

COVID-19 in India: Issues, Challenges and Lessons

ICT India Working Paper #34

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August 2020

Center for Sustainable Development
EARTH INSTITUTE | COLUMBIA UNIVERSITY

Abstract

COVID-19 has not left any part of the world untouched and India is one of the worst affected countries in the world. The cases in India are rising steadily with each passing day. As of August 10th 2020, India has over 2.3 million (the second million coming in exactly three weeks since the country hit a million infections on July 16, with 42 percent of the new cases coming from Andhra Pradesh, Karnataka, Uttar Pradesh, West Bengal and Bihar) confirmed COVID-19 cases and 46,188 reported deaths. The worst affected states of India include Maharashtra, Tamil Nadu, Andhra Pradesh, Karnataka, Delhi and Uttar Pradesh. Another growing concern is that interior parts of the country are emerging as new hotspots. Four states in eastern India, namely, Odisha, Bihar, Assam and West Bengal are increasingly reporting positive cases. The two main reasons being reported for this surge in cases in rural areas are the returning migrants from major cities who did not undergo screening or were asymptomatic and the poor healthcare infrastructure in the rural settings. Out of a total of 739 districts in India, 13 districts (across 8 states and a union territory) account for 1 in seven Covid-19 deaths. The 13 districts are: Kamrup Metro in Assam, Patna in Bihar, Ranchi in Jharkhand; Alappuzha and Thiruvananthapuram in Kerala, Ganjam in Odisha, Lucknow in UP; North 24 Paraganas, Hooghly, Howrah, Kolkata and Maldah in West Bengal, and Delhi. These districts account for nearly 9 percent of India's active cases and about 14 percent of COVID-19 deaths. Over the spring and summer, the COVID-19 situation in India has really deteriorated and could get much worse on the current trajectory with around 60,000 cases being reported per day and around 900 daily deaths.

Lockdown and travel bans due to COVID-19 have impacted almost every sector including tourism, hospitality, and education. To deal with the coronavirus crisis, the central government has undertaken various initiatives like monetary relief package under Pradhan Mantri Garib Kalyan Yojana, Uttar Pradesh Rojgar Abhiyaan, Atma Nirbhar Abhiyaan etc. The state governments have also undertaken various initiatives like Operation SHIELD, 5T Plan, Mission Fateh, Snehar Paras etc. We describe these briefly. Some regions in India have successfully contained COVID-19 like the state of Kerala, the district of Bhilwara in Rajasthan and the slums of Dharavi in Mumbai.

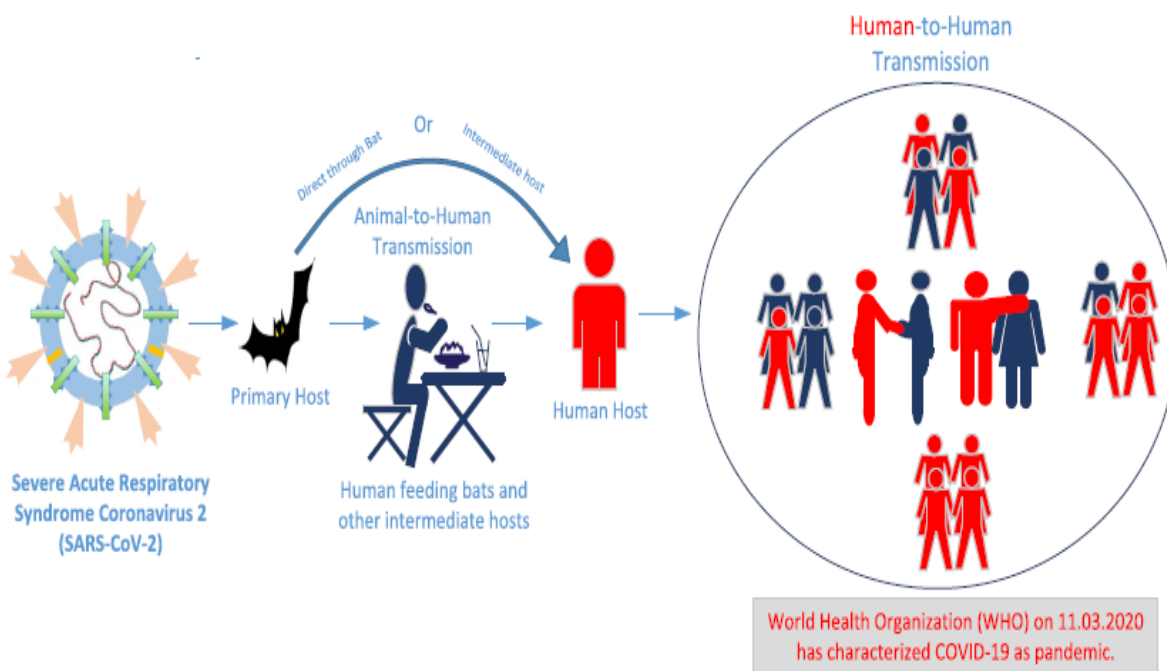
In order for a strategy of containment and recovery to succeed, it is vital to keep using public health measures to suppress the epidemic, that is to drive $R < 1$. Besides the infection rate, it is vital to closely monitor the positivity rate and the case fatality ratio (death rate) and rely not so much on the recovery rate which is what seems to be happening currently. Eventually, in all likelihood, as the pandemic subsides, close to 97 plus percent cases are likely to recover implying a 2 or 3 percent death rate. India needs a epidemic control strategy to be developed and put in place to control and contain the spread of the infection in the country, something that is not being done currently. Due to COVID-19, while most countries are facing the twin crises of public health and the consequent economic downturn, India has an additional challenge to deal with, namely a massive migrant workers crisis. While it is hard to say what long-term impact this home migration might have, but some trends were quite clear so we made a few recommendations to the government in May that we list along with some lessons for India to learn from elsewhere. On the economic front, a deep and prolonged economic slowdown is inevitable.

Keywords: COVID-19, India

Introduction

COVID-19, which originated in the Wuhan, Hubei Province, People's Republic of China (PRC), has spread to all parts of the world. COVID-19 is caused by severe acute respiratory syndrome coronavirus (SARS-CoV-2) which is a class of β -coronavirus. It is a highly contagious disease and has many potential hosts (Tomar and Gupta 2020). Figure 1 illustrates the process of transmission of COVID-19. Increased travel around the world and globalization accelerated its spread across countries. On 11th March 2020, World Health Organization (WHO) declared COVID-19 a pandemic as the number of cases rose to 118,000 in more than 110 countries around the world¹. COVID-19 has led to massive loss of lives and livelihoods. As per United Nations, it is the worst global crisis after World War II². COVID-19 has infected over 22 million people across the world and has taken the lives of more than 742,000 people as of August 10, 2020. The worst affected countries include USA, Brazil, India, Russia and the UK (see figure 2) (World Health Organization 2020b). India has third highest confirmed COVID-19 cases in the world after the United States and Brazil³.

Figure 1: Transmission of COVID-19



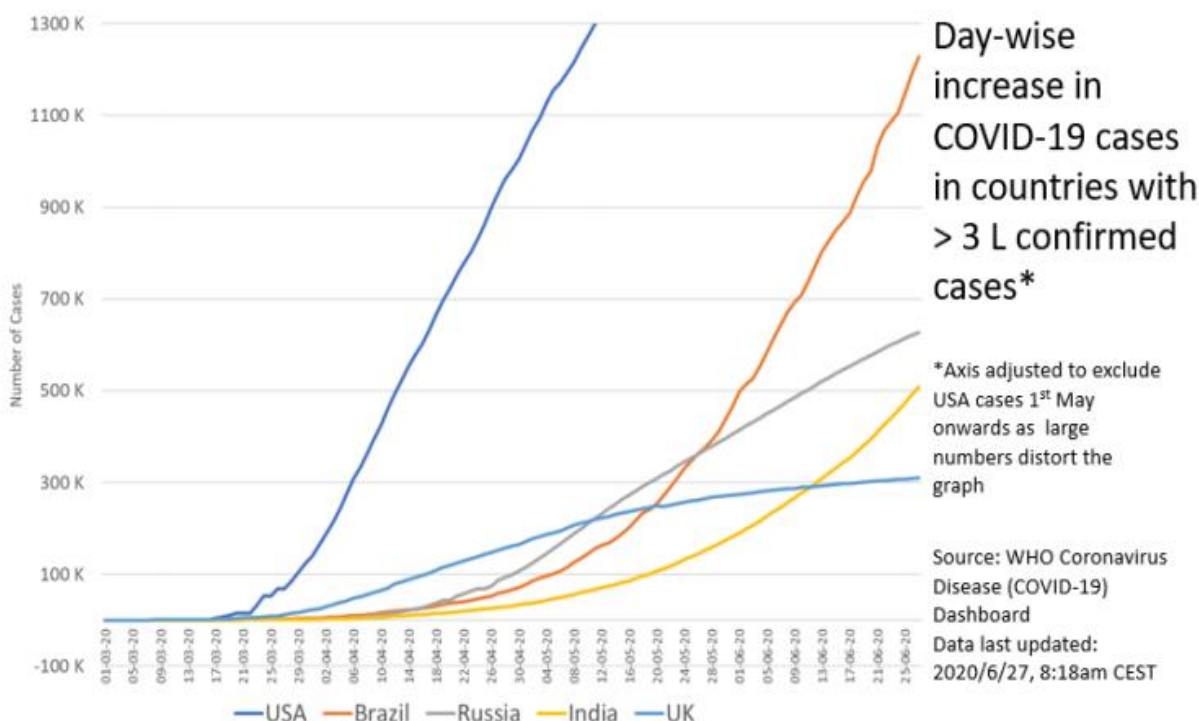
Source: Tomar, Anuradha, and Neeraj Gupta. 2020. "Prediction for the Spread of COVID-19 in India and Effectiveness of Preventive Measures." *Science of The Total Environment* 728 (August): 138762. <https://doi.org/10.1016/j.scitotenv.2020.138762>.

¹ <https://time.com/5791661/who-coronavirus-pandemic-declaration/>

² <https://www.hindustantimes.com/coronavirus/coronavirus-outbreak-globally-covid-19-pandemic-latest-updates/>

³ <https://www.deccanherald.com/national/india-becomes-third-worst-affected-country-by-coronavirus-overtakes-russia-857442.html>

Figure 2: Day-wise increase in COVID-19 cases in countries with >300,000 confirmed cases



Source: World Health Organization. 2020. “Novel Coronavirus Disease (COVID-19).” Situation Update Report 22. World Health Organization. https://www.who.int/docs/default-source/wrindia/situation-report/india-situation-report-22.pdf?sfvrsn=c49bf98d_2.

In India, the first case of COVID-19 was reported on 30th January, 2020. As of 17th July 2020, there were 1,003,832 confirmed COVID-19 cases, out of which 373,379 were active cases, 677,422 cured/discharged, 1 migrated, and 26,816 were reported deaths in India⁴. Figure 3 shows how COVID-19 outbreak unfolded in India (Hollingsworth et al. 2020). Compared to the global fatality rate of 6.19%, the fatality rate in India is relatively low at 2.83%⁵. India has the highest number of confirmed cases across Asia⁶.

⁴ https://www.who.int/docs/default-source/wrindia/situation-report/india-situation-report-25.pdf?sfvrsn=8269893f_2

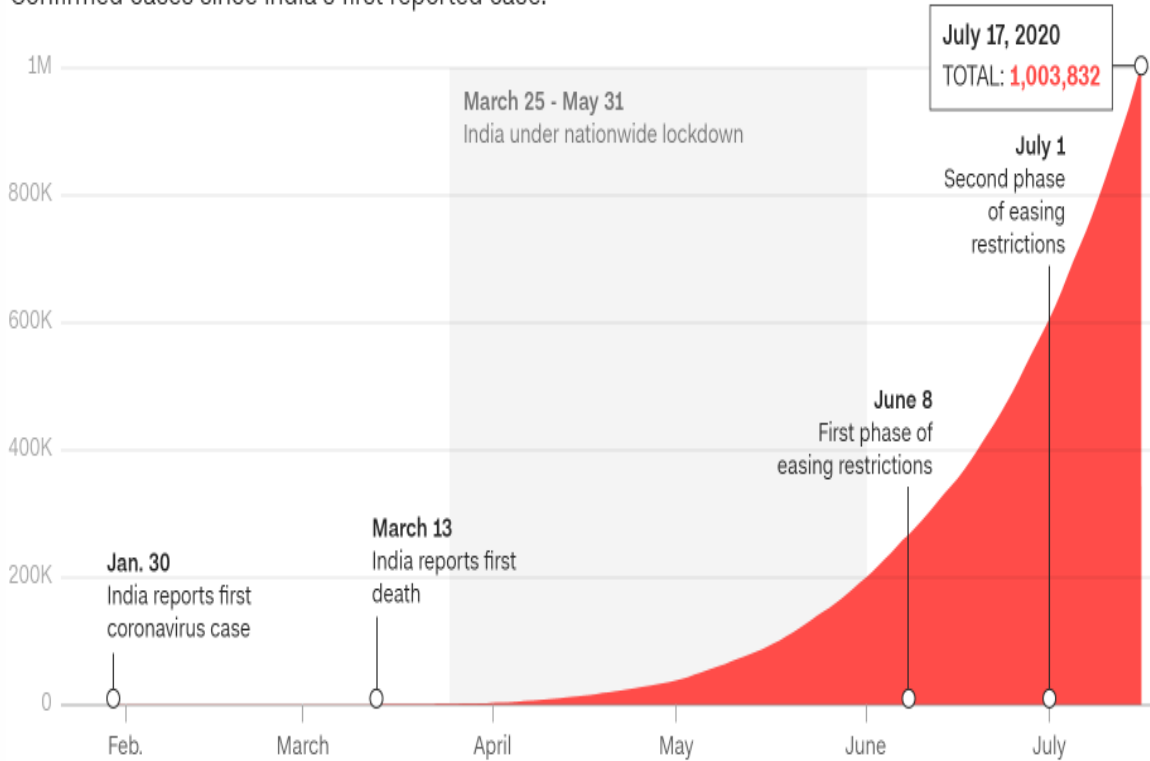
⁵ <https://economictimes.indiatimes.com/news/politics-and-nation/indias-covid-19-recovery-rate-improving-fatality-rate-declining-health-ministry/articleshow/76140228.cms?from=mdr>

⁶ <https://www.hindustantimes.com/india-news/india-most-infected-by-covid-19-among-asian-countries-leaves-turkey-behind/story-Jjd0AqIsuL3yjMWg29uJ3I.html>

