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When COVID-19 will Decline in India? Prediction by Combination of Recovery and Case Load Rate

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Abstract

Background: World Health Organization (WHO) declared that COVID-19 as a pandemic on March 11, 2020. There is sudden need of statistical modeling due to the onset of COVID-19 pandemic across the world. But health planning and policy requirements the estimates of disease problem form clinical data.

Objective: To predict recovery rate, cases load rate on the basis of cumulative confirmed Novel Coronavirus (NCV) cases, recovered cases, and deaths form COVID-19 in India.

Methods: The reported COVID-19 cases in the country were obtained from the website (https://datahub.io/core/covid-19#resource-covid-19_zip/). The cumulative NCV confirmed cases; recovery cases and deaths were used for estimating recovery rate, cases load rate and death rate till date 24 April 2020.

Results: A total of 24530 NCV confirmed cases were reported nationwide in India on 24 April 2020. It is found that the recovery rate increased 22% and case load rate decreased 74%. The death rate is found to be very low 3%. The difference of cases load rate and recovery rate (delta) coincide at 50 % then NCV cases expected would be declined.

Conclusion: The epidemic in the country was mainly caused by the importation of India. Lockdown as restricting the migration of population and decided to quarantine of population may greatly reduce the risk of continued spread of the epidemic in India. This study predicts that by 20 May 2020, the cases load rate lesser than the recovery rate thereafter COVID-19 patients would be started to reducing.

Keywords: COVID-19, recovery rate, case load rate, India.

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Introduction:

Unexpectedly, Wuhan city of Hubei province and rapidly spread to Hubei and the entire nation, and considerably nations in December 2019. Chinese health authorities notorious a cluster of pneumonia cases of unknown aetiology.[1] Relations between the key cases and the city's South China seafood market were found. The chance of another zoonosis or severe acute respiratory syndrome (SARS) outbreak at the top of the priority, investigations were attempted that have since recognized a novel coronavirus, SARS-CoV-2 (formerly 2019-nCoV), as the agent has entered as an international outbreak in Hubei. China has revealed a total of 72,528 confirmed cases on February 17, 2020.[2, 3] The novel coronavirus 2019 (COVID-19) has spread across 210 nations and regions with 1.2 million confirmed cases and 67594 deaths noted by April 6, 2020. At last 2019, WHO declared public health emergency at the international level.[4] The first two confirmed cases were reported in India on January 31, 2020. In India, screening of traveller at airport migrant has been started, immediate Chinese visas have been canceled, and who has found affected from COVID-19 have been quarantined.[5] The Ministry of Health and Family Welfare (MoHFW) of India had primarily warned to avoid traveling to China and quarantine of those returning from China.[6] In the absence of a licensed vaccine or effective therapeutics for COVID-19, other advises to hand cleanliness and quarantine a basic strategy to control and alleviation mediation towards the early detection and quarantine of cases to break the chain of transmission. The SARS-CoV-2 pandemic is currently a huge challenge for researchers, clinicians, health-care workers, and decision-makers. We depict the most striking difficulties for statisticians who need to provide support in this pandemic with their proficiency. In this article, we want see the exact date while the recovery rate of patients would be more than new NCV cases in India. This date is defined as a disease declined date.

Materials and Methods:

Data Sources:

Data safety, patient's consent, ethical approvals are essential in non-pandemic circumstance, but they are administrative barriers to get access to clinical data. Pandemic circumstances need precise handling of these issues and should be examined on nationwide. Clinical data are extremely time-dependent and involve progressive statistical methods.[7] Data has been obtained with covariates confirmed NCV cumulative cases, cumulative recovered cases, and deaths from the online websites (https://datahub.io/core/covid-19#resource-covid-

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19_zip/. Total 24530 confirmed NCV cases, 5498 recovered cases and 780 deaths were found till date 24 April 2020 and included in the study.

Methodology:

There are formulae have been used for estimation purpose in Table 1.

