

## Research Article

# Impact of COVID-19 on our Ecology in India

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## Abstract

Various environmental factors influence the outbreak and spread of epidemic or pandemics which, in turn, can damage our environment. COVID-19 has been declared as a global health emergency - a pandemic on 13 March 2020 due to spread of corona virus. It's rapid onset, spatial expansion and complex consequences made it a once-in-a-century global disaster. It is affecting 213 countries and territories around the world as on 15 September 2020. Signs of growing inequality because of covid-19 can be detected from cities to countryside.

Major ecological impacts will be of three types: 1) a) Temporary improvement in air and water pollution due to lock down implemented to minimize the transmission of the infection, that led to cessation of all economic and production activities and vehicular movements. b) Temporary ergonomic challenges due to work from home (WFH) culture working long hours at home with no proper furniture's. c) Impact of long hours of screen-time leading to fatigue, redness, dryness in the eyes, headache, and behavioural issues, 2) Long term negative ecological impacts a) arising out of millions of masks, face shields, personal protective equipment (PPEs), surgical gloves needing disposal as they are generating massive amount of medical wastes coupled with poor Medical waste management capacities due to limited investments for the last few decades by the municipal authorities. b) increased demand on water and soap for frequent hand washing or side effects of sanitizers to be used. All these will lead to worsening of physical environmental situation such as shoreline pollution or increased smoke due to the unhygienic disposal of sanitary consumables and dead bodies. 3) Mental health has been emerging as one of the most important concerns since the beginning of the pandemic.

This article presents an early overview of the observed and potential impacts of the COVID-19 on the environment. I argue that the effects of COVID-19 are determined mainly by anthropogenic factors. Most Public Health Professionals opine that the impact of mitigating actions taken will continue to have on the future of ecology and the objective of Sustainable Development Goals by 2030.

**Materials & methodology:** For this paper the National, State and City wise Covid-19 cumulative infection and death cases data were taken up to 15<sup>th</sup> September 2020 from the daily bulletins of the MOH&FW, GOI and the National Health Mission websites of State Governments (<https://www.mohfw.gov.in/>) & <https://covid19.karnataka.gov.in/>) and [www.health.economictimes.com](http://www.health.economictimes.com), [www.timesofindia.com](http://www.timesofindia.com). Some of the reviews and reports in print media of various institutions working both on the Covid 19 and Ecology.

**Study setting & sampling:** The review covers major states and cities setting. Being the secondary data review available data was used with no sampling.

## Introduction

Latitudinal, altitudinal, seasonal, and interannual associations between climate and disease along with historical and experimental evidence suggest that climate, along with many other factors, can affect infectious diseases in a nonlinear fashion. The globe is becoming significantly warmer decade after decade than it was a century ago. There is little evidence that climate change has either already favoured infectious diseases or the emergence or transmission of COVID-19 disease. Initial projections suggest dramatic future increase in the geographic span of infectious diseases. Many factors can

affect infectious disease, and some overshadow the effects of climate [1].

COVID-19 is one such infectious disease that has expanded geographically to all most all countries, including developed countries who were beaming with complacency of winning infectious diseases. It has perplexed the Public Health experts worldwide who were complacent with the sense of certainty, stability, and familiarity having to face an environment of the "Volatile," "Uncertain," "Complex," and "Ambiguous" commonly expressed using an acronym of VUCA. The Critical Medical Ecology model helps identify these elements



and dynamics in the context of ecological processes that create, shape, and sustain people in their multidimensional, intersecting environments [1].

It is known to be caused by Coronavirus 2019-nCoV and transmitted human-to-human by droplet infection. Some coronaviruses like those causing SARS and MERS clearly have bats as their reservoir. COVID-19 's effects on people is determined in part by the environment in which they live. "Populations living in more polluted environments, where there are more particulates and more ozone smog in the air, are more likely to have problems.

There is a confluence of things that influence the risk, lack of indoor, or outdoors- space for physical distancing, ambient air temperature or pollution, poor respiratory etiquette, open air spitting and defecation or use of a toilets by multiple persons with poor hygiene practises are some of the pieces of the puzzle," along with a density of the population.

All effected 213 countries, some after the first case in their country and others in anticipation took key actions to minimize the spread of the disease and damage to human health at a great economic loss and even at the cost of compromising ecological balance.

COVID-19 outbreak is primarily affecting physical health. Mild symptoms like sore throat, nasal congestion, myalgias, fever, cough, and anosmia are common. Around 20% of the infected patients show severe illness of breathlessness, respiratory failure, septic shock, gastrointestinal complications, lymphopenia, and parenchymal lung abnormalities. Fear of being infected due to close contact with infected patients, prolonged working schedules without proper rest, disturbed wake and sleep routines, loss of jobs, reduction in pay packages have increased the risk of stress and anxiety in the healthcare workers and general population.

### Facts, figures & observations

In this section I consider the facts, some data, and observations as they unfolded in India with global references now and then for comparison:

### The pandemic-history

The Pandemic began globally in China, according to an unpublicised report from the Chinese government, the first case can be traced back to 17 November 2019; the person was a 55-year old citizen in the Hubei province. On December 31, 2019, Chinese authorities informed the World Health Organization (WHO) the outbreak. On January 7, 2020, Chinese experts identified the infecting agent- Coronavirus 2019-nCoV. On 20 January, the first known case of COVID-19 was confirmed in the Pacific Northwest state of Washington in a man who had returned from Wuhan on 15 January. On 30 January, the first case was confirmed in Kerala's Thrissur district in a student who had returned home for a vacation from Wuhan University in China. Two patients from the same family in England have tested positive for coronavirus, the first such cases in Britain, on 31 January 2020 as an evacuation flight brought Britons

home from the centre of the outbreak in China. Cases of the new coronavirus were also confirmed in 21 other countries by 30 January 2020, the day on which the World Health Organization declared the new coronavirus outbreak as an international public health emergency- Pandemic.

### Global situation as on 15<sup>th</sup> september 2020

As of 15<sup>th</sup> September 2020, the coronavirus disease 2019 has spread in 213 countries globally, leading to devastating circumstances for individuals, communities, and countries.

There were 29.76 million cases, about 940,000 deaths and 21.76 million cases recovered leaving 7.25 million active cases worldwide. USA stands at the top with a contribution of 6.79 million cases and about 200,000 deaths. India is ranked second with 5 million cases and 82,124 deaths followed by Brazil with 4.38 million cases and 133,207 deaths and the fourth country to surpass a million cases is Russia 1.079 million cases and 18,197 deaths. China has only 85,214 cases but 4634 deaths. More than absolute number of cases rate per million population give better indication of the magnitude of the Pandemic. In the rate of infections per million population Qatar tops at 43,527, followed by Bahrain 35,982, Chile 22,871, Peru 22,319, Brazil 20,596. USA 20,484 and India just 3,634. The infection rate depends upon number of tests done. In the tests done UK tops with 298,584 per million population (Positive 5507/ m), Russia 283,663 (positives 7,397/Mil pop), USA 282,537, and India 42,977/Million population Table 1.

**Table 1:** Top 10 countries with cases and deaths per Million Population as on 15th September 2020.

SI NO	Country	Cases/M	Deaths/	CFR
1	USA	20030	594	3
2	India	3638	59	1.6
3	Brazil	20790	631	3
4	Russia	7370	129	1.8
5	Peru	22383	938	4.2
6	Colombia	14472	461	3.2
7	Mexico	5281	558	10.4
8	South Africa	9680	233	2.4
9	Spain	13140	647	4.5
10	Argentina	13032	268	2.1

Source: Times of india, Bengulur 2020

Another key Indicator is Death rates per million population (DRPMP) that shows the care seeking behaviour of the population and the case management efficiency at the facilities. In this indicator Chile tops with a rate of 22,871, followed by Peru 22,319, Brazil 20,596, USA 20,484 as against a world average of 3,819, China 111,163 and India 3634 per million population. The case fatality rate that indicates the case management success rate has been 2.95% in USA as compared to 5.44% in China, 3.03% in Brazil and 1.63% in India.

**September spurt:** More concerning issue for India is it is one of the three countries along with Argentina, Spain, where



more than 5 million cases are reported, the daily case addition is steadily increasing in September compared to 7 other countries including US, Brazil, and Russia are reporting far fewer cases now. At this pace in first half of September India may become world's number one Covid 19 country by November 2020 Figure 1.

**Situation in neighbouring countries:** Among our neighbouring countries Maldives has the highest proportion of population affected and deaths per million population. Bangladesh Nepal and Pakistan nearly 50-60% of Indian case load and casualties. Case fatality rate has been highest in Afghanistan followed by India, Pakistan, Bangladesh, and Myanmar reflecting upon the quality of the care in these countries Table 2, Figure 2.

**Indian scene as on 15 september 2020**

**No of cases and deaths due to Covid 19 disease:** India has become the second country in the world after the US to record 5 million Covid-19 cases, the grim milestone was reached on Tuesday,15<sup>th</sup> September 2020. While it took 167 days for cases in India to reach the first 1 million, 2<sup>nd</sup> million cases came in 21 days, third million in 16 days, fourth million in 13 days and the last 1 million coming in a world-record time of 11 days. No doubt, India was the slowest among the worst-hit countries, with a strict lockdown in place, but infections have been racing ever since unlock down started. Covid-19 fatality and recovery rates stand at 1.6% and 77.6% respectively.

The sates reporting at least 100,000 cases as on 15<sup>th</sup> September were: Maharashtra (C=10,97,856 D=30,409) , Andhra Pradesh C=5,83,925 D=5,041), Tamil Nadu - (C=5,14,208 D=8,502) Karnataka (C= 4,75,265 D=7,481), UP

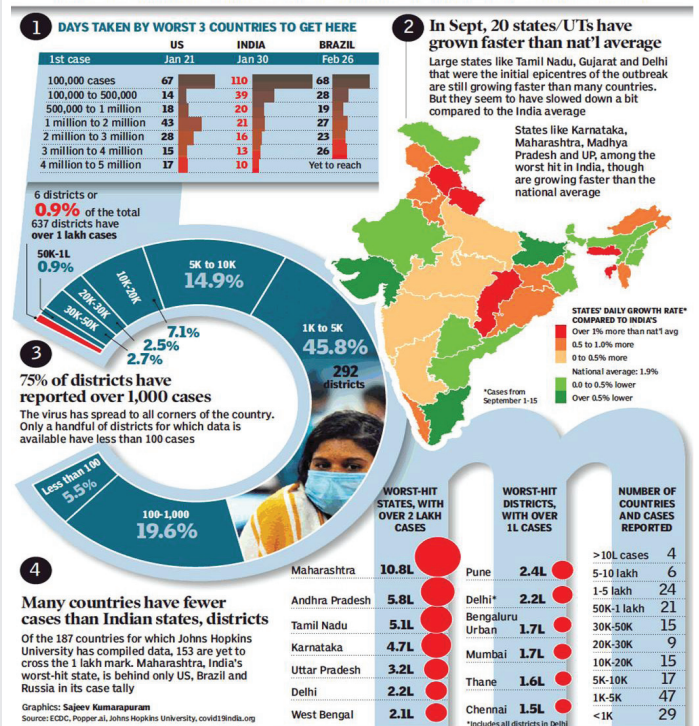
**Table 2:** Covid 19 Cases and Deaths Per Million Population in Neighbouring countries on 15<sup>th</sup> September 2020.

