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Plausible State-Specific Plans and Recommendations to Avert COVID-19 Community Transmission

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Abstract:
Current article emphasizes upon the strategy to increase the number of tests at the state-level so that majority of the suspected cases could be traced out, isolated and quarantined in order to contain them from becoming a source of infection and coronavirus disease-2019 (COVID-19) dissemination. The objective of the recommended testing is to contain the spread of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) infection. Lessons learnt so far points to the fact that earlier the identification and isolation of infected person, lesser are the chances that it would spread. Considering an example of Maharashtra which has reported cases above 20,000 in the last 7 days with 90,000 tests carried out each day with a test positive report (TPR) of 22%-25%. So, assuming that even if 20% of a particular locality in Maharashtra is infected, then at this rate, we shall be able to isolate only 20,000 each day, while rest of the untraced cases already existing in the locality would pass it on to other people, before being isolated. The only solution to stop this cycle is to outnumber the rate of growth of new cases by increasing the number of tests at a very fast pace. In order to contain the infection, our testing rate has to be much higher than the case growth rate.

Keywords: Test Positivity Rate (TPR), Cumulative Test Positivity Rate (CTPR), Case Growth Rate / rate of growth of cases (CGR), Test Growth Rate / rate of growth of tests (TGR), Testing, COVID-19, State-specific plan, Community transmission.

INTRODUCTION

A novel coronavirus SARS-CoV-2 has spread its tentacles to almost every part of the world and has been the third outbreak caused by the coronaviridae family of viruses leading to recent pandemic of Coronavirus disease (COVID-19) (Kumar et al., 2020; Sharma et al., 2020; Upadhyay et al., 2020a). Recent pandemic of Coronavirus disease COVID-19 has engulfed the whole world with millions of cases reported from many countries. India has been witnessing a large flux in terms of number of COVID-19 cases coming very close to the United States and Brazil, but mortality has been quite low compared to western countries such as the USA and Brazil, as far as the infected cases are concerned.

Though in terms of mortality, still India has reported significantly lower number than other worst affected countries (Dan et al., 2020; Ornell et al., 2020). Majority of the cases in Indian Scenario are reported to be either asymptomatic or having milder symptoms (Trivedi et al., 2020; Upadhyay et al., 2020b). More so the true mortality rate attributed specifically to COVID-19 is speculated to be even lower as majority of the deaths are reported in patients having comorbidities which is also supported by the Ministry of Health and Family Welfare guidelines (Chakrabarti et al., 2020a; MoHaFWUoC-IcAA, 2020). Recent days have witnessed high number of COVID-19 cases reported from various states as the testing were scaled up in order to trace and isolate the maximum cases as early as possible (Jha et al., 2020; Sood et al., 2020). This seems to be a potential option especially in Indian scenario so that the community spread could be averted. Also, many asymptomatic or patients having mild infections but remain untested, could go unnoticedbut are quite vulnerable to the healthy population as far as the spread of the disease is concerned (Yadav et al., 2020). So far at the national level, India has done a pretty good job in terms of testing as in absolute numbers, India stands second only to the USA, a remarkable feat for a developing country where the doctor-people ratio stands at 0.9 per 1000, which is even lower than its south Asian neighbours (Chakrabarti et al., 2020b; DWB, 2020; Gupta and Pal, 2020).

TRACING OF COVID-19 INFECTED CASES

Majority of the countries are facing the challenge to trace the COVID-19 infected cases at the initial stages. Towards this goal, India also increased substantially the rate of testing COVID-19 (Keeling et al., 2020). However, there is still a big gap and many asymptomatic or mild symptomatic patients are going unnoticed and significantly becoming the source of infection to others. If we look at the state-level scenario in India, there is a huge gap between the numbers of tests required to be done and tests actually being performed. This testing deficit may have deleterious consequences in the long run as far as quest to contain the spread of COVID-19 is concerned (Mbunge, 2020). Partial consequences are being seen in the form of increase in number of COVID-19 cases even in states where only very few cases of COVID-19 were there during the months of May and June, 2020.