Figure 3: How COVID-19 outbreak unfolded in India

How India's coronavirus outbreak unfolded

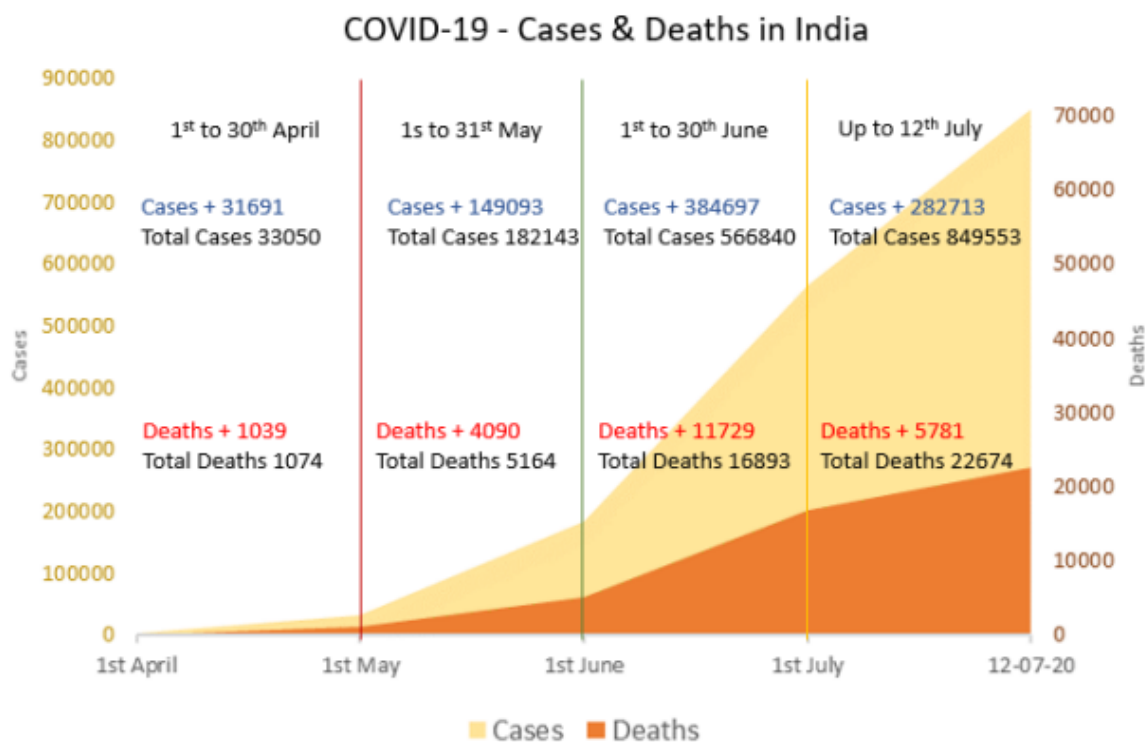
Confirmed cases since India's first reported case.



CNN Source: Johns Hopkins University Center for Systems Science and Engineering, Data as of July 17, 2020
Graphic: Natalie Leung and Jason Kwok, CNN

Source: Hollingsworth, Julia, Jason Kwok, Natalie Leung, and Swati Gupta. 2020. "India Now Has More than 1 Million Coronavirus Cases. What Does That Mean -- and How Did the Country Get Here?" July 2020. <https://edition.cnn.com/2020/07/18/asia/india-coronavirus-one-million-data-intl-hnk/index.html>

Figure 4: COVID-19 cases and deaths in India

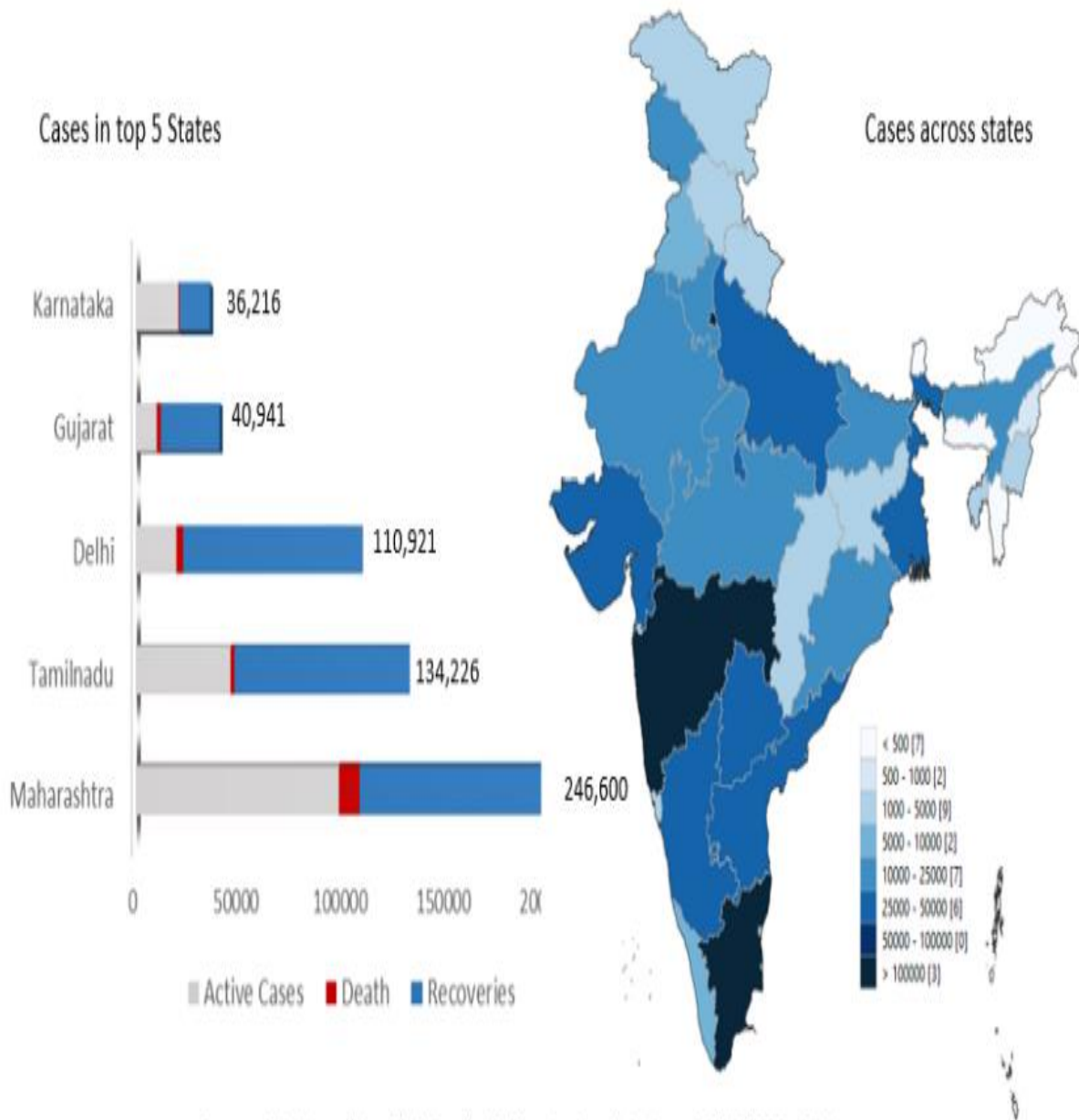


Source: MoHFW Government of India COVID-19 Last updated on: 12/07/2020, 8 AM

Source: World Health Organization. 2020. "Novel Coronavirus Disease (COVID-19)." Situation Update Report 24. https://www.who.int/docs/default-source/wrindia/situation-report/india-situation-report-24.pdf?sfvrsn=dd1c8402_2.

The worst hit states of India include Maharashtra, Delhi, Tamil Nadu, Gujarat and Karnataka. While figure 5 shows the burden of COVID-19 across states in India, figure 6 shows state-wise tests per million and the test positivity rate. States like Jammu & Kashmir, Delhi, Andhra Pradesh conducted the highest number of tests per million, while test positivity rate seems to be high in states like Maharashtra, Delhi and Telangana (World Health Organization 2020c). Over the time, recovery rate seems to improve in states like Delhi and West Bengal (see Figure 7) (World Health Organization 2020d). Delhi numbers have gone down from a peak of 3900+ to 1500 new cases daily. Still too high, but the new strategy of home care + ramping up testing seems to be working.

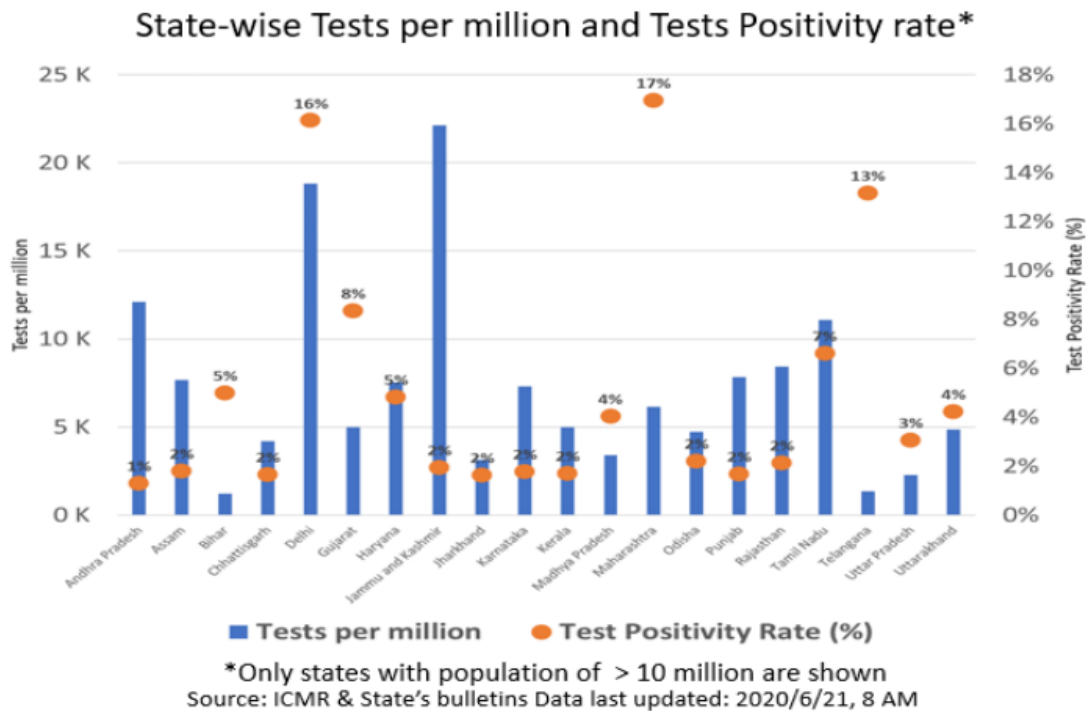
Figure 5: COVID-19 cases across states in India



Source: Ministry of Health & Family Welfare Last updated on : 12/07/2020, 8 AM

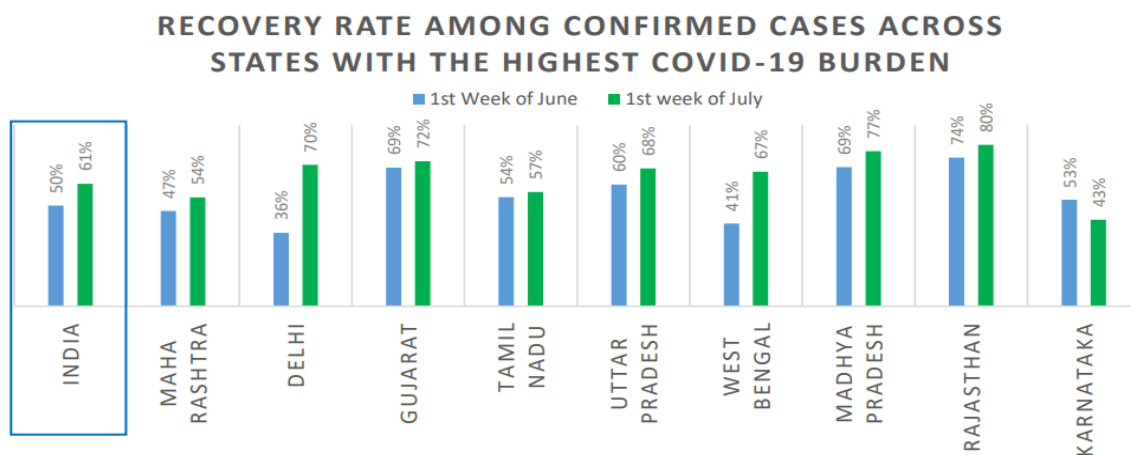
Source: World Health Organization. 2020. "Novel Coronavirus Disease (COVID-19)." Situation Update Report 24. https://www.who.int/docs/default-source/wrindia/situation-report/india-situation-report-24.pdf?sfvrsn=dd1c8402_2.

Figure 6: State-wise tests per million and tests positivity rate



Source: World Health Organization. 2020. “Novel Coronavirus Disease (COVID-19).” Situation Update Report 23. https://www.who.int/docs/default-source/wrindia/situation-report/india-situation-report-23.pdf?sfvrsn=b09ca466_2.

