

Covid-19- Second Wave in India

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Abstract:- Coronavirus disease 2019 (COVID-19) is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It was first identified in December 2019 in Wuhan, China, and has resulted in an ongoing pandemic. The first case may be traced back to 17 November 2019. As of 8 June 2020, more than 6.98 million cases have been reported across 188 countries and territories, resulting in more than 401,000 deaths. More than 3.13 million people have recovered.

The virus is primarily spread between people during close contact, most often via small droplets produced by coughing, sneezing, and talking. The droplets usually fall to the ground or onto surfaces rather than travelling through air over long distances. Less commonly, people may become infected by touching a contaminated surface and then touching their face. It is most contagious during the first three days after the onset of symptoms, although spread is possible before symptoms appear, and from people who do not show symptoms. The virus is primarily spread between people during close contact, most often via small droplets produced by coughing, sneezing, and talking. The droplets usually fall to the ground or onto surfaces rather than travelling through air over long distances. Less commonly, people may become infected by touching a contaminated surface and then touching their face. It is most contagious during the first three days after the onset of symptoms, although spread is possible before symptoms appear, and from people who do not show symptoms.

1.1 TECHNOLOGIES USED

Python for data scrapping, preprocessing, visualization etc.
Libraries Used:

- 1) Scrapy: Scraping data from Web
- 2) Pandas: Working with data files
- 3) Numpy: for Scientific Calculation
- 4) Matplotlib: Basic Visualization
- 5) Plotly : Advance Visualization
- 6) Dash : Creating Dashboard

1.2 DATA PRE-PROCESSING

Data preprocessing is a data mining technique that involves transforming raw data into an understandable format. Real-world data is often incomplete, inconsistent, and/or lacking in certain behaviors or trends, and is likely to contain many errors. Data preprocessing is a proven method of resolving such issues. Data preprocessing prepares raw data for further processing.

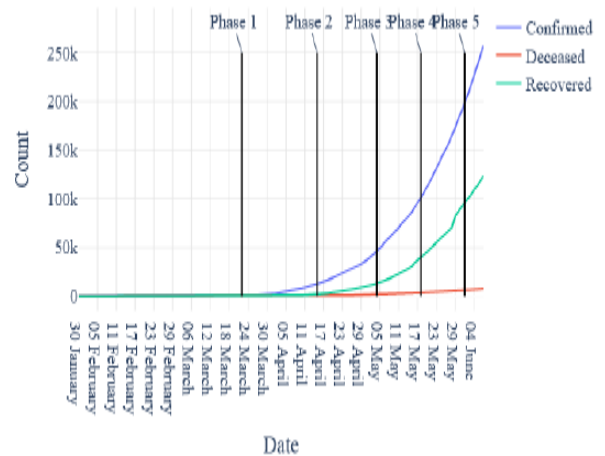
Steps Used :

1. Scrapped data was in raw form all information in a single file. So we needed to make separate files based on their purpose.

2. Death rate in each state is calculated by the formula (number of deaths/total confirmed cases)*100.
3. Recovery rate in each state is calculated by the formula (number of recoveries / total confirmed cases)*100.
4. Split the data according to the lockdown periods.
5. Null values in state wise GDP data filled with average

1.3 ANALYSIS (IMPLEMENTATION)

India recorded its first COVID-19 case on 30th January 2020 in Kerala. The infected person was a student who had travelled to china for academic purpose. And since then cases in India is rising exponentially.



(Fig 1)

As shown above, India had recorded over 500 cases till 24th March. So government declared nation-wide lockdown from 25th march to 14th April also known as lockdown 1.0 and after this government has been extending nation-wide lockdown step by step.

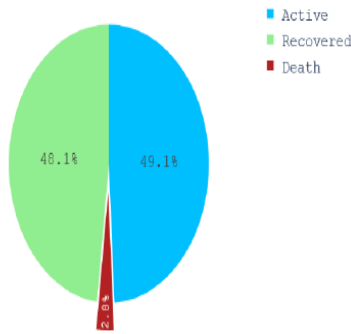
Situation in India till 7th June 2020.

