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# Spatial Mapping and Demographic Characteristics of the COVID-19 Positive Cases in India: A Situational Analysis

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## Abstract

**Context:** India lacks studies on spatial and demographic characteristics of the ongoing COVID – 19 pandemics.

**Objectives:** To examine the selected spatial and demographic characteristics of the COVID – 19 positive cases in India. The characteristics included are: spatial spread (state and district level) spread of the disease, age and gender, type of transmission, and the travel history of the diagnosed cases of the disease.

**Data:** The study used data for the period up to May 3, 2020 from the application based current dataset (Application Programming Interface). A total of 37,293 positive cases of COVID – 19 in India occurred between January 30 to May 3, 2020 have been analyzed.

**Methods:** The study results are presented for the states and districts with more than 100 cumulative COVID – 19 positive cases as of May 3, 2020. The results are sub-divided into four phases: Phase–1 (period before March 24, 2020), Phase–2: period between March 25 and April 14, 2020, Phase–3: period between April 15 and April 24, 2020, and Phase–4: period between April 25 and May 3, 2020. Phase–1 correspond to pre–lockdown 1.0, phase–2 to lockdown 1.0 and phases–3/3 together to lockdown 2.0. Beside simple bi-variate tables we use present maps of India for the four phases at the district level.

**Results:** One–quarter of national COVID – 19 cases were from Maharashtra, 10–11% each from Tamil Nadu, Gujarat and New Delhi. Rajasthan, Madhya Pradesh and Uttar Pradesh accounted for nearly 6–8% and Andhra Pradesh and Telangana for 4% cases each. India recorded 2100 times growth in new COVID – 19 cases during phases–1/2 which slowed down to 39% during phase–2/3 and became minus 51% during phases–3/4. The growth was rapid in nine states, including Maharashtra, Gujarat, West Bengal and Bihar (80%–261%) during phases–2/3. Majority states experienced negative growth in the new cases during phases–3/4. About half of the national COVID – 19 cases (46%) come from 45 districts of 13 states. Mumbai in Maharashtra (7.4%), Ahmedabad in Gujarat (6.3%), Chennai in Tamil Nadu (3.8%), Indore in Madhya Pradesh (2.8%), and Jaipur in Rajasthan (2.2%), together contributed to over 23% of the COVID – 19 cases in the country. Mumbai, Ahmedabad, Chennai and Indore recorded 1056 – 2710 positive cases by May 3, 2020. While number of districts with zero cases declined from 532 in phase–1 to 193 in phase–4. Correspondingly, districts with 100 to 999 COVID – 19 cases rose from zero to 41. Mean age of the positive cases declined by over four years in the last three months and share of children has risen to 15%. About 5% of the cases had a travel history; majority to Middle–eastern and European countries.

**Conclusions:** Understanding of characteristics of the COVID – 19 positive cases across smaller geographies and demographic subgroups would provide insights to the authorities in designing locally appropriate effective strategies and programs to prevent community spread of the disease.

**Keywords:** COVID – 19, India, Patients, Hospitalized, Recovered, Deceased, Transmission, Spatial, States, Districts, Hotspots.

**Word counts:** 491

# **Spatial Mapping and Demographic Characteristics of the COVID-19 Positive Cases in India: A Situational Analysis**

WORD count: **3222 (excluding references, tables and figures)**

## **Introduction:**

The official statistics of the Ministry of Health and Family Welfare, Government of India,<sup>1</sup> suggest that the country registered its first case of COVID – 19 on January 30, 2020 in Thrissur district of Kerala originating from China. Within less than a month's time, the cases rose to 22 on March 4 (making a cumulative case at 28) that included 14 infected Italian tourists.<sup>2</sup> The number of cases escalated during March (reaching around 1400 mark by March 31) as more and more cases were recorded from different parts of the country, and majority were linked to their travel history in the affected countries. Soon the Government of India initiated its protective measures including thermal screening of the passengers arriving from China, later extended to the travelers from Thailand, Singapore, Hong Kong, Japan, South Korea, Nepal, Vietnam, Indonesia and Malaysia. This was followed by a compulsory screening of all international passengers arriving in India as announced by Honorable Union Health Minister, Dr. Harsh Vardhan, on March 2, 2020. All international flights were cancelled from March 22, 2020. Until March, the surveillance systems and testing infrastructure in the country remained largely inactive.

By the mid-March, the Indian authorities developed a comprehensive plan to contain the pandemic and extended quarantining services for the positive cases coupled with treatment facilities. The medical surveillance was stepped up and the states governments were issued advisories for enforcing social distancing. The national and state helpline numbers were set up to spread awareness of the disease and preventive measures followed by compulsory wearing facial mask in many cities. Additionally, in the beginning of March, old visas were suspended and new visas were banned, borders with the neighboring countries were sealed, entry to foreign and domestic tourists into the states were banned. As a preventive measure to avoid mass interaction, district, city and state borders were closed and public spaces including all educational institutions, cinema halls, shopping malls etc. were closed. A mobile based app

named as “*Aarogya Setu* (Health Bridge)” was initiated on April 2 to enable contact tracing for containing the spread. Further, a nationwide ‘Janata (public) curfew’ between 7 am and 9 pm on March 22, 2020 as announced by the PM on 19<sup>th</sup> March on national telecast followed by a three-week nationwide complete lockdown from March 25, 2020 to April 14, 2020 as announced on 24<sup>th</sup> night by the PM was enforced (Lockdown 1.0). This was later extended by two more weeks until May 3, 2020 (Lockdown 2.0). On April 3, 2020, the Prime Minister announced 15,000 crore rupees (equivalent to US dollar One billion) aid to the health sector for expanding testing facilities, intensive care units, ventilators, necessary personnel protective equipments for those engaged in the service provision and for the training of the health workers. The federal government has now extended the complete lockdown (Lockdown 3.0) by another 2-weeks (from May 4 to 17, 2020) in red zone areas as identified on April 29, 2020.<sup>3</sup>

Even so, the number of COVID – 19 cases in the country are rising rapidly, more importantly as the Government is accelerating testing. As of May 3, 2020, the total number of COVID – 19 positive cases in India stood at 42,778. Of these, 11,763 (27.5%) recovered and 1463 (3.4%) died. As of May 6, 2020, a total of 12,76,781 samples have been tested in the country.<sup>4</sup> Although, presently India’s test rate is one of lowest (482 per million people) when compared with the global rates.<sup>5</sup> For example, as of April 27, 2020, between 10000 to 32414 COVID – 19 cases per million people were tested in Portugal, Italy, Switzerland, Spain, Germany, Russia, Canada, Belgium, Netherlands, and Turkey.

