90309	0		10	6	0
38	91	1.95904	11	1.04139	13	6	3
39	99	1.99564	8	0.90309	13	6	0
40	116	2.06446	17	1.23045	16	6	3

Table-2 For WEST BENGAL from 17th March

2.6 Study Site

We have studied the pandemic in West Bengal, a state of India extensively. Also, we have collected data about the pandemic situation in our country.

2.7 Study Period

We have started collected data about West Bengal and India since 1st March, 2020 when the number of cases in India was only 3 and in West Bengal it was zero and gathered information about both the places throughout the whole month of March and continued collecting data in the month April also.

From the various sources we have collected majority of the data related to the number of affected, recovered or dead people in this pandemic here in India and West Bengal We find the data of WHO and MoHFW, India (Ministry of Health and Family Welfare, India) quite misleading because both of them are showing less number of cases every time (less as compared to the world meters, India covid-19 tracker as well as other media resources.

The data has been collected by checking all the sites at 11.59pm every day. In case where there has been a mismatch in data of different sites the site which was showing maximum number of affected people has been taken.

3. Data Analysis

3.1 Initial Assumption

The very first assumption that has been made before analysing the data is that at initial stage COVID-19 spreads in geometric progression (GP) or rather we should say "Exponentially"[10,11,12,13], as others may have been quite familiar with this term already. All the countries and provinces have followed this exponential trend of spreading in case of COVID-19 at initial stage.

3.2 Another Important Point

Although the spread follows an exponential curve but it can't go on increasing exponentially forever. In later stages the spread definitely reaches an inflection point (it is bound to

reach either due to preventive measures taken by government as well as public or, because the whole population has been exhausted) and its growth rate starts decreasing (i.e. – if y be the total number of cases and t be the time period then (d^2y/dt^2) becomes negative as the growth rate dy/dt is a decreasing function). Overall, the spread curve follows a logistic curve up to the end of the spreading (given that once the spreading stopped there is no further outburst due to other issues). As of now, maximum countries haven't reached the inflection point and still in the exponential phase of the curve (you may view them in WORLDOMETERS site). In case of the countries which have almost healed or about to heal, you will find that they have more or less followed the logistic curve (e.g. South Korea, China, and Italy).

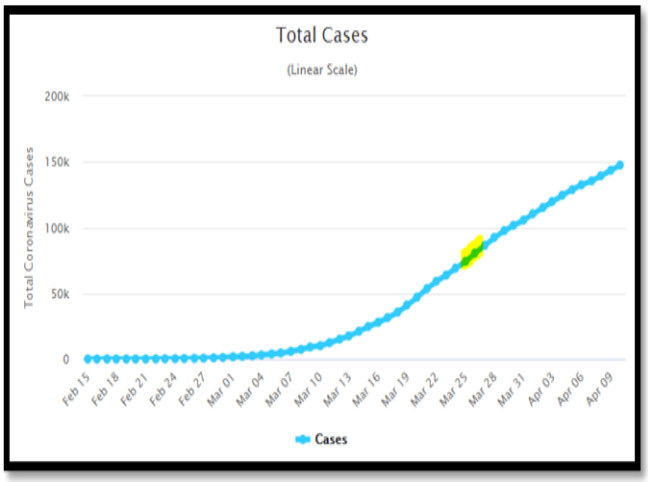

Fig – 3 (spreading curve in Italy. It has reached its inflection point and the growth is gradually slowing down. The inflection point is somewhere in between the yellow colouredregion).

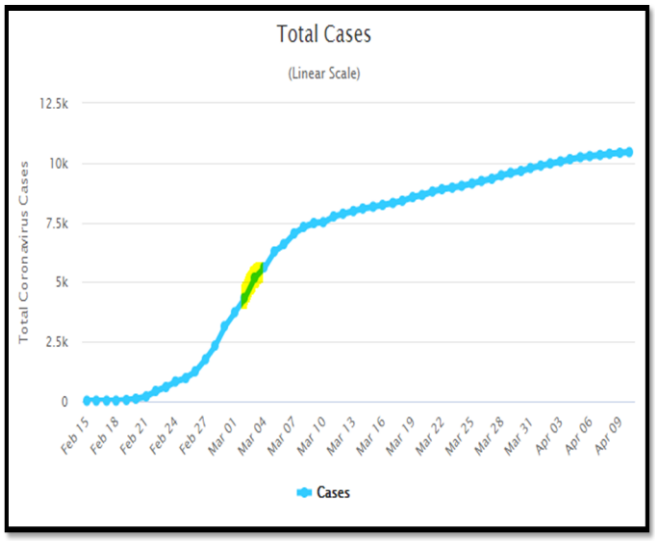

Fig – 4 (spreading curve in South Korea. It has also reached the inflection point and it is somewhere in between the yellow shaded region).