Confirm Cases: 257487

Recovered: 123848

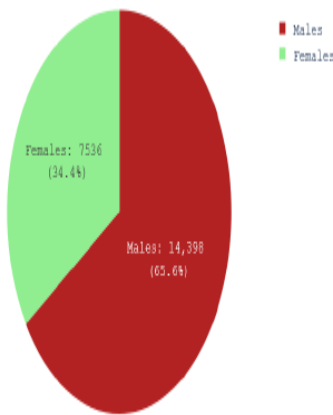
Active: 126433

Deceased: 7206



(Fig 2)

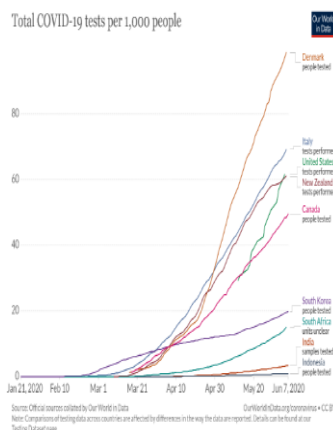
India is showing good recovery rate day by day with low rate of deaths but on the other hand it is also reaching new peak of confirmed cases every day. If we talk at the level of patients then as per sample size 21936 cases,



(Fig 3)

As shown above, number of infected males is greater than that of females. The more exposure of males in Indian family to outside work could be the reason behind this.

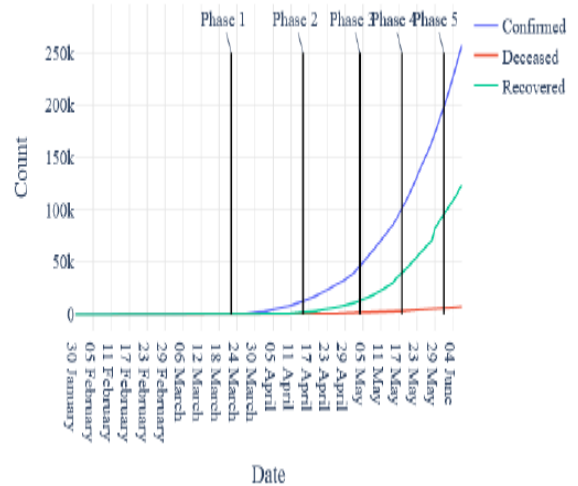
India is highly criticized by experts for the low number of tests being conducted.



(Fig 4)

As shown in the graph above India places itself at the tail-end of this comparison. Low number of tests conducted

was the reason behind at the lower end in worldwide tally of COVID-19 cases in early days. But as of now we are observing 8-9 thousand people being found positive every day.

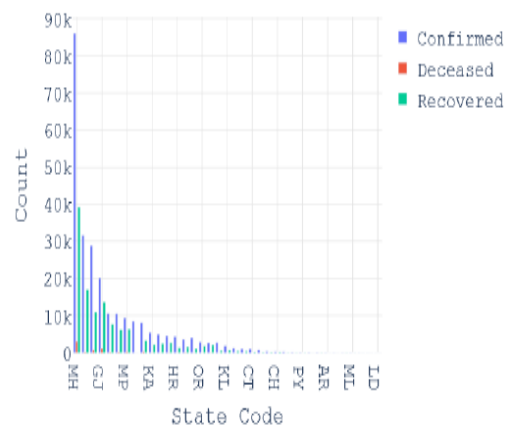


(Fig 5)

As confirmed cases are increasing day by day the positive side is recovered number is also showing somewhat same behavior with less number of people dying of COVID-19. India is yet to reach its peak of confirmed cases which is once reached then after that cases will start to decrease and recovered number will go higher to intersect confirmed cases at a point.