Sl No	Country	Cases/M	Death/M	CFR
1	Bangladesh	2081	29	1.4
2	Pakistan	1375	29	2.1
3	Afghanistan	998	37	3.7
4	Sri Lanka	153	1	0.4
5	Nepal	2002	13	0.7
6	Bhutan	319	0	0
7	Myanmar	72	1	1.2
8	Maldives	17440	61	0.4
9	India	3638	594	3

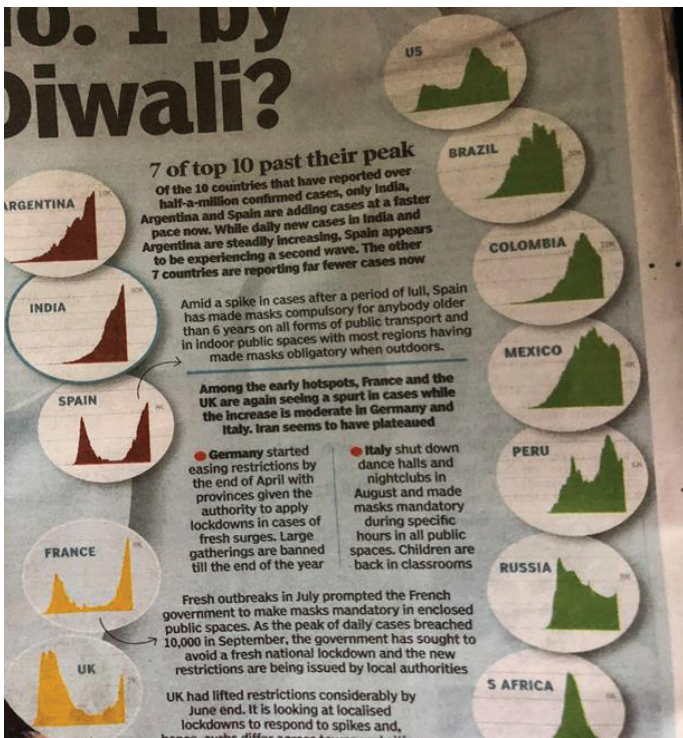
Source: Times of india, Bengalur 2020

# How India Raced To 5 Million Covid Cases

Among the three worst-hit countries, India was the slowest to reach 100,000 cases and took another two months to hit one million. But since crossing a million cases, each of the next million cases came quicker than the last. India grew from four million to five million cases in just 10 days, reports **Atul Thakur**



**Figure 2:** How india Raced to 5 million covid cases. Source: Times of India, www.TOI.Indiatimes.com Bengaluru 17 September 2020.



**Figure 1:** COVID 19 PACE by Countries in September 2020. Source: TOI Bengaluru 20 September 2020.

(C=3,24,036 D=4,604) , Delhi- (C=2,25,796D= 4,806) , West Bengal (C=2,09,146 D= 4,062), Bihar (C=1,61,101 D= 836), Telangana (C=1,60,571 D=984), Odisha (C=1,58,650 D=645), Assam (C=146,575 D=492), Kerala (C=1,14,033 D=466) and Gujarat (C=1,16,345 D=3,247).

Maharashtra and the southern states have been under the Covid-19 spotlight for the high number of cases and deaths reported. However, Goa and Puducherry are worse affected with one having the highest cases per Lakh population and the other



the highest deaths per Lakh from the pandemic, as seen in the tables above. Though per-Lakh count gives a more accurate picture of the pandemic's spread than the absolute numbers, smaller states and UTs cannot strictly be compared with bigger states. Puducherry, Goa, and Delhi are largely urban, while large states like UP and Maharashtra have a predominantly rural populace. Along with Delhi and Maharashtra, Puducherry, Goa and the Andamans figure among the top five having deaths per Lakh population Table 3.

**Table 3:** Covid 19 Cases and deaths per 100,000 Population in worst hit Indian states.

State name	Population	Cases	cases/Lp	Deaths	Deaths/Lp
GOA	15.4	26783	1739	327	21.2
Pondcherry	15.2	21428	1410	431	28.4
Delhi	199.4	234701	1177	4877	24.5
Andhra pardesh	523.2	601462	1150	5177	9.9
Maharashtra	1225.3	1145840	935	31351	25.6
A&N Islands	4	3593	898	52	13
Chandigarh	11.8	9246	784	NA	NA
kanataka	659.7	494356	749	7629	11.6
Population	in Lakhs (100,000) Cases & Deaths per Lakh population				

**Source:** Times of India, Bengaluru edition 19 september 2020.

**Covid 19 an urban phenomenon:** The Covid-19 pandemic started as an urban phenomenon in India. But it is now spreading at a faster rate in rural areas. As seen in the map (Figure 2) page previous page (the table right lower corner) Pune (2.4L), Delhi (2.2L), Bengaluru (1.7L), Mumbai (1.7L), Thane (1.6L) and Chennai (1.5L) lead the case count. Case fatality rates are much lower in the cities mainly due to availability of Testing facilities, early seeking of care and availability of ventilator beds both in public and private sectors.

An analysis of CFR based on 5 categories of the districts in the country shows a sharp drop from urban to rural districts. It is 2.66% in the 16 'entirely urban (RP<20%)' districts, 2.13 in mostly urban (RP<40%), Mixed Population (RP 40-60%), 1.42 % in mostly Rural (RP60-80%) to as low as 0.98% in the 357 'entirely rural (RP>80%)' districts.

### Indian data of ecology effecting covid 19 virus or vice versa

**Ambient temperature and humidity:** At the beginning of April, thousands of new cases have been documented in regions with temperatures >18 °C, suggesting that the role of warmer temperature in slowing the spread of the COVID-19, as suggested earlier, might only be observed, at much higher temperatures. In an Indian analytical study of daily averaged meteorological data for the last three years (2017-2019) for March, April and May months and the same for the year 2020 for March 1 to May 31, the study found a positive association between daily COVID-19 cases and temperature and a mixed association with relative and absolute humidity over India. The study examined variability in Temperature (Tem), relative

humidity (RH), and absolute humidity (AH) and transmission of COVID-19 across India. The study showed that the observed patterns of COVID-19 are not completely consistent with the hypothesis that high AH may limit the survival and transmission of this new virus Figure 3.

In India, the data does not support this hypothesis as many states having high temperate and high humidity are still leading in COVID-19 cases in India like Maharashtra, Delhi, Kerala and Tamil Nadu with an average AH, is between 8 and 11 g/m<sup>3</sup> during March and April and some times more than 15 g/m<sup>3</sup> in month of May (Figure 3). A higher number of cases also reported for Kerala [2].

**Air quality:** During the lockdown period, aerosols (AOD) and NO<sub>2</sub> reduced sharply with a maximum drop of about 60% and 45%, respectively. It also found a reduction in surface PM<sub>2.5</sub> PM<sub>10</sub> and NO<sub>2</sub> for the six mega cities during the lockdown period. Their predictions proved right that COVID-19 still may spread in warm, humid regions or during summer and monsoon Figure 5 [3].

A retrospective study to see whether air quality index (AQI), four ambient air pollutants (PM<sub>2.5</sub>, PM<sub>10</sub>, NO<sub>2</sub> and CO) and five meteorological variables (daily temperature, highest temperature, lowest temperature, temperature difference and sunshine duration) could increase COVID-19 incidence in Wuhan and XiaoGan between Jan 26th to Feb 29th in 2020, showed that 1) a significant correlation was found between COVID-19 incidence and AQI in both Wuhan (R<sub>2</sub> = 0.13, p<0.05) and XiaoGan (R<sub>2</sub> = 0.223, p<0.01). 2) Among the four pollutants, COVID-19 incidence was prominently correlated with PM<sub>2.5</sub> and NO<sub>2</sub> in both cities. In Wuhan, the tightest correlation was observed between NO<sub>2</sub> and COVID-19 incidence (R<sub>2</sub> = 0.329, p<0.01). In XiaoGan, in addition to the PM<sub>2.5</sub> (R<sub>2</sub> = 0.117, p<0.01) and NO<sub>2</sub> (R<sub>2</sub> = 0.015, p<0.05), a notable correlation was also observed between the PM<sub>10</sub> and COVID-19 incidence (R<sub>2</sub> = 0.105, p<0.05). 3) Temperature was the only meteorological parameter that constantly correlated {inverse correlation (p<0.05)} well with incidence in both Wuhan and XiaoGan, leading to the inference that AQI, PM<sub>2.5</sub>, NO<sub>2</sub>, and temperature are four variables that could promote the sustained transmission of COVID-19. [4,5]

Another study in China that matched daily confirmed cases and meteorological factors in 122 cities collected between January 23, 2020, to February 29, 2020. A generalized additive model (GAM) was applied to explore the nonlinear relationship between mean temperature and COVID-19 confirmed cases. They used a piecewise linear regression to determine the relationship in detail. Results indicated that the exposure-response curves suggested that the relationship between mean temperature and COVID-19 confirmed cases was linear in the range of <3 °C and became flat above 3 °C. The study concluded that mean temperature has a positive i) Mean temperature of last two weeks (when < 3 °C) was positively associated with newly confirmed COVID-19 cases. ii) 1 °C rise in the mean temperature of last weeks (when < 3 °C) was associated with a 4.861% increase in the daily confirmed cases. iii) There was no evidence supporting that case counts of COVID-19 could decline when the weather becomes warmer or linear relationship with a threshold of 3 °C [5-7].