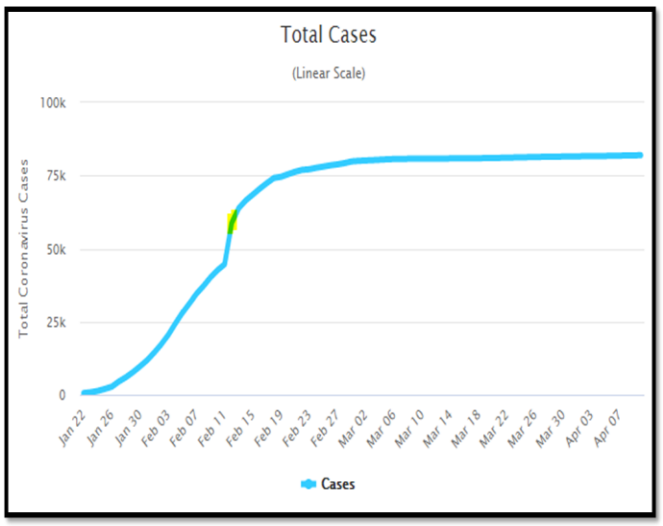

Fig – 5(spreading curve in China. It has also reached the inflection point and it is somewhere in between the yellow shaded region. The sudden increase in the number of cases just before the inflection point is reached is due to the spread of the disease suddenly otherwise the initially an inflection point was reached before).

But when a country or a region is in the exponential phase of the spreading it is difficult to predict when an inflection point is going to be reached or whether the spreading is slowing down or not. This piece of information is important as because we come to know whether the measures taken by government and us (the public) is sufficient or we have to take some more stern steps. So, another part of the analysis of data portion focuses on predicting whether the spread is slowing down in India and West Bengal.

3.3 The Mathematical Analysis of Nature of Spreading

By spreading of the disease, WE have meant the cumulative number of affected people, i.e. - the cumulative number of affected people follows a GP or exponential trend.

Let, the cumulative number of affected people (for now, we are going to say number of affected people) on n^{th} day be t_n. Then, according to the rule of geometric progression, we should be able to express t_n as follows,

$$t_n = a \times r^{n-1} \quad .....(1)$$

where, as we all know, r is the common ratio of the GP series and a is the initial term.

Now if we take log on both sides (base:10) then we have,

$$\log_{10}(t_n)=\log_{10}a+(n-1)\log_{10}r$$

i.e., $\log_{10}(t_n) = (\log_{10}a - \log_{10}r) + (\log_{10}r)\, n$ .....(2)

If one looks at the equation (2) carefully he/she may find that the equation resembles the slope-intercept form of a straight line (i.e., y = c + mx), where number of days (n) have been taken along X axis (independent variable) and log of number of affected people ($\log_{10}(t_n)$) has been taken along the Y axis (dependent variable).

Here, slope = $m = \log_{10}r$ i.e., $r = 10^m$..... (3)

and y-intercept = $c = (\log_{10}a - \log_{10}r)$ i.e., $a = r\times10^c$ .....(4)

Hence, if we plot the data in logarithmic scale and fit the data along a straight line then from the slope and the y intercept of the straight line we can easily find out "a" and "r" in

equation (1). Thus, we will be able to know the nature of spreading of the disease and also will be able to predict the total number of affected people in near future.

WE have plotted the data given in table.01 (i.e., for India) and table.02 (i.e., for West Bengal) in Origin graphing software and fitted it in 1st order polynomial fit. Here's what WE have got –

The picture of India. The logarithmic plot of India (i.e., the data of table.01 is presented in Fig – 06.