State-wise Comparison

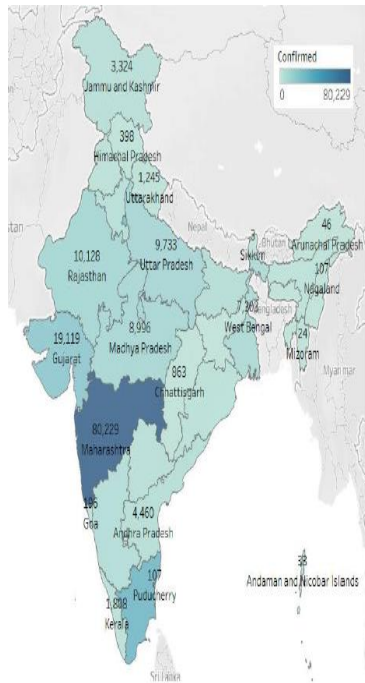
India consists of 28 states and 8 Union Territories with varying features such as demography, geography, location, lifestyle etc. Which can decide the spread of contagious virus? Comparing COVID-19 situation in states gives us insight of which state/area is to be focused.



(Fig 6)

As shown above, Maharashtra, Tamil Nadu, Delhi, Gujarat, Uttar Pradesh, Madhya

Pradesh are top 6 states in confirmed cases in India. When the cases started to be detected in India since that time only Maharashtra has been leading this tally. As of 5th June 2020, over 80,000 cases are confirmed in Maharashtra.



(Fig 7)

We can see that more number of COVID-19 clusters is in left half part of the India. In the North-East region of India, despite being close to China, there are very less number of confirmed cases. The possible reason of this variation is discussed later part of this analysis.

1.4 R0 FACTOR

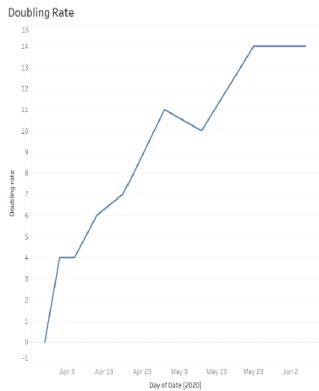
The R0 factor also known as Basic Reproduction Number. The R0 factor of an area denotes how many more persons can be infected due to a person who is having the disease. If R0 is 1.2 then it means 1 infected person can infect 1.2 people by the same disease. So that 5 people can infect total 6 new persons ($1.2 \times 5 = 6.0$).

Estimated R Value For States		
State	Period of Estimation	Estimated R
India	March 4 - April 11	1.83
	April 13-May 14	1.29
	May 16 - May 25	1.23
Maharashtra	April 13-April 26	1.49
	April 23-May 15	1.34
	May 4-May 25	1.27
Gujarat	April 30-May 9	1.23
	May 7-May 10	1.26
Tamil Nadu	April 29-May 4	1.83
	April 30-May 7	2.01
Delhi	May 7-May 10	1.31
	May 20-May 25	1.2
Punjab	April 28-May 4	1.48
	May 5-May 8	1.32
Rajasthan	April 19-April 22	1.34
	May 10-May 25	1.27
Madhya Pradesh	April 16-May 1	1.23
	May 10-May 23	1.23
Uttar Pradesh	May 1-May 4	1.28
	May 19-May 24	1.33
West Bengal	April 15-April 28	1.51
	April 28-May 1	1.14
	May 4-May 10	1.34
	May 15-May 25	1.22
Andhra Pradesh	April 6-May 1	1.27
Karnataka	May 16-May 24	1.62

It is believed that India is having steady $R_0=1.23$ since 25th May which is still higher than normal. While imposing nation-wide lockdown R_0 is considered as one of the factor. If the R_0 values are less than 1 i.e. one infected person cannot infect another person then lockdown is to be lifted. But Lockdown in India is being lifted in steps despite having R_0 factor greater than

1.5 DOUBLING RATE

Doubling rate is number of days taken to double the number of confirmed cases in a particular area. This number should be as large as possible. Large number of doubling rate will increase the hopes of situation under control.