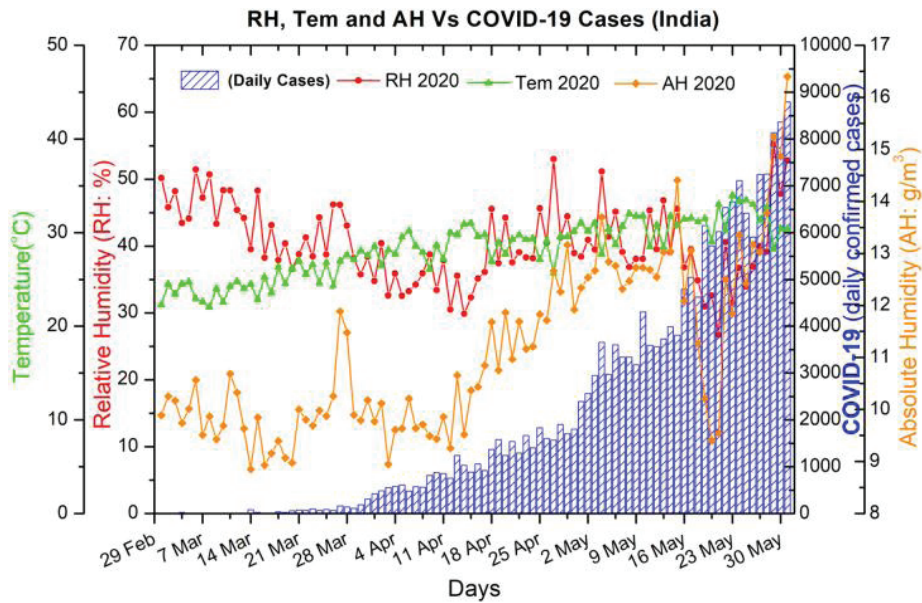


Figure 3: RH, Tem and AH Vs CoVID-19 Cases (India).

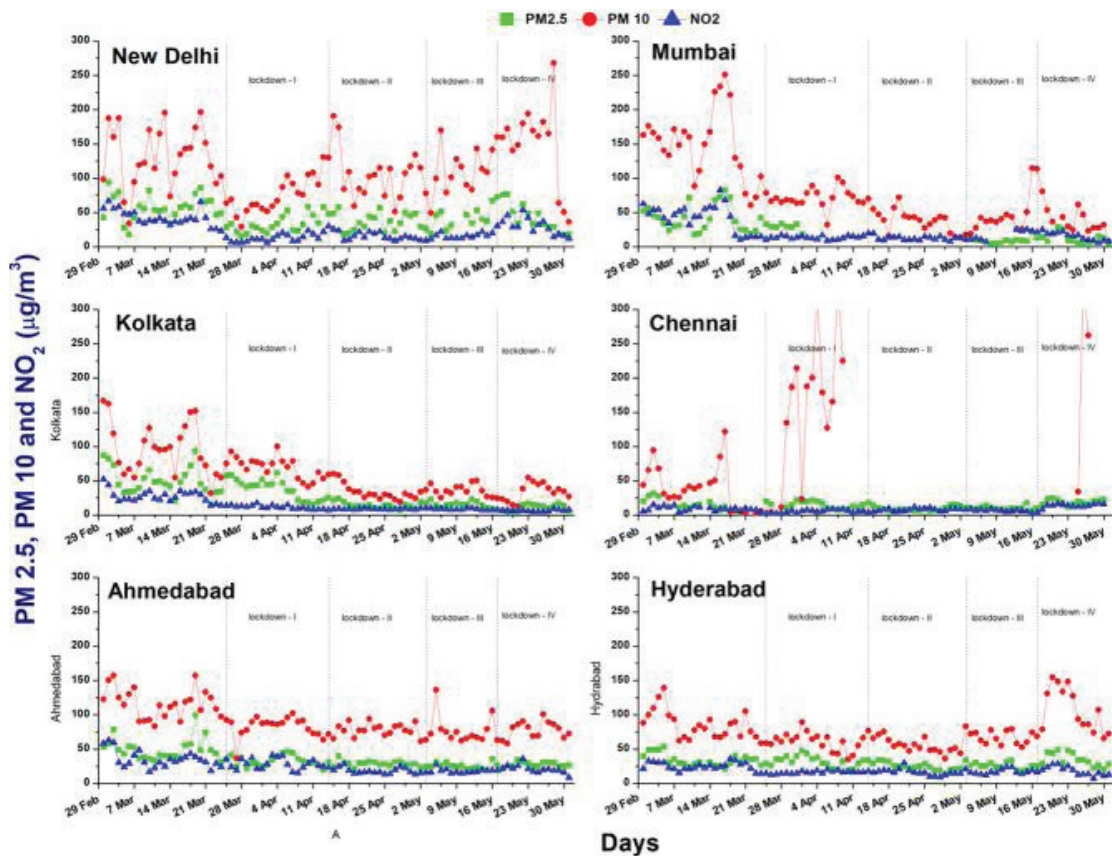


Figure 4: Air Quality.

A regional study in middle catchment of Dwarka river basin of Eastern India, well known for stone quarrying and crushing clearly exhibits that Maximum PM10 concentration was 189 to 278  $\mu\text{g}/\text{m}^3$  in pre lockdown period and it now ranges from 50 to 60  $\mu\text{g}/\text{m}^3$  after 18 days of the commencement of lockdown in selected four stone crushing clusters. LST is reduced by 3–5

$^{\circ}\text{C}$ , noise level is dropped to <65dBA which was above 85dBA in stone crusher dominated areas in pre lockdown period. Adjacent river water is qualitatively improved due to stoppage of dust release to the river. For instance, total dissolve solid (TDS) level in river water adjacent to crushing unit is attenuated by almost two times [8].

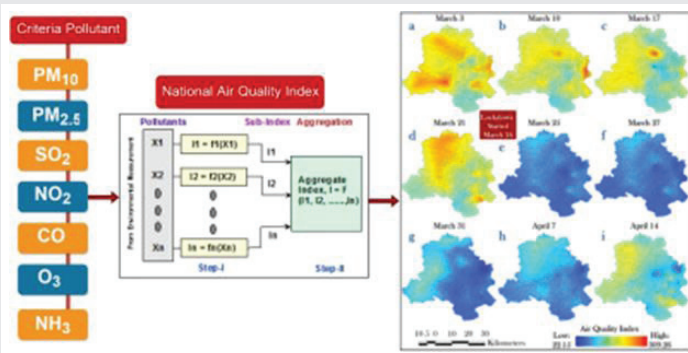


Figure 5:

A similar study in Delhi with the aid of air quality data of seven pollutant parameters (PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, NO<sub>2</sub>, CO, O<sub>3</sub> and NH<sub>3</sub>) for 34 monitoring stations spread over the megacity to show the spatial pattern of air quality in pre and during-lockdown phases. The results demonstrated that during lockdown air quality is significantly improved. Among the selected pollutants, concentrations of PM<sub>10</sub> and PM<sub>2.5</sub> have witnessed maximum reduction (>50%) in compare to the pre-lockdown phase. In compare to the last year (i.e. 2019) during the said time the reduction of PM<sub>10</sub> and PM<sub>2.5</sub> is as high as about 60% and 39% respectively. Among other pollutants, NO<sub>2</sub> (-52.68%) and CO (-30.35%) level have also reduced during-lockdown phase. About 40% to 50% improvement in air quality is identified just after four days of commencing lockdown. About 54%, 49%, 43%, 37% and 31% reduction in NAQI have been observed in Central, Eastern, Southern, Western and Northern parts of the megacity Figure 5 [9].

**Age, gender, & co morbidities:** According to a statement released by The Union Health Ministry, GOI, on Wednesday 1 October 2020, while the population over 60 years in India is around 8%, the proportion of Covid 19 cases was around 12% and the case fatality was around 51% among people aged 60 and above. Case fatality among with some underlying comorbidities was around 75%. Looking at the gender distribution 69 % of COVID-19 deaths have been reported among males and 31 % among females. In an initial report from ICMR in the Kerala state, 164 persons belonging to the 60-69 age group were infected, 28 persons in the 70-79, 16 in the 80-89, while only one was infected in the 90-100 age group. Among those in the 60-70 age group, the comorbid illness that resulted in fatality was cardiovascular disease; in the 70-80, it was diabetes mellitus; and chronic respiratory disease, systemic hypertension and cancer were the comorbidities that resulted in death for those above 80 years.

According to the Bengaluru civic agency's review of infections in the city on 13th October 2020, 2,316 of the 2,936 patients who died suffered comorbidities. Among them 1,843 had SARI, while 1,093 suffered from ILI. More than 1,800 were in the 51-75 years age group and 600 in the 26-50 years age group. The primary reason for increasing fatalities among those without comorbidities is People reaching hospitals when their oxygen saturation level is extremely low. Data accessed reveals that 315 people succumbed in the first 24 hours of admission

to hospital, while 414 died in the next 48 hours. In all, 2,043 people spent four or more days in hospital before losing the battle with the virus. Most people who died in the first 24 hours are those above 60 years and suffer comorbidities. The 2,043 people who died four or more days after admission are mostly in the 26-50 years age group and 75% of them had no comorbidities but had arrived late in the infection. Most of these people either suffer influenza-like illness (ILI) or severe acute respiratory infection (SARI) and needed constant oxygen support, they came in when their saturation level is below 65 and medical support did not help much and they died within three or four days of admission.

**Personal hygiene practices:** Importance of personal hygiene practices in public health is well accepted and documented especially in health care systems. Minimizing personal contacts, touching infected surfaces and hand sanitization are mandatory to limit the community spread of viral diseases, especially SARS-CoV-2 [2].

**a) Cough etiquette:** An average Indian generally lacks the habit of covering mouth and nose while coughing or sneezing. Some people are in the habit of speaking loudly. All these increase the chances of transmission.

**b) Toilet etiquette:** Though Indian government and most of the State governments claimed as of December 2019 universal open-air defecation free (ODF), many surveys indicate that 71% of households had access to a toilet and at least 10% of people are not comfortable using the toilets yet in Rural India. Majority of the household have one toilet and the same is used by an average of 4 persons in quick succession in the morning. The flushing phenomenon may also be inadequate for want of sufficient water and cleaning or sanitizing the squatting plate or commode is generally poor posing additional risk of feco-oral transmission.

