Optimizing India's Emergency Response System for Pandemics Like Covid-19

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Abstract:- **Sir Winston Churchill once said,** *"by failing to prepare, you are preparing to fail"*, **which is clearly seen in India's handling of the COVID-19 pandemic. Although, India came out triumphant after the first wave of the pandemic, the second wave hit her like a tsunami, fatally challenging the healthcare sector and its frontline workers. The common man was left without doctors to consult and oxygen to breathe. Therefore, with the plethora of festivals headed our way and taking into consideration human behavior combined with the easing of restrictions, it is necessary to anticipate, plan and prepare ourselves for the potential outbreak of a third wave of the pandemic. Hereby, this paper will encapsulate the concepts of Operation Research like PERT/CPM to create a Pan India model for handling future pandemics.**

Keywords:- *Covid in India, Swedish Model, Mumbai Model, Healthcare Sector, Network Analysis, Emergency Response Systems.*

I. INTRODUCTION

"COVID-19 will reshape our world. We don't yet know when the crisis will end. But we can be sure that by the time it does, our world will look very different." – Josep Borrell.

We have seen that the existing COVID-19 pandemic has had contrasting situations where either the patients have been knocking on the doors of hospitals in desperate need of emergency beds (ICU beds, COVID beds and normal beds) and oxygen cylinders and not getting assistance or aid or hospitals with empty beds and no patients. In addition, we've also observed that in a country like India, where unemployment in the healthcare sector is reasonably high, a lack of medical professionals to support the peak demand in the hospitals. Through this paper, we try to plan the resources to better match the needs of the individuals in a crisis situation.

Through this paper, we aim to optimize India's emergency response system through the effective application of the PERT/ CPM technique. The Project Evaluation and Review Technique (PERT) and the Critical Path Method (CPM) are project management techniques used for planning, scheduling, integrating, allocating and controlling resources. Commonly known as Network Analysis, these project scheduling techniques, consist of many time-oriented methods. The critical path method (CPM), or critical path analysis (CPA), is an algorithm use for planning and scheduling a set
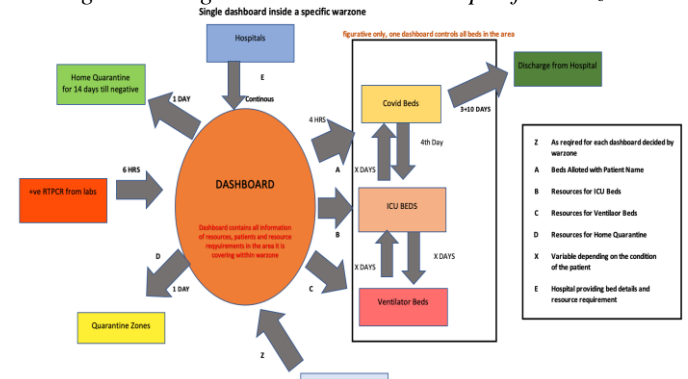
of project activities. PERT and CPM, both, are used to describe the timeline to complete a project. This provides the management with the progress report to the complete the project.

Figure 1:National Level Covid Action Plan
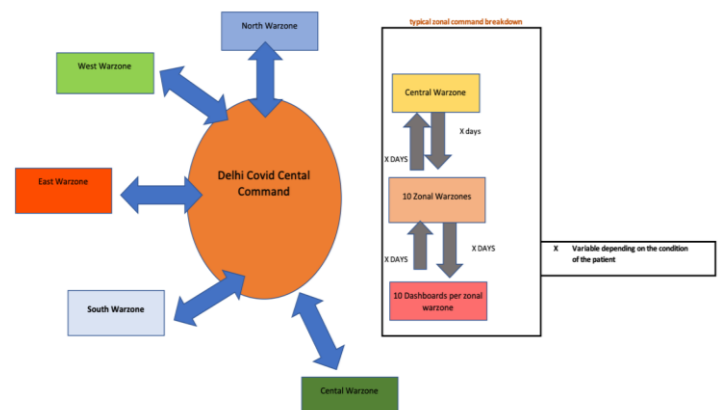
Source: The author

Figure 2: Single Dashboard inside a Specific Warzone

Source: The Author

Therefore, figure 2 shows within a warzone, in a typical dashboard, how PERT/CPM works. The hospital provides continuously the data of available beds, required resources like medical professionals, counsellors PPE kits and other requirements. The Dashboard forwards their requirement to the warzone and the same is allotted to it as the warzone deems necessary. The RT-PCR positive results in the area are informed directly to the dashboard before informing the patients within 6-10 hours and are informed to the patients before 24 hours. This lead time enables the dashboard to

allocate a bed for a particular patient as need be and coordinates with the respective hospital that the specific patient is arriving for the specific bed. Hence, the pressure and chaos on the hospital admissions and the patients are reduced.