STRATEGY FOR CONTAINMENT OF THE INFECTION RATE

Mathematically, for successful containment of the infection, the TGR should be much greater than CGR. The question arises as to how much tests should be conducted. The answer to this question is available in understanding the quantitative and qualitative understanding of the data for the past six months living with this infection in Indian scenario (Rocklov and Sjodin, 2020; Singh and Gupte, 2020). To begin with, we need to understand how to measure the spread of infection in a region / state. Test Positivity Rate (TPR), i.e. ratio of positive infection to the number of successfully conducted tests, gives a direct, approximate yet valuable measure of the spread of infection in any region / state. If TPR is on a decreasing trend, it is to be understood that the state / region is able to contain the spread while the vice versa is equally true. In the current study, we are analysing 18 states of India based on the data reported since 15th April 2020 (Fig. 1). Figure 1 (A,B,C,D,E,F) represent the detailed analysis for the states of Bihar, Tamil Nadu, Gujarat, Uttar Pradesh, Delhi and West Bengal respectively. Upon analysing of the plots that represents CGR, TGR, TPR, CPR against time divided into fortnights based on Table 1 for the respective states, it is evident that these states have TGR > CGR for at least the last 3-4 fortnights. While TGR > CGR, the CTPR has been coming down with falling TPR-15. All these four factors taken into consideration against time intervals clearly illustrate that these states are in the control of the pandemic management. This is also an indication of the fact that these states are testing enough to improve their situation, however consistency in terms of increasing the tests further, would be appreciated as it shall further lower the chances of newer infections as well as any scope of a second wave.

Interestingly, there are states viz. Rajasthan, Haryana, Uttarakhand, Odisha, Kerala and Jharkhand who are still struggling to bring the COVID-19 situation under control. Analysing the plots that represent CGR, TGR, TPR, CPR against time divided into fortnights, it was evident that these states have non-consistent TGR– CGR and because of the same, they are not completely in control. However, they have shown signs of hope as their TGR and CGR difference is not considerably high.

Due to inconsistency in the TGR and CGR, their TPR-15 and CTPR have been inconsistent too. This is also a direct measure of the fact that these states are not testing enough as per the spread of infection in their respective states.