The public health system in India is not well prepared for the pandemic and is already overburdened with the maternal-child health care and emerging non-communicable diseases (NCD). Thus, if India fails to prevent community spread of the disease, the country may suffer from serious adverse effect on the well-being of its people. The public authorities have recognized the need for real time unit level data to enable better strategies and plans to effectively address emerging challenges of the deadly disease. The social scientist in India, probably for the first time, have got access to a national treasure, the real time data and have

been intelligently analyzing it to extend their support to the authorities in their efforts in combating the situation from worsening in future.

Studies elsewhere<sup>6-12</sup> have suggested that the median age of COVID-19 patients was between 30 to 45 years with majority of the patients aged 20 to 70 years old. The proportion of male patients was higher compared to female patient; however, the difference was not huge (6,8–10). There are studies on projection of COVID-19 cases and assessing the effect of social distancing around the world and few in India<sup>13–16</sup>. Little is known about the COVID – 19 cases in India with respect to their spatial and demographic characteristics. In this study, we present, spatial spread of the COVID – 19 cases using unit level data of the positive cases in India at the state and district level over various phases of Government mass level interventions. Additionally, we present age, gender, transmission type and the travel history of cases at the state and district level. This information would be useful in understanding the pattern of the disease spread and thereby help in planning effective strategies to contain its further spread.

## **Data and methods**

The study used the application based current dataset (Application Programming Interface). This collates data on the COVID – 19 cases across geographies using multiple channels including Facebook, Twitter, Press releases/notifications, government websites etc. The information is updated on a daily basis in CSV format. The analysis in the study included COVID – 19 cases identified in India as of May 3, 2020, covering 92% of all positive cases. The researchers organized the relevant data to enable the analysis in STATA. For example, the data contained descriptive history of each of the COVID – 19 positive case. After careful reading of the same for every case, new variables were generated to measure if the individuals have had a travel history (both international and domestic), before being diagnosed for COVID – 19. If there was travel history, then the name of the country of origin, country from where individuals boarded the flight for India and if the individuals had any contact with other individuals who travelled internationally (either a visitor, relative or a tourist) were identified. The patients with no international travel history were classified separately. The names of the state where case was diagnosed was

available for almost all of the cases. However, district name was available for about two-thirds of the cases (66%). Age and gender of the patients was available for 12% and 20% of the cases, respectively. Transmission type (local or imported) was available for about 18% of the cases. About 8% of the cases had an international travel history. The analysis was performed separately for following phases:

1. **Phase-1:** defined as period before enforcement of the Lockdown 1.0, referring to period before March 25, 2020
2. **Phase-2:** defined as period of the Lockdown 1.0, referring to period between March 25 and April 14, 2020 (3-weeks)
3. **Phase-3:** First 10-days of the Lockdown 2.0, referring to the period between April 15 and April 24, 2020
4. **Phase-4:** Last 9-days of the Lockdown 2.0, referring to the period between April 25 and May 3, 2020.

These phases have been created to examine if the lockdowns are associated with the emergence / rise or fall of COVID – 19 cases in the states and districts of India. The results are presented for states and districts that have recorded 100 or more COVID – 19 positive cases by the end of the Lockdown 2.0 (that is, May 3, 2020). Additionally, we presented spatial pattern of the COVID – 19 positive cases over these four phases at the district level.

## Results

Of the states that have recorded 100 or more COVID – 19 positive case by May 3, 2020, Kerala recorded its first case on January 30, 2020 (Table 1, Col 3). New Delhi and Telangana became the second states to record COVID – 19 positive case on March 2, 2020. Soon other states joined the list; Rajasthan on March 3, Uttar Pradesh and Haryana on March 4, Tamil Nadu, Jammu and Kashmir and Chandigarh on March 7, Maharashtra, Karnataka and Punjab on March 9. Andhra Pradesh recorded its first case on March 12, Odisha on March 16, West Bengal on March 17, Gujarat on March 19, Madhya Pradesh on March 20, Bihar on March 22 and Jharkhand on March

31. One-quarter of all COVID – 19 positive case covered in the analysis were from Maharashtra followed by 10–11% in Tamil Nadu, Gujarat and New Delhi (Table 1, Col 9). Rajasthan, Madhya Pradesh and Uttar Pradesh each accounted for nearly 6–8% of the COVID – 19 positive cases. Andhra Pradesh and Telangana had almost 4% of the COVID – 19 positive cases each.

Fewer than two percent of the new COVID – 19 positive cases in India were diagnosed during phase–1 (pre-lockdown period), 32% during phase–2 (Lockdown 1.0) (Table 1, Cols. 4–7). The remaining, a little about 45% were diagnosed during the phase–3 (first 10 days of the Lockdown 2.0) and another about 22% during phase–4 (last nine days of the Lockdown 2.0). The pattern of share of cases across states remain largely similar across four phases included in the analysis. For example, Maharashtra followed by Tamil Nadu, Gujarat and New Delhi had higher share of cases regardless of phase.

At the national level, number of new COVID – 19 positive cases rose astonishingly from 571 to 12,579 between phase–1 and phase–2; an increase by over 2100 times (Table 2, Cols. 9–11). The number of new cases reduced to 17,476 at the end of the phase–3, an increase by 39%. However, in the next nine–days number of new cases further rose to 8,647. Notably, the percentage change in the cases between phase–3 and phase–4 turned negative to –51% nationally. At the state level, nine states each had positive and negative percentage change between phase–2 and phase–3; Tamil Nadu, New Delhi, Telangana, Kerala, Jammu and Kashmir, Haryana, Punjab, Odisha and Chandigarh recorded negative percentage change in the new COVID – 19 cases. The new cases increased by 261% in Gujarat, by 147% in Bihar, 80-90% in Maharashtra and West Bengal during the same period. Between phase–3 and phase–4, majority states showed negative growth in the new cases. The exceptions were – Tamil Nadu, Andhra Pradesh, Bihar, Odisha, Jharkhand and Chandigarh.