- $\text{Recovery rate} = \frac{\text{Recovered cases}}{\text{Confirmed cases}} * 100$
- $\text{Cases load} = \text{Confirmed cases} - \text{recovered cases} - \text{deaths}$
- $\text{Cases load rate} = \frac{\text{Cases load}}{\text{Confirmed cases}} * 100$
- $\text{Death rate} = \frac{\text{Deaths}}{\text{Confirmed cases}} * 100$
- $\text{Delta} = \text{Cases load rate} - \text{recovery rate}$

Result:

Total confirmed NCV cases 24530 and recovered cases 5498 were involved in the study. Recovery rate has been estimated 22 percent on the basis of confirmed and recovered cases. Total cases load was found 18252 cases and cases load rate estimated 74 percent. Death rate was obtained 3 percent based on 780 dead patients. Delta is difference of cases load rate and recovery rate was obtained 52 percent on 24 April 2020 (Table 1). The value of delta has been estimated from 22 January 2020 to 20 May 2020. It found that the value of delta was least on 20 May 2020; it means the difference between cases load rate and recovery rate was approximately zero. This indicates that NCV cases expected would be declined as compared to recovered cases in (Figure 1 & Table 2).

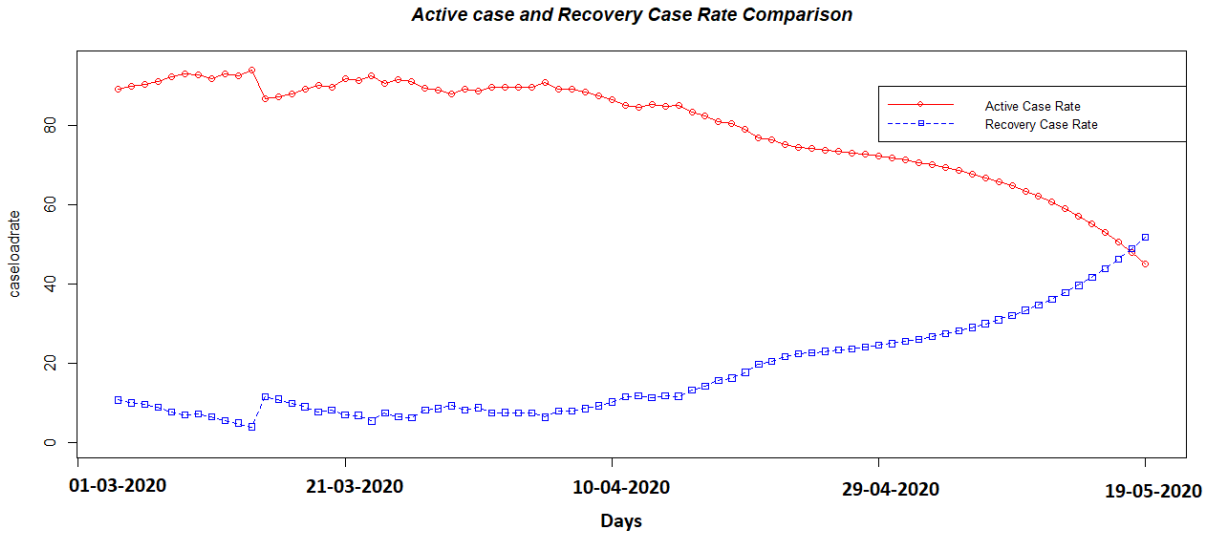

Figure 1: Comparison of recovery rate and active case rate of NCV patients in India

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Discussion:

2019-nCoV is a new coronavirus, which is unique in relation to SARS infections and has never been found in the human population afore.[8] The NCV cases caused by 2019-nCoV has evidently confirmed strong relational correspondence ability and the population is usually vulnerable.[9] This study estimated the recovery rate and cases load rate in India. The impact might be decreased with the prevention and control actions implemented by the Indian government. The results of this study suggest that actively adopting a containment strategy, continue to increase the control of the epidemic in India, lockdown, quarantine and clinical perception and suspected NCV cases, reduce the incidence, and control population movement (complete lockdown) will help reduce risk of NCV in India.[10] It is explicitly various kind of model utilized by the investigators, the main objective for which the model has been created with conclusion. The cumulative confirmed cases and evolving reports of better understanding and better expectation of the imminent estimates from other nations have started emerging mathematical tools for forecasts for validity of different preventive and management policies. Some of these predicting models have suggested useful insights and supported policy decisions. In this article, proposed model has been provided the findings regarding recovery rate and cases load rate associated with COVID-19 with the application of statistics. Estimates of delta have been used for prediction purpose.

Conclusion:

The various strategies are implemented as lockdown, quarantine of population to reduce the risk of spread of epidemic. This study predicts that by 20 May 2020, the NCV cases load rate lesser than the recovery rate there after COVID-19 patients would be started to reducing.