### Population density

The Indian evidences of explosive transmission of Covid 19 in Dharavi Slum, Mumbai, Tablighi Jamaat meeting in Delhi, and 107 JK Tyres factory employees testing positive belonging to at Metgalli in Mysuru, are some examples.

**Working from Home:** Indian data estimates report that 96% of organizations had rolled out working from home, a significant rise from 19% just two weeks before lockdown. This means approximately 2 million people worked from home. Laptops are a big culprit. Infosys India's second-largest IT exporter has over 95% of its workers working remotely now. In a real estate advisory survey of 1,600 technology professionals in India found that 30% of them reported deterioration in productivity and work performance while working from home. At homes people are forced to either look down to see the screen, or if it is elevated, raise your hands to type, etc A "forward head position" that loads pressure on the discs and joints of the spine, as well as causing muscle imbalance in the neck. The chairs in our houses are often the wrong height, preventing us from sitting in a neutral posture- "Ears over shoulders over hips, hips slightly higher than the knees, arms relaxed at





your side, neck relaxed and straight, forearms parallel to the ground, feet resting on the floor". Many of us have not just changed where we work; we have also changed how we work. We no longer walk down the hall for a meeting, dart across the street for a coffee, or even walk to the car for the commute. Instead we just sit. "Even if we have perfect ergonomics, if we are in the same position for too long, your body is not going to respond well. At the end of the day we are social animals. We crave for connects, which is other than virtual. You could remain in the virtual mode for a while, but then fatigue begins to set in.

### Impact of measure taken on ecology

**Disposal of Masks and Gloves:** Approximately 200 billion masks and gloves are being disposed of worldwide every month, and according to the Waste Free Oceans organisation, plastic masks take 450 years to decompose. Hence, Public Health professionals are recommending, and designers are increasingly coming up with eco-friendly versions. We estimate that if every person in the India used one single use mask each day for a year, that would create 16.5 million tonnes of plastic waste alone.

**PPE Kits:** Personal protective equipment (PPE) has emerged as a significant lifesaver for Corona warriors in 2020. Not heard in years past, PPEs have become a household term now, thanks to their critical role in shielding frontline workers from the Covid-19 pandemic. India did not even make PPEs till February 2020. It simply imported the coveralls. The need of the hour, however, made in-house manufacturing a necessity, and so in a span of three months India went from making zero to 4.5 lakh PPE kits a day.

Covid hospitals waste and containment zones waste in Mumbai alone amount to over 15,000 Kg per day (3.5% cases in Mumbai and 20% cases in Maharashtra of total national infections) in September 2020 [10]. Though countrywide data is not readily available, one can estimate it to be at least 30 folds, amounting roughly to 150,000 kg per day. Around the central incineration units in each state smoke has increased 10 times what was emanated earlier it is reported.

**Disposal of the dead bodies:** With nearly a million deaths in India by September, upholding the issue of Dignity in Death, disposing these bodies did create an ecological challenge. Incidence of mishandling the bodies, burial graves being shallow and use of electronic crematorium much against the religious sentiments had to be handles. This also added additional biomedical waste of not only the dead person, beds, and their linens but also the PPE used by service providers, relatives requesting attendance at last rites. At an average rate of 10 PPEs per dead person the volume swells into a million of PPEs, Lakhs of beds and linen. In some instances, the residents of the locality opposed his burial fearing it would expose them to additional risk of contracting the virus. Some people were mentally depressed as they did not have close look of their diseased relatives.

### Ecological consequences of frequent handwashing:

Washing hands often with soap and water for at least 20 seconds is essential. Four litres of water are required if tap is on while scrubbing. Two litres water if tap is off. Thus around 20 to 40 litres of water are need for every day per person. This is going to add to water crisis and add burden on ecology in the coming years.

**Impact of sanitisers:** The sanitiser market is increasing in India among urbanites who have disposable income and are more health conscious as the standard of living is improving. According to a market survey done in last week of July 2020 half of the respondents were not able to buy hand sanitizers at all due to its unavailability. Hand sanitizers from unknown brands were purchased by about 26 percent because and 24% bought from reputed brands mainly in cities and towns. New entrants and local brands now dominate India's sanitiser market that swelled more than fourfold after the novel coronavirus outbreak.

**Impact of long hours of screen-time:** Regular classes, tuitions, games, recreational activities, dance, music and chess lessons and watching movies have all gone online, leaving children and adults glued to mobiles or laptops or tablets, for many to no less than 8-10 hours. With no outdoor activities due to the pandemic, several children with excessive screen time are complaining of fatigue, redness, dryness in the eyes, headache, and behavioural issues, according to paediatricians.

**Impact on fossil fuel consumption:** With a nationwide lockdown in place over March to May, domestic fuel demand plummeted, reaching its nadir in April at 48.7%. As the lockdown was rolled back, demand began showing some signs of life, contracting by just 8.6 per cent in June. However, state-level restrictions, persistent disruption to economic activity and continued and aggressive spread of the virus dragged the demand lower again in August to 20.6% contraction.

Jet fuel has seen the sharpest contraction by 46.6% in the eight months to August, that was lowest in April by 91.4% y-o-y, due to a total ban on flights, excluding those for essential cargo movement, such as medicines. Gasoline (petrol) demand fell by an average of 16.1 per cent in the YTD (low of 60.4%) and diesel demand (which is widely used in the transport, industrial and power sectors) was down by 25 per cent, with a low of 55.5 per cent. The one bright spot was LPG, demand for which rose by 4.3 per cent in the year to date (YTD) [11,12].

**Impact on accidents:** The country has reported 1,60,797 cases of road accidents in the first six months of the year, as compared to 4.64 lakh In 2017, 4.67 lakh in 2018 and 4.49 Lakhs in 2019 Going by these estimates, the number of accidents by the end of 2020 may be lower by 30%. Mumbai the commercial city reported that High-velocity trauma cases have been reduced from 52% to 31% after lockdown, which indicates less road traffic-related injuries. Low-velocity trauma has shown an increase after lockdown from 42% to 64%, while the total numbers of cases are still less as compared to before the lockdown [13].

From March 21 to May 21 in 2019, the total number of



crime and accident recorded under all heads was 904 cases, and during the same period in this year the number of cases recorded was 358 In Visakhapatnam. Fatal accidents under Section 304A in 2019 during this period was 33 and in this year it is just five cases. Property offences, including house break-ins, were 111 and 43 [14].

### Impact on mental health

Mental health has been emerging as one of the most important concerns since the beginning of the pandemic. There are two studies indicatives of mental health implications

1. The 7th Fold's 'Employee Well-Being Survey, 2020' conducted in July and August with 509 respondents across metro cities in India and diverse sectors aimed to recognise the distress faced by employees. The survey found that employees below the salary of Rs. 5 lakhs per annum were more vulnerable and reported personal finances (55%) and career prospects (53%) as their biggest sources of stress. 35% of employees with an annual salary of Rs. 21 – 30 lakhs per annum reported burnout and poorest mental well-being scores. The self-employed category was slightly better placed when it came to overall well-being as compared to others. 45% of employees working for an employer complained of anxiety or depression against 30% of those who were self-employed. 44% of employees working full-time from home reported feelings of anxiety. Boredom was least reported by those who worked full-time from their workplace (26%). 28% of work-from-home employees reported burnout with 48% feeling stressed due to task deadlines, and 35% of employees working from home were worried about self/ family's mental health. Mental health of the unemployed was the worst. 47% of unemployed reported anxiety with 61% of them feeling stressed and 42% feeling anger. 60% of the unemployed showed stress regarding uncertainty of the future and 61% for career growth. The blended model of working from home and workplace showed higher benefits than those employees who were full-time working from either home or workplace.

2) In an online survey using a snowball sampling technique was undertaken with the help of a semi structured questionnaire involving 278 responses collected across various states of India & abroad from 17 March 2020 at 10AM IST – 23 May 2020 at 20 PM IST. The online tool was filled by the participants one by one as they were auto directed.

The mean age of the participants was 22.19 +8.83 years, 70.9% were female and 29.1% males. The lowest educational qualification level in this study was observed to be standard 10th and the highest qualification of > 69% of the population was graduation & above. Majority of respondents were Indians (87.8%) representing Maharashtra, Kerala, Haryana, Punjab, Uttarakhand, Tamil Nadu, and Andhra Pradesh. Other countries proportion was 12.2% that included UAE (7.6%), Australia (1.4%), US (1.4%) and Kuwait, Russia, New Zealand, Canada & Oman (1.8%). Near to half (46.7%) respondents were healthcare workers, 5% teachers, 3.6% were Défense personnel's and 44.6% were of various other professions. Out of total respondents 52.2% were students, private employees &

s Govt. Servants 38.8%, self-employed 4.7% and unemployed 4.3%. More than 80% of participants were urbanites. Single respondents were above 60% with 5% suffering from existing mental /physical illness. Nearly 45% were earning < 2.5 Lakh/ annum with 70% having own house.

### Results

The study reported that 83% of the participants reported of moderate stress and almost 6% had high level of perceived stress. The respondents who were directly impacted by Covid-19 expressed that approx. 10% had lost job, 21.2% experienced extra workloads at job. About 29.5% of respondents stated to have better resilience during pandemic, 1.4% were not able to cope with the stress perceived and almost 69.1% were confident enough to sail through the catastrophe. With the years of lived experience, the resilience was found to be better. 7.1% of the people responded of not being able to hold on to the situation, with 5% having suicidal ideation. Mental health care needs were found in 80% of the participants [14].

### Discussions

#### Primary prevention

**Health promotion:** Winning the battle against Covid will require people to strictly maintain hand hygiene, follow respiratory etiquette by wearing masks and stick to social distancing norms. Health promotion activities included promoting use of Masks when in group, Hand washing after touching surfaces, avoiding touching face, mouth, nose etc, Respiratory Hygiene including coughing, sneezing and spitting and use of personal protective by health workers and other corona warriors.

**Covid 19 & masks:** Wearing a face mask has rightly become the new normal for many, as we try to protect ourselves and others from COVID-19. But the rise in single-use masks and disposable gloves around the world has also come with a huge environmental cost. estimate that if every person in the UK used one single use mask each day for a year, that would create 66,000 tonnes of plastic waste alone. Single-use masks are typically made from polypropylene, a fossil fuel-derived plastic that can take hundreds of years to break down. Meanwhile, they also shed tiny harmful microplastics into our waterways, which are then consumed by unsuspecting fish (and then us, when we eat seafood). And while disposable gloves made from latex are biodegradable, ones made from Testing of vaccine candidates to prevent infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in an older population is important, since increased incidences of illness and death from coronavirus disease 2019 (Covid-19) have been associated with an older age.