Of all total confirmed COVID – 19 positive cases analyzed, 45 districts in the 13 states accounted for 46% (18,050 cases; Table 2) of total cases and are home to 14% of the national population. Of these 45 districts, 36 are marked as red zone areas and remaining nine as orange zone areas



by the government of India on April 30, 2020 where the Lockdown 3.0 is in effect until May 17, 2020. Five districts, namely Mumbai in Maharashtra (7.4%), Ahmedabad in Gujarat (6.3%), Chennai in Tamil Nadu (3.8%), Indore in Madhya Pradesh (2.8%), and Jaipur in Rajasthan (2.2%), together contributed to over 23% of the COVID – 19 positive cases in the country.

Nationally, the mean age of the COVID – 19 cases was 39 years (SD=17.9) and declined from 41.4 years (SD=17.6) in the phase–1 to 37.1 years (SD=17.6) in the phase–4 (Table 3). While children below 20 years of age contributed to about 13% of all COVID – 19 cases, share of people aged 60 years or older was about 16%. Majority of the cases belonged to the prime adult ages of 20–59 years (71%). Share of younger patients (below age 20 years) increased from 4% in phase–1 to about 15% during phase–4. Majority of the COVID – 19 cases in India were males (66%) and remained around the same over the phases as well. While majority of the cases were locally transmitted (82%), remaining 9% were imported. Share of imported transmission was over 62% in the phase–1, which declined to 11% in the phase–2 and subsequently to 0.1% in the phase–4. About 5% of the cases reported having an international travel history and another about 3.5% domestic travel history. Majority of the cases with an international travel history, had travelled from Middle Eastern countries including UAE, Saudi Arabia, Qatar (53%,) and about 31% from Europe including United Kingdom, Italy, Spain, Germany, France. About 8% of the cases had travelled from Asian countries (Indonesia, Thailand, China etc.) and 6% from USA and Canada (data not shown).

The spatial distribution of the number of cumulative COVID – 19 cases in the India revealed that the number of districts with zero cases has declined substantially from 532 in phase–1 to 244 in phase–2 to 193 at the end of phase–4 (Figure 1 and Table 4). Conversely, the number of districts with 1000 or more COVID – 19 cases rose from one in phase–2 to four in phase–4 (one each from Maharashtra, Gujarat, Tamil Nadu and Madhya Pradesh. Further, the districts with 100 to 999 COVID – 19 cases to had risen considerably from 13 in phase–2 to 21 in phase–3 and 41 in phase–4. The data suggested that the Eastern and North-eastern districts in the country are relatively less affected by the COVID-19 pandemic.

## Discussion and Conclusion

The present study is first to provide selected spatial and demographic characteristics of the COVID – 19 positive cases in India over a period of three months, from onset to May 3<sup>rd</sup>, 2020 (end of the nationwide five-week long lockdown). At the national level, Share of children below age 20 years showed an upward rise to 15% over the period of analysis, resulting in a decline on four years in the mean age of the COVID – 19 cases. Adult ages of 20–59 years are the most affected as they accounted for nearly three–fourths of the positive cases in India. Two–thirds of the positive cases in India were males. Local transmission was found in 82% of the cases and nearly 5% reported international travel history; in the countries of Middle Eastern and Europe.

The study finds that the number of COVID – 19 cases in India is rising at an escalated pace, more importantly in the last one month or so. This is mainly attributable to the fact that the government authorities have intensified their efforts and are now conducting more and more tests to identify the cases so that these cases can be isolated and treated without any further delay. After 30 April, India has been testing an average of about 70,000 per day (a jump from around 50,000 per day in the last week of April) and hence an acceleration in new cases of the disease is inevitably expected. Studies in India suggest that the COVID – 19 positive cases are likely to grow further in India<sup>17</sup> and in its red zone districts where the disease is spreading fast.<sup>18</sup> The country has succeeded in keeping the COVID – 19 case fatality ratio at relatively low levels, less than 4% when compared with other countries.<sup>19</sup> Nonetheless, the fatality ratios vary considerably across geographies, with Maharashtra and Madhya Pradesh at the top of the list.<sup>19</sup> The study<sup>18</sup> further found that the number of red zone districts may have to wait for about 4 to 6 weeks more to experience ‘zero new cases’ scenario if the current patterns continue; Hyderabad, for example, may experience ‘zero new cases’ of COVID – 19 only after mid-July or so. The same study found out that during the lockdown 2.0, the doubling time for the positive cases may go up to 21 days for Mumbai and Thane, 8–9 days for Hyderabad and Pune.

The present analysis further finds that the COVID – 19 cases are spatially concentrated in the selected states and districts of India. Nine states (Maharashtra, Tamil Nadu, Gujarat, New Delhi, Rajasthan, Madhya Pradesh, Uttar Pradesh, Andhra Pradesh and Telangana together account for 85% of the national COVID – 19 cases and are home to almost six in every 10 Indians. The government of India has already classified its districts in red, orange and green zones based on the mapping of the cases and contacts, their geographical dispersion, and areas with demarcated perimeter and enforceability.<sup>3</sup> This has helped in identifying area specific strategies to prevent further spread and provision of essential health care services to the patients suffering from the disease. Besides, as mentioned earlier, the Government of India has implemented some extreme steps that included a rigorous five-week long nationwide lockdown to quarantining the individuals with symptoms, screening of the international travelers to name a few. The social distancing measure is further extended until May 17<sup>th</sup> in the red zone districts and with some relaxation in the orange zone districts. In fact, to date, social distancing by way of national lockdown is considered to be the single most effective strategy India has adopted to prevent mass scale spread of the COVID – 19 cases. The social distancing has helped India put a brake on viral dissemination and has averted an estimated 63,334 confirmed cases and 3,845 deaths from COVID – 19 till April 23, 2020 in India.<sup>17</sup> India may need social distancing of one-year long lockdown is needed in India to effectively deal with the COVID – 19 crisis.<sup>20</sup>

These social distancing measures carry huge social and economic costs to individuals as well as communities. The migrant workers and the urban poor engaged in unorganized sectors may be the worst affected due to these. Additionally, the World Bank stated that the coronavirus pandemic has severely disrupted the Indian economy and it is expected to slow down to 5% in 2020 and further to 1.5% – 2.8% in the fiscal year 2020–21.<sup>21</sup> Thus clearly it may take a while before the country can re-build its economy. The global communities have applauded India for its timely, comprehensive and effective strategies to contain the disease. India is home to one-sixth of the global population (1.4 billion) and thus the global communities have keen eye on what is happening India in this challenging time. India should take this as an opportunity to re-build India's tumbling health system and strengthen its surveillance data system to provide real

time data to the researchers and scientists which in turn to help use them for evidence based planning and policies to address such unforeseen situations in future. There are concerns about the timely completion of the reporting of the data in some areas which led to a sudden surge in the cases based on the testing. The states and federal authorities should work together to ensure adherence to protocol of updating cases to help build real time data series to enable evidence based decision-making.