(The counting of day starts from March 1st for data of India, i.e. – on 1st March, n=1). The box at the top right corner shows the slope and y-intercept of the computerised fitted straight line of the real curve. The slope of the fitted straight line = 0.07484 (given as B1). The y-intercept of that line = 0.90742 (given as intercept)

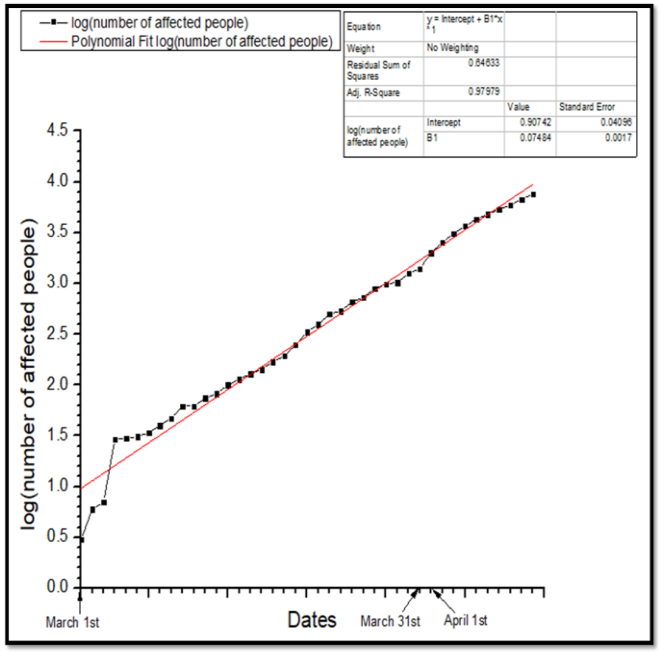

Fig – 06 (Logarithmic plot for India starting from 1st March to 10th April)
The black dots are the real data points of table.01 and the black line is the real curve (as it is just joining the black dots). The red line is the computerised fitted straight line of the data.
(The graph is made in ORIGIN graphing software and the fitted curve is obtained by using 1st order polynomial fit).

r = 1.188064448, a = 9.599751701

As, $r = 10^m$

So, ln(r) = m×ln (10)

i.e., (dr/r) = dm×ln (10) [differential form] .... (5)

i.e., (dr/r) % = (dm×ln (10)) ×100

dm is the standard error of measuring slope (B1 in Fig – 05), i.e. dm = 0.0017.

Therefore, %-age error of measuring r = 0.0017×ln (10) ×100 = 0.39% (approx.)

From equation (5) we can also obtain the absolute error range of measuring r as follows,

dr,=[r × dm × ln(10)]

= 1.188064448×0.0017×ln (10)

= 0.004650553

Hence, r = (1.188064448 ± 0.004650553)

The error in measuring r is quite small as compared to the value of r, hence can be ignored in my view.

Therefore, r = 1.188064448

Similarly, as $a = r\times10^c$

So, ln(a) = ln(r) + c×ln (10)

i.e., (da/a) = (dr/r) + dc×ln (10) [differential form] .... (6)

i.e., (da/a) % = (dr/r) ×100 + (dc×ln (10)) ×100

Therefore, %-age error of measuring a = 0.39 + (0.04096×ln (10) ×100) = 9.82%

The absolute error range of measuring a can be determined using equation (6) as follows,

da = a×(dr/r) + a×dc×ln (10) = 0.9428289135

This is no longer a negligible error range as compared to the value of a, hence should be considered.

Hence, a = (9.599751701 ± 0.9428289135)

Thus, we can say that the nature of spreading in India from 1st March to 10th April is as follows,

$t_n = (9.599751701 \pm 0.9428289135) \times(1.188064448^{(n-1)})$

Now, one may ask what WE have got out of this whole mathematical stuff or what the significance of this mathematical discussion is.

For that, we just have to realise the real-life significance of r.r is the factor by which, every day the number of affected people in India is more or less getting multiplied with, i.e. – the number of affected people in India tomorrow at 11.59 pm will be more or less 1.188 times of the number of affected people today at 11.59 pm. The day after tomorrow it will be around 1.188^2 = 1.411 times. A week later the number will be more or less 3.34 times of today.

Now, WE think the mathematical analysis is quite clear and intelligible to everyone.

An important point to be noted: r = 1.188 – this is an average r from 1st March to 10th April for India. But in reality, r keeps on varying from time to time. e.g.

In the 2nd week (8th – 14th March), r = 1.155

In the 3rd week (15th – 21st March), r = 1.188

In the 4th week (22nd – 28th March), r = 1.162

In the 5th week (29th March – 4th April), r = 1.250 (Fastest growing week)

In the last 6 days (5th – 10th April), r = 1.121 (Slowest growing phase)

(Deliberately, WE haven't mentioned about 1st week, because the values of t_n were so small in the 1st week and that's why a small fluctuation is enough to cause a big deviation in logarithmic scale. So, the data will be full of error.).

