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Expected course of Covid19 pandemic in India

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Abstract
India has been in the descending phase of Covid19 pandemic since 17 September 2020. The present study tried to estimate as to when pandemic in India would turn into high endemic and then to low endemic situations. Studying twenty nine districts from 16 high burden states on 30 October 2020 and examining the ascending and descending phases of pandemic, it was postulated that by 18 November 2020, India would expectedly be out of pandemic and enter into high endemic situation. Thereafter, in absence of potent and safe vaccine, India would achieve low endemic situation around 11 January 2021.

Keywords: Covid19 Index**,** end of pandemic, category of districts, high endemic

Introduction
Covid19 pandemic started in India on 30 January 2020. The pandemic was naturally slowly at initial stage. There was also complete nationwide continuous lock-down [1] for 68 day from 25 March 2020. The real impact of the pandemic was observed from June 2020 onwards [2]. Fortunately, the pandemic curve has reached peak in India and was in descending phase [2].
With an intention to understand the Covid19 situation at district level, the present author monitored 29 districts of India from 16 high burden states in four groups in four phases [3, 4, 5]. Those phases ended on 04 August, 12 August, 19 August and 05 October, 2020 respectively.
The present study was indented to look at the situation of all those 29 districts on a latter single date, that is, 30 October 2020. The aim was to extrapolate the findings of 29 districts and see the overall situation about the course of pandemic in India. These 16 high burden states from which 29 districts were selected contributed to 84.44 per cent[6] of total Covid19 cases in India on 30 October 2020.
The additional purpose of the study was to propose as to how some objectivity can be put forward in declaring 'end of Covid19 pandemic' in India. A disease outbreak was the occurrence of disease cases clearly in excess of 'normal expectancy'. In case of novel Covid19 virus, we had no data or idea of 'normal expectancy'. So, average number of daily new cases in the ascending phase of pandemic in India was taken as 'clearly in excess of normal expectancy'.
It was postulated that when the number of daily new cases, in descending phase of pandemic, would be less than average number of daily new cases in the ascending phase, the country could be declared to be out of pandemic and the high endemic phase of Covid19 would start in India. That would prove or disprove if India could be said to be coming out of Covid19 pandemic (due to achieving herd immunity) around 17 November 2020, as suggested by the same author in a previous study [7].

Methodology
A total of 29 districts were selected from 16 high burden states. States and districts were selected through non-random purposive sampling. States selected included five topmost high burden states, then three out of next five high burden states and lastly eight out of next eleven high burden states.
From Uttar Pradesh 4 districts were selected. Three districts were selected from each of Maharashtra and Karnataka. There were 2 districts from each of Rajasthan, Andhra Pradesh, West Bengal, Tamil Nadu, Odisha and Kerala and 1district from each of Chhattisgarh, Jharkhand, Madhya Pradesh (MP), Uttarakhand, Bihar, Haryana and Gujarat.

For objective assessment of situation in the districts, a composite index [3] called 'Covid19 Index' was used in the study. Mathematically, Covid19 Index = [{Total recovered cases / (Total active cases + Total deaths)} x Tests per 1000 population / district population in million]. 'Test per 1000 population' was restricted to 25 to avoid high numerator value. The required data for calculating Covid19 Index of the districts were concurrently taken from a reliable source [6].

From the perspective of situation of pandemic, all 29 districts were categorized on the basis of their Covid19 Index. Districts with >40 Covid19 Index were categorized as 'Good', with >20 to 40 were categorized as 'Fair' and with ≤20 Covid19 Index were called 'Bad'. The category 'Good' meant that the district had very few daily new cases (and deaths) vis-à-vis total number of cured cases.

Data on daily reported Covid19 cases in India and progressive total of number of cases were studied to find when India reached peak of pandemic and what was the daily average number of new cases during the ascending phase of pandemic in India [2, 6]. Similar data examination was done in descending phase of the pandemic up to 30 October 2020 to make a projection of the date when the expected number of daily new cases, in descending phase of pandemic, would be less than average number of daily new cases in the ascending phase. It was to be seen if that date fell around 17 November 2020 or not.

Results

A total of 149.94 million ≈ 150 million, that is ≈ 11 per cent of India's population was covered in the study. In 14 out of the 16 states, first Covid19 case was reported during March 2020. In rest 2 states, first case was reported on 30 January and 1 April respectively. The average time gap between first reported case in the state and 30 October was 233 days with range from 221 to 274 days. It was found that on 30 October 2020, out of 29 districts, 22 became of 'Good' category, 4 of 'Fair' category, but 3 districts continued to maintain the 'Bad' category status. The information and data were presented in Table-1 below. The details of information/data about individual districts studied early and on 30 October, 2020 were presented in Appendix.