**Authors contribution:** UR conceptualized the study. UR, PK and SK organized the data. UR and PK conducted data analysis. UR wrote the first draft of the manuscript. All authors helped in the interpretation of the study results, reviewed the manuscript and approve the final version.

## References

1. Ministry of Health and Family Welfare, Government of India. [www.mohfw.gov.in](http://www.mohfw.gov.in). Retrieved 28 April 2020.
2. <https://www.thehindu.com/news/cities/Delhi/covid-19-6-members-of-delhi-patients-family-test-positive-for-coronavirus/article30980724.ece> (accessed on April 29, 2020)
3. <https://indianexpress.com/article/india/covid-19-lockdown-centre-identifies-red-green-orange-zones-for-week-after-may-3-check-full-list-here-6388654/> (accessed on May 3, 2020)
4. [https://www.icmr.gov.in/pdf/covid/update/ICMR\\_testing\\_update\\_06May2020\\_9AM\\_IST.pdf](https://www.icmr.gov.in/pdf/covid/update/ICMR_testing_update_06May2020_9AM_IST.pdf); (accessed on May 7, 2020 at 8.24AM)
5. <https://www.statista.com/statistics/1104645/covid19-testing-rate-select-countries-worldwide/> (accessed on April 28, 2020)
6. Li Q, Guan X, Wu P, Wang X, Zhou L, Tong Y, et al. Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus-Infected Pneumonia. *N Engl J Med*. 2020;382(13):1199–207.
7. Tian S, Hu N, Lou J, Chen K, Kang X, Xiang Z, et al. Characteristics of COVID-19 infection in Beijing. *J Infect* [Internet]. 2020;80(4):401–6. Available from: <https://doi.org/10.1016/j.jinf.2020.02.018>
8. Sun K, Chen J, Viboud C. Early epidemiological analysis of the coronavirus disease 2019 outbreak based on crowdsourced data: a population-level observational study. *Lancet Digit Heal*. 2020;2(4):e201–8.
9. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical Characteristics of 138 Hospitalized Patients with 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China. *JAMA - J Am Med Assoc*. 2020;323(11):1061–9.
10. Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *Lancet* [Internet]. 2020;395(10229):1054–62. Available from: [http://dx.doi.org/10.1016/S0140-6736\(20\)30566-3](http://dx.doi.org/10.1016/S0140-6736(20)30566-3)
11. Surveillances V. The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in China. *Zhonghua Liu Xing Bing Xue Za Zhi*. 2020;41(2):145–51.
12. Wu Z, McGoogan JM. Characteristics of and Important Lessons from the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72314 Cases from the Chinese Center for Disease Control and Prevention. *JAMA - J Am Med Assoc*. 2020;323(13):1239–42.
13. Deb S, Majumdar M. A time series method to analyze incidence pattern and estimate reproduction number of COVID-19. *arXiv Prepr* [Internet]. 2020;(arXiv: 2003.10655v1):1–14. Available from: <http://arxiv.org/abs/2003.10655>
14. Singh R, Adhikari R. Age-structured impact of social distancing on the COVID-19 epidemic in India. 2020;1–9. Available from: <http://arxiv.org/abs/2003.12055>

15. Chinazzi M, Davis JT, Ajelli M, Gioannini C, Litvinova M, Merler S, et al. The effect of travel restrictions on the spread of the 2019 novel coronavirus (COVID-19) outbreak. *Science*. 2020;9757(March):1–12.
16. Gupta R, Pal SK. Trend Analysis and Forecasting of COVID-19 Outbreak in India. *medRxiv*. 2020;2020.03.26.20044511.
17. Dwivedi LK et. al (2020) Assessing the Impact of Complete Lockdown on COVID-19 Infections in India and its Burden on Public Health Facilities. Working paper no. 3 of the International Institute for Population Sciences, Mumbai.
18. Ram U and P Kumar (2020) Pattern and Future Magnitude of COVID 19 Cases in Selected Red Zone Areas of India. Working paper no. 2 of the International Institute for Population Sciences, Mumbai.
19. Dhillon P et. al. (2020). Case-Fatality Ratio and Recovery Rate of COVID-19: Scenario of Most Affected Countries and Indian States. Working paper no. 1 of the International Institute for Population Sciences, Mumbai.
20. <https://www.financialexpress.com/lifestyle/health/covid-19-crisis-need-social-distancing-for-one-year-says-phfi-president-srinath-reddy/1934568/> (accessed on April 22, 2020)
21. World Bank. Spring 2020. The Economic Impact of COVID 19 on South Asia: The Cursed Blessing of Public Banks. (South Asia Economic Focus) <file:///C:/Users/USHA/Downloads/9781464815669.pdf> (accessed on April 30, 2020).

**Table 1: Population, date first case recorded, total number, and percent change in COVID – 19 positive cases in the states of India**