This data (the value of r in different weeks) may also seem to be a nice data to predict whether the spread is slowing down or not, but predicting about the pace of spread from the slight decrease and increase in r is actually inconclusive cause that slight deviation can occur due to the variation of different small factors in reality, i.e. – we can consider the slight deviation in r as randomness associated with the data. But yes, when the value changes a lot then we can say either the pace of the spread is changing or, there is a change in one or more important factors that regulate the spread. In our view, a

permissible range of randomness is ±0.025 from the average r value (i.e., 1.163–1.213) as the value of r in the whole world has ranged between 1.17–1.21.

According to this permissible range, the values of r in 2nd, 5th week and in the last 6 days are unnatural, so do they denote some different in the pace of spreading? Let us discuss over every case individually. (WE haven't taken the value of r in the 3rd week as an abnormal one because it is too near to the lower limit of the permissible range).Actually, in 2nd week, the disease just hit India a few days back so we were less prepared as well as less concerned. Consequently, the rate of testing was very low at that time. As the testing rate was low so was the number of cases. Hence, the value of r was low also in the 2nd week. In my view it has nothing to do with slow pace of spreading.

In the 5th week, there was a sudden outbreak of cases in India due to the mass gathering of Tablighi Jamaat, that occurred up to 15th March, 2020 at Nizamuddin, Delhi (up to the starting of the 3rd week). As, the incubation period of COVID-19 is about 10-14 days[14] so, those affected people as well as the people who came in contact with those persons and caught the disease in those 10-14 days suddenly started showing the symptoms and got identified in a large scale. That is why the value of r in that week was unnaturally high

We will focus on the significance of the value of r in the last 6 days a little later. Actually it has a co-relation with the lockdown that has been announced nationwide. Does this small value of r indicate that we're defeating the disease – this question I'm going to answer within awhile.

3.5 The picture of West Bengal.

A similar kind of mathematical analysis has been discussed thoroughly in this section but before discussing those things in details, we first want you to get acquainted with some caveats regarding the data of the West Bengal. These are –

1. The sample space (total numbers of affected people) is quite low. So, a little difference creates a considerable error.

2. The time period of collection of data is small. The 1st COVID-19 case was identified in West Bengal (WB) on 17th March. The data is updated till 9th April, 2020 (i.e. – the data is in the 4th week only). This is also a source of error or rather we should better say uncertainty (or instability), as increase in study time naturally brings stability in the data.

3. Thirdly and lastly the insufficiency of reliable data resources is a big challenge in case of WB cause, as the number of affected persons is quite low as compared to the total cases in the whole country so, no other reliable organisations have started collecting data independently so far. Thus, the data largely depends over the data provided by government of WB, where we personally have found some flaws (e.g. Recently in Paschim Bardhhaman district, one person was identified as COVID-19 infected and he has also been shifted to the nearby COVID-19 treatment centre but still his case hasn't been recorded in the government data).

Media resources publish these kinds of unreported cases in their local additional pages but while counting the total number they also rely on the data provided by the government of WB. So, there might be some flaws in my data also as we have also majorly taken the data provided by WB government.

Now, we come back to the mathematical analysis of the data of WB. First of all, here the counting of days starts from 17th March, i.e. – on 17th March, n = 1. Now, by similar methods, that has been adopted to analyse the data of India, the values and the errors in the parameters are found to be as follows,

r=1.241395023

%-age error in measuring r = 0.90%
absolute error in measuring r = 0.01111924476
(This error in measuring r is almost negligible, hence can be ignored).