Table 1: State wise categorization of 29 districts on 30 October, 2020

Sl. No	Name of State (Date of 1st reported case)	Duration between 1st reported case & 30 October in days	No. of districts selected	No. of district found 'Good'	No. of district found 'Fair	No. of district found 'Bad'
1	Uttar Pradesh (05 March)	239	4	4	Nil	Nil
2	Maharashtra (09 March)	235	3	1	1	1
3	Karnataka (09 March)	235	3	3	Nil	Nil
4	Rajasthan (03 March)	241	2	1	1	Nil
5	West Bengal (17 March)	227	2	1	Nil	1
6	Andhra Pradesh (12 March)	232	2	2	Nil	Nil
7	Tamil Nadu (07 March)	237	2	2	Nil	Nil
8	Odisha (16 March)	228	2	2	Nil	Nil
9	Kerala (30 Jan)	274	2	Nil	2	Nil
10	Chhattisgarh (19 March)	225	1	Nil	Nil	1
11	Jharkhand (01 April)	221	1	1	Nil	Nil
12	Madhya Pradesh (20 March)	224	1	1	Nil	Nil
13	Uttarakhand (16 March)	228	1	1	Nil	Nil
14	Bihar (22 March)	222	1	1	Nil	Nil
15	Haryana (04 March)	240	1	1	Nil	Nil
16	Gujarat (20 March)	224	1	1	Nil	Nil
Average/ Total		233 (221 – 274)	29	22	4	3

Peak of Pandemic in India was reached on 17 September 2020 with 97,894 new cases on that day. There were a total of 52,12,680 Covid19 cases [2 & 6] up to 17 September 2020. Pandemic started in India[8] on 30 January 2020. So, the peak of pandemic was reached after 231 day (30 January to 17 September 2020). Thus on an average, there were 22,566 (52,12,680 / 231) ≈ 22,500 new Covid19 cases daily during the ascending phase of the pandemic.

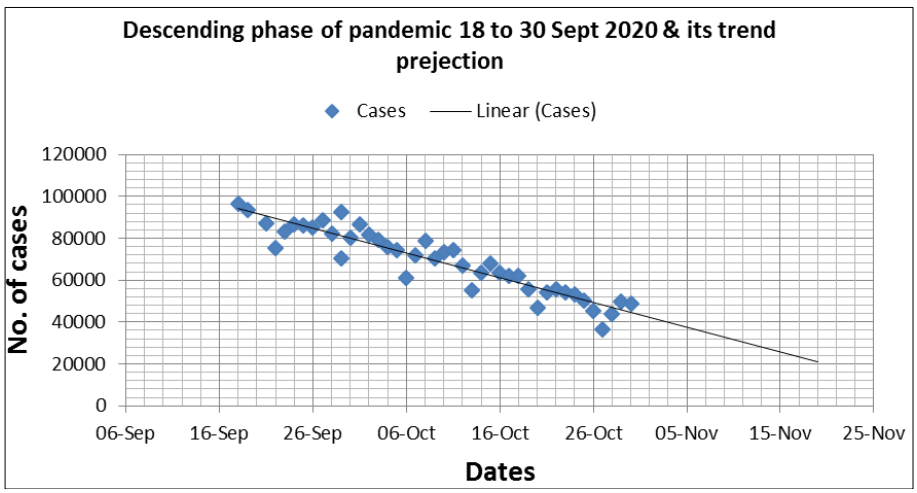

Fig 1: Scattered-cum-trend diagram showing descending phase of Pandemic & its trend

During initial phase of pandemic, there were not many daily new cases. It was on 19 April 2020, that is, 79 days after the beginning of pandemic in India, the number of daily new cases reached four figures [2]. Thereafter, on 04 July 2020, that is, 156 days after the beginning of Covid19 pandemic, India reported 22,771 daily new cases [2] ≈ 22,500, which were similar to the average daily new cases in ascending phase of pandemic as explained above. In next 75 days (05 July to 17 September, 2020), the pandemic reached the peak.

A scattered-cum-trend diagram given below (Figure-1) showed daily number of new cases in India during the descending phase of pandemic between 18 September and 30 October 2020. The trend projection indicated that on 18 November 2020, there would be about 22,500 new cases of Covid19 in India (the diagram may be magnified to get a better view).

Discussions

India has been under Covid19 pandemic since 30 January 2020. But in most of the states studied (14 out of 16), first Covid19 case was reported during March 2020. The present study gave a glimpse and further course of pandemic situation in those 29 districts after about seven months. On 30 October, 2020, twenty two out of 29 districts (76 per cent) achieved 'Good' category. If that was extrapolated, 562 out of total 739 districts [9] in India have achieved 'Good' category on 30 October 2020. That indicated that broadly speaking India, as a whole on 30 October 2020, was coming out of pandemic.

But as has been shown in the Table-1 above, there were problems in 3 districts, which seemed to be hard-core and continued to remain in 'Bad' category. The public health measures must be compromised in those hard core districts. This type of situation was not uncommon in a vast and populous country like India. However, these 3 hard-core districts needed special attention from health authorities and administrative officials for enhancement of appropriate containment activities.