| State / UTs Name<br>(as per Census 2011) | Population<br>March 2020 <sup>§</sup><br>(in Million) | Date first<br>case<br>recorded | Number and state share of new COVID – 19 positive cases during |                                                                |                                                                |                                                             |                                                | % Change between          |                           |                           |
|------------------------------------------|-------------------------------------------------------|--------------------------------|----------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------|-------------------------------------------------------------|------------------------------------------------|---------------------------|---------------------------|---------------------------|
|                                          |                                                       |                                | Phase–1:<br>Before<br>March 25 <sup>th</sup>                   | Phase–2:<br>March 25 <sup>th</sup> –<br>April 14 <sup>th</sup> | Phase–3:<br>April 15 <sup>th</sup> –<br>April 24 <sup>th</sup> | Phase–4:<br>April 25 <sup>th</sup> –<br>May 3 <sup>rd</sup> | Total<br>(as of May<br>3 <sup>rd</sup> , 2020) | Phase–1<br>and<br>Phase–2 | Phase–2<br>and<br>Phase–3 | Phase–3<br>and<br>Phase–4 |
| (1)                                      | (2)                                                   | (3)                            | (4)                                                            | (5)                                                            | (6)                                                            | (7)                                                         | (8)                                            | (9)                       | (10)                      | (11)                      |
| Maharashtra                              | 127.3                                                 | March 09                       | 107 (18.7)                                                     | 2862 (22.8)                                                    | 5163 (28.4)                                                    | 1670 (24.4)                                                 | 9802 (25.0)                                    | 2574.8                    | 80.4                      | -67.7                     |
| Tamil Nadu                               | 78.5                                                  | March 07                       | 18 (3.2)                                                       | 1524 (12.1)                                                    | 1121 (6.6)                                                     | 1493 (12.7)                                                 | 4156 (10.6)                                    | 8366.7                    | -26.4                     | 33.2                      |
| Gujarat                                  | 71.1                                                  | March 19                       | 36 (6.3)                                                       | 691 (5.5)                                                      | 2491 (15.4)                                                    | 833 (10.7)                                                  | 4051 (10.3)                                    | 1819.4                    | 260.5                     | -66.6                     |
| New Delhi                                | 20.8                                                  | March 02                       | 30 (5.3)                                                       | 1716 (13.6)                                                    | 1482 (8.0)                                                     | 646 (8.2)                                                   | 3874 (9.9)                                     | 5620.0                    | -13.6                     | -56.4                     |
| Rajasthan                                | 80.8                                                  | March 03                       | 32 (5.6)                                                       | 1104 (8.8)                                                     | 1487 (8.4)                                                     | 446 (6.6)                                                   | 3069 (7.8)                                     | 3350.0                    | 34.7                      | -70.0                     |
| Madhya Pradesh                           | 86.1                                                  | March 20                       | 7 (1.2)                                                        | 802 (6.4)                                                      | 1396 (8.8)                                                     | 437 (5.7)                                                   | 2642 (6.7)                                     | 11357.1                   | 74.1                      | -68.7                     |
| Uttar Pradesh                            | 235.3                                                 | March 04                       | 35 (6.1)                                                       | 688 (5.5)                                                      | 1211 (7.0)                                                     | 540 (6.5)                                                   | 2474 (6.3)                                     | 1865.7                    | 76.0                      | -55.4                     |
| Andhra Pradesh                           | 54.2                                                  | March 12                       | 8 (1.4)                                                        | 568 (4.5)                                                      | 598 (3.0)                                                      | 705 (6.5)                                                   | 1879 (4.8)                                     | 7000.0                    | 5.3                       | 17.9                      |
| Telangana                                | 38.7                                                  | March 02                       | 39 (6.8)                                                       | 710 (5.6)                                                      | 530 (3.6)                                                      | 89 (1.5)                                                    | 1368 (3.5)                                     | 1720.5                    | -25.4                     | -83.2                     |
| Karnataka                                | 68.4                                                  | March 09                       | 41 (7.2)                                                       | 270 (2.2)                                                      | 294 (1.8)                                                      | 280 (2.5)                                                   | 885 (2.3)                                      | 558.5                     | 8.9                       | -4.8                      |
| Kerala                                   | 36.4                                                  | January 30                     | 109 (19.1)                                                     | 385 (3.1)                                                      | 239 (1.5)                                                      | 129 (1.4)                                                   | 862 (2.2)                                      | 253.2                     | -37.9                     | -46.0                     |
| Jammu & Kashmir                          | 13.7                                                  | March 07                       | 19 (3.3)                                                       | 299 (2.4)                                                      | 266 (1.4)                                                      | 206 (2.1)                                                   | 790 (2.0)                                      | 1473.7                    | -11.0                     | -22.6                     |
| West Bengal                              | 100.6                                                 | March 17                       | 9 (1.6)                                                        | 214 (1.7)                                                      | 407 (2.2)                                                      | 126 (1.9)                                                   | 756 (1.9)                                      | 2277.8                    | 90.2                      | -69.0                     |
| Bihar                                    | 125.2                                                 | March 22                       | 3 (0.5)                                                        | 77 (0.6)                                                       | 190 (0.7)                                                      | 333 (3.1)                                                   | 603 (1.5)                                      | 2466.7                    | 146.8                     | 75.3                      |
| Haryana                                  | 30.0                                                  | March 04                       | 30 (5.3)                                                       | 198 (1.6)                                                      | 184 (1.1)                                                      | 131 (1.3)                                                   | 543 (1.4)                                      | 560.0                     | -7.1                      | -28.8                     |
| Punjab                                   | 31.1                                                  | March 09                       | 29 (5.1)                                                       | 175 (1.4)                                                      | 165 (0.9)                                                      | 144 (1.4)                                                   | 513 (1.3)                                      | 503.4                     | -5.7                      | -12.7                     |
| Odisha                                   | 45.3                                                  | March 16                       | 2 (0.4)                                                        | 65 (0.5)                                                       | 54 (0.3)                                                       | 88 (0.7)                                                    | 209 (0.5)                                      | 3150.0                    | -16.9                     | 63.0                      |
| Jharkhand                                | 39.2                                                  | March 31                       | 0 (0.0)                                                        | 29 (0.2)                                                       | 43 (0.2)                                                       | 45 (0.4)                                                    | 117 (0.3)                                      | nc                        | 32.6                      | 4.4                       |
| Chandigarh                               | 1.2                                                   | March 07                       | 7 (1.2)                                                        | 17 (0.1)                                                       | 16 (0.1)                                                       | 72 (0.5)                                                    | 112 (0.3)                                      | 142.9                     | -5.9                      | 350.0                     |
| Other States & UTs                       | 63.2                                                  |                                | 10 (1.8)                                                       | 185 (1.5)                                                      | 139 (0.7)                                                      | 234 (2.0)                                                   | 568 (1.5)                                      | 1750.0                    | -24.9                     | 68.3                      |
| Overall (%)                              | 1347.1                                                |                                | 571<br>(100.0)                                                 | 12,579<br>(100.0)                                              | 17,476<br>(100.0)                                              | 8,647<br>(100.0)                                            | 39,273<br>(100.0)                              | 2103.0                    | 38.9                      | -50.5                     |
| COVID – 19 cases (%) over 4 –phases      |                                                       |                                | 1.5                                                            | 32.0                                                           | 44.5                                                           | 22.4                                                        | 100.0                                          |                           |                           |                           |

<sup>§</sup> National Commission on Population Projection, Ministry of Health and Family Welfare, Government of India. Population Projection for India and States 2011 – 2036. Report of the Technical Group on Population Projections. November, 2019. Census of India, 2011.