a=1.274207039

%-age error in measuring a = 13.70%
absolute error in measuring a = 0.1745672631

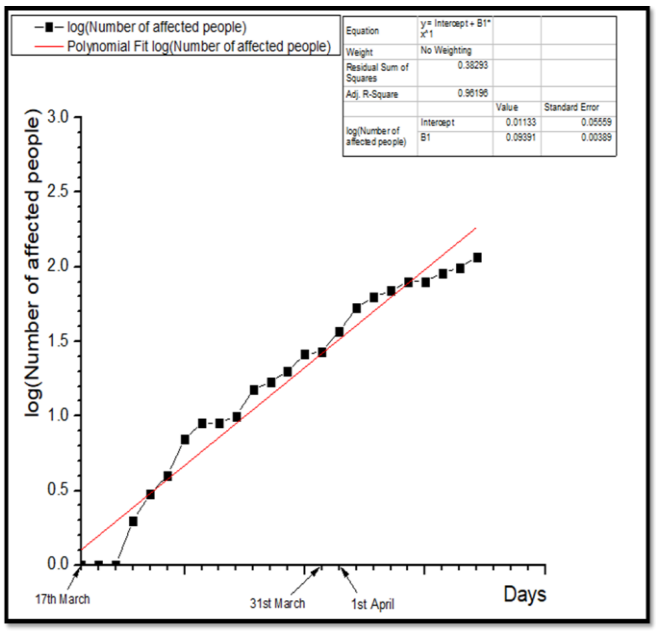

Fig – 07 (Logarithmic plot for WB starting from 17th March to 9th April) The black dots are the real data points of table.02 and the black line is the real curve (as it is just joining the black dots). The red line is the computerised fitted straight line of the data. (The graph is made in ORIGIN graphing software and the fitted curve is obtained by using 1st order polynomial fit).

Hence, the spreading function for WB so far is given by, $t_n = (1.274207039 \pm 0.1745672631) \times (1.241395023^{(n-1)})$

But as WE said before that the real values of t_n in the 1st week are quite small (hence chances of error are more) and the data of West Bengal is quite young, so, the data of the 1st

week (i.e. – 17th–23rd March) imparts a large amount of error in the data as a whole.

If we examine the data from 24th March, we have the following values,

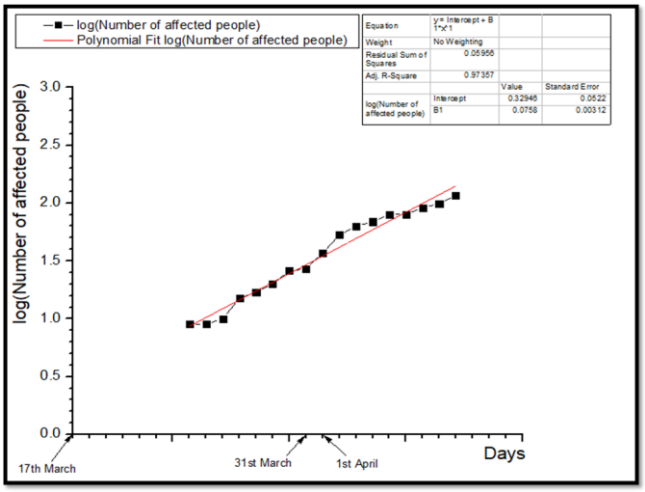

Fig – 08 (Logarithmic plot for WB starting from 24th March to 9th April)

The black dots are the real data points of table.02 and the black line is the real curve (as it is just joining the black dots). The red line is the computerised fitted straight line of the data.

(The graph is made in ORIGIN graphing software and the fitted curve is obtained by using 1st order polynomial fit).

r = 1.190693547

%-age error in measuring r = 0.72%

Absolute error in measuring r = 0.00855402

(The error in measuring r is negligible hence can be ignored)

a = 2.542494371

%-age error in measuring a = 12.74%

Absolute error in measuring a = 0.3239009266

Hence,

$t_n = (2.542494371 \pm 0.3239009266) \times (1.190693547^{(n-1)})$

This can be taken as the equation of spreading of WB as of now (as the data is too young).

Now, let's have a look over the values of r weekly –

In the 2nd week of spreading (24th–30th March), r = 1.209

In the 3rd week of spreading (31st March – 6th April), r = 1.198

In the last 3 days (7th–9th April), r = 1.129

The interesting fact one should notice that the recent value of r is low in case of WB and it is true for India as well. As We mentioned before this value is the direct consequence of the lockdown actually. As the lockdown was announced nation-wide same scenario like India is being observed in WB as well.

3.6 The Crucial Point – Whether We Are Beating the Spread or Not?

The idea of this analysis has been taken from – Aatish Bhatia and Henry Reich's work in this regard. If anyone's interested about their work and wants to study them, we have provided the links of their works in the bibliography section.

Till now We have only discussed about the total number of affected people or the cumulative number of affected people. But to answer the question, the number of new cases in a given time period has to be taken in picture from now onwards. Now, let's look at the mathematical analysis –

The defining feature of an exponential growth or a GP series is such that t_n and $(t_n - t_{n-1})$ is always proportional to each other (i.e., their ratio is a constant and doesn't depend on n). Another important piece of information is that, if two quantities are proportional to each other then they always form a straight line with positive slope in logarithmic scale. These two facts are very easy to prove mathematically and going to be the pillars of the discussion in this section.