Limitation:

This study is restricted within the time period of analysis till 24 April 2020 in India. Different models were considered to estimate COVID-19 extent, and claimed to be precise, however, they critically revealed data gaps and prerequisites to adjust difficult variables such as effect and uncertainty of lockdown, risk factors, and social distancing might be reflected before generalizing the findings.

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Conflicts of Interest: The authors declare no conflict of interest.

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References:

1. Liu T, Hu J, Xiao J, et al., Time-varying transmission dynamics of Novel Coronavirus Pneumonia in China. BioRxiv, 2020, In pressing. DOI: 10.1101 / 2020.01.25.919787.
2. Wu JT, Leung K, Leung GM, Now casting and forecasting the potential domestic and international spread of the 2019-nCoV outbreak originating in Wuhan, China: a modeling study. Lancet,2020, In pressing. DOI: 10.1016 / S0140- 6736 (20) 30260-9.
3. Chen Wei, Wang Qing , Li Yuanqiu, et al., Novel coronavirus pneumonia epidemic of early containment strategies outlined. Journal of Preventive Medicine, 2020, 54 (3): 239-244 . DOI:10.3760 / cma.j.issn.0253-9624.2020.03.003.
4. WHO. Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV). Jan 30, 2020. https://www.who.int/newsroom/ detail/30-01-2020-statement-on-thesecond-meeting-of-the-international-healthregulations-(2005)-emergency-committeeregarding-the-outbreak-of-novelcoronavirus-(2019-ncov).
5. Ministry of Home Affairs Government of India, Advisory: travel and VISA restrictions related to COVID-19 https://boi.gov.in/content/advisory-travel-and-visa-restrictions-related-covid-19-0.
6. Ministry of Health Family Welfare Government of India https://www.mohfw.gov.in/.
7. Martin Wolkewitz and Livia Puljak. Methodological challenges of analyzing COVID-19 data during the pandemic, BMC Medical Research Methodology 2020) 20:81 DOI: 10.1186/s12874-020-00972-6.
8. Mary A Lake, What we know so far: COVID-19 current clinical knowledge and research, Clinical Medicine 2020, vol. 20, no. 2: 124–7.
9. Chen Ze, Liang, Zhang Wen, Lu Yi, et al. From SARS-CoV Outbreak: Similarities in early Epidemics and Prediction of Future Trends Chi Med J, 2020,133(2020-02-25) DOI: 10.1097/CM9.0000000000000776.
10. Mandal S, Bhatnagar T, Arinaminpathy N, Agarwal A, et al., Prudent public health intervention strategies to control the coronavirus disease 2019 transmission in India: A mathematical model-based approach DOI: 10.4103/ijmr.IJMR_504_20.

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Table 1: Estimate of recovery rate, cases load rate on the basis of confirmed and recovered cases