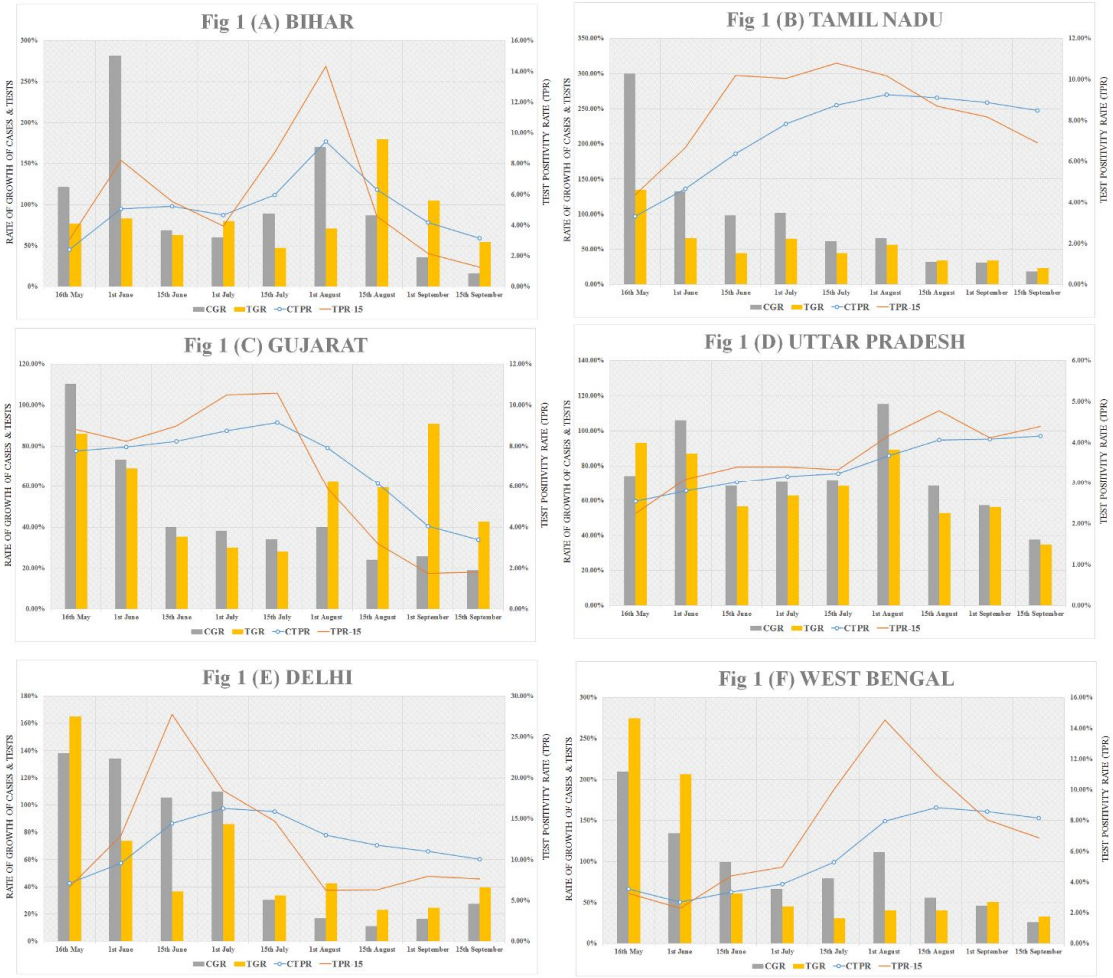

Figure 1: Plot between Rate of Growth of Cases & tests (on Primary Axis) and CTPR & TPR-15 (on Secondary Axis) over fortnightly time intervals for Bihar, Tamil Nadu, Gujarat, Delhi and West Bengal

Table 1: Classification of states based on their current TPR

Category	TPR reported in previous 15 days	Target for the next 7 or 15 days
A	TPR > 20%	Bring TPR to 17.5%
B	TPR between 7.5%-20%	Aim to reduce TPR by 2.5% - 5% each week / fortnight depending upon spread
C	TPR below 7.5%	Aim to bring TPR below 5%
D	TPR below 5%	Aim to bring TPR down by 0.5% each week

Upon analysis another set of states in Figure 2(A,B,C,D,E,F) which represent states of Punjab, Karnataka, Jammu and Kashmir, Andhra Pradesh, Chhattisgarh and Maharashtra respectively. Analysing the plots that represent CGR, TGR, TPR, CPR against time divided into fortnights as per based on Table 1, it is evident that these states have not been able to keep pace with the growth of cases i.e. CGR >> TGR resulting in increasing CTPR as well as TPR-15. This analyses also clearly states that these states have not been able to match up the rate of growth of new infections and have

been testing at a critically very low rate, leading to upsurge in both TPR-15 as well as CTPR. If these states do not ramp up their tests exponentially, they shall move into a loop of never-ending cases. By the time they shall be able to handle a particular locality, the infection would be spread to the next and so on.

Out of these 18 states, we have analysed two states particularly for the last 48 days: Gujarat & Maharashtra. While, Gujarat has shown significant improvement in Covid-19 management, Maharashtra's situation has actually worsened with time. Gujarat had CTPR of 8.05% on 1st August 2020 and has been able to bring it down to 3.33% on 17th Sep. 2020. On the other hand, Maharashtra which had CTPR of 19.6% on 1st August 2020, it has further increased CTPR to 20.4% during the same period.