As, $(t_n - t_{n-1})$ is proportional to t_n so, the graph of $\log_{10}(t_n - t_{n-1})$ and $\log_{10}(t_n)$ should also be a straight line with positive slope. WE think one have already noticed that it implies that the number of newly affected people in a day and the total number of affected people in that day – these two parameters should form a straight line with positive slope in logarithmic scale. Or if we speak oppositely, this means that as long as the $\log_{10}(t_n - t_{n-1})$ vs $\log(t_n)$ curve remains a straight line with positive slope, it denotes that the spread is still in an exponential phase. As soon as the curve becomes horizontal or shows a downward trend for some days (like a week or more) we can say that we have come out of the exponential phase.

Now, this was a discussion from totally mathematical point of view. Although the data follows an exponential growth in both India and WB but it is not "Perfectly exponential" (and it would be a Panglossian idea to expect so). Thus, there is too much fluctuation in the $\log_{10}(t_n - t_{n-1})$ vs $\log(t_n)$ curve.

Instead, according to the idea of Aatish Bhatia and Henry Reich, WE also plotted the $\log_{10}(t_{n-1} - t_{n-8})$ vs $\log(t_n)$ curve (logarithmic plot of 'The number of newly affected people last week' vs 'Number of total people affected till today') to answer the question with which WE started the discussion in this section.

The number of newly affected people in the last week is also proportional to the number of total people affected till today so, their logarithmic plot is expected to be a straight line with positive slope as long as the spread is in exponential phase. The extra advantage of this $\log_{10}(t_{n-1} - t_{n-8})$ vs $\log(t_n)$ plot lies in increasing the time span of measuring newly affected people. This gives extra stability to the graph and almost reduces the fluctuations totally. This extra stability is advantageous in another sense that if the curve moves downwards for a week or more then, that will indicate a real downward trend and not any random fluctuation (given that there is no resurgence of the disease again due to different causes).

Hence, by examining $\log_{10}(t_{n-1} - t_{n-8})$ vs $\log(t_n)$ curve for both India and WB, it can be predicted whether we are in the right way or not (i.e., whether we 'are beating the disease or not).

The scenario of India in this regard till 10th April is given below.

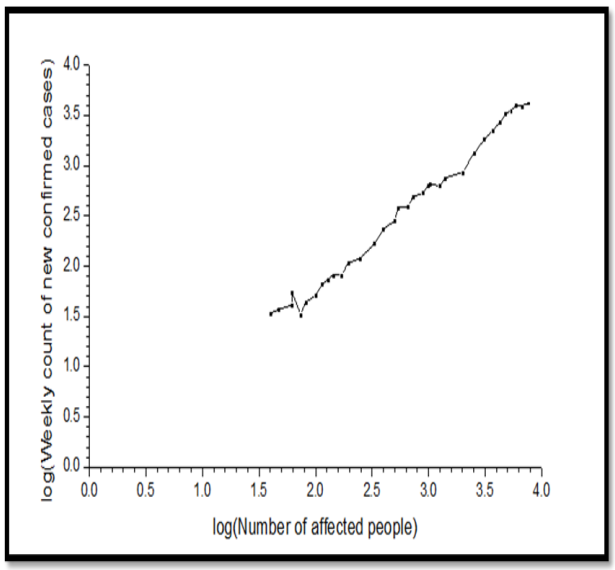

Fig – 09: $\log_{10}(t_{n-1} - t_{n-8})$ vs $\log(t_n)$ curve for India up to 10th April.

From Fig – 09, it is clear that we're still in the exponential phase. It is because the curve is showing a linear trend with positive slope. It is true that the last three days have shown a more or less horizontal trend but it is not enough to predict that we have crossed the exponential phase. It can be a random fluctuation and believe me, it's actually exactly that (because we writing this on 12th April. By today the curve has again start uprising).

The scenario of West Bengal till 9th April is given below.