(Fig 8)

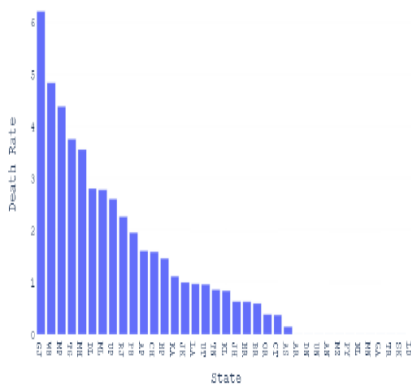
India is showing positive trend in doubling rate but the situation is still a not under the control of government and administration. This is a thing to worry about.

1.6 DEATH RATE

Death rate is calculated by,

$100 * (\text{number of deaths in a state} / \text{number of confirmed cases in a state})$

The number obtain after this calculation is the number of deaths behind every 100 confirmed cases in that state. Higher the number more the area is to be focused



(Fig 9)

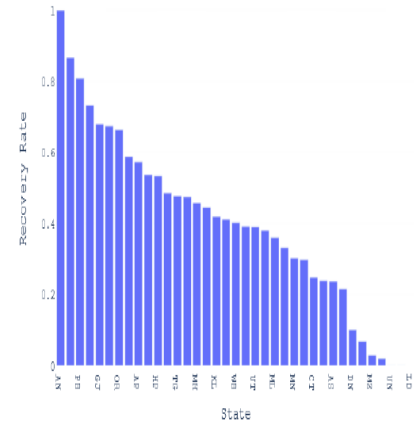
Gujarat is having death rate over 6 followed by West Bengal, Madhya Pradesh, Maharashtra, and Telangana with death rates 5, 4.2, 3.5, 3.4 respectively. Whereas whole country's death rate on 5th June 2020 is 2.78 .All the states/UTs with death rate more than 2.78 are to be taken care of more intensively.

1.7 RECOVERY RATE

Recovery rate is calculated by,

$100 * (\text{number of recoveries in a state} / \text{number of confirmed cases in a state})$

The number obtain after this calculation is the number of recovered patients behind every 100 confirmed cases in that state.



(Fig 10)

Chandigarh is having recovery rate close to 90 followed by Punjab, Rajasthan, Gujarat, and Madhya Pradesh with recovery rates 84, 72, 68, 65 respectively. Whereas whole country's death rate on 5th June 2020 is 47.48.

2 CLUSTER ANALYSIS

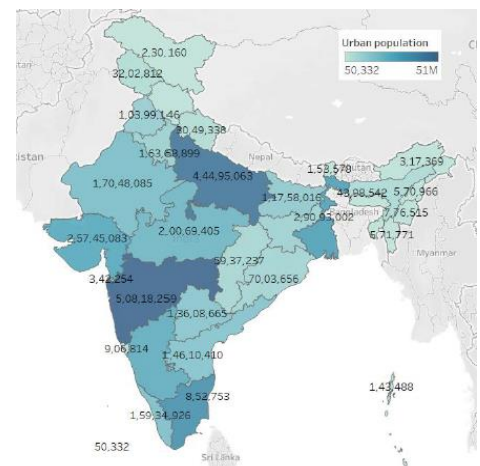
What could be the reasons behind cases clusters found in India?

2.1 URBAN POPULATION

As discussed earlier, there are more cases found in western part than the eastern part of India. We tried to find out some of the reasons that may have caused this situation in India.

India has 2nd most population in the world and places itself at 7th position in the tally of surface area. So somewhere population is going

To be major factor in spread of such pandemic.



(Fig 11)

Above is the map of India showing urban population in each state.

And Fig 4.7 is the graph showing confirmed covid-19 cases in each state in India. They both look somewhat similar indicating 'More urban population causes quick spread of corona viruses.

Top 8 States with highest urban population:

Maharashtra, Uttar Pradesh, Tamil Nadu, West Bengal, Gujarat, Karnataka, Madhya Pradesh, Rajasthan.