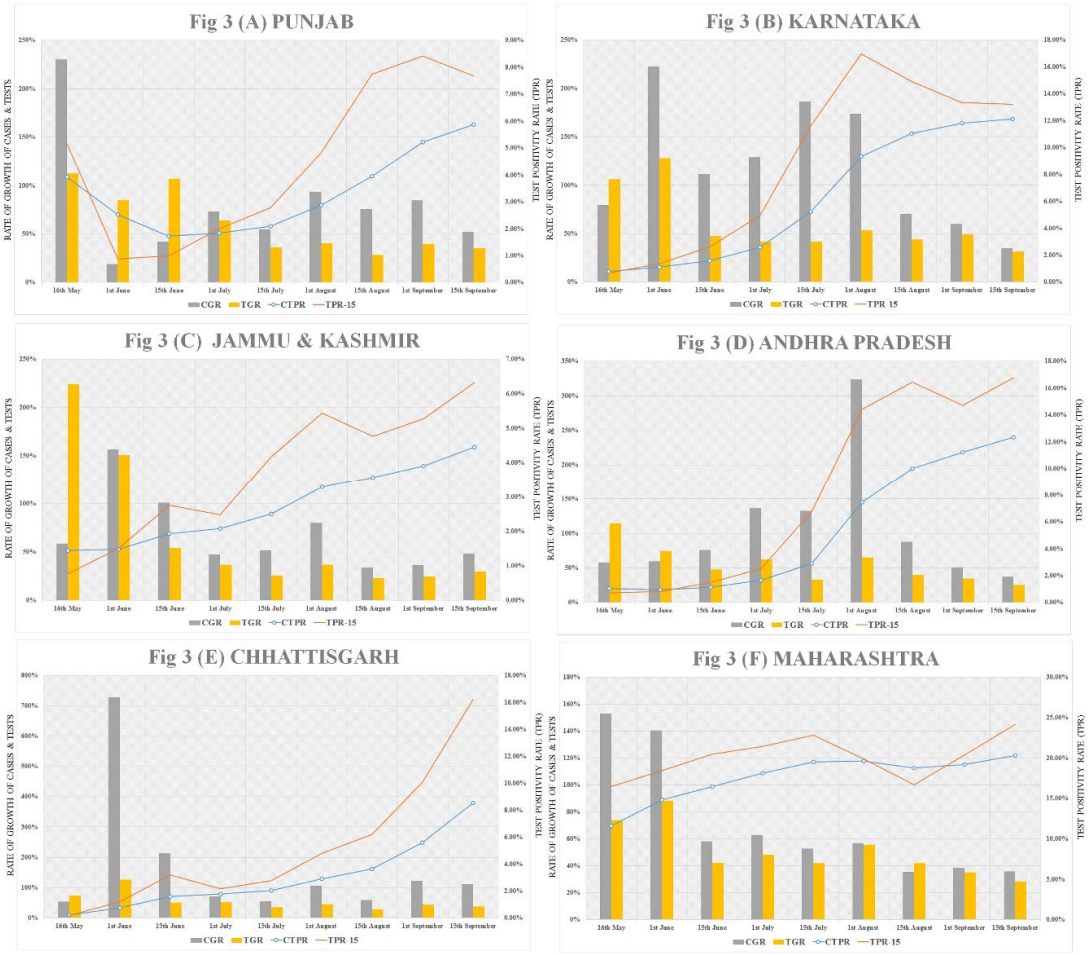

Figure 2: Plot between Rate of Growth of Cases & tests (on Primary Axis) and CTPR & TPR-15 (on Secondary Axis) over fortnightly time intervals for Punjab, Karnataka, Jammu & Kashmir, Andhra Pradesh, Chhattisgarh and Maharashtra

Upon analysis of the statistics reported for Maharashtra and Gujarat which is plotted in figure 2 in the last 48 days, there is a clear illustration of how Gujarat kept ramping up their tests and not only reduced their CTPR, but also have effectively contained the virus, bring the CTPR to below 3.5% while the benchmark for this is 5% as per WHO's guidelines (Figure 3). On the other hand, Maharashtra kept their TGR lower than CGR throughout and the end result has been the continuously rising CTPR.

FUTURE RECOMMENDATIONS

The very relevant question before us remains as how much tests should we do.Based on WHO's guidelines which state that for a region / state to be in control, their CTPR, test positivity rate should fall below 5% with consistently reducing TPR-15 below 5%. So, the ultimate goal is to aim for TPR-15 below 5%, so that CTPR starts falling gradually. However, CTPR in India has been varying from 2.8% to 20.4% and the pandemic has behaved dynamically with things changing in days. Therefore, the states have to decide where they stand and what are their short-term goals (of 7 days or 15 days)? Firstly, the states should be classified based on their current TPR for example as shown in Table 1. Following four steps need to be followed; Step 1: Find out the average number of cases reported in the last 15 days. Step 2: Find out the average number of tests conducted in the last 15 days. Step 3: Find out what is your TPR for the last 15 days. Step 4: Find out the category out of the above 4 (shown in Table 1). The outcome based upon mathematical modelling for the above 4 categories of states for the first fortnight of September has been elucidated in Table 2.