A long-standing theory of viral pathogenesis holds that the severity of a viral/bacterial disease is proportionate to the viral /bacterial inoculum (infecting amount of the virus/bacteria) received. Since masks filter out some virus-containing droplets (with filtering capacity determined by mask type), masking might reduce the inoculum that an exposed person inhale. An experiment conducted on hamsters supported showed with





simulated masking that the animals were less likely to get infected or were either asymptomatic or had milder symptoms than unmasked hamsters. Wearing a designer mask, a fancy mask, a mask with cartoons or a mask laden with jewels does not make the mask a better mask but yes touching your mask is dangerous. A fresh mask, a clean mask, an appropriate mask (like 3 ply surgical mask or N95 mask), a well-fitting mask, a mask that is worn properly and most important a mask that is doffed off (taken off) properly, and using sanitizer before wearing and after removing the mask and then appropriate and safe disposal of the mask will only protect you well.

Approximately 200 billion masks and gloves are being disposed of worldwide every month, and according to the Waste Free Oceans organisation, plastic masks take 450 years to decompose. India contributes about 10% of this volume. Hence, Public Health professionals are recommending, and designers are increasingly coming up with eco-friendly versions. Among these is Chennai-based designer label 'Aeshaane' make 100% organic cotton masks. "These are made from fabric and have reversible options, so they are reusable, machine washable and last a year or two. Bengaluru's 'Puraani Sandook' (old boxes) is making masks out of pure cotton fabrics sourced from local tailors and leftover scrap materials. Auroville-based 'Upasana' makes handwoven masks with a layer of medicinal herbs like neem, turmeric, and aloe vera variants. Guwahati's Natural Producer Collective Company makes triple-layer masks, using eri-silk, (due to its eco-friendly production process where the Silk is obtained without killing of any living creature), it is the most preferred fabric for Vegans that are dyed in turmeric and neem that are eco-friendly.

**PPE kits:** Personal Protective Equipment (PPE) has emerged as a significant lifesaver for Corona warriors in 2020. Not heard in years past, PPEs have become a household term now, thanks to their critical role in shielding frontline workers from the Covid-19 pandemic. India did not even make PPEs till February 2020. It simply imported the coveralls. The need of the hour, however, made in-house manufacturing a necessity, and so in a span of three months India went from making zero to 4.5 lakh PPE kits a day. It is now a Rs 7,000-crore industry in the making. Bengaluru, Karnataka's capital, has become a major hub for PPE coveralls production in the country, accounting for nearly 50 per cent of the total output. The coveralls are also being manufactured at approved production units in Tiruppur, Chennai and Coimbatore in Tamil Nadu, Ahmedabad and Vadodara in Gujarat, Phagwara and Ludhiana in Punjab, Kusumnagar and Bhiwandi in Maharashtra, Dungarpur in Rajasthan, Kolkata, Delhi, Noida, Gurugram and few other places. Coimbatore-based South India Textile Research Association (SITRA) tested if the samples of the kits met the specified standards and certify them for use by frontline workers. The Hindustan Latex Limited (HLL) was made the centralised handling agency for procurement and getting intents for supply from manufacturers.

Before the Covid-19 pandemic, India generated some 550 tonnes of biomedical waste every day, but non-compliance was rampant. This waste quantity has gone up by 10 folds in

the current peak of the Pandemic. Mumbai, Delhi, Kolkata, Bengaluru, and many other cities generated three times the daily average COVID-19 waste in July as compared to April and 42 times compared to that of 12 days of the pandemic in March. By July, the cities were generating almost the same amount of COVID-19 waste as regular biomedical waste in pre-pandemic times. Bengaluru on 15 September 2020 has more than 1.7 lakh infected people compared to Mumbai, once the city with the largest number of infected people, that 1.69 lakh confirmed infections in the total number of confirmed infections of 48.46 lakh in India. Covid hospitals waste and containment zones waste in Mumbai alone amount to over 15,000 Kg per day (3.5% cases in Mumbai and 20% cases in Maharashtra of total national infections) in September 2020. Though countrywide data is not readily available, one can estimate it to be at least 30 folds, meaning a rough 150,000 kg per day. Around the central incineration units in each state smoke has increased 10 times what was emanated earlier it is reported.

Millions of used gloves, PPE, and other medical waste are being processed in repositories which are now a significant source of contamination in the country. According to a report by the Central Pollution Control Board (CPCB) in the National Green Tribunal, India generates about 101 Metric Tonnes per day (MT/day) of COVID-19 related biomedical waste. This quantity is in addition to the normal biomedical waste generation of about 609 MT/day. Coronavirus medical waste has become a new source of pollution as PPEs and masks also flood our oceans. Disposal of PPE is a concern owing to its material, non-woven polypropylene (plastic) — adding that these are being designed for single-use followed by disposal. According to the researchers, when these plastic materials are discharged into the environment they end up in landfill or oceans, as their natural degradation is difficult at ambient temperature. They need decades to decompose [3,4].

On the brighter side an environmentalist and innovator from Gujarat is now creating eco-friendly bricks out of PPE kits and masks made from non-woven fabric to help decrease the burden on the environment. Binish had developed P-bricks, which was mainly made from paper waste, leftovers of chewing gum, some organic binders, and plant extracts. P-Block 2.0 are made using PPE discards, and the bricks will contain 52 percent of shredded PPE and masks, three percent of the binder, and 45 percent paper waste. They will be water-repellent, fire retardant, and pest resistant. Each brick is 12 x 8 x 4 inches in size, and it uses 7 kg of biomedical waste per square foot. He plans to introduce Eco Bins, which will help them to collect the waste generated in hospitals, police stations, other places where the staff or people are using PPE kits and medical-grade masks. The bins will have an indication mark to show that it is full. Once it reaches that mark, the waste is left untouched for the next 72 hours, and then it will be disinfected thoroughly. Once that is done, it is shredded, added along with paper sludge and the binding agent. Once developed, these bricks can be used for construction purposes, to build cost-effective, portable isolation wards that can be supplied across the country easily.

Other Indian scientists have suggested a method to convert



the plastic used in personal protective equipment (PPE) into renewable liquid fuels, an advance that could help mitigate the problem of dumped PPE, currently being disposed of at unprecedented levels due to the COVID-19 pandemic. According to the study, published in the journal *Biofuels*, billions of items of disposable PPE can be converted from its plastic state into biofuels using a high-temperature chemical process called pyrolysis.

**Disposal of the dead bodies:** When a person dies, his/her body must be disposed of and under normal circumstances, religion takes over in these matters with an elaborately laid out rituals. But novel coronavirus pandemic has not only presented a health and economic crisis but also a crisis of faith in the final journey of humans. Funeral rites of those succumbing to Covid-19 have been an issue of controversy at least in China, Sri Lanka, and India. Should the body of a Covid-19 victim be cremated or buried? Dignity in death is recognised as a human right world over.

As we know the pathogen novel coronavirus transmits from one person to another through droplets. Burial takes 7-10 days in the decomposition of a body. The body retains fluid for three-four days. So novel coronavirus can transmit during preparing the body for burial or if the grave is shallow over three-four days after the death. In the case of cremation, ashes do not present that risk. In India, the Union health ministry allows both burial and cremation of the dead body in the manner wished, by diseased family. The guidelines say that the body would be handled by a trained health professional, who must be wearing full personal protective equipment (PPE). The dead body should be placed in a leak-proof plastic body bag, the exterior of which can be decontaminated with 1 per cent hypochlorite. The body bag can be wrapped with a mortuary sheet or sheet provided by the family members. Nose and mouth of the body should be plugged to prevent oozing out of any body-fluid. Advisory recommends avoiding autopsy. Embalming of the body is also prohibited.

This process contributed to three types of challenges 1) additional biomedical waste of not only the dead person, beds, and their linens but also the PPE used by service providers, relatives requesting attendance at last rites. At an average rate of 10 PPEs per dead person the volume swells into a million of PPEs, Lakhs of beds and linen. 2) In some instances, the residents of the locality opposed his burial fearing it would expose them to additional risk of contracting the virus. 3) Some people were mentally depressed as they did not have close look of their diseased relatives.

- o **Handwashing:** Handwashing with ample soap and water is the preferred action for avoid transmission of the Covid 19 virus through touching infected surfaces. People were advised to wash their hands after coming back home when go out and use sanitizers when that is not possible. Water is very essential for every individual depends on water for livelihood it includes both quality and quantity of water utilization and it is basic need for growing saving water not only for humans for all species on earth. As water scarcity problems will probably increase over the next decade, it is important to explore ways to

reduce water consumption in everyday individual behaviours. Because the impact of such actions would be valuable if repeated over time. Conservation includes - policies, strategies, activities to sustainably manage the natural resources of fresh water to protect hydrosphere and to meet Current and future human demand. Water conservation is one of the most important pro-environmental behaviours, with water scarcity. It is impossible task for the homeless and urban poor who live in slum in cities and town to maintain good hygiene by filling water containers in household and soap for hand washing requires constant user effort and expense creates barrier against proper hand washing. Washing hands often with soap and water for at least 20 seconds is essential, especially after going to the bathroom; before eating; and after coughing, sneezing, or blowing one's nose. A proper hand wash involves soap and scrubbing hands on both sides for 20 seconds according to WHO guidelines. hand wash water is used -four litres of water if tap is on while scrubbing with water. Two litres water if tap is off. Thus around 20 to 40 litres of water are need for every day per person. This is going to be challenge on ecology in the coming years. Simple measure like advocated Water leakages should be reduced while supplying water

- o Water supply system designed in such a way that used water is collected for recycling process, used for many times by installing sewage treatment plants (STP)
- o Using advanced technology for rainwater and wastewater for water resources
- o Water using can be reduced by installing low- flush toilets.

Simplest of the ways that could lead to reduced water consumption is, turning off the tap when soaping hands to wash them. Turning off the tap as well as using the minimum possible amount of water. The message targeting the minimum possible amount of water while washing hands led individuals to both use less water while also turning off the tap more often. In fact, for turning off the tap, the options are restricted to doing versus not doing it. However, for the goal of using the minimum possible amount of water, there are some measures of implementation such as closing the tap, washing more quickly, lowering the flow rate of water coming out of the tap during use, and so on. It was and will be a challenge to motivate people towards frequent handwashing with the conservation of water by using it according to our need so that there will be no wastage of water and scarcity of water will be reduced. And this helps in the conservation of water and this helps in the practice of saving water.