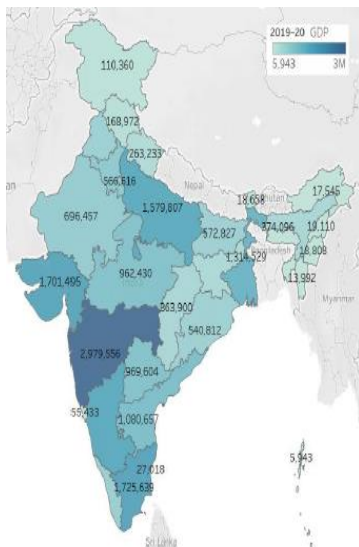
Top 8 States with highest number of COVID-19 cases:

Maharashtra, Tamil Nadu, Delhi, Gujarat, Rajasthan, Uttar Pradesh, Madhya Pradesh, West Bengal.

Out of top 8 states 7 states are common in both categories. This indicates more urban population in these states causing higher number of cases.

2.2 GDP CONTRIBUTION

India is the world’s 5th largest economy by nominal GDP. All states contribute in GDP of India.



(Fig 12)

These are the figures of state and its GDP for the financial year 2019-20 in Cores.

Fig 4.7 graph is state and its confirmed COVID-19 cases. These two graphs too look somewhat identical indicating that ‘Public movements, interaction, contact with each other in activities which contribute in GDP, causes a favorable environment for the spread of such viruses.’

Top 8 States with highest GDP:

Maharashtra, Tamil Nadu, Gujarat, Karnataka, Uttar Pradesh, West Bengal, Andhra Pradesh, Telangana

Top 8 States with highest number of COVID-19 cases:

Maharashtra, Tamil Nadu, Delhi, Gujarat, Rajasthan, Uttar Pradesh, Madhya Pradesh, West Bengal.

The comparison above showing out of top 8 states 5 states falls in both of the category, Which indicates that if more number of businesses running in a state the more will such viruses spread in that state. Pandemics like COVID-19 hits the economy building factors the most.

2.3 LOCKDOWN

Is lockdown in India a successful or not?

Indian government implemented lock down in 4 phases. In comparison with other countries, India declared lockdown in its early days of COVID-19 outbreak.

Phase 1: 25th March – 14th April

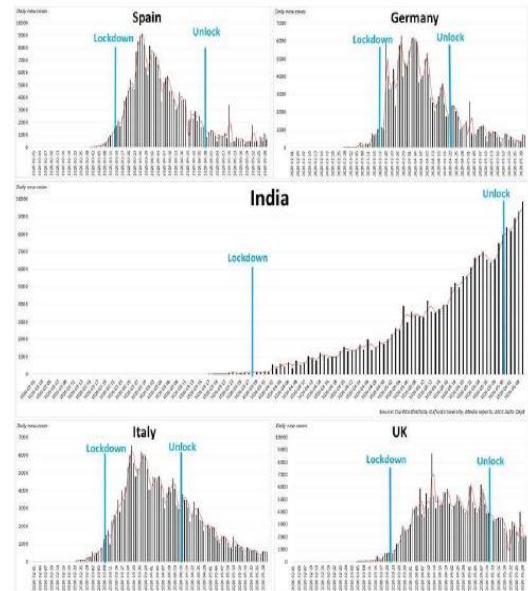
Phase 2: 15th April – 3rd May

Phase 3: 4th May – 17th May

Phase 4: 18th May – 31st May

Among which phase 1 and 2 of lockdown were very strict whereas phase 3 and phase 4 were comparatively lenient.

In all 4 phases of lockdown, not a single lockdown showed any down falling of the curve and yet India has not reached the peak yet.



In all the phases of lockdown in India, cases graph is showing increasing trend only. Lockdown was meant to find a peak of cases in India but it failed to do so. When we compare India’s lockdown phase with other country’s lockdown phases, we see India loosing with great margin. As per experts’ analysis we are still very far from a peak which is quite scary. Lockdown in India did not serve its purpose and caused economic harm as well as non-decreasing cases in India.

2.4 How Bad Is India’s Covid-19 Second Wave?

India’s second wave of coronavirus infections is the world’s fastest growing as Asia’s third-largest economy adds more cases than the U.S. and Brazil in a week on an average.