Similarly, the above chart explains how the basic requirements in the different sectors are planned, coordinated, synchronized and better monitored for smooth operation during the chaotic phase of the pandemic.

II. LITERATURE REVIEW

Epicentred in the city of Wuhan in Hubei Province, Covid 19, a respiratory disease, has spread around the world and brought unforeseen and critical challenges to public health, research, medical communities and the entire world. (Anthony S. Fauci, H. Clifford Lane, & Robert R. Redfield, 2020) This global threat infiltrated India on the 30th of January through Indian students evacuated from Wuhan and has since spread rapidly resulting in a record high number of confirmed cases making India one of the worst hit in the world.

Thrissur, Alappuzha and Kasaragod were the three towns in Kerala to first report cases of COVID-19 in India. Lockdowns were announced in Kerala on the 23rd of March, while the Indian government introduced a nationwide lockdown on the 25th of March. India's prompt response has been rated as one of the most stringent in the world which in turn helped reduce the predicted case numbers by a large margin, given India's vulnerability to the pandemic due to its high population density, socio economic conditions and overstretched healthcare facilities.

As novel coronavirus (CoV) is easily transmitted through close contact, dealing with a population of 1.3 billion people proved to be an immense challenge for India. The imposition of a sudden and indefinite nationwide lockdown increased the frustration among the migrant labourers prompting them to return to their villages in huge numbers without proper social distancing norms causing spikes in the number of covid cases. Furthermore, the lack of initiative in people to follow proper norms and shortages of doctors healthcare infrastructure proved to be major hurdles. In addition, states like West Bengal and Odisha were hit by a super cyclone named Amphan that wreaked absolute havoc. People stranded homeless by this natural calamity were rescued and placed in cyclone shelters where social distancing was practically impossible. (Pal & Yadav, 2020)

Nearly six months after the peak of the first wave in September of 2020, India was hit by a disastrous second wave of the pandemic that surged since the month March of 2021. Despite expert warnings about the possibility of an impending second wave, the government reduced the restrictions and the Health Minister declared that India was in the "endgame" of the epidemic, which gave the impression that India has beaten the virus. This led to the misconception that India had conquered the virus, all of which encouraging complacency and insufficient preparation. (Lancet, 2021)

"The second wave has made the last one look like a ripple in a bathtub," says Zarir Udwadia, a clinician-researcher in pulmonary medicine at P D Hinduja Hospital & Medical Research Centre in Mumbai. The healthcare system of our country collapsed leaving people gasping for oxygen and scrambling for beds. (Mallapaty, 2021)

Political factors like carelessly holding assembly elections in the states of West Bengal, Tamil Nadu, Assam and Kerala, the Kumbh Mela in Haridwar and the large farmers protests on the outskirts of the capital, in the month of December, in response to the new agricultural laws led to a spike in the case count. In addition, the introduction of many new mutant strains with the high transmissibility rate, the second wave proved more dangerous than the first. Psychological factors like mask hesitancy, lack of social distancing and vaccine hesitancy also led to the surge in the cases. (Chakraborty, Sharma, Bhattacharya, Agoramoorthy, & Lee, 2021) Apart from this, the second wave also saw an increase in the number of secondary infections and black and white fungus infections due to excessive use of steroids in the treatment of COVID-19 and immunosuppression by the virus.