If 'Good' category in 76 per cent districts was achieved in 233 days (Table-1), 100 per cent districts would achieve 'Good' category in 306 [(233 / 76) x 100] days. In other words, 73 more days (306 – 233) from 30 October 2020 would be required to achieve 'Good' category in all districts of India. And that date would be 11 January 2021. So, it could be reasonably said that, in absence of vaccine, all districts of India would be in 'Good' category by second week of January 2021.

After 17 September 2020, the pandemic curve started its descending journey and the number of daily new cases started reducing. On 30 October 2020, new cases to the tune of 48,6,48 were reported [2]. The scattered-cum-trend diagram also showed that on 18 November 2020, the expected number of new cases would be about 22,500. This was cut off figure for 'end of pandemic'. Since the trend line was in sharp descending mode, the number of daily new cases was expected to be less and less than 22,500 after 18 November 2020, pushing India out of the pandemic and high endemic phase of Covid19 would start in India.

This 'high endemic' phase, in absence of a safe and potent vaccine, might continue for weeks before becoming 'low endemic' around the second week of January 2021, when all district of the country would expectedly achieve 'Good' category. In a nut shell, around 18 November 2020, India would be out of pandemic and enter into high endemic phase. Thereafter around 11 January 2021, India would enter into low endemic phase of Covid-19. The limitation of the study was that the results and inferences were obtained in simplistic manner.

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9. List of districts in India during 2020 via www.google.com

Appendix

Detailed information and data of 29 districts studied.

Sl. No.	Name of district (State)	Approx. Populati-on in 2020, in million	Initial date of Covid19 Index studied	Initial Covid19 Index	Final date of Covid19 Index studied	Final Covid19 Index	Gaps between two dates in days	Initial category of districts	Final category of districts
1	Agra (UP)	5.16	04.08.20	10.18	30.10.20	66.93	87	Bad	Good
2	Lucknow (UP)	5.50	12.09.20	12.80	30.10.20	64.98	48	Bad	Good
3	Praygraj (UP)	6.89	05.10.20	25.99	30.10.20	51.87	25	Fair	Good
4	Ghazaibad (UP)	2.86	19.08.20	43.41	30.10.20	167.03	72	Good	Good
5	Thane (Maharashtra)	11.84	04.08.20	2.85	30.10.20	16.94	87	Bad	Bad
6	Pune (Maharashtra)	11.58	19.08.20	7.98	30.10.20	21.10	72	Bad	Fair
7	Nashik (Maharashtra)	7.15	05.10.20	12.19	30.10.20	46.17	25	Bad	Good
8	Ballary (Karnataka)	2.70	19.08.20	13.68	30.10.20	179.23	72	Bad	Good
9	Mysuru (Karnataka)	3.50	12.09.20	15.91	30.10.20	111.46	48	Bad	Good
10	Belagavi (Karnataka)	5.27	05.10.20	34.45	30.10.20	128.70	25	Fair	Good
11	Jodhpur (Rajasthan)	4.47	04.08.20	14.35	30.10.20	27.21	87	Bad	Fair

12	Alwar (Rajasthan)	4.31	05.10.20	137.17	30.10.20	211.43	25	Good	Good
13	North 24 Parghanas (West Bengal)	11.20	12.09.20	13.40	30.10.20	17.82	48	Bad	Bad
14	Howrah (West Bengal)	5.35	05.10.20	41.68	30.10.20	46.30	25	Good	Good
15	East Gadavari (Andhra P)	5.86	19.08.20	7.42	30.10.20	86.85	72	Bad	Good
16	Kurnool (Andhra P)	4.51	05.10.20	132.91	30.10.20	341.41	25	Good	Good
17	Chengalpattu (Tamil Nadu)	3.00	04.08.20	41.53	30.10.20	191.43	87	Good	Good
18	Thiruvallur (Tamil Nadu)	4.73	05.10.20	71.68	30.10.20	113.63	25	Good	Good
19	Ganjam (Odhisa)	3.57	12.09.20	168.30	30.10.20	358.65	48	Good	Good
20	Puri (Odhisa)	1.87	05.10.20	78.25	30.10.20	242.18	25	Good	Good
21	Malappuram (Kerala)	4.60	12.09.20	18.73	30.10.20	20.99	48	Bad	Fair
22	Kozhikode (Kerala)	3.26	05.10.20	11.01	30.10.20	30.34	25	Bad	Fair
23	Raipur (Chhattisgarh)	5.10	12.09.20	2.94	30.10.20	20.06	48	Bad	Bad
24	Ranchi (Jharkhand)	3.50	12.09.20	16.71	30.10.20	87.99	48	Bad	Good
25	Indore (MP)	4.10	05.10.20	25.16	30.10.20	47.41	25	Fair	Good
26	Dehradun (Uttarakhand)	2.12	05.10.20	41.33	30.10.20	135.91	25	Good	Good
27	Muzaffarpur (Bihar)	5.95	05.10.20	61.23	30.10.20	73.01	25	Good	Good
28	Faridabad (Haryana)	2.26	05.10.20	182.78	30.10.20	194.59	25	Good	Good
29	Surat (Gujarat)	8.03	04.08.20	4.08	30.10.20	40.30	87	Bad	Good