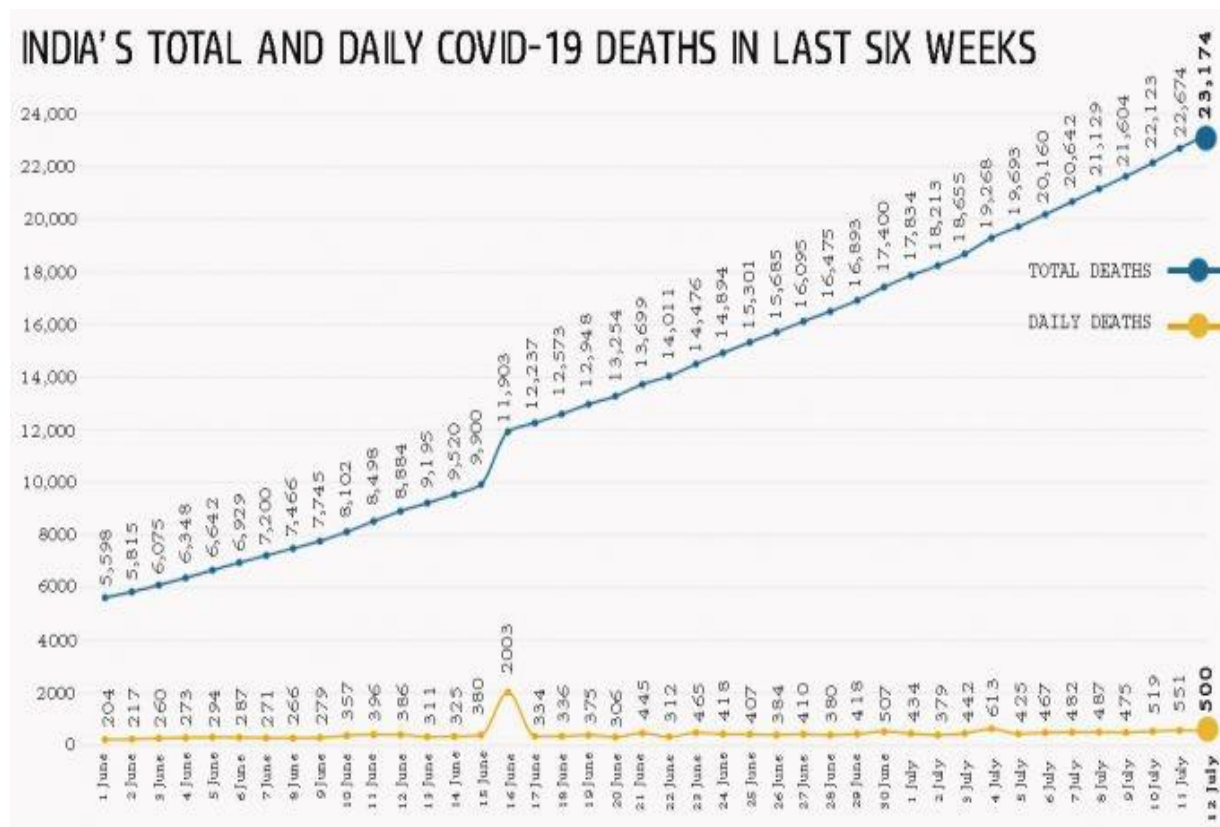
Figure 7: Recovery rate among confirmed cases across states with the highest COVID-19 burden



Source: World Health Organization. 2020. “Novel Coronavirus Disease (COVID-19).” Situation Update Report 23. https://www.who.int/docs/default-source/wrindia/situation-report/india-situation-report-23.pdf?sfvrsn=b09ca466_2.

The daily COVID-19 deaths from early June till mid July do not seem to have climbed except for a spike on 16th June, 2020 (see Figure 8)(A. Ghosh 2020). Figure 9 depicts state-wise COVID-19 mortality rate in India (A. Ghosh and Kapoor 2020).

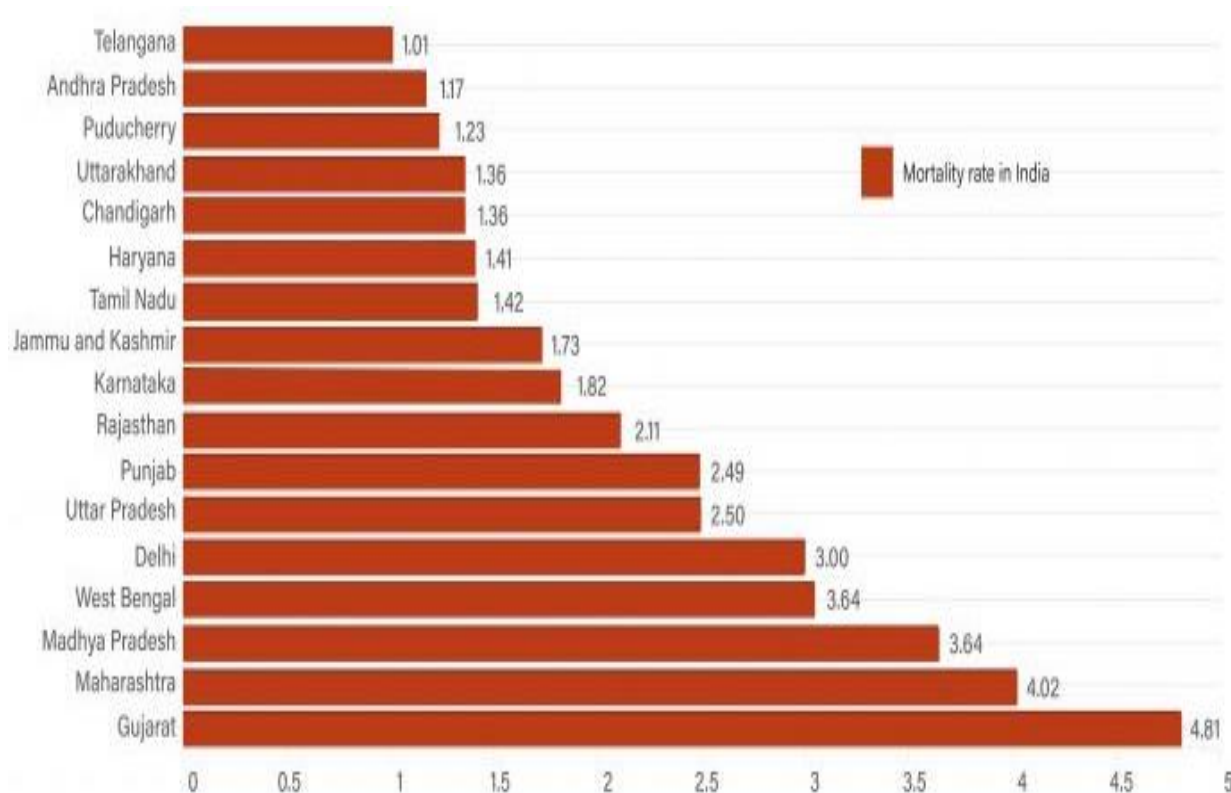
Figure 8: Total and daily COVID-19 deaths in India



Source: Ghosh, Abantika. 2020. “India’s Daily Covid Deaths Have More than Doubled in 6 Weeks, Positivity Rate Too on the Rise.” July 2020. <https://theprint.in/health/indias-daily-covid-deaths-have-more-than-doubled-in-6-weeks-positivity-rate-too-on-the-rise/459920/>.

Until mid-July or so, the number of COVID-19 deaths in India were relatively low compared to other countries with similar disease burdens. Many believed that early and stringent nationwide lockdown (from March 24, 2020 for 21 days) worked for India as it gave the authorities precious time to arrange for the necessary PPE, masks, ventilators, isolation centers, hospital beds, and strengthen testing infrastructure. etc. to deal with the situation. Others were of the opinion that India’s young population had a vital role to play who could withstand the virus because of their stronger immunity. As the number of COVID-19 cases are rising at a much faster rate compared to deaths, the more number of tests will further decline the COVID-19 related mortality rate in India.

Figure 9: State-wise COVID-19 mortality rate in India



*Data from Maharashtra government report

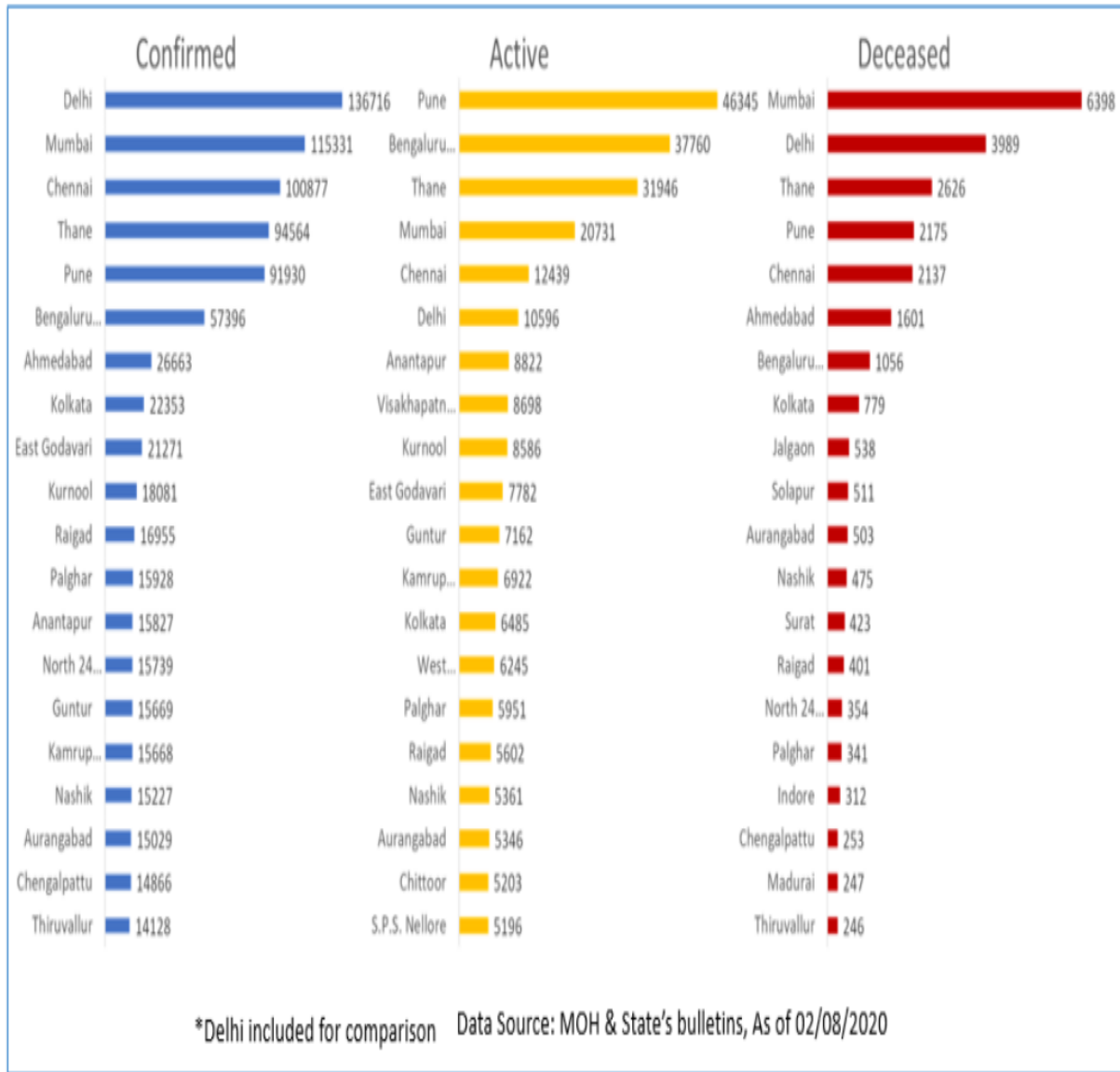
Only states with mortality rate of 1% and above are depicted.

Source: Ghosh, Abantika, and Shipra Kapoor. 2020. “204 Deaths on 1 June to 553 on 13 July, India’s Mortality Rate 2.6% Now — Latest Covid Numbers.” July 2020.

<https://theprint.in/india/daily-covid-tracker-latest-india-coronavirus-numbers-14-july/460672/>.

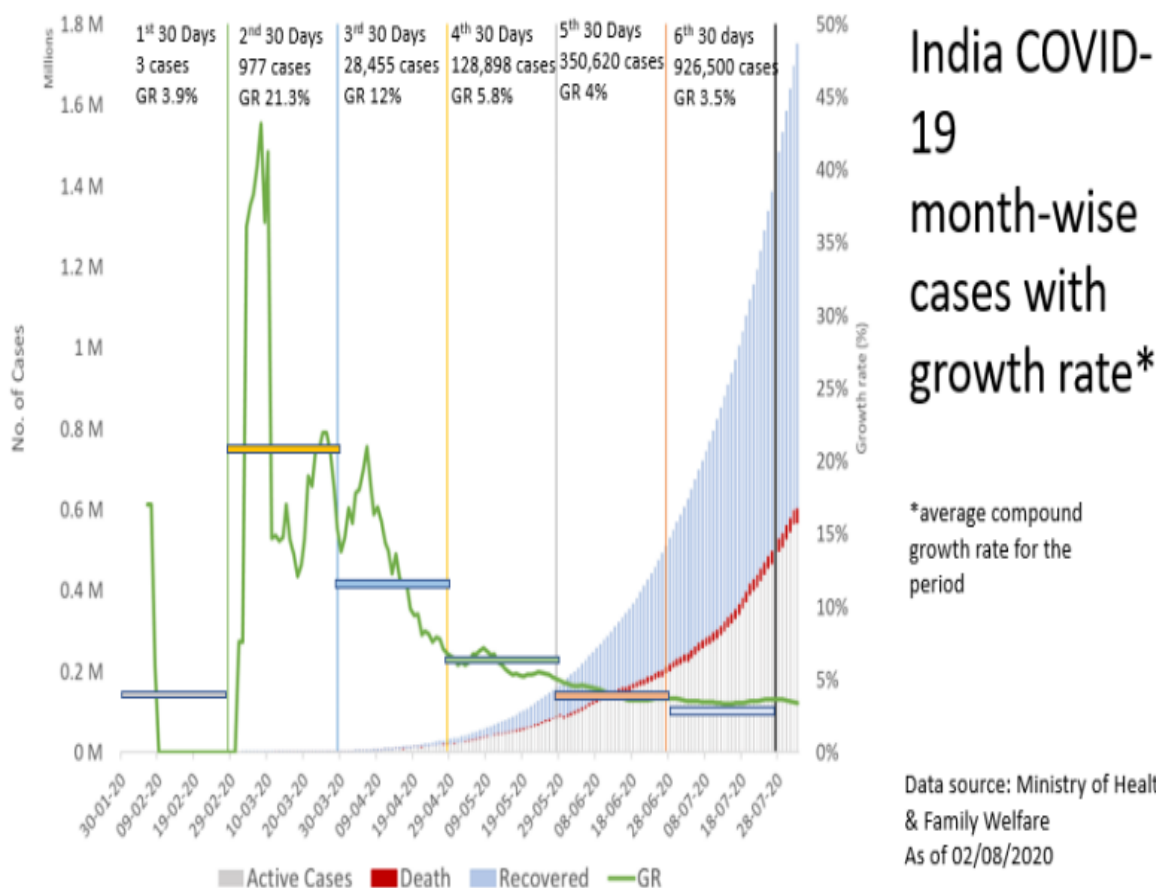
As on 6th August 2020, there are at least 1,964,500 confirmed COVID-19 cases and 40,699 reported deaths in India (The New York Times 2020). The state of Maharashtra has reported the highest number of deaths so far(The New York Times 2020). Figure 10 shows confirmed cases, active cases and deceased cases in top 20 cities or districts (as on 2nd August 2020) in India(World Health Organization 2020a). On one hand there has been a gradual decline in the COVID-19 growth rate, on the other the number of deaths have increased gradually (see figure 11).