With India's public healthcare being gravely underfunded for years together, it posed several obstacles for the country's emergency response strategies. The magnitude of the pandemic has caused hospitals to become overwhelmed and frontline workers to be exhausted and even many becoming infected and succumbing to the virus. While the first wave saw the healthcare sector and workers stretched thin, the second wave saw a collapse of the system as entire hospitals had to be used and expanded for exclusive COVID-19 care that still proved to be insufficient in catering to the huge number of patients queuing up outside the hospital. The inability to meet the surplus demand for hospital infrastructure, oxygen cylinders and healthcare workers reemphasized the needs for improvements in its capacity and quantity. In addition, we witnessed the conversion of *maidans, gurdwaras* and other open areas into makeshift wards and hubs for covid care. The crisis revealed the pre-existing cracks in India's underprepared and inadequate healthcare system. (Neha Faruqui, et al., 2021)

This led to nightmarish situations in hospitals due to the deficiency in the supply of medicines, beds, oxygen cylinders and doctors in comparison to the demand of the population. The crisis was not equally distributed, with places with higher population density like Uttar Pradesh and Delhi NCR unprepared for the sudden spike in cases, quickly running out of hospital space, medical oxygen and overwhelming the capacity of cremation sites. Meanwhile, some places like Mumbai (Mumbai Model) were better prepared, and have been able to produce enough medical oxygen in this second wave to reduce the severity of the second wave. (NDTV, 2021) In addition, the government abruptly expanded vaccination to everyone older than the age of 18 years, draining supplies and creating mass confusion.

The second wave has resulted in huge losses for our country and has affected almost all sections of society, creating a domino effect on the health, healthcare and lives of millions of people creating a major setback for India. Thus, apart from firm economic measures, all National Health Programs should be optimized to avert any possible surge of future communicable (apart from COVID19) and non-communicable diseases.

Hence, through this part of the paper, we aim to illustrate a Pan India model for handling the pandemic and attempt to analyze its positives and negatives in real time.

III. OBJECTIVES OF THE RESEARCH PAPER

In this paper we aim to:
• Give structured solutions to help identify the potential areas of diagnostics to target with future control strategies to avoid the stress if identified with the sickness, to coordinate patients with the availability of resources and to ensure hospitals are properly resourced.
• Check the applicability of the solutions in the real-world scenario

IV. ANALYSIS AND FINDINGS

We aim to analyze the contrasting models (approaches) of handling the pandemic undertaken by two different governments and attempt to utilize the positives and negatives observed to create a theoretical Pan India model of handling future pandemics.

The Swedish Model

Prior to the outbreak of coronavirus, Sweden was ranked one of the most prepared to handle a pandemic. However, in March 2021, when the world was imposing mandatory lockdowns and closing its borders, Sweden opted for an unorthodox approach that let residents decide individually what precautions to take. The Swedish government predicted that people vulnerable would voluntarily choose to stay home, their economy wouldn't suffer as much, and healthier people might get mild symptoms to the virus that would ultimate contribute to the population's collective immunity.

However, this gamble did not pay off in the long run and the Swedish National Covid 19 strategy was majorly botched. This response resulted in the ever-increasing cases and deaths in a rapid manner as compared to its Nordic neighbors. Had Sweden opted for tighter rules, the country might've seen results similar to its neighboring countries.

Although, Anders Tegnell, the chief architect of Sweden's coronavirus strategy, was previously warned of the consequences of opting for a lax approach, he was skeptical about depriving citizens of their income or personal freedom and Sweden of her economy. Tegnell considered lockdowns as effective as "using a hammer to kill a fly." (Bendix, 2021)
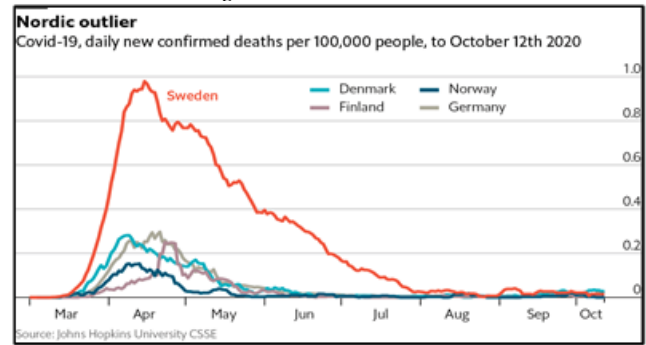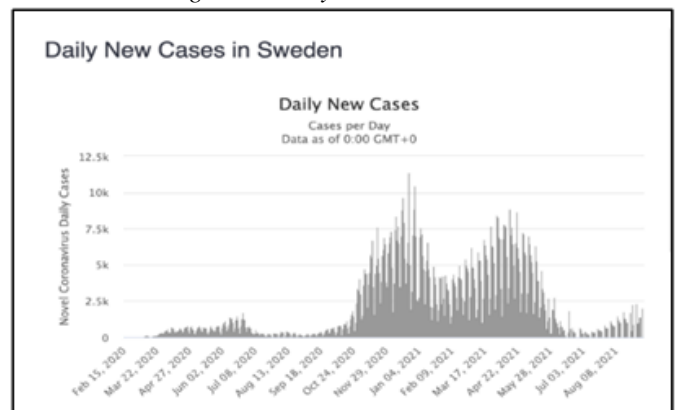
Figure 3: Nordic Outlier