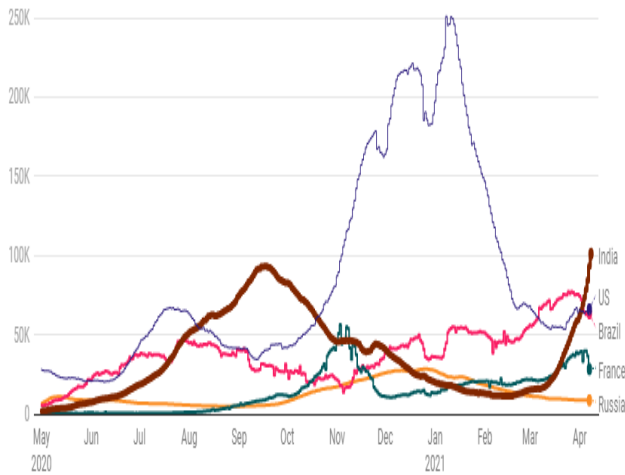
The South Asian nation of 130 crore people—only trailing the U.S. and Brazil in total number of confirmed Covid-19 cases—added more than 1 lakh infections on an average over the last one week, according to BloombergQuint’s calculations. That compares with the seven-day rolling average of around 65,000 and 63,000 cases added by the U.S. and Brazil, respectively.

On April 9 alone, India reported 1.32 lakh fresh cases, taking the total count in the country to 1.31 crore, the union Health Ministry’s update at 8 a.m. showed. This is the third consecutive day of adding more than 1 lakh infections. Daily additions have been exceeding single-day recoveries

since March 11, causing the active cases to bounce back to close to 10 lakh—a tally last touched in September

2.5 Covid-19: India vs. World

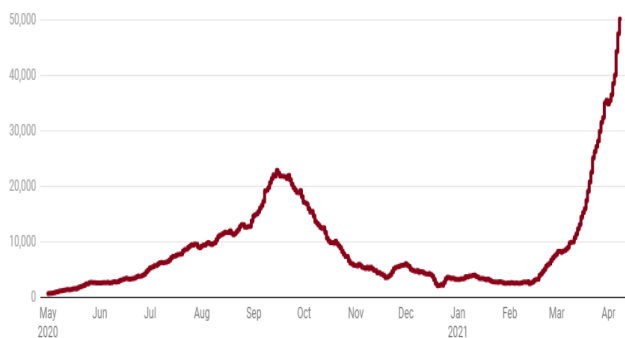
Seven-day rolling average of new cases



India's Hotspot Maharashtra has once again emerged as the epicenter of the outbreak, with the wealthiest state accounting for more than half of the daily additions. Of the 10 districts with most number of cases, seven are in Maharashtra. This has forced the state government to stop all non-essential services, shut malls and restaurants, and urge companies to resort to work from home for the ongoing month.

Maharashtra Surge Unabated

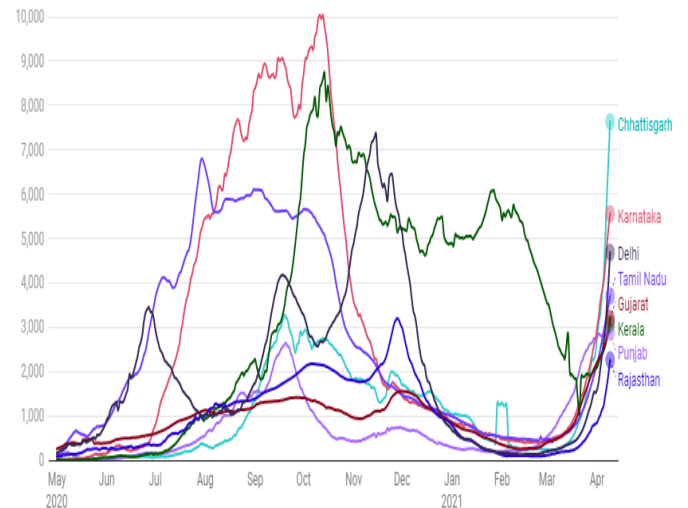
Seven-day rolling average of new cases in Maharashtra



Punjab and Chhattisgarh are witnessing a surge, too. They have added most Covid-19 cases after Maharashtra over the last couple of weeks. The average daily cases in a week in Punjab have gone up from 240 in February to more than 2,700 in April, while in Chhattisgarh; it has gone up from 250 to more than 2,400 during the period. Chhattisgarh accounts for 6% of the total cases and 3% of total deaths in the country, according to health ministry data, while Punjab accounts for 3% of the total cases and 4.5% of the total fatalities.