Phase–1: Pre – Lockdown to Lockdown 1.0 (Before March 25<sup>th</sup>, 2020); Phase–2: Lockdown 1.0 (March 25<sup>th</sup> to April 14<sup>th</sup>, 2020); Phase–3: First ten days of the Lockdown 2.0 (April 15<sup>th</sup> to April 24<sup>th</sup>, 2020); Phase–4: Last nine days of the Lockdown 2.0 (April 25<sup>th</sup> to May 3<sup>rd</sup>, 2020)

nc = not calculated

UTs = Union Territories of India

**Table 2: Forty-five RED and ORANGE zone districts with 100 or more COVID – 19 positive cases as of May 3, 2020**

| State (district boundaries as per census 2011) | District Name and Status as on April 30, 2020 | Population March 2020 <sup>§</sup> (in Million) | Date first COVID-19 case recorded | Number positive cases | % within state | % Sub-total  | % India Total |
|------------------------------------------------|-----------------------------------------------|-------------------------------------------------|-----------------------------------|-----------------------|----------------|--------------|---------------|
| <b>Maharashtra (35)</b>                        | Mumbai                                        | 14.1                                            | March 11                          | 2,902                 | 29.6           | 16.1         | 7.4           |
|                                                | Pune                                          | 10.7                                            | March 09                          | 773                   | 7.9            | 4.3          | 2.0           |
|                                                | Thane                                         | 12.5                                            | March 14                          | 526                   | 5.4            | 2.9          | 1.3           |
| <b>Tamil Nadu (32)</b>                         | Chennai                                       | 5.1                                             | March 18                          | 1,485                 | 35.7           | 8.2          | 3.8           |
|                                                | Coimbatore                                    | 3.8                                             | March 22                          | 157                   | 3.8            | 0.9          | 0.4           |
|                                                | Kanchipuram                                   | 4.4                                             | March 07                          | 133                   | 3.2            | 0.7          | 0.3           |
|                                                | Tiruppur                                      | 2.7                                             | March 23                          | 118                   | 2.8            | 0.7          | 0.3           |
|                                                | Viluppuram                                    | 3.7                                             | March 31                          | 109                   | 2.6            | 0.6          | 0.3           |
|                                                | Tirunelveli                                   | 3.3                                             | March 22                          | 108                   | 2.6            | 0.6          | 0.3           |
| <b>Gujarat (26)</b>                            | Ahmadabad                                     | 8.4                                             | March 20                          | 2,490                 | 61.5           | 13.8         | 6.3           |
|                                                | Surat                                         | 7.2                                             | March 19                          | 584                   | 14.4           | 3.2          | 1.5           |
|                                                | Vadodara                                      | 4.9                                             | March 20                          | 341                   | 8.4            | 1.9          | 0.9           |
| <b>Rajasthan (33)</b>                          | Jaipur                                        | 7.8                                             | March 03                          | 870                   | 28.3           | 4.8          | 2.2           |
|                                                | Jodhpur                                       | 4.3                                             | March 22                          | 396                   | 12.9           | 2.2          | 1.0           |
|                                                | Kota                                          | 2.3                                             | April 06                          | 203                   | 6.6            | 1.1          | 0.5           |
|                                                | Ajmer                                         | 3.0                                             | March 28                          | 137                   | 4.5            | 0.8          | 0.3           |
|                                                | Tonk                                          | 1.7                                             | April 01                          | 125                   | 4.1            | 0.7          | 0.3           |
|                                                | Nagaur                                        | 3.9                                             | April 05                          | 122                   | 4.0            | 0.7          | 0.3           |
|                                                | Bharatpur                                     | 3.0                                             | April 02                          | 117                   | 3.8            | 0.6          | 0.3           |
|                                                | Jaisalmer                                     | 0.8                                             | March 30                          | 100                   | 3.3            | 0.6          | 0.3           |
| <b>Madhya Pradesh (50)</b>                     | Indore                                        | 3.9                                             | March 25                          | 1,100                 | 41.6           | 6.1          | 2.8           |
|                                                | Bhopal                                        | 2.8                                             | March 22                          | 342                   | 12.9           | 1.9          | 0.9           |
|                                                | Ujjain                                        | 2.4                                             | March 25                          | 109                   | 4.1            | 0.6          | 0.3           |
| <b>Uttar Pradesh (71)</b>                      | Agra                                          | 5.2                                             | March 04                          | 403                   | 16.3           | 2.2          | 1.0           |
|                                                | Lucknow                                       | 5.4                                             | March 12                          | 205                   | 8.3            | 1.1          | 0.5           |
|                                                | Saharanpur                                    | 4.1                                             | April 03                          | 189                   | 7.6            | 1.0          | 0.5           |
|                                                | Kanpur Nagar                                  | 5.4                                             | March 23                          | 181                   | 7.3            | 1.0          | 0.5           |
|                                                | Gautam B Nagar                                | 1.9                                             | March 17                          | 140                   | 5.7            | 0.8          | 0.4           |
|                                                | Moradabad                                     | 5.6                                             | March 21                          | 138                   | 5.6            | 0.8          | 0.4           |
|                                                | Meerut                                        | 4.1                                             | March 28                          | 113                   | 4.6            | 0.6          | 0.3           |
|                                                | Ghaziabad                                     | 5.5                                             | March 05                          | 104                   | 4.2            | 0.6          | 0.3           |
| <b>Andhra Pradesh (13)</b>                     | Kurnool                                       | 4.3                                             | March 28                          | 500                   | 26.6           | 2.8          | 1.3           |
|                                                | Guntur                                        | 5.4                                             | March 25                          | 343                   | 18.3           | 1.9          | 0.9           |
|                                                | Krishna                                       | 4.4                                             | March 21                          | 280                   | 14.9           | 1.6          | 0.7           |
|                                                | S.P.S. Nellore                                | 3.3                                             | March 12                          | 118                   | 6.3            | 0.7          | 0.3           |
| <b>Telangana(10)</b>                           | Hyderabad                                     | 4.3                                             | March 02                          | 577                   | 42.2           | 3.2          | 1.5           |
| <b>Karnataka (30)</b>                          | Bengaluru                                     | 10.8                                            | March 09                          | 189                   | 21.4           | 1.0          | 0.5           |
|                                                | Mysuru                                        | 3.4                                             | March 21                          | 133                   | 15.0           | 0.7          | 0.3           |
| <b>Kerala (14)</b>                             | Kasaragod                                     | 1.4                                             | February 03                       | 332                   | 38.5           | 1.8          | 0.8           |
|                                                | Kannur                                        | 2.8                                             | March 09                          | 171                   | 19.8           | 0.9          | 0.4           |
| <b>Jammu &amp; Kashmir (22)</b>                | Bandipore                                     | 0.4                                             | March 24                          | 143                   | 18.1           | 0.8          | 0.4           |
|                                                | Srinagar                                      | 1.4                                             | March 18                          | 116                   | 14.7           | 0.6          | 0.3           |
| <b>Bihar (38)</b>                              | Munger                                        | 1.6                                             | March 22                          | 119                   | 19.7           | 0.7          | 0.3           |
| <b>Haryana (21)</b>                            | Gurugram                                      | 1.8                                             | March 04                          | 107                   | 19.7           | 0.6          | 0.3           |
|                                                | Mewat                                         | 1.3                                             | March 03                          | 102                   | 18.8           | 0.6          | 0.3           |
| <b>Sub – Total (45 districts)</b>              |                                               | <b>200.5</b>                                    |                                   | <b>18,050</b>         |                | <b>100.0</b> | <b>46.0</b>   |
| <b>Population / Positive cases</b>             |                                               | <b>1,347.1</b>                                  |                                   | <b>39,273</b>         |                |              | <b>100.0</b>  |