**Sanitizers:** India implemented series of lockdowns from March 24, 2020, after the "Janata Curfew" on March 22, 2020 - a so-called practice lockdown. Panic-buying commenced among consumers days before the lockdown was announced. World Health Organization and Government of India recommend consumers use a hand sanitizer that contains at least 60 percent alcohol if soap and water are not readily available. New entrants and local brands now dominate India's sanitiser market that swelled more than fourfold



after the novel coronavirus outbreak. The size of the category touched Rs 430 million. The sanitiser market is increasing in India among urbanites who have disposable income and are more health conscious as the standard of living is improving. According to a market survey done in last week of July 2020 to know the impact of the coronavirus (COVID-19), half of the respondents were not able to buy hand sanitizers at all due to its unavailability. Hand sanitizers from unknown brands were purchased by about 26 percent because and 24% bought from reputed brands mainly in cities and towns.

Consumers were reminded to keep hand sanitizers out of the reach of children and, in case of ingestion, to get medical help or contact a Poison Control Center. Small amounts of hand sanitizer can be toxic, even lethal, to young children. Although Sanitisers have ruled our lives amid the pandemic, and have become a necessity in the 'new normal' world — blame it on the paranoia, or stress owing to the spread of the virus — there have been times where people have used sanitisers excessively. And this has reportedly led to breathing problems and hand allergies, among other health concerns. Often, just one trip to the market leaves one with sore hands due to copious amounts of sanitisers poured, at the entry of most stores. Alcohol-based hand sanitisers are extremely effective in killing bacteria and viruses, but they also kill the good protective bacteria on your hands, leading to Allergic Dermatitis or Eczema on the hands, and dryness, burning, redness and even bleeding. Inhaling the sanitiser can lead to allergic bronchitis or cough. Excessive use led to conjunctivitis, hormonal issues, fertility issues, abdominal pain and metabolic disorders and even reduced immunity. The best resort is to use a sanitiser sparingly. Also, after washing or sanitising your hands, must use moisturising creams that contain petroleum jelly or oil. Cases of patients with Obsessive Compulsive Disorder (OCD), who know that it is irrational to keep rubbing hands with sanitisers yet are unable to stop themselves have been reported. Also, when we use sanitisers, they not only kill the unhealthy pathogens, but even kill the healthy ones.

### Specific protection

**Vaccination:** Three vaccine candidates have reached different stages of trial - Phase 1, Phase 2, and Phase 3, even if the vaccine is developed, it will take 2-3 years to be made available in large quantities. Adar Poonawalla, the chief executive of Serum Institute of India (SII), has warned that there will not be enough vaccines against the Covid-19 for everyone in the world till the end of 2024, though Pune-based pharma firm has partnered with five international pharmaceutical firms, including AstraZeneca and Novavax, to develop a Covid-19 vaccine and committed to producing one billion doses.

Last week, human trials of the Oxford vaccine candidate by AstraZeneca were halted after a volunteer fell sick in the UK following which the Serum Institute of India also paused the trials as it was issued a show-cause notice by the Drug Controller of India. The trials, however, have resumed in Britain. After the human trials of the Oxford vaccine resumed in the UK late last week, there was an alert from scientist worldwide not jump to conclusions until the trials are fully concluded.

A recent vaccine trials phase 1, dose-escalation, open-label trial of a messenger RNA vaccine, mRNA-1273, has encoded the stabilized prefusion SARS-CoV-2 spike protein (S-2P) in healthy adults. Concluded that adverse events associated with the mRNA-1273 vaccine were mainly mild or moderate. The 100-µg dose induced higher binding- and neutralizing-antibody titres than the 25-µg dose, which supports the use of the 100-µg dose in a phase 3 vaccine trial [15-17].

**General measures- lockdowns:** Imposing emergency lockdown to stop infection of COVID 19 virus on 24<sup>th</sup> March 2020 in India has created economic crisis but it has facilitated environment to restore its quality. Global scale study has already proved the qualitative improvement of air quality but its possible impact at regional level is not investigated yet.

**Air quality and surface energy using transport:** One of the biggest impacts has been the reduction in passenger transport demand, due to a combination of government lockdowns and fears of contracting and spreading the virus when using mass transport modes. While freight transport has also been reduced, the drivers of freight activity during the current crisis are complex, driven by both supply- and demand-side factors, and in the latter, by the need to keep essential services operating. In contrast, passenger transport, (for both leisure and business travel) is often optional, and more influenced by people's decision-making processes. This has led to improvement in Air quality across the country in last 6 months.

### India's fuel demand contracted

Industrial demand has declined sharply, due to restrictions in place on business activities, labour and supply shortages and credit constraints. Its economists forecast India's real GDP to contract by 8.6 per cent in the fiscal year 2020-21 (April 2020 to March 2021), down from -4.5 per cent previously. In the first quarter of 2020-21, the GDP shrank by 23.9 per cent, the steepest contraction on record. The domestic COVID-19 outbreak shows no signs of abating, with daily cases continuing to accelerate. 'While the nationwide lockdown (in place since March 25) was lifted on May 31, state-level restrictions remain in place and will likely drag on the economic recovery. High unemployment and the loss of income stemming from the coronavirus have severely depressed consumer spending.

### Air and surface energy using transport

The transport sectors have suffered the heaviest losses, as social distancing measures cut off traffic and travel and curbed demand for road, rail, air, and shipping freight. GOI and the state Governments had to arrange special trains and buses to move the labour to their homes initially and of late back to the cities. The continued social distancing norms will on one side may increase the number of trips and pollution in turn. The use of personal vehicles and the demand for private vehicles (to avoid contact with asymptomatic) is increasing in cities that will again impact the ecology. One of the biggest challenges for developing cities in India is that most public transport is informal and privately owned. More than 50% of commuters rely on privately-operated matatus to get to work. For millions, these unregulated minivans, taxis, or scooters are the only





source of motorised travel not to mention, a significant source of employment. The restricted transport systems thrown many of the labour force in this sector without a job and has made their living challenging. Non-essential travel and in relatively wealthy countries where people have access to remote working facilities or alternative, private forms of transport the impact may not be big. But for middle class and poor people, the decision to cease commuting during a crisis may not be an option at all. Mass transport, which brings people into proximity with each other, is where some of the most tangible behavioural changes are manifesting during this crisis, particularly air, train, and bus transport, which is generally perceived as being non-essential. The combined impact of passengers' perceptions of danger and inconvenience on transport demand was demonstrated across the country. The domestic aviation, rail, and Bus market is starting to rebound as domestic travel restrictions are eased. The cost of the travel is almost doubling and the extent to which the Covid-19 crisis will affect national aviation, Rail and Bus demand in the longer term remains to be seen. For many commuters, the Pandemic may act as a catalyst for switching to active transport modes, convinced after experiencing benefits such as cost and time savings over public transport or better health.

### Secondary prevention

**Early diagnosis:** Suspect cases are screened for the virus with nucleic acid amplification tests (NAAT), such as RT-PCR. Rapid diagnostic tests (RDT) detect the presence of viral proteins (antigens) expressed by the COVID-19 virus in a sample from the respiratory tract of a person. If the target antigen is present in sufficient concentrations in the sample, it will bind to specific antibodies fixed to a paper strip enclosed in a plastic casing and generate a visually detectable signal, typically within 30 minutes. With the pandemic gripping firmly, availability of accurate and rapid diagnostic procedures becomes imminent to develop understanding about various facets of SARS-CoV-2 infection and immunity. While boosting testing is regarded as a key part of the battle against the coronavirus. India's top medical research body, the Indian Council of Medical Research (ICMR), has approved the use of three antigen tests developed in South Korea, India, and Belgium. India increased its Covid testing capacity from 52 labs to over 1,300 in 4 months by end early August 2020 and only 152 districts of India's 739 do not have Covid-19 testing facilities even today. In other words, approximately 80 per cent of the country's districts have labs which can test for the novel coronavirus. The biological waste about 100 Metric tons per day attributable to laboratory testing has increased by many-folds due to intensive testing embarked though India is far below many other countries testing level. An increased capacity of 1-1.2 million tests per day since 16th September with about 10-12% turning positive has increased the Biomedical waste for disposal, that is not getting due attention. India has crossed the sixty million mark in conducting tests for detection of Covid-19, examined till 16<sup>th</sup> September 2020

**Treatment:** The disease is self-limiting. Indian experience of over 5 million cases so far indicates that most people (about 80%) recover from the disease without needing special

treatment, and for the majority – especially for children and young adults – illness due to COVID-19 is generally minor. Around 1 in every 5 people who are infected with COVID-19 develop difficulty in breathing and require hospital care. People who are aged over 60 years, and people who have underlying medical conditions such as diabetes, heart disease, respiratory disease or hypertension are among those who are at greater risk. To date, there is no specific medicine recommended to prevent or treat the new coronavirus. However, those infected with the virus should receive appropriate care to relieve and treat symptoms, and those with severe illness are receiving optimized supportive care. Some specific treatments are under investigation and are being tested through clinical trials.

Investigational therapies include a) Remdesivir has been approved under emergency use for patients with moderate COVID-19 and on oxygen therapy b) Corticosteroid drugs such as Methylprednisolone and Dexamethasone have been approved for the clinical management of patients with moderate and severe COVID-19. c) Hydroxychloroquine has been approved as a treatment in mild and moderate cases, and as prophylactic. d) Under off label use, convalescent plasma may be considered in patients with moderate COVID-19 who are not improving based on progressively increasing oxygen requirement is despite the use of steroids. e) Under off label use, Tocilizumab may be considered in patients with moderate COVID-19 who are not improving (progressively increasing oxygen requirements and in mechanical ventilation) despite the use of steroids. f) Low molecular weight Heparin has been prescribed to prevent blood clots and thrombotic response. While one study reported in NEJM reported that Remdesivir shortens the time to recovery in adults who were hospitalized with Covid-19 and had evidence of lower respiratory tract infection, yet another recent double blind study indicating the Remdesivir had no definite value add in the treatment of Covid19.

The country's health system was poorly equipped with ventilator beds for managing severe pneumonia caused by the disease. The initial lock down helped upgrading infrastructure, and as of early September 2020 there were 62,979 ICU beds and 32,862 ventilators available in Covid-19 dedicated government and private health facilities across the country.