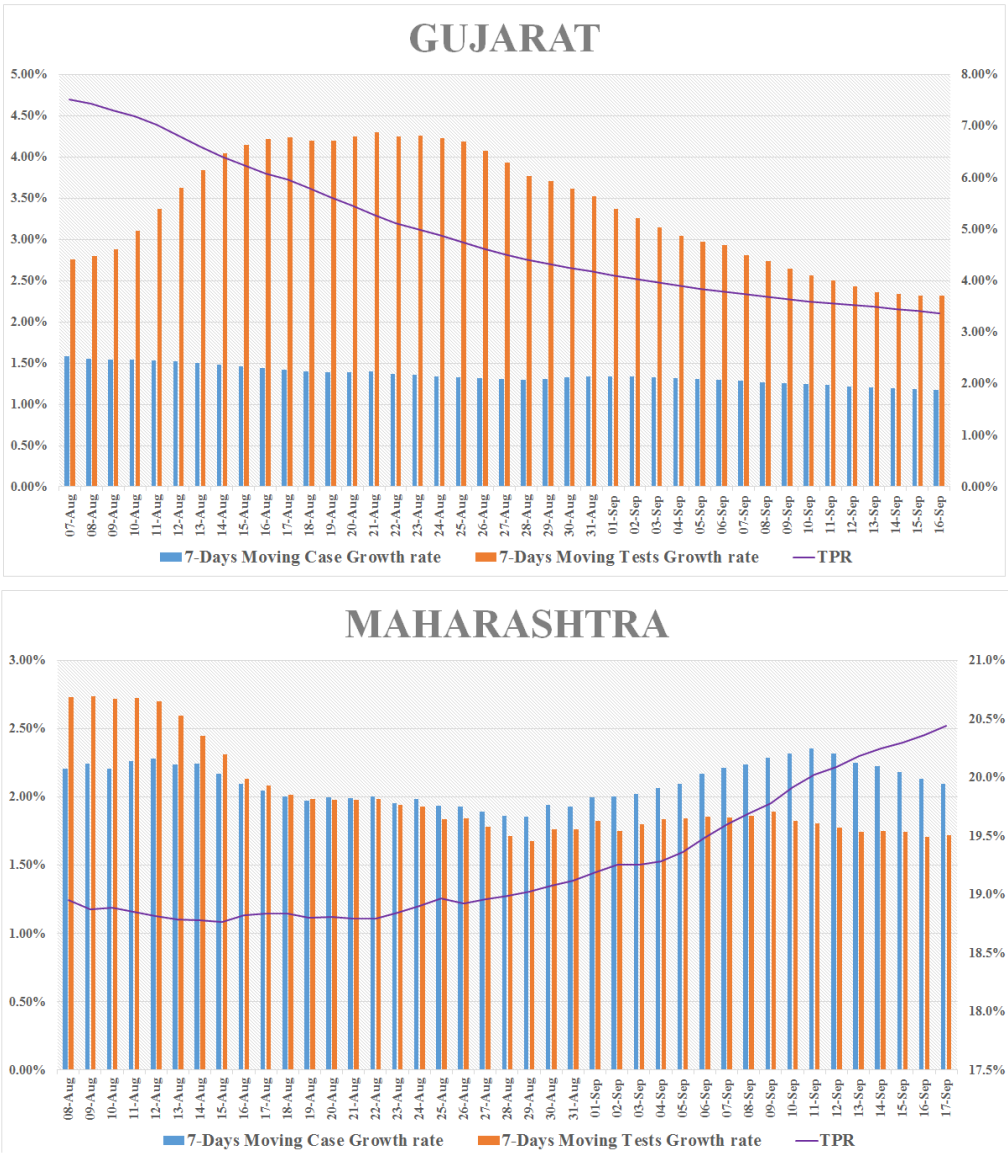

Figure 3: Plot of 7-Days Moving Case Growth Rate & 7-Days Moving Test Growth Rate (Primary Axis) and Cumulative Test Positivity Rate (Secondary Axis) vs Time (Date in consideration: 1st August, 2020 – 16th September, 2020).

Table 2: Category-wise classification of the states based upon the mathematical modelling (1st September to 15th September, 2020)

Category	State	Cases	Tests	Average Cases	Approx. Average Tests	TPR-15
A	MH	305315	1263900	20354	84260	24.16%
B	AP	149154	1008800	9934	67250	14.79%
C	RJ	25997	407000	1733	27000	6.39%
D	UP	93622	2170000	6241	145000	4.31%

Category A: Maharashtra
Last 15 days TPR = 24.16%
Target for next 15 days: TPR-15 to be kept 17.5% or lower
So, these 24.16% of average tests conducted in the last 15 days be assumed to be 17.5% of "X" where "X" is the ideal / optimum number of tests that Maharashtra should conduct each day in the next 15 days to bring down TPR-15 to 17.5%.
So, 17.5% of "X" = 20354,
Hence, "X" = 20354*100/17.5, therefore, "X" = 116308, so the optimum / ideal number of tests Maharashtra should attempt each day in the next 7-15 days should be 116308 or above.

Category B: Andhra Pradesh
Last 15 days TPR = 14.49%
Target for next 15 days: TPR-15 to be kept 10% or lower
So, these 14.49% of average tests conducted in the last 15 days be assumed to be 10% of "X" where "X" is the ideal / optimum number of tests that Andhra Pradesh should conduct each day in the next 15 days to bring down TPR-15 to 10%.
So, 10% of "X" = 9934, therefore, "X" = 99340, so the optimum / ideal number of tests Andhra Pradesh should attempt each day in the next 7-15 days should be 99340 or above.