<sup>§</sup> Same as Table 2

Status of the district in RED and ORANGE zones as identified by the Government of India on April 30, 2020



**Table 3: Selected characteristics of COVID – 19 positive cases, India**

| Characteristics             | Phase-1:<br>Before March 25 <sup>th</sup> | Phase-2:<br>Mar 25 <sup>th</sup> – Apr 14 <sup>th</sup> | Phase-3: April<br>15 <sup>th</sup> – 24 <sup>th</sup> | Phase-4:<br>April 25 <sup>th</sup> –May 3 <sup>rd</sup> | Total        |
|-----------------------------|-------------------------------------------|---------------------------------------------------------|-------------------------------------------------------|---------------------------------------------------------|--------------|
| <b>Age (in years)</b>       |                                           |                                                         |                                                       |                                                         |              |
| 0-9                         | 1.9                                       | 2.9                                                     | 3.1                                                   | 4.7                                                     | 3.7          |
| 10-19                       | 2.2                                       | 7.9                                                     | 8.29                                                  | 10.6                                                    | 8.8          |
| 20-29                       | 27.2                                      | 17.1                                                    | 18.5                                                  | 22.12                                                   | 20.4         |
| 30-39                       | 19.2                                      | 22.5                                                    | 20.43                                                 | 20.34                                                   | 20.9         |
| 40-49                       | 15.2                                      | 17.5                                                    | 13.96                                                 | 16.87                                                   | 16.4         |
| 50-59                       | 17.3                                      | 14.3                                                    | 15.6                                                  | 11.9                                                    | 13.7         |
| 60 & Above                  | 17.0                                      | 17.8                                                    | 20.2                                                  | 13.5                                                    | 16.2         |
| <b>Total</b>                | <b>323</b>                                | <b>1,260</b>                                            | <b>881</b>                                            | <b>2,075</b>                                            | <b>4,539</b> |
| <b>Mean</b>                 | 41.4                                      | 40.7                                                    | 41.2                                                  | 37.1                                                    | 39.2         |
| <b>SD</b>                   | 17.6                                      | 17.6                                                    | 18.7                                                  | 17.6                                                    | 17.9         |
| <b>Gender</b>               |                                           |                                                         |                                                       |                                                         |              |
| Female                      | 37.1                                      | 29.8                                                    | 35.3                                                  | 36.4                                                    | 34.0         |
| Male                        | 63.0                                      | 70.2                                                    | 64.7                                                  | 63.6                                                    | 66.0         |
| <b>Total</b>                | <b>359</b>                                | <b>2304</b>                                             | <b>2909</b>                                           | <b>2084</b>                                             | <b>7656</b>  |
| <b>Transmission type</b>    |                                           |                                                         |                                                       |                                                         |              |
| Local                       | 23.5                                      | 65.7                                                    | 62.1                                                  | 100.0                                                   | 82.0         |
| Imported                    | 62.4                                      | 10.7                                                    | 37.9                                                  | 0.0                                                     | 8.9          |
| Undecided                   | 14.2                                      | 23.6                                                    | 0.0                                                   | 0.0                                                     | 9.0          |
| <b>Total</b>                | <b>571</b>                                | <b>2356</b>                                             | <b>58</b>                                             | <b>4084</b>                                             | <b>7069</b>  |
| <b>International travel</b> |                                           |                                                         |                                                       |                                                         |              |
| Did not travel              | 16.1                                      | 4.0                                                     | 0.6                                                   | 0.7                                                     | 2.1          |
| Yes, International          | 70.1                                      | 6.4                                                     | 2.8                                                   | 1.3                                                     | 5.2          |
| Yes, Domestic               | 0.9                                       | 9.6                                                     | 0.2                                                   | 0.2                                                     | 3.5          |
| Details awaited             | 12.9                                      | 80.0                                                    | 96.3                                                  | 97.9                                                    | 89.3         |
| <b>Total</b>                | <b>566</b>                                | <b>9857</b>                                             | <b>13170</b>                                          | <b>4767</b>                                             | <b>28360</b> |

Phase-1: Pre – Lockdown to Lockdown 1.0 (Before March 25<sup>th</sup>, 2020); Phase-2: Lockdown 1.0 (March 25<sup>th</sup> to April 14<sup>th</sup>, 2020); Phase-3: First ten days of the Lockdown 2.0 (April 15<sup>th</sup> to April 24<sup>th</sup>, 2020); Phase-4: Last nine days of the Lockdown 2.0 (April 25<sup>th</sup> to May 3<sup>rd</sup>, 2020)