Figure 4: Daily Cases in Sweden

Source: Google Images

Thus, Sweden became one of the few European countries to neglect the idea of a full-scale lockdown and to decide against a mask mandate, although there was overwhelming evidence that supported it. However, Sweden did opt for measures to limit crowds in public areas such as bars and restaurants and to close schools and colleges. Nevertheless, as the graph fell, the government decided to remove their restrictions which included opening up of the schools and colleges. Hence, attendance in schools was made mandatory and online schooling wasn't an option. Reports suggest, Tegnell allowed the virus to infect the young and healthy people as a means of increasing Sweden's overall immunity. This led to things going haywire for Sweden during the second wave, the major reason for this was that instead of anticipating the second wave and implementing changes to the existing model, the Swedish government started doing away with the restrictions in early October, 2020 which led to a huge spike in the number of cases towards the end of 2020. (Ewing & Bjorklund, 2020)

In addition to the laxing of restrictions, the high infection rates across the country led to innumerable people becoming infected in care homes. A substantial number of the sick and elderly found it hard to visit a doctor due to the triage system implemented by the country's hospitals. Many studies state that the triaging system factored in age and predicted prognosis.

Coronavirus testing, contact tracing, source identification, and reporting, as recommended by WHO, were limited and remained inadequate. There had not been any sufficient recognition under the strategy for the importance of pre-symptomatic and asymptomatic transmission, aerosol transmission and use of face masks. Even when the Swedish government started considering the required precautions and framework to fight covid, it was a very slow and gradual process, and this gradual approach resulted in a higher death rate and a slower decline rate as compared to its neighboring countries. (Claeson & Hanson, 2021)

At that point of time, if herd immunity was the indeed the "goal" or the "by product" of the Swedish plan is semantics, as this strategy didn't turn out as planned. In the month of April, the Public Health Agency forecasted that around 40% of the Stockholm population would have had the disease and would acquire the protective antibodies by May. Yet, according to the agency's own studies published in the month of September for the samples collected in June, the actual figure for random testing of 3/10 antibodies was only 11.4% for Stockholm, 6.3% for Gothenburg and 7.1% across Sweden. Hence, in the month of August, herd immunity was still "nowhere in sight" which shouldn't have been a surprise as herd immunity to an infectious disease has never been achieved without a vaccine.

The country's failed response has shown us the failures in the governance and legal framework existing in the healthcare and social services sector in the country. Had a denser, more populous country, like Brazil, adopted Sweden's strategy, it would've resulted in a massacre.