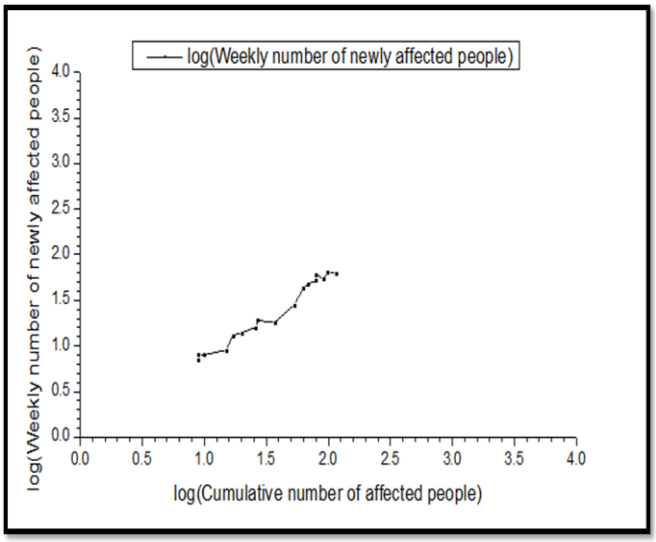

Fig – 10: $(t_{n-1} - t_{n-8})$ vs $\log(t_n)$ curve for West Bengal up to 9th April.

Although the data is too young, but still it is clear that that the curve is following more or less a linear pattern with positive slope. So, it is again evident that the spread is in exponential phase in West Bengal also. Till now, no sign of downward trend is available.

So, it is evident that even if the value of r is less in the last week in India as well as in WB, the disease is still in exponential phase and increasing rapidly. If we only see the value of r and due to its less value if we think that we're beating the disease then that will be a completely wrong notion. The low value of r only indicates the spread has slowed down a beat but never indicates that we're defeating it.

4. Inference

After all these discussion and analysis, it is quite clear that – The spread is following exponential trend in India as well as WB till now. The lockdown has been able to slow down the spreading a little bit. Although, the lockdown has been able to slow down the curve a little bit but still, we are following the exponential trend and aren't showing any sign to reach the inflection point as of now. Based on the analysis we want to make a prediction also – If this trend continues then, India will probably reach 20000 affected people on 21st - 22nd April. Similarly, it seems from the latest trends that WB will reach 1000 people mark on 31st April or 1st May.

5. Future Problems for India in Medical Field

This disease has posed some questions on the medical field of India. Naturally, one day this spread will come under our control, no matter how much distant that seems to be as of now and eventually will stop. But if those questions get buried with the disease then that will be a disaster in future cause believe me this is not going to be the last pandemic that the world is ever going to see. Alanna Shaikh has delivered a wonderful speech over in which she has mentioned this thing also along with many more serious questions. Hence, we do need to care about the questions which have arisen in this pandemic period on our medical field cause otherwise we may face more serious problem in future. These questions can be taken as existing as well as future problems of the medical sector of India.

In our view these are – The very first thing we do want mention first and compelled to mention is the low budget that is being granted in medical healthcare sector. It's a very serious problem and is intentionally or unintentionally is being kept unnoticed for years after years. Unless, we take care of this problem, nothing is going to develop. Every time after budget it is hallucinated by other illusive issues by government, opposing leaders as well as media and still in this time of crisis no media house or government official is talking on this. Government is only casting false light on other granted immediate budgets and people are getting fooled everyday every time in our country just by these illusive decisions and the main issue is always kept unnoticed. Our country spends only 1.6% (financial year 2020)[15] of our GDP in healthcare and medical budget still in 21st century. What can be more problematic than this? The numbers of doctors in India are also less as compared to the expected ratio. According to WHO recommendation the doctor-population ratio should be 1:1000, but in India it is 1:1456 till now[16], which is far from the recommended ratio (and the distribution is uneven too, because most of the doctors are in towns and cities). Population is going to increase in regular basis but the numbers of doctors are not increasing in that rate. This is an existing problem as well as a potential serious problem in India

in future. We need to increase the number of doctors and establish more medical colleges. Privatisation of medical sector is going to be a serious problem for India in future as the medical expenses will become unbounded once it gets enough privatised. It will become unaffordable to lower class and middle-class people who form the vast majority of this country. It will increase the pressure on the still existing government hospitals and healthcare centres. People will not get proper treatment and will tend to take drugs and medicines on their own. Even those medicines and medical testing may become unaffordable to them. Believe me, nothing is more shameful to mankind if one person remains untreated and suffers or dies just because he/she can't bear the medical expenses. The current signs of privatisation should be bridled as soon as possible.

Poor infrastructure of the healthcare system is another existing problem in our country (e.g. we don't have enough PPEs to protect the doctors in this pandemic situation, we don't have enough ventilators for the COVID-19 patients, we don't have enough testing kits to conduct tests to determine whether a person is COVID-19 affected or not). We don't have enough numbers of hospitals or health centres. There are a lot more problems which should be taken care of immediately. Many more hospitals and nursing homes should be established under governmental control.