India's Hotspots

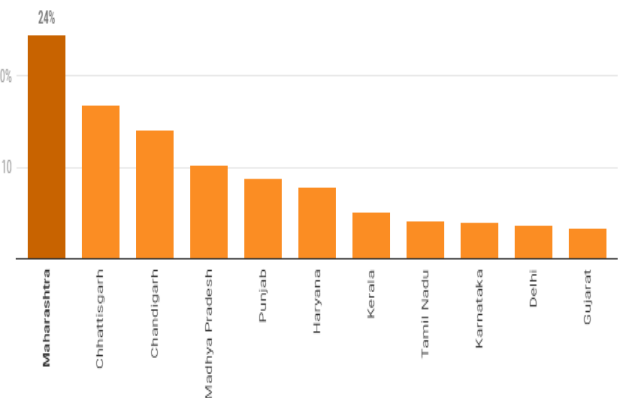
Seven-day Rolling average of large outbreaks in India



The positivity rate among the states has also gone up as the virus spreads at an aggressive pace. Newer hotspots such as Chhattisgarh, Madhya Pradesh, Chandigarh and Punjab are reporting positivity rates of more than 8%.

States with High Positivity Rate

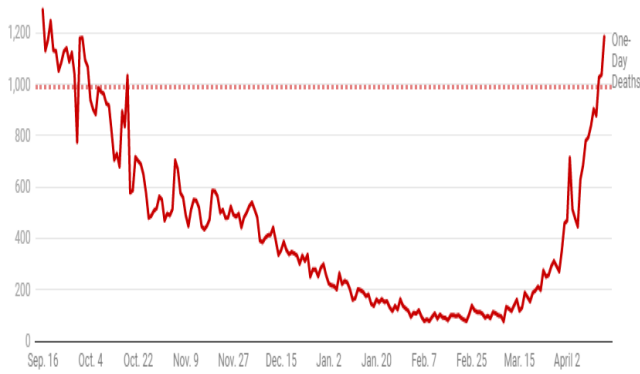
% of confirmed Covid-19 cases per 100 tests



The mortality rate in the country is also on the rise, with daily deaths at a six-month high. Maharashtra reported average daily deaths of 250 in the first week of April, followed by Punjab with an average of 58 casualties, according to the Health Ministry data.

Covid-19 Death Toll Rising Again

India reports 1,185 deaths, the most since September 2020-2021

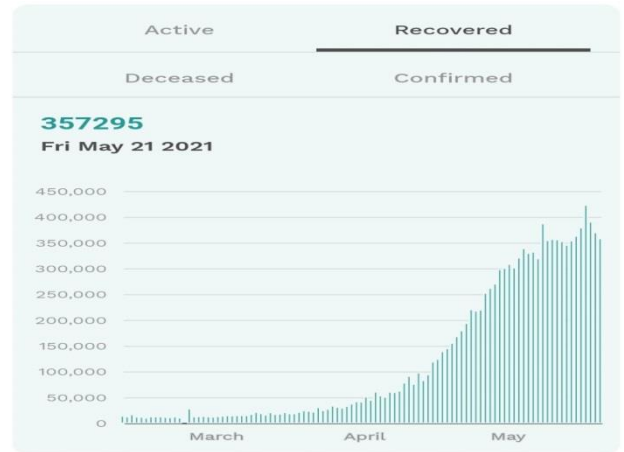


The spike in coronavirus cases is also seen at a time new variants have been reported in the country. As on March 30, India reported 807 cases related to the U.K. variant, 47 from the South African strain and one in the Brazilian form, the Health Ministry said.