**Oxygen demand:** Covid-19 patients suffering from breathlessness require high-flow nasal oxygen as a lifesaving measure, pushing up the demand for medical oxygen. With the number of severely infected Covid-19 patients increasing, there is up to a four-fold increase in the daily demand for medical oxygen. For example, in Karnataka state needs 400-500 metric tonnes of liquid oxygen daily in September 2020, up from 100-150 metric tonnes in March-April. Consequently, medical oxygen's price has shot up from Rs 13-18 per cubic metre; to Rs 24-25 per cubic metre and Rs 40 per cubic metre in emergencies.

### Tertiary prevention

**Disability limitation:** Of those hospitalized 15% needs oxygen support in ICU and around 4% need ventilator support. Post recovery complications including sudden cardiac arrest, pulmonary embolism is being reported recently.

## How the pandemic has played culprit in mental health

In contrast to the common belief that exercise has been shown to reduce anxiety and stress, *but* now, in a major study, the researchers have revealed that it may not be enough for the levels caused by COVID-19. People who reported increasing their physical activity after the COVID-19 stay-at-home orders reported higher levels of stress and anxiety than those whose activity levels stayed the same. Of the survey respondents, 42% reported decreasing levels of physical activity since the COVID-19 crisis began, and 27 % had increased their activities and another 31 % reported no change. Those who reported a decrease in physical activity within two weeks after the start of stay-at-home orders had a perceived higher level of stress and anxiety, which was expected.

Personal anxieties, financial distress and career upsets can tip a person over. When something bad happens, Indian culture preaches us to give it a positive spin, saying, 'Everything happens for the best.' No, it does not. One must face it; it is not the end of the world. Unless we focus on mental health completely and take macro decisions, there will be increased cases of anxiety, phobia, depression, and suicide in post-pandemic period.

The new normal due to the pandemic paints an extremely grim picture — desperation in emergency rooms, social isolation, rising cases, and fear, red flagged with potential long-term consequences. The current mental health situation is like a ticking bomb waiting to burst," Some people contemplate taking their lives in this environment for fear of death, fear of illness and fear of uncertainty. For many who have died, the families have not seen their faces as they were cremated by the state, so there was no closure at all. While we are only focusing on deaths related to coronavirus, we need to realise that with mental issues, people end up dying every single day. It could be a breeding ground for suicide.

### False memories

Prolonged levels of high stress from continuing financial, educational, and social uncertainty are a major cause of persistent negative moods. Thanks to the uncertainties of the COVID-19 pandemic, the entire country has been experiencing such prolonged levels of high stress for many months. Worse, those uncertainties have been heightened by the lack of clear federal policies to contain the pandemic. There are two types of memories – verbatim and gist. Verbatim is remembering the vividly and literally specific details of what happened. Gist, on the other hand, are fuzzier recollections, but they affect us for a longer period. A recent study in Psychology today has reported that the stress of the pandemic can affect emotions, particularly those evoked by negative events, can lead to not only inaccurate but in some cases, false memories. The pandemic and depression, anxiety and stress and intricately linked and these mental health problems can lead to false memories.

**Disrupting our lives through misuse of information technology and e-devices:** Employees are continuously on

alert for the next email or message on their mobiles from their bosses and colleagues or are having to participate in a great many web conferences, Now, there is no distinction between home and office. This kind of 24X7 preoccupation with work is threatening to become a full-blown physical and mental health crisis.

In the case of Covid-19 where misleading and fabricated news stories abound, false memories can get accentuated. A recent study of 3,700 participants examined how fabricated news stories changed the way people remembered the virus itself. People who believed themselves to be knowledgeable about the pandemic were more likely to report having a memory of any story, whether it is true or false. Those who reported high levels of anxiety or "media engagement" were more likely to recall both true and false stories but were more in tune with the difference between them.

Already, anxiety and stress-related disorders are on the rise and frustration is leading to depression and even suicides. The data on distress related to the pandemic is available, the distress caused by going online has not yet been assessed. People are already suffering web /screen fatigue — that implies stress caused by being overwhelmed by online interactions. There is ample evidence to suggest that exhaustion from excessive video chatting is harmful to both mind and body as the total psychobiology gets affected.

**Impact on sexual life:** A small informal study using six questionnaires, surveying a total of 2,000 users of which 70% were men, as many as 53% said they had never spent so much time around their spouse as they were forced to when the lock down orders were brought in March 2020, but the sexual acts were initially for a month or so totally stopped and later saw a 50% dip. 60% of female surveyed said their partner did not initiate sex even once from mid-March until early August. The lack of private time, time outside the home, and inability to see friends has caused tension in many marriages, driving them to seek out extra-marital affairs. About 25% of all surveyed found to be the most distressed and that is why they decided to actively to give up on their "dead bedroom" and seek romantic fulfilment elsewhere or took shelter in viewing pornography.

### Other ecological impact

**Impact on travels & tourism industry:** The COVID-19 pandemic of 2019–2020 has the potential to transform the tourism industry as well as the context in which it operates. This global crisis in which travel, tourism, hospitality, and events have been shut down in many parts of the world, provides an opportunity to uncover the possibilities in this historic transformative moment. A critical tourism analysis of these events briefly uncovers the ways in which tourism has supported neoliberal injustices and exploitation. The COVID-19 pandemic crisis may offer a rare and invaluable opportunity to rethink and reset tourism toward a better pathway for the future. 'Responsible' approaches to tourism alone, however, will not offer sufficient capacity to enable such a reset. Instead, such a vision requires a community-centred tourism framework that redefines and reorients tourism based on the

rights and interests of local communities and local peoples. Theoretically, such an approach includes a way tourism could be 'socialised' by being recentred on the public good. This is essential for tourism to be made accountable to social and ecological limits of the planet [18].

**Public health management practices:** The national management of Covid 19 can best be described as Jugaad. The word commonly used in Hindi/Urdu means an innovative fix or a simple work-around, used for solutions that bend rules, or a resource that can be used as such, or a person who can solve a complicated issue. Jugaad simply means something that is made to serve a purpose on temporary basis. Countries around the world are beginning to adopt jugaad to maximize resources (Figure 6).

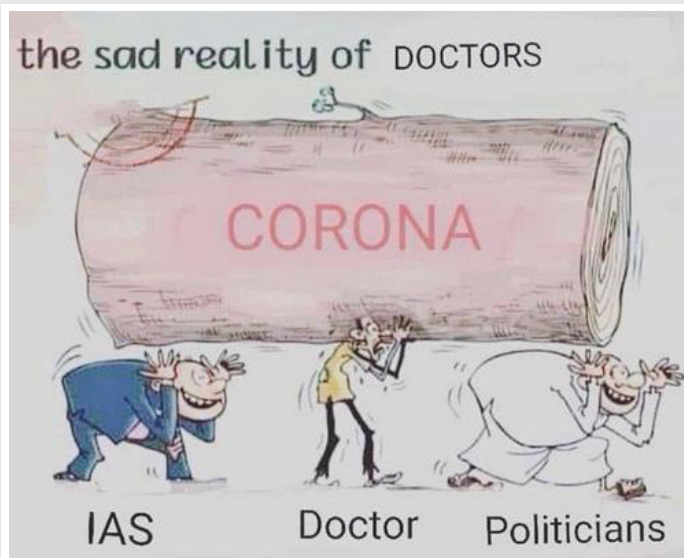


Figure 6: The sad reality of doctors.

As envisaged in our Constitution, pandemic management is the central government's responsibility for which it has several institutions in place: Directorate General of Health Services (DGHS), National Centre for Disease Control (NCDC), Department of Health Research (DHR) and Indian Council of Medical Research (ICMR). These agencies have not functioned harmoniously in the best of times. It was asking too much to expect them to weave into a cohesive unit at this pivotal time. Therefore GOI bypassed them, in designating the country's pandemic response to the National Disaster Management Agency (NDMA) and invoked the Epidemic Diseases Act of 1897, giving the Centre extraordinary powers to mitigate the consequences of the pandemic – as if the pandemic demanded not public health but political, Police and civil administrative responses. Since healthcare is constitutionally each state government's responsibility, India's 28 states and 8 Union territories were conveniently left bereft of a strategic plan and implementation plans at the corporation and district levels. Operational guidance and timely release of adequate funds were missing. The Centre and States took on the role of umpire instead of coach, sending inspecting teams to selected states and districts as if they needed umpiring [19].

The new protocol states that recovered patients should continue to practise "Covid-appropriate behaviour" at the individual level that includes wearing a mask, hand hygiene and following social distancing norms. There is a wide variation in recovery and in some cases, patients have taken several weeks to fully recoup. Doctors are also watching out for long term effects. "Adequate amount of warm water", if not indicated otherwise by doctor, and immunity boosting Ayush medicines, only on the advice of a qualified practitioner, have been suggested too. The guidelines also recommend one spoon of chawanprash in the morning with water or milk. The ministry said regular household work can be done "if health permits", while professional work can be resumed "in graded manner". Medicines to alleviate Covid-19 symptoms should also be continued, along with those for co-morbidities, if any. Patients have been asked to monitor their oxygen levels, temperature, blood pressure and, in case of diabetic patients, blood sugar too. For persistent cough, the guidelines recommend gargling with saline water and steam inhalation using herbs. Patients have been asked to look for signs of high-grade fever, breathlessness, and weakness. The government also suggested consultation with a doctor, either through a physical visit or online, within seven days of discharge from a hospital.

**General sickness care seeking behaviours:** Over the last six month the general medical consultations and care both in OPD and inpatients for non-Covid 19 cases and planned surgical procedures (except deliveries and emergency surgeries) have been stopped. Both the public and private sector hospital have stopped catering to the common illnesses that need regular check up and advises to cancers, diabetes, Cardiac and Kidney diseases, Asthma and COPDs. Majority of such patients are deciding themselves or being advised by their family doctors, to seek any medical care in hospitals that have dedicated unit for Covid 19 until it is unavoidable [20].