The Mumbai Model

In an absolute contrast to Sweden, with a population of around 1.25 crores densely concentrated in glistening skyscrapers, apartment complexes and sprawling slums, Mumbai is one of India's largest cities. The state of Maharashtra and its capital Mumbai were at the epicenter of the covid-19 pandemic, contributing to nearly 30-50% of the total cases of the country, overwhelming the hospitals in the state. The second wave of the pandemic saw Mumbai recording a record high positivity rate of 20-24%, as compared to an average of 8-9% in the preceding months.
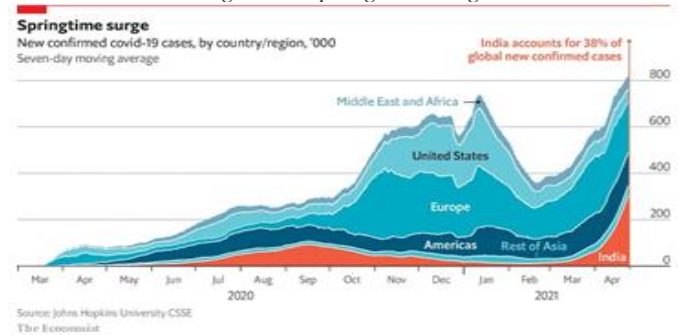
Mumbai's achievement in flattening the curve during the second wave of the pandemic began in February and has been credited to a mix of decentralization of responsibilities, timely lockdowns, aggressive testing, and an excellent triaging system with efficient resource management. This led to the Mumbai Model emerging as a successful model of covid management. (Pandya & Sanjai, 2021)

Figure 5: India's Cases Increase
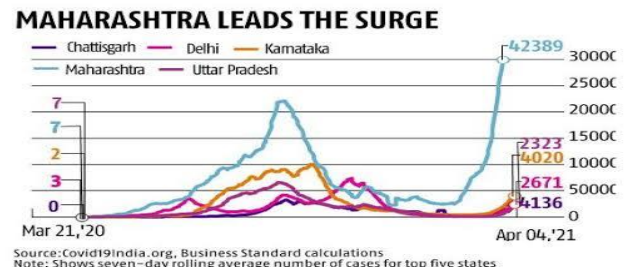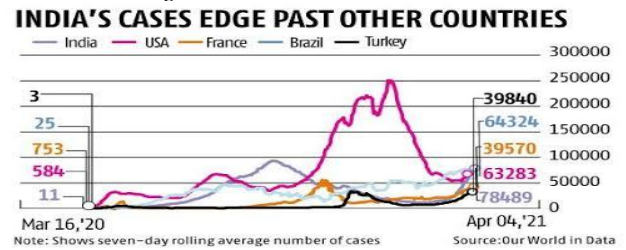
Source: Covid19India.org

Figure 6: Springtime Surge

Source: Johns Hopkins University CSSE

Figure 7: Daily Cases Maharashtra

Source: covid19india.org

According to Iqbal Singh Chahal, who took over as the Commissioner of BMC in May 2020, one of the most crucial decisions he had to make was that of decentralizing the disaster control room, till then a single unit, into 24 different Covid response war rooms, one for each of the city's administrative wards. This decision made by Chahal to replace the central control room gave relative autonomy to the assistant municipal commissioner of the ward. This implied that every positive RT-PCR test report that came in the months of March and April did not overwhelm one central facility. In addition, the 24X7 monitoring of patients and maintaining COVID-19 facilities that were initially set up to respond to the first wave of the pandemic were crucial in the second wave response. According to Chahal, the system was on "auto-pilot" this time. (Tare, 2021)

Patient admissions were mandated through the war rooms, which were equipped with a 24x7 team of doctors, trained staff who would triage cases and allot ICU or oxygen beds to only serious patients, and a dashboard of hospital beds and network of ambulances that ran on Uber's software which in turn enabled equitable access to hospital beds as per the availability. This prevented overwhelming the health facilities and optimized utilization of critical medical supplies.

The BMC's triaging system also depended on another controversial decision- they had forbidden the testing laboratories to share positive reports with patients. Only negative reports were allowed to be shared directly and this prevented the chaos and turmoil that would have come in response to the positive reports.(Tare, 2021)

The BMC decided that in the war against covid-19, they would take over 80% of beds in private hospitals, which was reactivated as soon as the second wave struck Mumbai thus increasing the number of hospital beds, including ICU and oxygenated beds to 1.5 times more than what the city had during the first wave. By incorporating the private hospital beds into the dashboard, BMC was now able to allot beds in both the public and private hospitals. Furthermore, the BMC retained the jumbo field hospitals, that were created at the time of the first wave, when the cases fell and admissions reduced, and used them to set up vaccination centres in support of the vaccination drive. Furthermore, civic authorities advised against and prevented hospitals from adding beds beyond their oxygen storing capacity, hence dodging the shortages, confusion, and mayhem that rocked the other states and cities. (Phadnis, 2021)

The "Mumbai model" has showcased optimum utilization of resources by working within the limits of the public structure by merging with private resources through a robust real time monitoring system, inventory management, and decentralization to flatten the curve of the second wave and save hundreds of lives.