Figure 10: COVID-19 confirmed cases, active cases and deceased cases in top 20 cities or districts



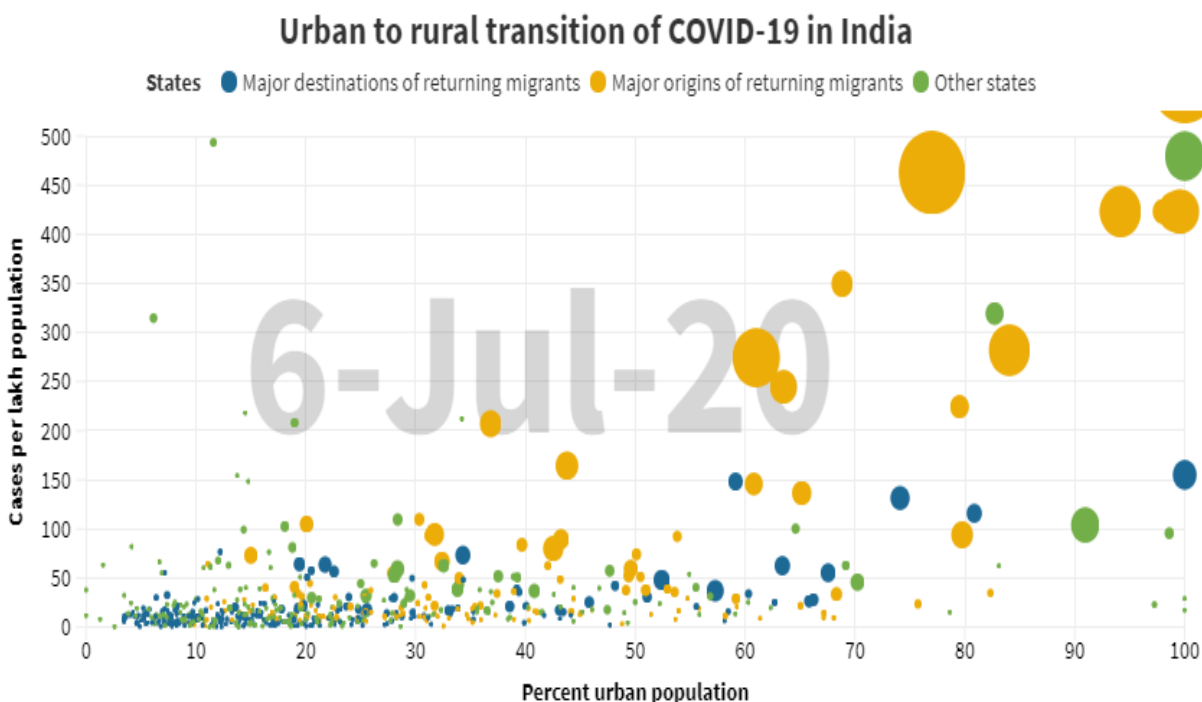
Source: World Health Organization. 2020. "Novel Coronavirus Disease (COVID-19)*." Situation Update Report 27. https://www.who.int/docs/default-source/wrindia/situation-report/india-situation-report-27.pdf?sfvrsn=8d0d1850_2.

Figure 11: India COVID-19 month-wise active cases, recovered cases, growth rate and deaths



Source: World Health Organization. 2020. “Novel Coronavirus Disease (COVID-19)*.” Situation Update Report 27. https://www.who.int/docs/default-source/wrindia/situation-report/india-situation-report-27.pdf?sfvrsn=8d0d1850_2.

Another growing concern is that interior parts of the country are emerging as new hotspots. Four states in eastern India, namely, Odisha, Bihar, Assam and West Bengal are increasingly reporting COVID-19 positive cases. A large number of cases have been reported from various districts in Bihar which includes Patna, Nalanda, Bhalagpur, Begusarai, Munger and Gaya. COVID-19 is increasing its hold in other cities, towns and rural areas apart from Greater Hyderabad in the state of Telangana (Pulipaka 2020). These include districts like Rajanna-Sircilla , Nagarkurnoo, Nalgonda, Suryapet, Nizamabad, Medchal-Malkajgiri, Sangareddy, Medak and Warangal Rural. The state of Uttar Pradesh has also reported increasing number of COVID-19 cases in districts like Sonbhadra, Hardoi, Sultanpur, Ballia and Meerut and in two holy towns of Varanasi and Prayagraj (Jafri 2020). The two main reasons being reported for this surge in COVID-19 cases in rural areas are the poor healthcare infrastructure and the returning of migrants who did not undergo screening or were asymptomatic. The rural areas in the states of Rajasthan and Karnataka have also shown an increase in COVID-19 cases (Mishra et al. 2020). Figure 12 depicts the urban to rural transition of COVID-19 in India. Increasing number of COVID-19 cases are being reported in the major destinations of returning migrants: Uttar Pradesh, Bihar, Madhya Pradesh, Rajasthan, West Bengal, Jharkhand and Odisha (Mishra et al. 2020).

Figure 12: Urban to rural transition of COVID-19 in India

Source: Mishra, Nand Lal, Kanupriya Kothiwala, Md Sayeef Alam, and Singh Akancha. 2020. “How to Stall COVID’s March in Rural India.” July 2020. <https://www.downtoearth.org.in/blog/health/how-to-stall-covid-s-march-in-rural-india-72358>.

Literature review

The first case of COVID-19 in India was reported on 30th January 2020 in the state of Kerala (Kachroo 2020; Vaman et al. 2020). Gupta et al. investigated the clinical and epidemiological profile of first 21 COVID-19 patients in India and found that the mean age was 40.3 years and majority of them were males (N. Gupta et al. 2020). The most common clinical symptoms were fever and cough, followed by sore throat, headache and breathlessness (N. Gupta et al. 2020). On 24th March 2020, when the number of confirmed COVID-19 cases touched 500, the Government of India announced a 21 days nationwide lockdown (Pulla 2020; Press Information Bureau, Government of India 2020). Mahajan and Kaushal found that majority of the confirmed COVID-19 cases during Lockdown 1.0 were in the age group 20-49 and mostly were men (Mahajan and Kaushal 2020). Barani et al. investigated the profile of COVID-19 patients detected between January 22nd- and April 30th 2020. They found that attack rate (per million) was highest among the age group 50-69 years and lowest among the age group under 10 years; attack rate was higher among males compared to females; and the secondary attack rate was 6 per cent (Barani et al. 2020). Increasing number of COVID-19 cases emerged (Shetti et al. 2020). Lockdown 1.0 was followed by Lockdown 2.0; Lockdown 3.0 and Lockdown 4.0 which ended on May 31, 2020 (Ramachandran and Kalaivani 2020). Maharashtra became the epicenter of confirmed COVID-19 cases in India in all the phases of lockdown, while Tamil Nadu, Punjab and Kerala performed well in terms of COVID-19 cases cured (Prabhakar et al. 2020).

Literature suggests many models predicting the course and impact of COVID-19 in India. Acharya and Porwal identified that a number of districts in nine states namely, Bihar, Madhya Pradesh, Telangana, Jharkhand, Uttar Pradesh, Maharashtra, West Bengal, Odisha, and Gujarat are highly vulnerable to COVID-19 (Acharya and Porwal 2020). Rafiq et al. predicted that ten worst hit states in India, namely Maharashtra, Gujarat, Tamil Nadu, Delhi, Rajasthan, Madhya Pradesh, Uttar Pradesh, Andhra Pradesh, Punjab and Telangana will witness a steep rise in cases and deaths in the month of June 2020 (Rafiq, Suhail, and Bazaz 2020). Some models predicted peak in COVID-19 cases by April, while others predicted the pandemic to be over by July (Tiwari, Kumar, and Guleria 2020; Gupta and Pal 2020; B. P. Singh 2020; M. S. Ghosh 2020).

However, models can only provide an idea about the worst and best case scenarios. In the current situation, cases are rising with each passing day (World Health Organization 2020e). Tomar and Gupta used a data-driven forecasting/estimation method and found that social isolation and lockdown can help reduce the spread of the corona virus significantly (Tomar and Gupta 2020). Ray et al. used a Bayesian extension of the Susceptible-Infected-Removed (eSIR) model to study the short and long term effects of 21 days national lockdown in India (Ray et al. 2020). They found that in the short term, lockdown can help reduce the overall COVID-19 cases and provide time for preparation of healthcare and disease monitoring system, while in long term, lockdown of 42-56 days could substantially flatten the curve. Prinja et al. also used a susceptible-exposed-infectious-recovered (SEIR) model and found that lockdown helps in delaying the onset of peak and provides the necessary time for health systems to prepare (Prinja et al. 2020). In addition, they found that strengthening of public health response system can significantly reduce case load and requirement of ICU beds and ventilators (Prinja et al. 2020). Singh and Adhikari found that lockdown of 3 weeks to be insufficient in preventing the resurgence and suggested sustained lockdown along with periodic relaxation (R. Singh and Adhikari 2020). Sarkar et al. suggested that quarantine of COVID-19 suspects can effectively reduce the basic reproduction number and combining measures like social distancing and contact tracing can help in the elimination of COVID-19 pandemic (Sarkar, Khajanchi, and Nieto 2020). Pujari and Shekatkar warranted serious supervision of domestic transport which can expose significant population with COVID-19 (Pujari and Shekatkar 2020). Khanna et al. in their paper suggested that strict containment measures, increased case detection, isolation, quarantine, social distancing, community support, avoidance of mass gatherings could help in the containment of the corona virus (Khanna et al. 2020). Varghese and John emphasized the importance of community mitigation strategies like social distancing measures which include isolation of COVID-19 cases, quarantine of their contacts, work from home options for people, the closure of schools and the cancellation of large gatherings etc. in dealing with the pandemic (Varghese and John 2020).

To contain the spread of COVID-19, Government of India drew up the National Containment Plan which envisaged screening for early detection, primary care for mild infection cases, tertiary care for severe infection cases, and emphasized health education through media to facilitate reduction of person-to-person transmission of COVID-19 (Ramachandran and Kalaivani 2020). Various initiatives were undertaken like establishment of quarantine centers, raising the laboratory capacity, strengthening of surveillance measures, using Artificial Intelligence for contact tracing etc. (Khan et al. 2020). The government hospitals were scaled up and private hospitals were also involved in the testing and treatment of COVID-19 (Kakar

and Nundy 2020; Prasad 2020). Some of the railway coaches were turned into quarantine and isolation facilities (Kakar and Nundy 2020). Treatment of COVID-19 patients comprised of basically symptomatic treatment such as paracetamol for fever, however, combination of medicines including anti-malarial, anti-Swine flu and anti-HIV have also been tried (Prasad 2020). Public health measures like nationwide lockdown, mass awareness regarding hand washing, usage of facial masks, social distancing measures etc. were adopted (Zodpey et al. 2020). The use of masks has been made mandatory in public place (Ramachandran and Kalaivani 2020). The central government and state governments have launched various mobile applications for the containment of COVID-19 in India (Bassi et al. 2020). Telemedicine have proven to be a useful tool for doctor patient interaction in the times of COVID-19 pandemic (Koliyath et al. 2020; Das, Rani, and Vaddavalli 2020). The Indian armed forces launched 'Operation Namaste' to help the government fight against COVID-19 and established several quarantine centres, isolation centres, testing facilities at various places in the country (Sarla 2020). Corporate sector and entertainment industry donated huge sum of money to aid government in dealing with the COVID-19 crisis in the country (Sarla 2020).

Thankappan outlines the Kerala's success story in managing the COVID-19. Prior experience of managing NIPAH virus epidemic, adherence to World Health Organization guidelines, enhancing health infrastructure in the state on war footing, enforcement of Kerala epidemic disease act, quarantine of all contacts, establishment of community kitchens, advertisement of "Break the Chain Campaign" for hand washing, sanitization and social distancing, financial aid to vulnerable population and strong political commitment helped Kerala in beating the COVID-19 (Thankappan 2020). Bidhan et al. also highlights the Kasargod initiative, a successful COVID-19 containment model in the state of Kerala. In addition, they also describe the intervention strategies that helped in containment of COVID-19 in Bhilwara district of Rajasthan (Bidhan et al. 2020). Meghwal et al. describes the field experiences of Rapid Response Teams (RRTs) in the containment of COVID-19 in Bhilwara. Stringent implementation of the cluster containment plan, ruthless containment, active surveillance, strong leadership and intersectoral coordination became the backbone of Bhilwara's success story (Meghwal et al. 2020).

Impact of COVID-19 and associated lockdown is enormous. Hospitals faced shortage of manpower, drugs and equipments (Dore 2020). This has adversely affected other emergency patients like pregnant women, cancer patients etc. in getting the timely treatment (Kundu and Bhowmik 2020; Dore 2020). There was a huge shortage of N95 masks and personal protective equipment (PPE) for the health care workers and many migrant workers suffered from starvation (Kundu and Bhowmik 2020). Social media created a panic situation of lack of stocks of masks and sanitizers, discrimination against the healthcare workers who provided treatment to COVID-19 cases, fake claims about herbal and immunity-booster medicines, religious and spiritual ways of COVID-19 treatment etc. (Kadam and Atre 2020). The domestic violence against women increased after lockdown was imposed (vora et al. 2020). Lockdown has tremendously affected the supply chain and economy of India (Agrawal, Jamwal, and Gupta 2020). Evidence of considerable distress was found in Micro, Small and Medium Enterprises (MSMEs), with production falling from 75% of the capacity to 11% and 55% loss in employment (Rathore and Khanna 2020). The tourism and hospitality industry are worst hit by COVID-19 (Pravin Kumar Patel et al. 2020). The entire education system turned digitally making the situation challenging

for both students and teachers(Goswami 2020).‘Herd mentality’ such as blindly following untrusted advice regarding hydroxychloroquine prophylaxis and ‘Herd behavior’ such as herds of migrants returning from cities to their native places, herd of people gathering in religious assemblies, in marriage ceremonies and in meetings of ‘super spreader’ preachers was observed in many parts of India during the period of lockdown(A. K. Singh and Misra 2020).

Loss of income, fear of contracting COVID-19 and related expenditure added to people worries. A survey conducted by Roy et al. revealed sleep difficulties, paranoia about acquiring COVID-19 in 12.5 % and 37.8 % respondents respectively (Roy et al. 2020). Further, perceived mental healthcare needs were found in more than 80% of the respondents(Roy et al. 2020). Sahoo et al. reported two cases of self harm due to COVID-19 in India. On becoming aware that they were in contact with COVID-19 patient, both the cases developed severe depressive symptoms and even tried to commit suicide (Sahoo et al. 2020). Dsouza et al. reported 69 COVID-19 suicide cases due to various underlying reasons such as fear of COVID-19 infection, financial crisis, loneliness, social boycott, pressure to be quarantine, COVID-19 positive, COVID-19 work-related stress, unable to come back home due to lockdown, unavailability of alcohol etc.(Dsouza et al. 2020). Study conducted by Gupta et al. found that people who observed COVID-19 positive cases in their respective cities are more prone to issues related to mental health than others (D. P. Gupta, Rai, and Dang 2020). Further, study reported that people and healthcare workers who spent excessive time on COVID-19 epidemic are at high risk of mental illness (D. P. Gupta, Rai, and Dang 2020). Mental health challenges of internal migrant workers are also a matter of concern(Choudhari 2020).