There is another serious problem in my view. Although we have some excellent research institutes but still, we must need to focus on increasing the numbers of medical research institutes, develop the level of research and trigger research works in medical sector.

Another serious future problem as well as a challenge will be the burden of population. 50% of Indian population is under 25 age who will eventually get old one day and will be more prone to diseases. 15% is between 25-35-year age. Demography of Indian population is immensely hopeful in the sense we have a huge manpower which is potential to develop the country. Unless we use a part of this manpower and develop the medical sector of India, it's going to be a disastrous for us in future.

6. Future Scope in Indian Medical Field

We are living in a country which is full of resources. We just have to use it efficiently and stop its misuse. We have vast forests in which a lot of medicinal plants grow and I do believe a much more is yet to be revealed in future. If we trigger medical researches and produce medicines from these plants in large scale as well as keeping it economically affordable then we will eventually become big manufacturer of many medicines in the world. Besides that, we should focus on developing the modern medical fields like gene therapy and many more research arenas. It will make our country self-dependent in future.

7. Suggestion to Local People

In this time of distress, some of the suggestions that we do like to give to common people as science enthusiasts are – Please obey the lockdown strictly and don't come out unless it is very essential. Lockdown does slow down spread. Yes, it's government's part to use this slow down and perform as many tests as possible in order to eradicate the disease but please do your part and save the society. "Prevention is better than cure" – this is not just a proverb. It is completely true and applies for every disease especially in case of a disease like COVID-19, in case of which we don't even know a sure medicine. Maintain hygiene, wash your hands frequently and make it a habit, don't touch your face with your hands and use mask whenever you come outside. If you feel some of the symptoms of COVID – 19 call a physician as soon as possible. If that is not possible then put on mask and go to the nearby hospital where this is taken care of completely maintaining distance from others and avoiding public transport.

8. Conclusion

Alanna Shaikh, a senior international development consultant and senior TED fellow told, "This is not the last major outbreak we're ever going to see. There's going to be more outbreaks and there's going to be more epidemics. Human choices are driving us into a position where we're going to see more outbreaks. Part of that is about climate change and the way a warming climate makes the world more hospitable to viruses and bacteria. But it's also about the way we're pushing into the last wild spaces on our planet. When we burn and plow the Amazon rain forest so that we can have cheap land for ranching, when the last of the African bush gets converted into farms, when wild animals in China are hunted to extinction, human beings come into contact with wild life populations that they've never come into contact with before; and those populations have new kinds of diseases : bacteria, viruses – stuff we're not ready for."We think this beautiful speech alone sums up the whole idea of this point so, it is needless to mention them again.But what certainly we optimistically do need to pay attention is the positive aspects of the worldwide grave situation. The worldwide pollution is in steady downfall, ejection of green house gases has fallen drastically, Dolphins are again coming back to the shores of Italy and countless more pictures of the earth that were the ideal pictures of earth to us but at the same time were Panglossian thoughts to us!
Phoenix rises from its ashes. Now, it's our turn....

Acknowledgements

The work was greatly supported by my mother of Archisman Roy, with her supervision and guidance in editing. We would like to extend our gratitude to those people who helped us to bring this Paper to fruition. First, we would like to thank Tushar Banerjee for giving us the opportunity and a fine guidance in paving all the way up to fulfilment as well as showing us the process of this paper's publication. Finally, our most warm and hearty gratefulness is for our parents to aid us a great deal, and helped us throughout the whole paper by all means. From all the co-authors a hearty thank is being delivered to dear, A.K.M. sir for his aid in formulation of mathematics and combining all these to physical world of instrumentation. In case computation one of our friend helped wildly, so we also heartily pay our gratitude to Jaidip Patra for his great help. We are especially grateful to one of our co-authors, Archisman Roy for his fine handling of the paper and above all, helping us by

his own means for methodically arranging and editing all the mathematical works including field survey, computing and providing research materials. We are also thankful to Mr. Tushar Banerjee for his kind guidance cum editing, and to Mr. Aritra Konar for his field survey as well as initial preparation of the manuscript. Finally we would like to acknowledge Chhabi De, mother of Aritra Konar who encouraged us on every exchange of information in our study. And we are also grateful to Tuhin Banerjee and friends to help us to write the paper.

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