Category C: Rajasthan
Last 15 days TPR = 6.39%
Target for next 15 days: TPR-15 to be kept 5% or lower
Therefore, these 6.39% of average tests conducted in the last 15 days be assumed to be 5% of "X" where "X" is the ideal / optimum number of tests that Rajasthan should conduct each day in the next 15 days to bring down TPR-15 to 5%.So, 5% of "X" = 1733, therefore, "X" = 34660, so the optimum / ideal number of tests Rajasthan should attempt each day in the next 7-15 days should be 34660 or above.

Category D: Uttar Pradesh
Last 15 days TPR = 4.31%
Target for next 15 days: TPR-15 to be kept 3.5% or lower
Therefore, these 4.31% of average tests conducted in the last 15 days be assumed to be 3.5% of "X" where "X" is the ideal / optimum number of tests that Uttar Pradesh should conduct each day in the next 15 days to bring down TPR-15 to 3.5%.So, 4.31% of "X" = 6241, therefore, "X" = 178314, so the optimum / ideal number of tests Uttar Pradesh should attempt each day in the next 7-15 days should be 178314 or above.

CONCLUSIONS

Overall, the study emphasizes upon the need to seal the gap between the number of tests required to be done and tests to be actually performed.The need of the hour for the state governments is to strictly implement the optimum number of tests to be performed each and every day so that the TPR-15 could be brought down to less than 5% resulting in the decline of the CTPR below 5% (Table 3). Therefore, the only solution to bring this pandemic under control is to outnumber the rate of growth of new cases by increasing the number of tests which would ultimately assist in keeping a check upon contain the spread of infection.

Table 3: Proposed optimum number of tests recommended for each of the states

State	Average Cases	Average Test	Current TPR-15	Target TPR-15	Optimum No. of Test	Daily Number of Test to be Increased
Andhra Pradesh	9944	67253	14.79%	10%	99436	32183
Arunachal Pradesh	157	2840	5.53%	4.50%	3487	647
Assam	2502	34640	7.22%	5%	50045	15405
Bihar	1650	127333	1.30%	1%	164960	37627
Chandigarh	263	1626	16.16%	10%	2627	1001
Chhattisgarh	2618	16293	16.07%	10%	26182	9889
Delhi	3403	44233	7.69%	5%	68064	23831
Goa	540	2991	18.04%	12.50%	4316	1326
Gujarat	1327	73793	1.80%	1%	132733	58940
Haryana	2259	25773	8.77%	5%	45187	19413
Himachal Pradesh	281	2487	11.31%	7.5%	3750	1264
Jammu and Kashmir	1264	20267	6.24%	5%	25275	5008
Jharkhand	1519	37020	4.10%	4%	43396	6376
Karnataka	8856	67973	13.03%	10%	88561	20588
Kerala	2457	33147	7.41%	5%	49141	15995
Ladakh	55	730	7.48%	5%	1091	361
Madhya Pradesh	1939	22927	8.46%	5%	38784	15857
Maharashtra	20354	84260	24.16%	15%	135696	51436
Manipur	151	2945	5.12%	5%	3353	407
Meghalaya	111	2182	5.10%	5%	2473	291
Mizoram	30	794	3.83%	3%	1016	221
Nagaland	85	675	12.63%	7.5%	1137	462
Odisha	3674	48473	7.58%	5%	73485	25012
Puducherry	413	2513	16.42%	10%	4127	1613
Punjab	2033	25127	8.09%	5%	40653	15527
Rajasthan	1733	27133	6.39%	5%	34663	7529
Sikkim	35	282	12.31%	7.5%	463	181
Tamil Nadu	5744	82387	6.97%	5%	114889	32503
Telangana	2374	56980	4.17%	3.5%	67825	10845
Tripura	538	4300	12.51%	7.5%	7174	2874
Uttar Pradesh	6241	144667	4.31%	3.5%	178328	33661
Uttarakhand	972	9853	9.86%	5.0%	19440	9587
West Bengal	3091	44993	6.87%	5.0%	61824	16831

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Conflict of Interest
This is to note that all the authors have read and agreed to publish the said article and there are no conflicts of interest amongst authors regarding this manuscript.

Ethical Clearance
Ethical clearance not applicable, because this study does not involve working with human subjects, blood samples or animal studies.

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