While on one hand, negative impact of COVID-19 is boundless, on the other hand restriction of movement and activities has positively impacted the environment. Due to lesser movement of vehicles on the roads, there has been a reduction in the emission of green house gases; air pollution levels have declined; non-functioning industries has led to lowering of waste emissions; and use of fossil fuels have reduced because of less demand of power in industries (Gautam 2020; Chakraborty and Maity 2020; Srivastava et al. 2020). Another collateral benefit of lockdown is the reduction in the number of road traffic accidents which has helped save many lives(Sarla 2020).

Antibody-based serological surveillance conducted in Delhi and Ahemdabad reported antibody prevalence of 23% and 17% respectively (Reddy 2020). However, K Srinath Reddy advises caution with the results and asserts that because of the inflation of false positives on mass screening, the true prevalence rates are likely to be lower than the reported rates (Reddy 2020). Rajendra et al. conducted a systematic review and found that Convalescent Plasma Therapy (CPT) for COVID-19 appears safe, clinically effective and reduces mortality (Rajendran et al. 2020). However, the study recommends conducting well-designed multicenter clinical trials to establish the efficacy of CPT for COVID-19 (Rajendran et al. 2020). Ayurveda therapeutic agents and practices like drinking warm water, mouth gargle , nasal oil application, steam inhalation etc. can reduce the risk of COVID-19 infection (Tillu et al. 2020).

Development of COVID-19 vaccine is underway at a frantic pace. Bharat, India, Biological E, India, Zydus Cadila, India are among the Developing Countries Vaccine Manufacturers Network

(DCVMN) member companies who are currently engaged in COVID-19 vaccine research and development (Pagliusi et al. 2020).

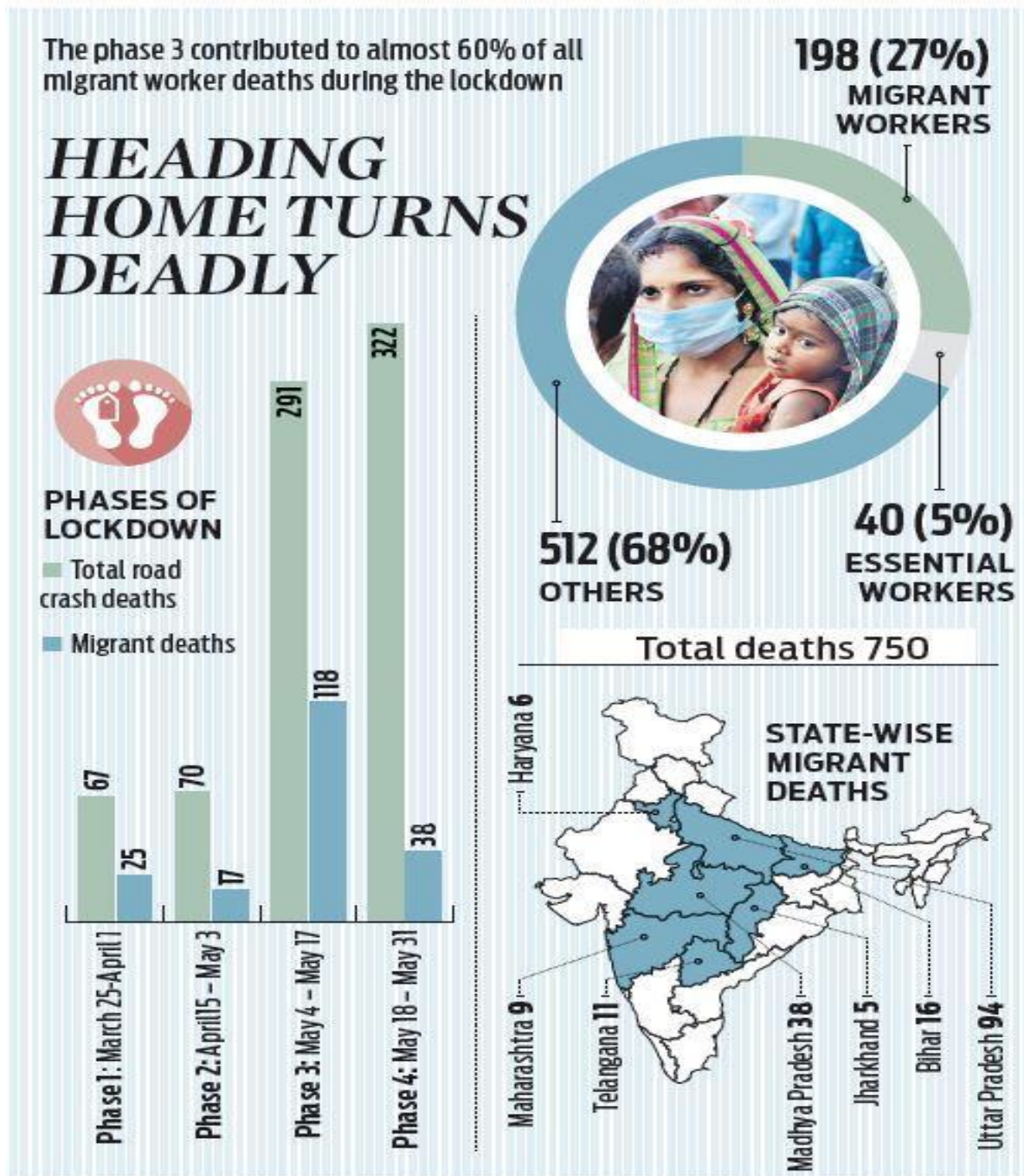
Bhatia and Abraham highlight the lessons learnt during the first 100 days of COVID-19 pandemic in India and assert the importance of public engagement, pan-India laboratory networks and responsible role of mainstream and social media in the fight against COVID-19 (R. Bhatia and Abraham 2020). They also suggest that arrangements should be made to make health systems robust so that non-COVID-19 healthcare services to people are not affected and strategies should be made to ensure protection of vulnerable senior citizens. Tagat and Kapoor highlight the importance of behavioral interventions to mitigate the spread of COVID-19 in India. For instance, in some cities police officials wore “corona helmets” to raise awareness about COVID-19 among the commuters, implementation of social distancing using circles and squares drawn on the ground etc. (Tagat and Kapoor 2020). To improve psychological immunity towards COVID-19 fear, measures like relaxation exercises, meditation, breathing exercise, yoga, practicing hobbies, listening to music, reading good literature, seeking professional help if needed etc. could be helpful (Chaurasiya et al. 2020). Zodpey et al. suggests that moving forward governments should focus on enhancing preparedness and response system, enable care for patients by enhancing treatment and testing facilities, and broaden community and stakeholder engagement by involving private sector, voluntary organizations, civil society, and nongovernmental organizations (Zodpey et al. 2020).

Impact on migrants

According to World Economic Forum, India is a home to around 139 million migrants in the country⁷. Most of the migrants belong to the states of Uttar Pradesh, Bihar, Rajasthan and Madhya Pradesh. Cities like Delhi and Mumbai attract the highest number of migrants due to abundance of work opportunities. Lockdown and travel bans due to COVID-19 have impacted the migrant population the most. Due to shutdown of factories, construction sites and other workplaces, millions of migrants suffered serious loss of income and availability of food. Loss of income posed other worries like inability to pay home rentals and uncertainty about their future. All this forced thousands of workers to move back to the villages they had come from. Due to no means of transport, migrants were forced to walk thousands of miles back home and many of them starved on the way. Many migrant workers lost their lives due to various reasons like hunger, accidents, police brutality, lack of medical care, suicides etc. (see figure 13) (The New Indian Express 2020).

⁷ https://en.wikipedia.org/wiki/Indian_migrant_workers_during_the_COVID-19_pandemic

Figure 13 : Migrant deaths during COVID-19



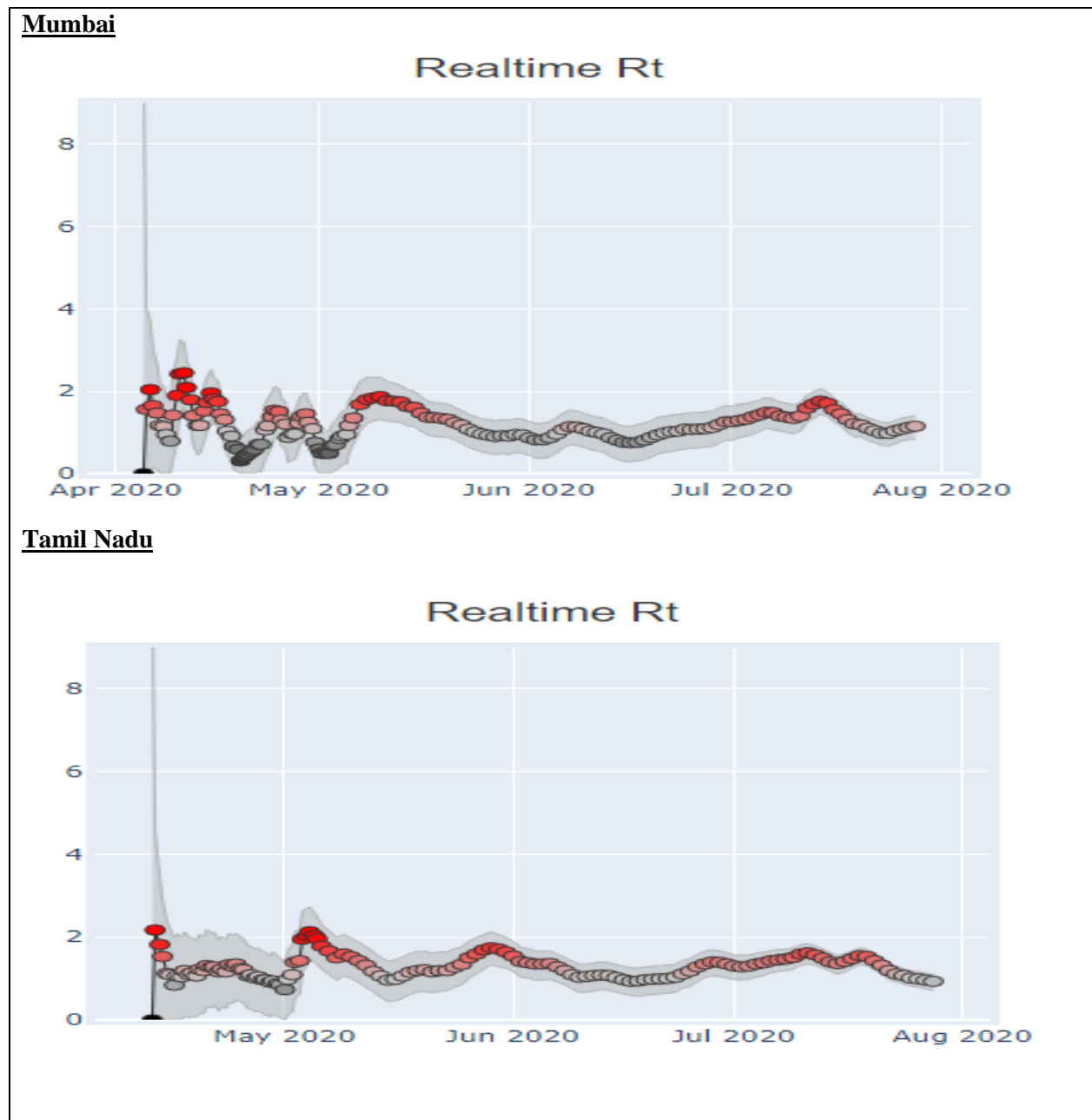
Source: The New Indian Express. 2020. "Most Migrants Died during COVID-19 Lockdown 3.0: SaveLife Foundation." June 2020.

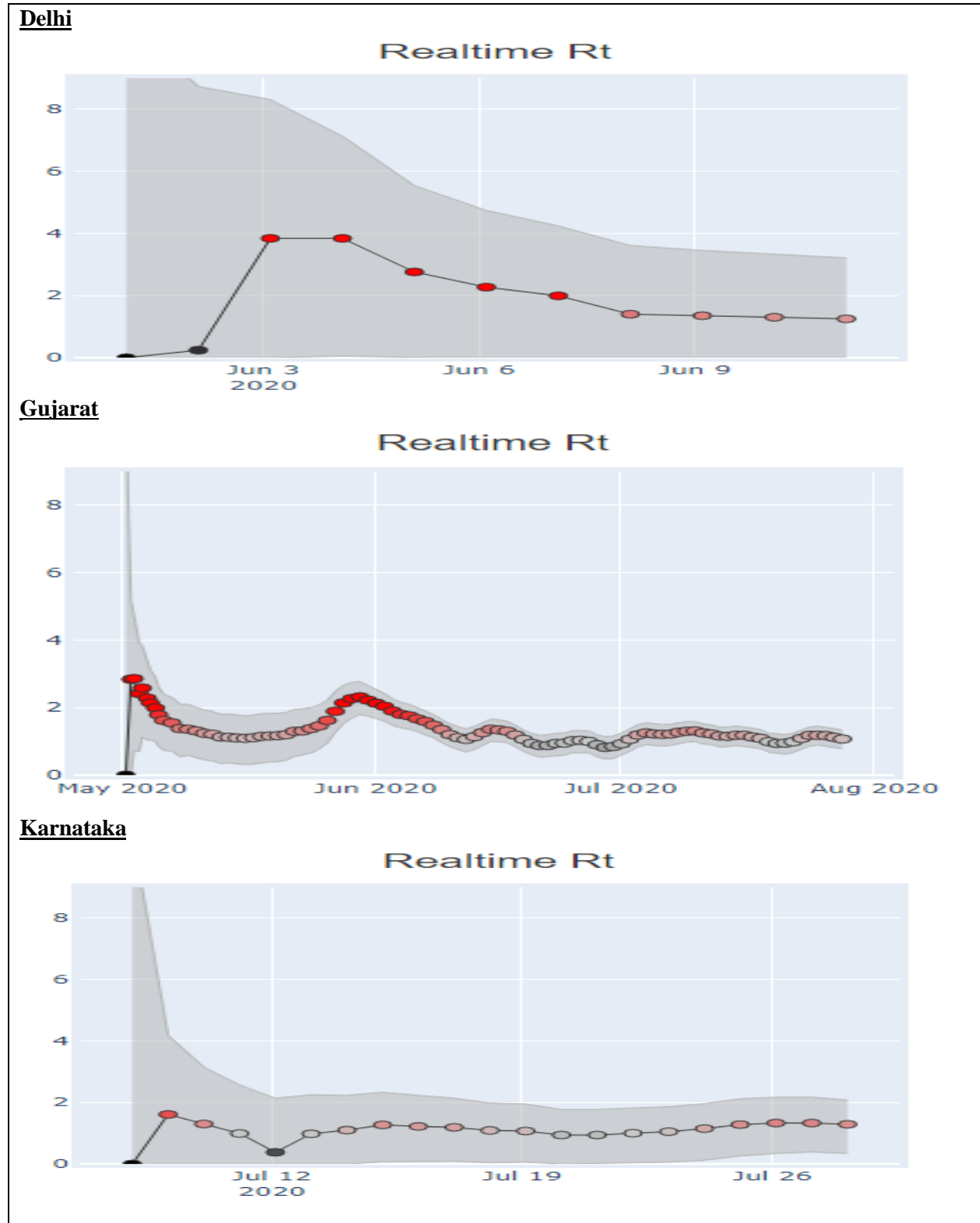
<https://www.newindianexpress.com/nation/2020/jun/03/most-migrants-died-during-covid-19-lockdown-30-savelife-foundation-2151565.html>

COVID-19 R

R is a key measure of how fast the virus is growing. It is the average number of people who become infected by an infectious person. R_t is the number of people who become infected by an infectious person at time t . If R is above 1.0, the virus will spread quickly. When R is below 1.0, the virus will stop spreading. The value of R is indicative of how effective have the measures been in controlling the outbreak. Figure 14 depicts the value of COVID-19 R in worst affected states in India. India should be tracking it as a target variable and not just the recovery rate or the doubling rate.