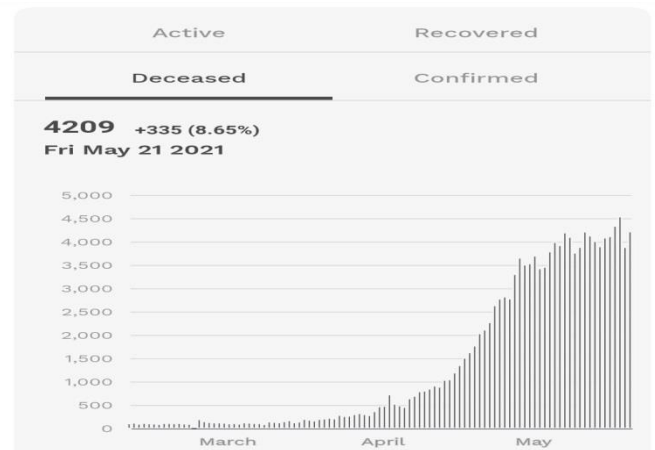
“There is definitely a possibility of multiple new variants which are more infectious and are adding to the rapid surge,” Babu said. But here isn’t enough investigation which variant is leading to this and the country needs to examine new variants, he said.

The Maharashtra government has already indicated that the state will be forced to go into another lockdown if the situation doesn’t improve.

Muliyil, however, thinks that a “lockdown will be a foolish move”. It’s not that the virus disappeared after the first lockdown. “We must also remember that we don’t have just one disease; there are thousands of others diseases, and going the lockdown way could lead to more deaths as it disrupts everything.”



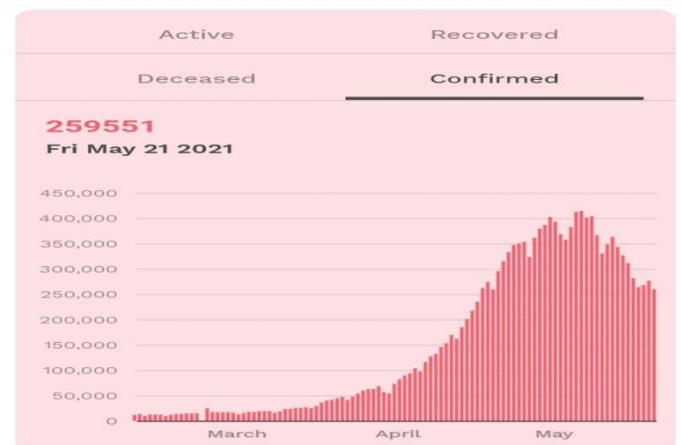
DEATH RATE



TOTAL NO. OF PATIENTS CONFIRMED



PATIENTS RECOVERED



2.6 CONCLUSION

- India is now 6th largest confirmed cases of COVID-19 in the world.
- India has not reached the peak yet so as of now we cannot predict the approximate number of confirmed cases in India.

- Recovery rate of India is also showing exponential behavior same as confirmed cases. But if cases increase beyond certain point then thing can go out of control which will affect the recovery rate.
- Gender information of most of the patients neither is nor released by the government but whatever data is available shows number of infected males is more than that of females. This is may be due to more exposure/contact of males with outdoor world.
- Same as gender, age information is unavailable for most of the patients , but whatever data is available shows age and cases are normally distributed and 21-40 is the age bin which has been infected more.
- This analysis showed that pandemic like this affects economy the most. Whichever the country's GDP source is , it gets targeted the most. Slowing down the economy then unemployment, job losses and then this chain reaction continues.
- India was in lockdown for more than 2 months but still situation did not get any better. This may be due to weak administration or the violation of lockdown by citizens.

FUTURE ENHANCEMENT

1. Prediction Model

India has not reached the peak yet , once it reaches the peak the prediction model can be built to show that how much time it will take to get things back to the normal.

2. Sentiment Analysis

India has never experience such pandemic in last 100 years so what do people think about this pandemic, lockdown , government approach/policies etc. can be studied to have sentiment insight of this pandemic.

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