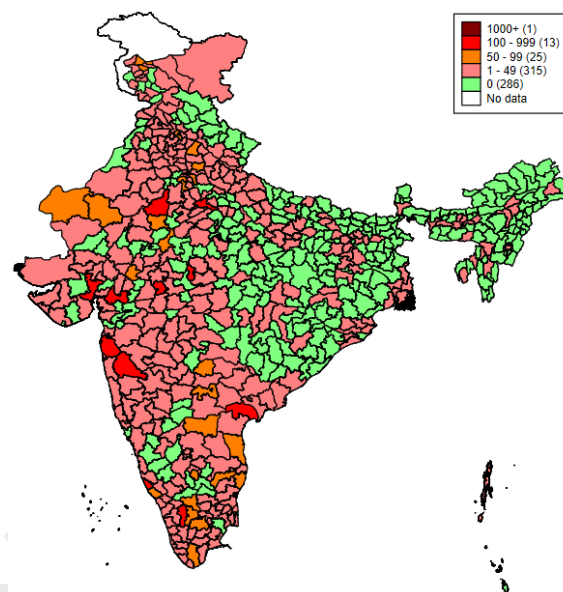
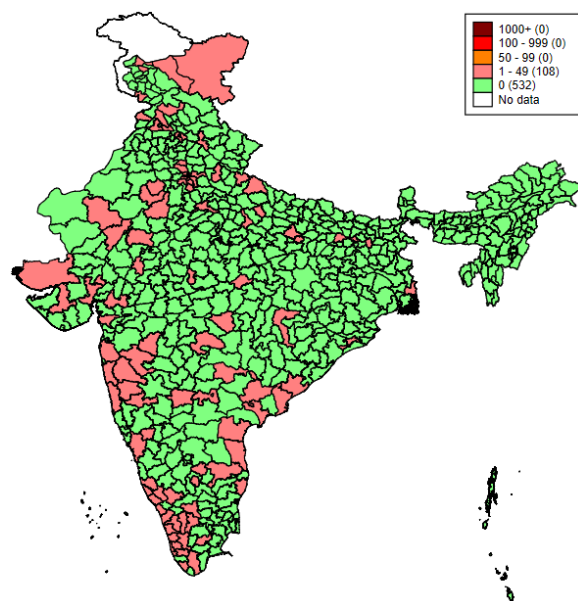
**Table 4: Number and percentage of districts by COVID – 19 positive cases (Cumulative) in different lockdown phases, India**

| Number of districts<br>(as per census 2011) | Phase-1:<br>Before March<br>25 <sup>th</sup> | Phase-2:<br>March 25 <sup>th</sup> –<br>April 14 <sup>th</sup> | Phase-3:<br>April 15 <sup>th</sup> –<br>April 24 <sup>th</sup> | Phase-4:<br>April 25 <sup>th</sup> –<br>May 3 <sup>rd</sup> |
|---------------------------------------------|----------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------------|-------------------------------------------------------------|
| <b>1000 or more cases</b>                   | 0 (0.0)                                      | 1 (0.2)                                                        | 2 (0.3)                                                        | 4 (0.6)                                                     |
| <b>100 to 999 cases</b>                     | 0 (0.0)                                      | 13 (2.0)                                                       | 29 (4.5)                                                       | 41 (6.4)                                                    |
| <b>Fewer than 100 cases</b>                 | 108 (16.9)                                   | 340 (53.1)                                                     | 365 (57.1)                                                     | 402 (62.8)                                                  |
| <b>Zero cases</b>                           | 532 (83.1)                                   | 286 (44.7)                                                     | 244 (38.1)                                                     | 193 (30.2)                                                  |
| <b>Total</b>                                | 640 (100.0)                                  | 640 (100.0)                                                    | 640 (100.0)                                                    | 640 (100.0)                                                 |

**Figure 1: District-wise<sup>§</sup> Increase in COVID – 19 positive cases (cumulative) until May 3, 2020, India**

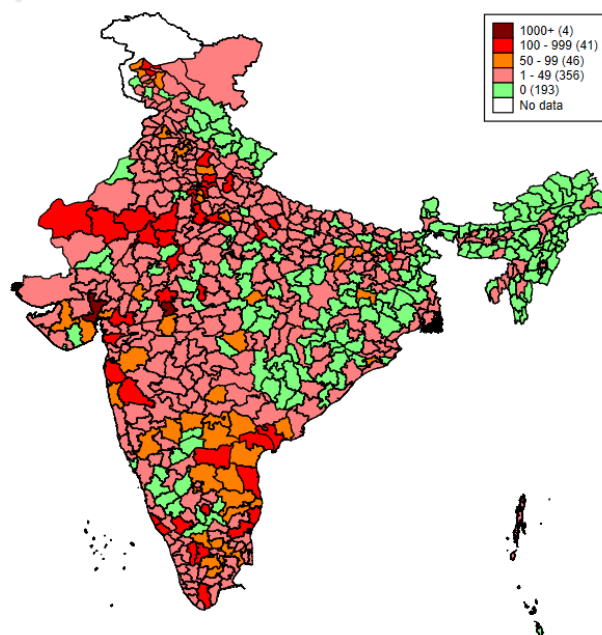
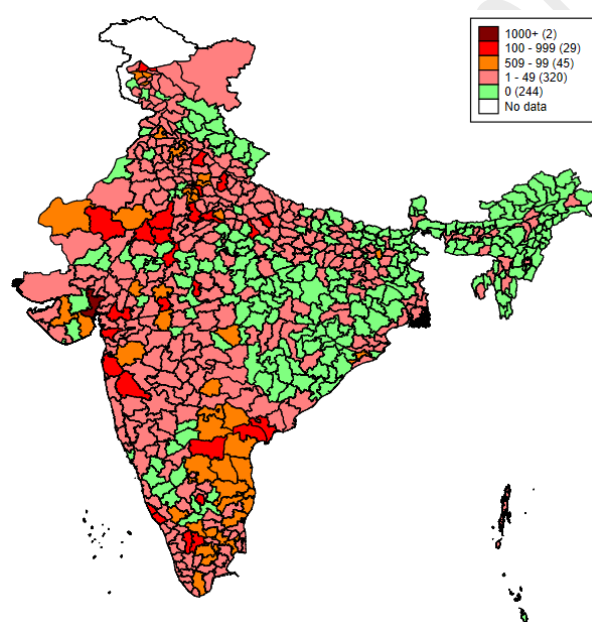
**A: Phase-1: Before March 25<sup>th</sup>, 2020**

**B: Phase-2: Between March 24<sup>th</sup> and April 14<sup>th</sup> 2020**



**C: Phase-3: Between April 15<sup>th</sup> and 25<sup>th</sup> 2020**

**D: Phase-4: Between April 25<sup>th</sup> and May 3<sup>rd</sup> 2020**



<sup>§</sup> District boundaries are as per the census of India 2011.