Figure 14: Statewise COVID-19 R





Source: GitHub. 2020. "COVID-19 Rt Analysis in Indian Context." 2020.
[https://parijat29.github.io/COVID-19-India-R0-Analysis/.](https://parijat29.github.io/COVID-19-India-R0-Analysis/)

Central Government Initiatives

The Indian government was quick to take necessary actions since the reporting of the first case in January. This included screening of passengers at all the airports across the country, entry restrictions for people travelling from mainland China and other affected countries etc. All international travelers entering the country were asked to self-quarantine for a period of 14 days. All Indian states were asked to invoke the Epidemic Disease Act under which the authorities will be allowed to close down public places and quarantine COVID-19 suspects. An intensive campaign was launched and guidelines related to quarantine, personal hygiene, surveillance, contact tracing, diagnosis and management were issued. By 20th March 2020, all flights, both domestic and international were suspended. The central government announced one day “**Janta Curfew**” (Peoples curfew) on 22nd March 2020 to prepare citizens for the upcoming situation. On 24th March 2020, when the number of confirmed COVID-19 cases touched 500, Government of India announced a **21 days nationwide lockdown** (Press Information Bureau, Government of India 2020). The idea was to break the chain of transmission and flatten the curve. A COVID-19 Containment Plan was put together. To address the queries related to COVID-19, a 24*7 control room was set up at the the Director General of Health Service (DGHS) headquarters. During the 21 days nationwide lockdown period, government focused on preparing for the upcoming serious COVID-19 crisis. This included establishment of COVID-19 hospitals, isolation wards, quarantine centers and laboratory facilities. Rapid Response Teams were formed to deal with the upcoming emergencies. The Ministry of Health and Family Welfare, Government of India issued various guidelines and advisories to create mass awareness and control the spread of the deadly virus.

On 26th March 2020, the Union Finance Minister announced relief package of **INR 1,700 billion under Pradhan Mantri Garib Kalyan Yojana** to deal with the financial crisis in the country (Ministry of Finance, Government of India 2020). Salient features of the scheme are as below:

- Safai karamcharis, ward-boys, nurses, ASHA workers, paramedics, technicians, doctors and specialists and other health workers would be covered by a Special insurance Scheme.
- Any health professional, who while treating Covid-19 patients, meets with some accident, then he/she would be compensated with an amount of Rs 5 million under the scheme.
- To ensure adequate availability of protein to all the above mentioned individuals, 1 kg of pulses per family would be provided according to regional preferences for next three months. These pulses would be provided free of cost by the Government of India.
- Under PM Garib Kalyan Yojana, gas cylinders, free of cost, would be provided to 0.8 million) poor families for the next three months.
- Wage-earners below Rs 15,000 per month in businesses having less than 100 workers are at risk of losing their employment. Under this package, government proposed to pay 24 percent of their monthly wages into their Provident Fund (PF) accounts for next three months.

- There are around 30 million widows and people in handicapped category who are vulnerable due to the economic disruptions caused by Covid-19. Government will give them Rs 1,000 to tide over difficulties during next three months.

Initially, the swift and stringent response of the Government of India was praised all over the world. India recorded a score of “100” on the Oxford COVID-19 Government Response Tracker (OxCGRT)⁸. The United Nations and the World Health Organization also praised India’s response as ‘Comprehensive and Robust’⁹. Despite being the second most populous country in the world with the population of around 1.3 billion, COVID-19 infection rate was very low. Many believed that numbers were low because enough testing was not being done to identify the actual number of cases and associated deaths. Others were of the opinion that the 21 day lockdown played a key role in the suppression of the pandemic. Some pointed towards India’s protective characteristics such as high immune response of Indian population, high temperatures and humidity, etc. Many believed that it is because of demographics as similar low fatality rate was being observed in other South Asian countries like Bangladesh and Pakistan. While on one hand India’s immediate action of imposing nationwide lockdown gathered all praises, many opined that Indian government failed this pandemic test. This is because of the difficulties faced by the workers in the informal sector during the period of nationwide lockdown¹⁰. These workers suffered in every aspect - physically, financially and mentally. Due to the ad-hoc announcement of lockdown and shut down of all modes of transport, migrants were left with no option but to walk hundreds of miles to reach their villages. As an exit plan from the nationwide lockdown, the districts across India were divided into three zones - Green, Red and Orange based on the case load¹¹. After 20th April 2020, conditional relaxations were given in Green and Orange Zones. Within the red and orange zones, two more zones - containment zone and buffer zone were later added in the revised guidelines issued by the government of India^{12, 13}.

The Government of India launched ‘**Vande Bharat Mission**’ on May 7th 2020, to bring back Indian citizens who were stranded in various parts of the world because of the COVID-19 induced travel restrictions. It was the biggest evacuation exercise in the world¹⁴. The Mission gave priority to citizens who have compelling reasons to return like loss of employment, non-renewal of visa, death of family member, tourists, students whose colleges and hostels were shut, medical emergency etc (Drishti The Vision Foundation 2020). The Mission was launched in a phased manner (Phase 1–Phase 4). The mission began on May 7th 2020 and citizens have been evacuated from various countries like UAE, USA, Singapore, Bangladesh, Saudi Arabia, Kuwait, Oman, Malaysia, Qatar, Philippines, UK, Bahrain, Armenia, Australia, Egypt,

⁸ <https://www.cnbcvt18.com/healthcare/study-reveals-indias-response-to-coronavirus-most-stringent-5666531.htm>

⁹ https://en.wikipedia.org/wiki/COVID-19_pandemic_in_India

¹⁰ <https://www.nytimes.com/2020/05/27/opinion/india-modi-coronavirus.html>

¹¹ Red Zone: Areas or the hotspots classified as those with the highest caseload; Orange Zone: Areas which have reported a limited number of cases in the past and no surge in positive cases recently; Green Zone: Areas with zero confirmed cases till date or no confirmed case in the last 21 days.

¹² Containment zone: The area of 3-kilometre radius around the epicentre (the residence of the positive case or where he has been isolated).

¹³ Buffer zones: The adjoining blocks of the affected district or rural districts of the affected city.

¹⁴ Over 10 lakh Indians (over one million) have returned from abroad after the government launched the “Vande Bharat” evacuation mission.

Indonesia, Italy, Kazakhstan, Kenya, Nigeria, Netherlands, New Zealand, Nepal, Russia, Sri Lanka, Thailand and Ukraine etc. (Ministry of External Affairs, Government of India 2020). Indian Navy also launched Operation ‘**Samudra Setu**’ as a part of 'Vande Bharat Mission' to evacuate Indian citizens stranded in the Maldives. Two ships of Indian Navy - NS Jalashwa and INS Magar were operated from May 8th2020 (Javaid 2020).

On 12th May 2020, the Prime Minister of India announced an economic package of Rs 20 Lakh crore under the '**Aatma Nirbhar Bharat Abhiyaan**'(Government of India 2020). The Abhiyan focuses on making India self-reliant. The Prime Minister appealed to the citizens to consider COVID-19 crisis as an opportunity and lay emphasis on the domestic products to make India economically self-reliant. Five Pillars of Atma Nirbhar Abhiyan are detailed in Table 1.

Table 1: Five Pillars of Atma Nirbhar Abhiyan

Pillar	Description
Economy	An economy that brings Quantum Jump rather than Incremental change
Infrastructure	An infrastructure that became the identity of modern India
System	A system that is driven by technology which can fulfill the dreams of the 21st century; a system not based on the policy of the past century
Demography	Our Vibrant Demography is our strength in the world's largest democracy, our source of energy for self-reliant India
Demand	The cycle of demand and supply chain in our economy, is the strength that needs to be harnessed to its full potential

Source: Government of India. 2020. “AatmaNirbhar Bharat Abhiyan.” AatmaNirbharBharat Abhiyan - Transforming India. 2020. <https://transformingindia.mygov.in/aatmanirbharbharat/>.

With the continuous rise in COVID-19 cases, the government of India adopted **Intelligent Testing strategy** (ETHealthworld 2020). The strategy stressed on tracing and remaining ahead of coronavirus by creation of an infrastructure for testing facilities and services across the country. This involved distribution of TrueNat machines for COVID-19 testing, procurement of COBAS-8800 machines, expansion of laboratories and testing infrastructure in the country. The central government has extended its full support to the state governments in dealing with the COVID-19 situation. The central government has proactively supported the North Eastern states in establishing testing facilities, COVID hospitals and other health care infrastructure in dealing with the COVID-19 (Ministry of Health & Family Welfare, Government of India 2020). On 18th June, 2020, the Minister for Science & Technology, Earth Sciences launched India’s first Infectious disease diagnostic lab (I-lab) for Covid testing in rural, interior and inaccessible parts of the country (see figure 15) (Ministry of Science & Technology, Government of India 2020).

From June 1, 2020 till June 30th, 2020, Ministry of Home Affairs (MHA), Government of India issued Unlock 1 guidelines for re-opening of areas outside the Containment Zones. On 26th June, 2020, the Prime Minister of India launched '**Aatma Nirbhar Uttar Pradesh Rojgar Abhiyaan**'. The scheme is focused on providing employment opportunities to those migrant workers who recently returned to the state of Uttar Pradesh due to the pandemic. The scheme will benefit more

than one crore (10 million) migrant workers. From July 1st, 2020, Unlock 2 guidelines were issued by the Government of India.

Figure 15: India's First Infectious disease diagnostic lab (I-Lab)



Source: Ministry of Science & Technology, Government of India. 2020. “Dr Harsh Vardhan Launches DBT – AMTZ Mobile Diagnostic Unit for Covid Testing- I-Lab [Press Release].” <https://pib.gov.in/PressReleasePage.aspx?PRID=1632393>.

ICT Initiatives

The Central Government has taken various ICT Initiatives to deal with the COVID-19 situation in the country. For the purpose of mass awareness, the Department of Telecom, Government of India has launched COVID-19 awareness messages as a caller tune instead of regular ringtone (Times of India 2020). In addition, the Government of India has made available a number of authentic information portals. These include MyGov Portal, National Health Portal of India, the Ministry of Health and Family Welfare website, WhatsApp bot called MyGov Helpdesk (WhatsApp Number: +919013151515), MyGov Social Media Hub etc. (Ministry of Communications & Information Technology (Government of India) 2020). The central government has also launched citizen engagement platforms like MyGov App and COVID-19 feedback app. The National Informatics Centre (NIC), Ministry of Electronics and Information Technology, Government of India has developed the Aarogya Setu App and Aarogya Setu IVRS for the purpose of contact tracing (National Informatics Centre, Ministry of Electronics & Information Technology, Government of India 2020). The Survey of India (SOI), India's National Mapping Agency (NMA) under the Department of Science & Technology, Government of India has developed the SAHYOG app for the purpose of contact tracing, public awareness and self assessment (Survey Of India 2020).

State Government Initiatives

On 30th January 2020, India reported its first COVID-19 case in the state of Kerala. The number rose to 3 by Feb 3rd 2020 and all three cases were students who returned from the city of Wuhan, China. Cases gradually rose in the month of March when a number of tourists along with Indian citizens who came from affected nations were found to be COVID-19 positive. Over the month

of March, Indian state governments declared emergency, directed closure of schools, colleges, malls, gyms, cinema halls and other public places. The state governments issued necessary advisories and guidelines. State helpline numbers were established. The state governments followed the trace-test-treat principle to contain the spread of corona virus. Designated COVID-19 care centres, hospitals, laboratory facilities were established by the state governments. Schools and hotels were turned into quarantine centres.

To deal with the COVID-19 crisis, the Uttar Pradesh Government announced monetary help of INR 1000 monthly allowance to daily wage workers registered under the labour department (International Labour Organization 2020). The Government of West Bengal also launched **Snehar Paras** scheme offering INR 1000 to the migrant workers who are resident of West Bengal, but were stuck outside due to COVID-19 (Gul 2020). Many state governments mobilized resources towards the establishment of community kitchens. The state of Uttar Pradesh established community kitchens on a massive scale. The state established 7,368 community kitchens across 75 districts which produced 12 lakh food packets a day. Uttar Pradesh was the first state in the country to geo-map these establishments on google maps for the ease of beneficiaries (Press Trust of India 2020b). The state of Kerala also established 1,255 Community Kitchens across 14 districts which served 2.5-2.8 lakh of food packets per day¹⁵. The mission of these community kitchens is to ensure that everybody is hunger free. These community kitchens particularly serve weaker sections of the society like migrant labourers, homeless people etc. Community kitchens are run in collaboration with the civil society, non-governmental organizations, religious establishments, local self-governing bodies and voluntary organizations. Many state governments announced financial compensation to front line staff like healthcare workers, sanitation workers, police personnel etc. if they get infected and die in the line of duty. The Delhi Government announced a compensation of INR 1 Crore, while Gujarat Government announced assistance of Rs 25 Lakhs¹⁶.