**Impact on Accidents and Emergency Ambulance Services:** Poor emergency care is one of the reasons why lives that could have been saved were not saved. The pandemic has led to better emergency care facilities in hospitals both in public and private sectors. In the next few months when the pandemic wears out, the improved emergency care facilities can be moulded to cater to accident emergencies, that can improve outcomes of road accidents

### Hospitals and doctors behaviour

Doctors across specialities have seen an intense reversal of normal times, wrestling with questions about the entire healthcare setup. Multiple challenges mean longer hours for doctors, who must cope by getting simple things right first. Is it safe to call a patient for a check-up or a procedure?; should a problem be allowed to fester to avoid possibly bigger complications the virus may cause?; are video consultations helpful?; how to protect and reassure stressed out and stretched staff? Medical professionals have had to rethink their approach as counselling or treatment for conditions other than Covid-19 cannot be deferred indefinitely. Many healthcare workers, fear if, they will carry the infection home to family, that must be eased and ensure staff safety so that patient care do not suffer.





In India, more than systems, it is the doctor's personal touch and relationship that reassure patients. We are personally invested in our patients' health. The distance created by Covid, where in-person consultations cannot happen regularly, is challenging for many. The standard way of practice, which we followed for decades, has changed. New protocols require numerous precautions. Some ground can be covered through video consultations. Uncertainty is a stressor for both care seekers and givers. Some procedures can be put off, but the question troubling everyone is: what next and when? Childbirth, for instance, cannot be postponed. A big ask for doctors has been to broaden their focus from treatment to protocols. Telehealth helped us continue our communication. One advantage of telemedicine is approachability, but patients' expectations are high. Not all pieces can be put together on video. You need to examine the patient physically for the satisfaction of both the clinician and the patients.

Managing facilities amid staff shortages is taking up a large part of the day. Hospitals must screen everyone, missing an ailing person, whether they are entering or leaving the premises, is not an option. Some patients do not want to use public conveyances even in emergencies, so they must arrange transport to get them here, that may take hours. Retraining staff and making them confident is important as they are the first point of contact. They must remind everyone to follow distancing and wear a mask. It is tough. For instance, childbirth is a joyous moment and relatives naturally want to see the baby at the hospital, but that is not advisable. "Most mental and dementia, patients are elders, who are prone to multiple health issues, needing regular mental support is crucial now, but Covid 19 has forced them into extreme confinement, affecting them physically and emotionally. More than medicines, aged patients need interactions, eye-to-eye contact, and empathy.

Covid-19 has complicated the straightforward dimension of treatment in cancer, diabetes, Cardiovascular conditions, and TB care, where regularity of treatment is critical. The pandemic has disrupted this frequency as, people have been avoiding hospitals and it is hard to persuade them. When they finally come in, they are extremely ill and in pain. Suppose a diagnosis was made in February and patient visits the doctor only in September, a lot of time allowed for things to go wrong.

**Economic environment:** After the deep GDP contraction in April-June 2020, people are deeply split on what lies ahead. In a recent survey, one half expects a long and tough road to recovery, while the other sees clearer skies ahead. The bottom 50-60 per cent — for whom the hardships range from sleeping hungry, to making distress sales, to even taking their own lives. The four major aspects of the survey are: a) lockdowns damaged economies the most; b) boosting middle-class sentiments is India's best bet; c) lack of Centre-state cohesion can make the road to recovery difficult; and d) There is a need for a Stimulus 2.0 [21].

**Moving forwards:** Even though it looks like a while before Covid-19 Pandemic will be over, everybody can see how it is going to leave a long-lasting impact on the way we do our day to day business. Covid-19 certainly came as a rude shock

for enterprises not prepared for working remotely, would that change in the future? Yes! Post Covid-19 enterprises will spend considerable amount of resources in getting their critical functions remote enabled. Would remote working become the new norm post Covid-19? I doubt and I really hope it does not end up being like that. Clinicians have a role to play in reducing the risks posed by climate change in relationship to COVID-19 as well as other diseases and become vocal about how important it is to adjust our way of life so that we produce less air pollution, to improve our health, that will also create a lot of jobs.

**The steps needed from the government:** The path-breaking agricultural reforms will unleash new opportunities and help raise farmers' incomes. The thrust on infrastructure development and policy interventions to shape competitive 'Make in India' supply chains augur well for the economy. The pandemic has not only tested the resilience and adaptive capacity but also unleash powerful forces of innovation. Government and major private organizations have nurtured vitality to create differentiated products & services in record speed, realign supply chains to react swiftly to disruptions, orchestrate timely partnerships, repurpose critical infrastructure to sharpen competitive advantage and embed sustainability meaningfully in strategy & action. It is important to be compassionate and agile in crisis. Entire country saw with priority, the safety of employees, partners and associates as also to helped communities. Streamlining operations with agility, re-aligning the supply chain, ramping up capacity & repurposing facilities swiftly to meet the demand surge and fast-tracking design, development & go-to-market strategies of innovative products received extreme focus.

Providing "flexibility" to resources to work from wherever is alright but many in developing countries do not think that we can build a team camaraderie without the face to face interaction. Face to face interaction is what adds the human touch, otherwise it is easy to confuse a person with a phone call without any emotions being at play.

Another field which would see rapid innovations and gains would be consumer health wearables, consumer health IOT devices, and AI in consumer health. A lot of consumers are lot more concerned about their overall health well-being so I would not be surprised if there is a surge in demand for self-monitoring devices and wearables. Healthcare which has traditionally been an in-person thing, would see more and more remote consultation for trivial diseases and OTC drug prescriptions. The doctors would rely on the wearables to get the vitals and the entire consultation would be done remotely — perhaps we will see an end-to-end system which integrates the patient, wearables, and the hospitals/doctors as one eco-system.

Use of Artificial Intelligence in quickly identifying symptoms would also see an uptick. Since early identification potential virus carriers and isolating them is the key to containing this virus, a lot of emphasis has been put on testing more and more people. New York, the current epicentre of the Covid-19, has already done close to half a million tests. India is doing almost



a million test per day. The burden on state agencies would have been lot less if the tests could have been self-performed by everyone themselves – which is what Government of India is trying to do with Aarogya Setu app, the only issue with it being that it is more of a self-assessment rather than a test. Instead imagine if we were wearing a temperature measuring band tracking our temperature, use phone's accelerometer along with voice sensor to detect if you are constantly coughing and then raise an alarm to you to go check with a doctor. With more powerful AI comes more privacy concerns – so “intelligent” anonymizers and cloaking will also see an upward trend.

Finally, more organizations would spend time and resources on nailing the data sciences part, not just in terms of analysing large amount of data in optimal time frame [22].

COVID-19 has brought into clear view that every person's health is interconnected, in such a way that every country must work with the others to protect the health and lives of all people in their nation, and the global cooperation is crucial now than never before.

An immediate casualty of these opposing forces is the global effort towards vaccines for COVID-19 and the climate emergency. 170 countries plan to participate, but the USA, for one, is opting not to join COVAX. Instead, the USA has secured bilateral deals with several companies for millions of doses of promising COVID-19 vaccines. Similar deals have been struck by Australia, the EU, and the UK. These bilateral deals will reduce the initial global vaccine stocks available for vulnerable groups in poorer countries and undermine global efforts to ensure fair allocation [23].

The climate emergency is another subject on which the global response to COVID-19 depends heavily on the idea of creating a better future for human and planetary health. Degraded landscapes harm humanity-healthy natural ecosystems perform vital functions, from seed dispersal to carbon sequestration, control of invasive plants and protection against flooding. The scientists find for every hectare, conserved woodlands absorb 12.8 tonnes of carbon dioxide per annum, wetlands absorb 5.1 tonnes of carbon dioxide per hectare each year and every hectare of thriving marine environments absorbs 4 tonnes of carbon dioxide annually. Rewilding is a powerful nature-based strategy- it restores ecosystem processes created by flora and fauna, leading to a self-regulated ecological community. Rewilding or 'network rewiring' includes reintroducing vanished species and translocating surrogate wildlife with equivalent ecological roles. Therefore, Restoration is the key. For a health living in future.

The world is looking forwards to the Summit on Biodiversity on Sept 30, that may change the UNGA's focus to the Sustainable Development Goals, by 2030, and to defining a post-2020 biodiversity framework. Launched in Japan on Sept 3, 2020, the Resilient Recovery Platform is a global sharing of policy and actions to address the response to COVID-19 coupled with the response to the climate emergency, with stakeholders such as governments, businesses, non-governmental organisations,

and civil society. The participation of 80 countries shows a willingness to engage in overhauling socioeconomic models towards a sustainable future.

## Summary

The origin of the Covid 19 Pandemic and its transmission pathway are yet to be asserted. With COVID-19 pandemic continuing to spread, national and local governments are struggling to treat waste management, including medical, household and other hazardous waste, as an urgent and essential public service in order to minimise possible secondary impacts upon health and the environment. Researchers found that air pollution had intensified the pandemic, but the lockdown and related measures implemented by countries to stop the spread of COVID-19. They have led to a decrease in economic activities and drop in road transport, temporarily cleaning skies and decreasing levels of certain air pollutants. The spread of COVID-19 is closely related to water and sanitation, Respiratory and toilet etiquette as cleaning hands, using masks, avoiding going into crowd can reduce the transmission and help people stay healthy. The demand for more water for additional hand washings advised to minimize the transmission of Covid19 when billions of people still lack safe water is a worldwide challenge. There are competing priorities for funds in all countries between the health crisis and wider economic and ecological initiatives. The fight against plastic pollution is being hit by the COVID-19 pandemic, as the use of disposable masks, gloves and other protective equipment soars. Plastic does not inherently make anything clean and safe. Hosing down migrants and workers with bleach to 'disinfect' them or insisting on frequent use of sanitisers is a ghastly inhumane practice to combat COVID-19. There has been a significant increase in Shoreline pollution or increased smoke due to the disposal of sanitary consumables and dead bodies. There has been a special demand on the States and businesses houses on the dire need to protect the brave doctors, nurses, police, Municipal workers, Police forces first responders on the front lines in this fight.

COVID-19 is having an impact on animals, Lockdowns and the loss of tourism revenue also create challenges for protecting wildlife. The cost of COVID-19 to zoos could mean extinction in the wild and exist only in zoological and botanical collections. The postponement of several international meetings and negotiations to agree on solutions for climate change mitigation and additional benefits, may lead to losing critical time to address the biodiversity crisis. While all country Government rightly point to the significant challenges posed by Covid 19 Pandemic the global health crisis, some have explicitly called for postponement of environmental laws or loosening regulations that limit emissions from their facilities leading to Carbon dioxide remaining in the atmosphere and oceans for long.

A profound, systemic shift to a more sustainable economy that works for both people and the planet is the need of the time. This calls for sustainable financing by employing wise range of measures to respond to both and health crises and to the wider economic impacts.



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