Date	Confirmed	Recovered	Deaths	Recovery rate	Case load	Case load rate	Death rate	Delta
03-03-2020	5	3	0	0.00	0.00	0.00	0.00	0.00
04-03-2020	28	3	0	10.71	25	89.29	0.00	78.57
05-03-2020	30	3	0	10.00	27	90.00	0.00	80.00
06-03-2020	31	3	0	9.68	28	90.32	0.00	80.65
07-03-2020	34	3	0	8.82	31	91.18	0.00	82.35
08-03-2020	39	3	0	7.69	36	92.31	0.00	84.62
09-03-2020	43	3	0	6.98	40	93.02	0.00	86.05
10-03-2020	56	4	0	7.14	52	92.86	0.00	85.71
11-03-2020	62	4	1	6.45	57	91.94	1.61	85.48
12-03-2020	73	4	1	5.48	68	93.15	1.37	87.67
13-03-2020	82	4	2	4.88	76	92.68	2.44	87.80
14-03-2020	102	4	2	3.92	96	94.12	1.96	90.20
15-03-2020	113	13	2	11.50	98	86.73	1.77	75.22
16-03-2020	119	13	2	10.92	104	87.39	1.68	76.47
17-03-2020	142	14	3	9.86	125	88.03	2.11	78.17
18-03-2020	156	14	3	8.97	139	89.10	1.92	80.13
19-03-2020	194	15	4	7.73	175	90.21	2.06	82.47
20-03-2020	244	20	5	8.20	219	89.75	2.05	81.56
21-03-2020	330	23	4	6.97	303	91.82	1.21	84.85
22-03-2020	396	27	7	6.82	362	91.41	1.77	84.60
23-03-2020	499	27	10	5.41	462	92.59	2.00	87.17
24-03-2020	536	40	10	7.46	486	90.67	1.87	83.21
25-03-2020	657	43	12	6.54	602	91.63	1.83	85.08
26-03-2020	727	45	20	6.19	662	91.06	2.75	84.87
27-03-2020	887	73	20	8.23	794	89.52	2.25	81.29
28-03-2020	987	84	24	8.51	879	89.06	2.43	80.55
29-03-2020	1024	95	27	9.28	902	88.09	2.64	78.81
30-03-2020	1251	102	32	8.15	1117	89.29	2.56	81.14
31-03-2020	1397	123	35	8.80	1239	88.69	2.51	79.89
01-04-2020	1998	148	58	7.41	1792	89.69	2.90	82.28
02-04-2020	2543	191	72	7.51	2280	89.66	2.83	82.15
03-04-2020	2567	192	72	7.48	2303	89.72	2.80	82.24
04-04-2020	3082	229	86	7.43	2767	89.78	2.79	82.35
05-04-2020	3588	229	99	6.38	3260	90.86	2.76	84.48
06-04-2020	4778	375	136	7.85	4267	89.31	2.85	81.46
07-04-2020	5311	421	150	7.93	4740	89.25	2.82	81.32
08-04-2020	5916	506	178	8.55	5232	88.44	3.01	79.89
09-04-2020	6725	620	226	9.22	5879	87.42	3.36	78.20
10-04-2020	7598	774	246	10.19	6578	86.58	3.24	76.39
11-04-2020	8446	969	288	11.47	7189	85.12	3.41	73.64
12-04-2020	9205	1080	331	11.73	7794	84.67	3.60	72.94
13-04-2020	10453	1181	358	11.30	8914	85.28	3.42	73.98
14-04-2020	11487	1359	393	11.83	9735	84.75	3.42	72.92
15-04-2020	12322	1432	405	11.62	10485	85.09	3.29	73.47
16-04-2020	13430	1768	448	13.16	11214	83.50	3.34	70.34
17-04-2020	14352	2041	486	14.22	11825	82.39	3.39	68.17
18-04-2020	15722	2463	521	15.67	12738	81.02	3.31	65.35
19-04-2020	17615	2854	559	16.20	14202	80.62	3.17	64.42
20-04-2020	18539	3273	592	17.65	14674	79.15	3.19	61.50
21-04-2020	20080	3975	645	19.80	15460	76.99	3.21	57.20

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22-04-2020	21370	4370	681	20.45	16319	76.36	3.19	55.91
23-04-2020	23077	5012	721	21.72	17344	75.16	3.12	53.44
24-04-2020	**24530**	**5498**	**780**	**22.41**	**18252**	**74.41**	**3.18**	**51.99**

Table 2: Estimate of predicted recovery rate, cases load rate and delta with change

Date	Recovery rate	Cases load rate	Delta	Change
25-04-2020	22.68	74.14	51.45	0.54
26-04-2020	22.98	73.84	50.92	0.59
27-04-2020	23.30	73.52	50.38	0.65
28-04-2020	23.66	73.16	49.84	0.72
29-04-2020	24.06	72.76	49.30	0.79
30-04-2020	24.49	72.33	48.76	0.87
01-05-2020	24.97	71.85	48.22	0.95
02-05-2020	25.49	71.33	47.68	1.05
03-05-2020	26.07	70.75	47.15	1.15
04-05-2020	26.71	70.12	46.61	1.27
05-05-2020	27.40	69.42	46.07	1.40
06-05-2020	28.17	68.65	45.53	1.54
07-05-2020	29.02	67.80	44.99	1.69
08-05-2020	29.95	66.87	44.45	1.86
09-05-2020	30.97	65.85	43.91	2.05
10-05-2020	32.09	64.73	43.38	2.25
11-05-2020	33.33	63.49	42.84	2.47
12-05-2020	34.69	62.13	42.30	2.72
13-05-2020	36.19	60.63	41.76	2.99
14-05-2020	37.84	58.98	41.22	3.29
15-05-2020	39.65	57.17	40.68	3.62
16-05-2020	41.64	55.18	40.14	3.99
17-05-2020	43.83	52.99	39.61	4.38
18-05-2020	46.25	50.58	39.07	4.82
19-05-2020	48.90	47.92	38.53	5.30
20-05-2020	51.82	45.00	37.99	5.84