5T Plan

The Government of Delhi launched 5T Plan for the control of COVID-19 in the National Capital (see Figure 16)(Kaushik 2020). The First “T” stands for “**Testing**” which involves conducting rapid tests in hot spot areas; the second “T” stands for “**Tracing**” which involves identification of those who have come in contact with COVID-19 patient; third “T” stands for “**Treatment**” which includes treatment of COVID-19 patients; fourth “T” stands for “**Team Work**”; and fifth “T” stands for “**Tracking and Monitoring**” which involves active tracking of all the activities for control of COVID-19 in the National Capital.

¹⁵ <https://www.thehindubusinessline.com/news/national/keralas-community-kitchens-serve-28-lakh-food-packets-a-day/article31309814.ece>

¹⁶ <https://www.thehindu.com/news/national/delhi-to-pay-1-crore-ex-gratia-to-kin-of-front-line-personnel/article31230190.ece>
<https://economictimes.indiatimes.com/news/politics-and-nation/gujarat-government-announces-rs-25-lakh-compensation-for-staff/articleshow/75031976.cms?from=mdr>

Figure 16: 5T Plan

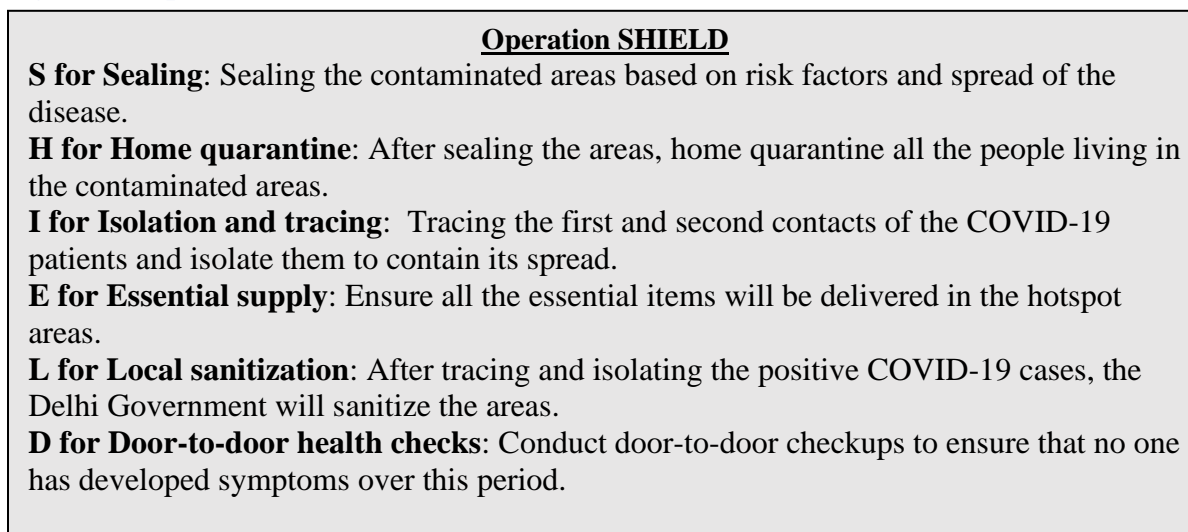


Source: Kaushik, Devanshu. 2020. “Delhi Govt. Launches 5T Plan to Contain COVID-19 Crisis.” April 2020. <https://currentaffairs.adda247.com/delhi-govt-launches-5t-plan-to-contain-covid-19-crisis/>.

Operation SHIELD

On 9th April 2020, the Government of Delhi announced **Operation SHIELD** to combat COVID-19 (see Figure 17 for details)(Arfa 2020).

Figure 17: Operation SHIELD



Source: Arfa, Javaid. 2020. “What Is Operation SHIELD?” What Is Operation SHIELD? - Jagran Josh. April 2020. <https://www.jagranjosh.com/general-knowledge/operation-shield-1586526395-1>.

Mission Fateh

The Government of Punjab launched ‘Mission Fateh’ to involve people of Punjab in the fight against COVID-19(Department of Governance Reforms and Public Grievances, Government of

Punjab 2020). *“It is a Mission of the people, by the people and for the people”*(Department of Governance Reforms and Public Grievances, Government of Punjab 2020).

“Mission Fateh symbolises the resolve of the people of Punjab to halt the spread of the Novel Coronavirus through discipline, cooperation and compassion. Discipline in observing all precautions, cooperation with the state government by faithfully abiding by the lockdown restrictions and compassion towards the poor by helping them and giving them aid. It is the true reflection of the Punjabi spirit that can overcome all odds to emerge victorious”(Guru Nanak Dev University 2020)

The mission involved one month awareness campaign starting 1st June 2020. The focus was to create awareness about 11 things (see Table 2).

Table 2: Eleven things to focus on during one month awareness campaign under Mission Fateh

1.	Wearing masks
2.	Washing hands
3.	Maintaining social distancing
4.	Taking care of the elderly
5.	Remaining vigilant about entry of outsiders in the locality
6.	Use of COVA App to track patients of the virus and maintaining a safe distance from them
7.	Importance of home quarantine
8.	Symptoms of the flu and action thereafter
9.	Restrictions during Lockdown 5.0 and penalties /fines in case of violations
10.	Community mobilization to jointly fight against the pandemic
11.	Emphasizing that the threat of the virus has not diminished, rather it has become more menacing

Source: Department of Governance Reforms and Public Grievances, Government of Punjab. 2020. *“Punjab COVID-19 Response: Initiatives and Policy Measures.”*
http://covidhelp.punjab.gov.in/COVID_RESPONSE_PUNJAB.pdf.

For Mission Fateh three committees were formed - state-level campaign committee, state-level implementation committee and district level implementation committee. These committees were responsible for undertaking awareness activities such as placing advertisements in newspaper and TV; put up hoardings; make use of IVRS and SMS service to reach citizens and urge them to take all the necessary precautions; sensitize citizens with the experiences of people who have recovered from COVID-19, involve local leaders like Sarpanch and frontline health care workers like ASHA, Anganwadi workers etc. for mass awareness. A campaign song was launched to create awareness and various NGOs (non-governmental organizations) were also involved to give a boost to state government’s initiative. Three success indicators of the campaign were:

- Increase in COVA App download by 20%
- Identification of 1,00,000 CORONA Warriors and uploading of their data on the App
- Identification of 1,000 Mission Fateh warriors and their recognition on the App

ICT Initiatives

The state governments have been quite active in leveraging ICT for control of COVID-19. They have launched various mobile applications for the purpose of mass awareness, providing information, contact tracing, monitoring suspects in quarantine etc. Table 3 enlists few of these mobile applications.

Table 3: Mobile applications launched by various state governments

State	Name of the mobile application	Purpose
Delhi	Delhi Corona	Provides real time information on the availability of beds and ventilators at both government and private hospitals, COVID-19 cases and number of tests conducted, government orders, containment zones, COVID-19 Health Services, and lockdown services like finding a hunger relief centre or a shelter or to apply for ration; a platform to donate to the Chief Minister/ Lt. Governor relief Fund
Punjab	COVA Punjab	Provides access to real time dashboard for COVID-19 statistics, helpline numbers, prevention measures, government advisories, travel instructions; a geofencing app; a platform for self-screening for COVID-19 and locates nearest COVID-19 hospital
Telangana	T-COVID'19	Provides live COVID-19 statistics, access to government and WHO advisories, details related to government approved labs and test centers, isolation wards in government and private hospitals and quarantine centers; self assessment for COVID-19 ; a telemedicine platform
Kerala	Gok Direct Kerala	Generate awareness and disseminate credible information related to COVID-19
Goa	Test Yourself Goa	Assists in carrying out a self assessment test for COVID-19
Karnataka	Test Yourself Karnataka	Assists in carrying out a self assessment test for COVID-19
West Bengal	Sandhane	Trace COVID-19 suspects in rural and remote areas
Maharashtra	MahaKavach	Geofencing app: Helps track movement of COVID-19 suspect in quarantine
Tamil Nadu	Quarantine Monitor	Geofencing app: Helps track movement of COVID-19 suspect in quarantine
Karnataka	Corona Watch	Geofencing app: Helps track movement of COVID-19 suspect in quarantine
Himachal Pradesh	Corona Mukh Himachal	Geofencing app: Helps track movement of COVID-19 suspect in quarantine
Gujarat	SMC COVID-19 Tracker App	Geofencing app: Helps track movement of COVID-19 suspect in quarantine
Mizoram	mCOVID-19	Provides access to COVID-19 updates, government advisories, task force and volunteer registration, volunteer mPASS (pass to permit movement of goods, vehicles and people); a geofencing app

Source:(Mitter 2020; Anand 2020; ET Wing, Govt of Telangana 2020; Mizoram State e-Governance Society 2020; Press Trust of India 2020a; Nag 2020; ETGovernment 2020)

State governments have also launched robots to fight against COVID-19 situation. The Kerala Government has initiated the use of robots ‘KARMI-Bot’ and ‘Nightingale-19’(A. Bhatia 2020; Zachariah 2020). These robots serve food and medicines to the COVID-19 patients, collect trash used by the patients, enable video call between patients and doctors or relatives and perform disinfection of the isolation ward. ‘Milagrow iMap 9’ a robot designed for floor disinfection purposes, is being pilot tested at All India Institute of Medical Sciences (AIIMS) in New Delhi(Press Trust of India 2020c). Other states like Tamil Nadu and Jaipur have also explored the use of robots. The states are also exploring the use of drones for the purpose of sanitization, monitoring the movement of people etc. For monitoring COVID-19 Patients, states are exploring the use of remote monitoring systems. These include Indore 311 mobile app by state of Madhya Pradesh, Monal 2020 by the state of Uttarakhand, Milagrow Humanoid ELF in AIIMS,New Delhi, LiFi (Light Fidelity) technology in Ahmadabad(Press Trust of India 2020c; Vora 2020; Express News Service 2020). These remote monitoring systems enables remote monitoring of patient’s vital parameters like pulse rate, blood oxygen level, body temperature, respiration rate, heart rate etc.

Success Models

Kerala Model: A state scale model

As India struggles to cope with the COVID-19 pandemic, Kerala stands out in dealing with the COVID-19 crisis. Kerala has been so successful in its initial efforts to flatten the COVID-19 curve that many call it the ‘Kerala Model’ for dealing with the COVID-19 situation (The Indian Express 2020; Tharoor 2020). Kerala is one of the densely populated states in the country with high number of visiting tourists, which makes its success in dealing with the pandemic even more remarkable. In general, compared to other Indian states, Kerala is unique in various aspects. Kerala is a model for other states in India as the state has the best social indicators. The state has laid strong emphasis on two key sectors - health and education. Historically, it has allocated significant amount of resources to strengthen its public health infrastructure. It has decentralized funding and power to village level bodies. Its social system promotes participation from community and demands cooperation from public. The state continuously improves government run primary healthcare system and education system which lays a strong foundation for sustained development. Kerala has a history of standing out in dealing with many catastrophic situations in the past such as containment of Nipah Virus, dealing with natural disasters etc.

Kerala government stands out with a unique leadership style in dealing with COVID-19 pandemic. In mid-January, Kerala initiated screening at all its four international airports. By early Feb, Kerala declared COVID-19 a state level disaster and closed all the schools and restricted public gatherings. The entire state was in lockdown by early March. By the time central government announced nationwide lockdown, Kerala had already sent thousands of suspects in quarantine. Public Health authorities in Kerala emphasized early detection through extensive testing on a large scale. Further, they announced a quarantine period of 28 days instead of 14 days (as per WHO guideline and which was followed by rest of India). Prompt action from the state government yielded good results by mid-April when cases began to decline.

There are many reasons behind Kerala's success in dealing with COVID-19 pandemic. Kerala government communicated with the public consistently and informed them about the health risks through various official channels. Undoubtedly, Kerala has a well laid healthcare system, but apart from that, general level of awareness among people is quite high, especially among the women owing to high women literacy rate in the state. Huge investments in the social sector and making people aware of the gravity of situation so that they can deal with the situation at individual level is one of the key factors behind Kerala's success in fighting COVID-19. Further, Kerala was able to follow WHO strategy of 'test, trace, isolate, treat' so carefully because of the availability of public goods in the system. Kerala's public health system has the capacity to ramp up testing of hundreds and thousands of people and treat patients with utmost care. Besides, the Kerala government acted very quickly to deal with the secondary effects of the lockdown and quarantine. Kerala authorities were always on the forefront in fulfilling the needs of the people. This included supply of essential items including meals, medicines etc. Kerala's well functioning public distribution system acted as a safety net for vulnerable sections of the society. Kerala government also announced an economic relief package for its citizens. Many local organizations in the state have helped the government in containment of the coronavirus by producing masks and sanitizers in large numbers and setting up community kitchens.

Kerala is also quite active in leveraging ICT for dealing with the COVID-19 situation. The Kerala Government along with Qkopy (a local social communication platform) developed 'Gok Direct Kerala' app for the purpose of generating awareness and disseminating credible information related to COVID-19. To control the spread of coronavirus, Kerala adopted the "Phone Booth" testing method. Kerala has initiated the use of robot "KARMI-Bot" in one of the hospitals in Ernakulum district for the purpose of serving food and medicines to the COVID-19 patients, collecting the trash discarded by the patients, enabling video call between patients and doctors or relatives and performing disinfection of the isolation ward.

Undoubtedly, Kerala model offer lessons for other Indian states in not only dealing with the current COVID-19 crisis, but also to prepare for the next one. Kerala's experience provides lessons for framing of policies for sustained development and not for short term interventions.

Bhilwara Model: A district scale Strict Lockdown & Systematic Follow-up Model

In the fight against coronavirus, Bhilwara Model is another successful example (Aurora 2020; Manish 2020). Bhilwara was the first district in the country to stop new coronavirus infections in less than two weeks time. Of course, this was based on the strictest of lockdowns. On March 19, the Government of Rajasthan directed all the state districts including Bhilwara to impose section 144 in their districts¹⁷. This was the time when cases began to appear in the state including first case reported by Bhilwara district. By 21st March, half of all the cases in Rajasthan were recorded in Bhilwara. On investigation it was found that the epicentre of the outbreak in the district was Brijesh Banger Memorial Hospital where one medical officer and five other staff

¹⁷ Section 144 of the Criminal Procedure Code (CrPC) of 1973 authorises the Executive Magistrate of any state or territory to issue an order to prohibit the assembly of four or more people in an area. According to the law, every member of such 'unlawful assembly' can be booked for engaging in rioting. <https://www.business-standard.com/about/what-is-section-144#:~:text=Section%20144%20of%20the%20Criminal,booked%20for%20engaging%20in%20rioting.>

members were infected with COVID-19. To control the situation, the district collector of Bhilwara issued the orders to shut down all the establishments in the district like industries, factories, brick kilns etc. with more than 10 employees. All religious and social gatherings were reduced to 5 people. All types of public transport were banned in the district. The police officials erected barricades to restrict intra and inter district movement. The entire district was in lockdown. No one was allowed to step out of their homes. The district administration took the responsibility of delivering essential items like ration, food items, medicines, cow's fodder etc. at everyone's doorstep.