After analyzing and interpreting in real time how both these approaches developed, we understand that when a pandemic hits the world, governments have to make a critical decision between saving lives of the people impacted and affected by the pandemic and keeping the lives of the people and protecting their economy. Depending on this analysis, we feel that a periodical toggle between protecting the economy and saving lives has to be dynamically controlled.

Therefore, based on our analysis we recommend implementing and expanding the Mumbai Model to a nationwide scale but with each state in a position to dynamically disengage their economy depending on their localized density of the cases.

V.　　RECOMMENDATIONS

a. The Pan India Model

As we have observed in the past, the third wave would not be as severe as the second wave but it will undoubtedly be a more grievous blow as compared to the first.

This theoretical model is entirely decentralized and data driven. The Pan India model sets up its base in the capital, Delhi and divides India into five war zones- the Central Zone, Eastern Zone, Northern Zone, Western Zone and the Southern Zone. Each zone is further divided into 10 zonal areas, on the basis of area of land and population, that are independently administrated. Respective state governments have no jurisdiction to avoid any bias. Each and every zone should be equipped with its very own control room with a real time integrated dashboard of all the hospitals. Furthermore, the 10 zonal areas are to be appropriately equipped with their own sets of doctors, medical teams & PPE kits, ambulances, telephone lines & operators and counsellors & covid warriors to interact with the containment zones on a pro rata basis. Through efficient decentralization, we aim to manage resources and prevent the overcrowding and influx of data and information to a single entity.

To prevent chaos in the situation of an outbreak of the third wave, it is important to ensure that patients are prevented from getting their positive results directly from the labs. Instead, all positive reports will flow towards the government's dashboard at 00:00 hrs and will subsequently reach the respected zonal areas by 6:00 am. In addition, to resolve mayhem and turmoil in hospitals with respect to the shortfall of resources, private hospitals should hand over around 85% of their beds and 100% of their ICU beds to the government. This helps in removing the inequality of attaining the beds as beds would be charged on the basis of the government rates. Moreover, all public and private hospitals should permit patients with respect to the amount of beds and resources they're able to provide. Young medical students

should be deployed to help hospitals facing shortages in staff. Lastly, it is mandatory to ensure that there is buffer stock kept round the clock.

Jumbo centres and hospitals should be established in suitable areas to make up for shortages in beds in a specific war zone with fully functioning ICUs, ventilators, oxygen beds and pathology labs with the presumption of a possible influx of patients in the need of beds and oxygen cylinders. To reserve the oxygen cylinder capacity, it is necessary that a saturation level beyond 94% is not maintained. Besides, weekly audits to compare the consumption of oxygen must be conducted. In addition, jumbo centres should be equipped with oxygen plants in case of shortages due to influx of patients.

Vaccine prevents death. It is crucial that all zonal administrators prioritize the vaccine drives to accelerate the vaccination process. Post the second wave, there should be unabated rise in door to door vaccinations for the destitute living in the society. Proper procedure should be carried out to procure and contain vaccines from around the world.

Additionally, researchers insinuate a pediatric dimension for the third wave. Accordingly, arrangements must be made in jumbo centres to accommodate families of the patients. In addition, pediatric doctors are required to guide and train families.

VI. LIMITATIONS

Few of the obstacles preventing the smooth functioning of this model include the lack of accurate data collected and made available to the public, the inability to predict the rate of transmission of the virus, i.e., although we might be prepared for the virus, there's no evidence to predict the magnitude of the wave. In addition, the implementation of this theoretical Pan India model would be expensive thus opening it up to criticism. Lastly, the vaccine hesitancy in rural areas hinders immunity against the virus.

VII. CONCLUSION

Thus, based on the CPM/PERT model, if we can compile all the available data and monitor it efficiently, we would be able to minimize the chaos, mayhem and turmoil that we experienced at the start of the second wave and be better prepared in anticipating and minimizing the drastic effects of the existing/expected third wave of the pandemic, both financially and economically for the individuals, their families and the country, at large.

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