Social distancing was strictly followed. Daily disinfection was carried out in the district. 'Corona captains' were appointed from among the Sub Divisional Magistrates (SDMs) and Block Development officers (BDOs) who in turn selected 'corona fighters' from among the Panchayat members, teachers, ASHA workers, Anganwadi workers. Corona fighters conducted door-to-door survey and monitored movement of quarantined families. Screening and testing was prioritized for the Brijesh Banger Memorial Hospital employees and their contacts. Room in hotels, resorts, Dharamshalas and educational institutions were used for quarantine and emergency care purposes. A 24*7 war room was established at the district collector's office where three teams were appointed to work on 8 hour shift/day for monitoring all aspects of contact tracing, testing, quarantine, lockdown etc. The first door-to-door one was completed by 28th March and others followed based on its findings. By end of the March, door to door screening was completed for almost 92% of the population. Overall, around 3000 teams were made to reach out to 32 lakh (3.2 million) people in the district and around 6,000 people were quarantined. The last new case in the district was reported on 30th March and by then Bhilwara overall had 27 cases. Third door-to-door survey was conducted after April 1st to screen the migrants who came from other regions and the people who might have been left out in first two rounds.

Bhilwara model teaches us how relevant follow-up measures (during and post-lockdown periods) like door-door-door screening, contact tracing, strict isolation and vigilance can help save countless lives.

Dharavi Model: A slum Model

Dharavi, which is Asia's largest slum, showed the world its success in containing COVID-19. Dharavi is a densely packed slum in the Indian city of Mumbai in the state of Maharashtra. It covers an area of more than 2.5 sq km and has a population density of around 2,77,136 per sq km¹⁸.

¹⁸ <https://en.wikipedia.org/wiki/Dharavi>

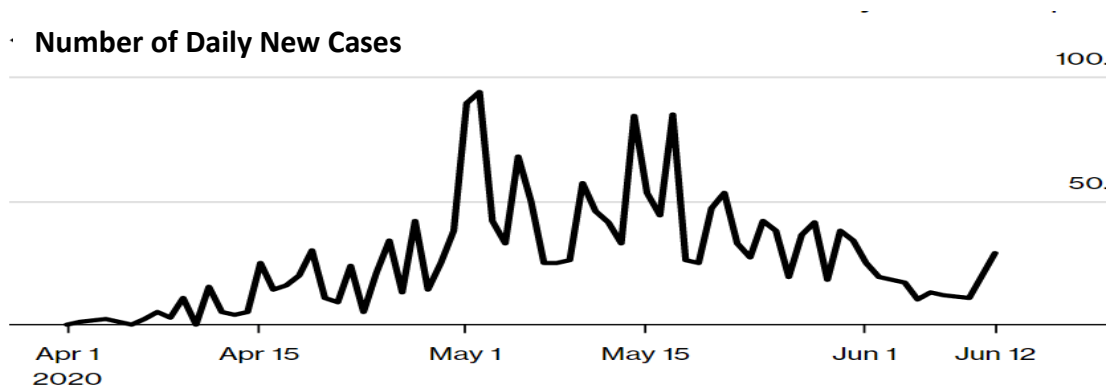


Figure18: Aerial View of Dharavi, Mumbai, India

Source: Hindustan Times. 2020. “‘Mission Dharavi’: Covid-19 Battleground in Country’s Biggest Slum in Mumbai.” April 2020. <https://www.hindustantimes.com/india-news/mission-dharavi-coronavirus-battleground-in-india-s-biggest-slum/story-W4vXSPyUef7YidghCDhTLK.html>.

On April 1st, 2020 Dharavi witnessed its first COVID-19 case and also the first death due to COVID-19. Soon, the number began to rise and reached its peak in early May, but then started to show a steady decline by early June (see figure 21 and figure 22) (Pandya 2020; Pinto 2020). The doubling rate which was 18 days in April gradually improved to 43 days in May, and 80 days in June and 430 days in July¹⁹.

Figure 15 : Number of daily new cases in Dharavi, Mumbai



Source: Municipal Corporation of Greater Mumbai

Source: Pandya, Dhvani. 2020. “How Asia’s Densest Slum Chased the Virus Has Lessons for Others.” June 2020. <https://www.bloomberg.com/news/articles/2020-06-13/how-asia-s-densest-slum-chased-the-virus-has-lessons-for-others>.

¹⁹ <https://www.news18.com/news/india/tracing-tracking-testing-treating-day-after-who-praise-bmc-outlines-4-ts-behind-mission-dharavi-2711469.html>

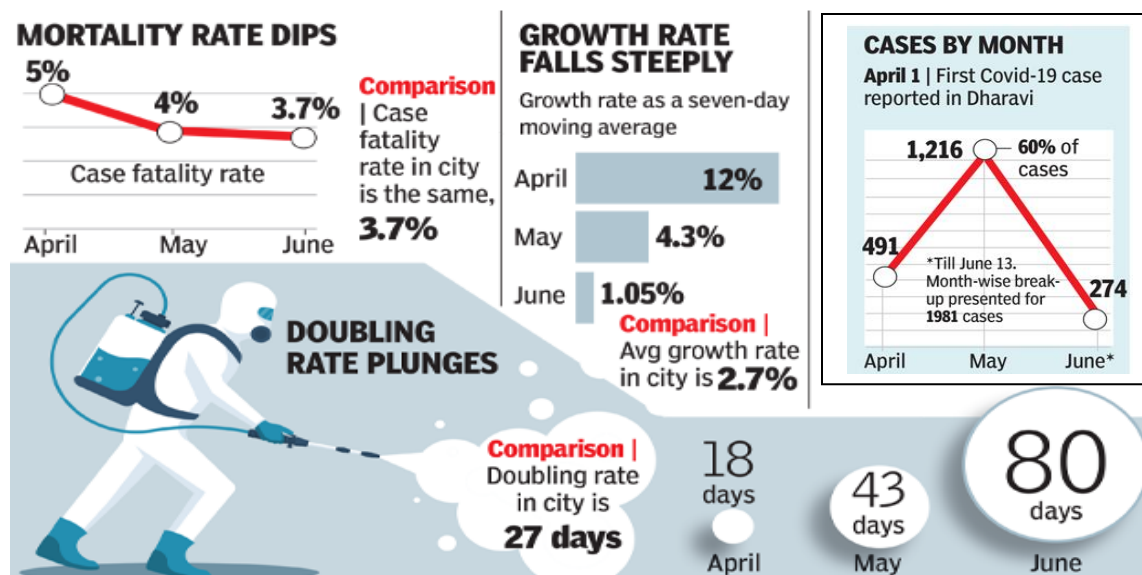


Figure 16: COVID-19 situation in Dharavi

Source: Pinto, Richa. 2020. "Dharavi on Way to Win Battle? 53% Patients Have Recovered." June 2020. <https://timesofindia.indiatimes.com/india/dharavi-on-way-to-win-battle-53-patients-have-recovered/articleshow/76402723.cms>.

Containment of COVID-19 in the continent's most crowded slum was a big challenge. Around 80 percent of its population uses 450 community toilets which have to be disinfected several times a day. Social distancing was near to impossible because families of around 8-10 members live in 10x10 hutments and the area has narrow lanes with crowded tenements lined on either side. Dharavi apart from having congested slum areas, houses many small-scale industries like textile, leather, pottery etc. It has many single room factories and is a hub of international exports. Arranging manpower for carrying out screening and sanitization was a big challenge. Moreover, one of the major challenges was the lack of people's trust in the Brihanmumbai Municipal Corporation (Municipal corporation of Greater Mumbai). People were of the view that Municipal Corporation staff visit the area only to evict the people as most of them were migrants.

Unlike the traditional approach of passive screening, the civic authorities adopted a proactive screening strategy in Dharavi and went door-to-door looking for COVID-19 suspects²⁰. The strategy to contain coronavirus in Dharavi focused on four Ts - tracing, tracking, testing and treating. Mobile vans were deployed for the purpose of screening. Fever camps were established. Private practitioners and hospitals were mobilised. The local doctors, whom residents trusted, acted as the bridge between the Brihanmumbai Municipal Corporation and the residents in Dharavi. Schools, marriage halls and sports complexes were used for quarantine purposes. Strict lockdown was enforced in the containment zones in the area. Grocery kits and food packets were distributed in the containment zones to restrict people's movement. Around 90 percent of the

²⁰ 'Passive screening' is detection triggered by patients seeking care for their illness from clinicians working in static health facilities. 'Active screening' means that health staff reach out to the community and systematically screen the population. <https://www.who.int/leishmaniasis/surveillance/en/>

patients were treated in Dharavi itself and only critically ill patients were sent to hospitals in other areas. The 24*7 free of cost medical supervision was done in the isolation centres. The foot operated hand wash stations, which eliminates the direct contact with the high-infection areas and thereby reduces the chances of virus transmission, were established to deal with the sanitation issues²¹. Drones were used by the police authorities to keep an eye on peoples movements. Community participation and support was of paramount importance to fight against the disease. People with COVID-19 related symptoms volunteered themselves to be quarantined. Further, local community leaders who were appointed as “COVID Yodhaas” (warriors) played a crucial role in the containment of COVID-19. At least 6-7 lakh (600,000 to 700,000) people have been screened, 14,000 were tested and 13,000 were kept in institutional quarantine²². As on July 11th 2020, a total of 2,359 COVID-19 cases were recorded in Dharavi, out of which 1,952 have recovered, leaving only around 166 active cases¹⁷. Two new hot spot cities in Maharashtra, Thane and Kalyan-Dombuvali have planned to follow Dharavi model for the containment of virus (S. Gupta 2020). In addition, “Family Doctor COVID War Fighter” campaign will be implemented in the cities under which the clusters of family doctors will be formed who will approach everyone in the city and conduct antigen testing (S. Gupta 2020).

World Health Organization has applauded the efforts to contain the coronavirus in Dharavi. The success of Mission Dharavi offers a model for other nations with sizable slum populations to proactively chase the virus and contain the pandemic.

Challenges

Due to enforced lockdowns, closure of work places and loss of income, it is quite evident that the economic damage caused by COVID-19 is massive. The government revenues have fallen drastically. Many businesses have lost income on a large scale. There are also challenges related to inadequate public health infrastructure, poor working conditions, lack of protective kits and overburdened manpower in healthcare facilities. The challenges are more severe in small cities and rural areas. Due to COVID-19, while most countries are facing the twin crises of public health and the consequent economic downturn, India has an additional challenge to deal with, namely a massive migrant workers crisis. It is hard to say what long-term impact this home migration might have, but some things were quite clear to us in early May:

1. There are virtually no significant work opportunities awaiting the migrant workers when they are back home in their villages;
2. The agriculture sector is already saturated with existing workers;
3. Most states do not have any major rural area agro-based industries which could potentially employ some of these returning workers;
4. While the workers will be back home with their families (which in itself is a big relief), but lack of earnings will push millions of them back into poverty;
5. Within weeks, they will all be ready and desperate to go back to their jobs in the cities, but when will those jobs come back is a complete unknown factor at this stage; &

²¹ <https://www.hindustantimes.com/india-news/india-s-top-scientist-comes-up-with-a-simple-hand-wash-station-for-dharavi/story-cQRLJGzPM73YhDkWpNchuK.html>

²² <https://www.news18.com/news/india/tracing-tracking-testing-treating-day-after-who-praise-bmc-outlines-4-ts-behind-mission-dharavi-2711469.html>

6. Cities will find returning back to normal very difficult without these workers.

Recommendations

To create employment opportunities for the migrant workers, in mid-late May, we recommended that the government should consider undertaking the following:

- 1) The central government should design and fund major public works programs and the states should help implement them;
- 2) These should be in rural areas, namely road building, digging up ponds, (for rainwater harvesting) tree planting, engaging workers in the PM's nation-wide affordable housing program, seriously think about easy to set-up agro-based small scale industries, solar paneling where needed; and so on; &
- 3) Lots of jobs in the cities, in all likelihood may not come back, hence creating employment opportunities in the villages is key. Agro-based industrialization will have major backward and forward linkages and will be very beneficial to the rural areas.

The above is like the Civilian Conservation Corps (C.C.C.) set-up by President Roosevelt during the Great Depression in the United States of America²³. In 1933, when President Franklin Roosevelt created the C.C.C., he was facing, as we are today, the possibility of a lost generation of young people. The conservation-minded president's idea was to hire young unemployed men for projects in forestry, soil conservation and recreation. By 1942, the "Roosevelt's Tree Army" had planted more than three billion trees, built hundreds of parks and wildlife refuges and completed thousands of miles of trails and roads²⁴.

Lessons to be Learnt

Based on what we know about COVID-19 so far and the experiences of countries around the world, here are some lessons India can learn to minimize the disease burden:

- 1) The argument that more testing leads to more cases is a false argument. All that it means is large number of positive cases exist on the ground (whether tested or not) and hence even more testing is called for so that strict contact tracing and remedial follow-up actions can be undertaken;
- 2) Until a successful vaccine is developed and made widely available, the only option to suppress the epidemic is to adopt the necessary public health measures, namely wear a mask when outside; socially distance; avoid large gatherings; and wash hands frequently among others;

²³ Suggestion made by Sonia Ehrlich Sachs

²⁴ <https://www.nytimes.com/2020/05/18/opinion/coronavirus-unemployment-youth.html>

- 3) In order for a strategy of containment and recovery to succeed, it is vital to focus on the infection rate. Public health measures can drive $R < 1$. Besides the infection rate, it is vital to closely monitor the positivity rate and the case fatality ratio (death rate) and rely not so much on the recovery rate;
- 4) India needs to develop a epidemic control strategy to be put in place so as to contain and control the spread of the infection in India, something that is not being done currently;
- 5) Largely, the governments or the public sector is best equipped with resources, both human and financial to deal with a public health crisis of such proportions. Hence, just as South Korea did, all testing should be made free of charge, undertaken on a far higher scale, and followed up with thorough contact tracing;
- 6) In India's public health system, there are approximately 900,000 community health workers called the Accredited Social Health Activists (ASHAs). They are an extremely vital human resource that can be used for effective identification of potential cases and in contact tracing if the ASHAs are adequately paid and trained. This is all the more vital since cases are now seen to be surging in rural India; and
- 7) Experience from numerous countries suggests that premature opening up after a period of lockdown and letting the guard down by not wearing masks, not physically distancing, being a part of large events or being indoors, such as in restaurants or bars etc. are in all likelihood going to spread the infection.

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