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Disaster management of COVID-19: A study of India

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ABSTRACT:
COVID-19 capsulated the whole world in a dangerous loop of death and crippled the transformative capacity of science and technology to save the mankind. Law, once monopolized by man, was soon hijacked by the law of nature and the only remedy available was to draw boundaries (in form of lockdown). Legislative measures, medical facilities, and vaccine drives altogether helped in timely control of COVID-19; however, the world statistical data is evident of the fact that few countries were able to manage COVID-19 very well in contrast to others. It is true that no country was prepared for COVID-19 and neither was India, however, India objectified the interpretation of its existing legislations purposefully to control the spread of COVID-19. The objective of this article is to narrate the best practices adopted by India which helped in timely control of COVID-19 and finally suggest guidelines to control such pandemics in future.

Keywords: COVID-19, Disaster Management, Drugs, Lockdown, Vaccines.

1. Introduction

On 17/1/2020 Ministry of Health and Family Welfare (India) confirmed spread of COVID-19 across China and on 30/1/2020, India reported its first case.[1] India was one of the first country to declare nationwide lockdown, which helped in timely control of the infection. 24/3/2020 to 15/4/2020, first nationwide lockdown was declared[2] and only essential goods[3] and services[4] were permitted to operate. As far as infrastructure is concerned, 136 government-testing centers, 3 additional-collection centers, 59 private-testing labs in 12 states, and approx. 3,000 vaccination centers across states and union territories were established by India, to control the spread of infection and reach the target population.[5] Two types of containment zones were declared, *viz.* geographical quarantine (applicable to whole area) and cluster containment (small zones within large areas). District-wise division was also adopted and projected in terms of red (district having more than 15 cases), orange (district having 0 - 15 cases), and green zone (district having zero

[1] The infection grew fast and by 30th May 2020, India reported 1,73,763 cases; by August, 3,542,733 cases; by 31 December 2020, 10,266,674 cases; by 30th June, 2021 [2nd Wave], 30,362,848 cases; and by February, 2022, 42,924,130 cases; See https://prsindia.org/covid-19/cases (last accessed 04/08/2024).
[2] Next lockdown was from 15th to 30th March, 2020, then extended till 1st to 17th May, 2020, and then again from 18th to 31st May, 2020. During the second wave (2021), India adopted local level lockdowns.
[3] Food, medicine, and electricity.
[4] Telecommunications, banking services, and pharmaceuticals.
[5] See https://prsindia.org/theprsblog/central-government%E2%80%99s-response-to-the-covid-19-pandemic-jan-2020-apr-7-2020#_edn22 (last accessed 04/08/2024).

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cases). Rules such as restriction on large gathering, compulsory mask, and social distancing were imposed throughout India. Domestic and International travel and issue of visas was suspended, even railway travel was suspended. Serum Institute of India Ltd. and Bharat Biotech International Ltd. came up with vaccine manufacturing units to cater the sheer demand of vaccines. In fact, India's vaccine production was running at its prime and it even made international commitments of exporting vaccines to other countries. By early 2021, life appeared to be back on track and unlock guidelines were issued, but it was a miscalculation. India got hit by the second wave of COVID-19 and relaxations in form of reduced roll-out of vaccine production, reluctance of getting vaccinated, elections, T-20 cricket match(Purushothaman & Moolakkattu, 2021), etc., altogether contributed in making it the worst-case scenario. Even Serum Institute of India (SII), world's largest vaccine manufacturer, could not manage to increase vaccine production because of export-ban (on raw material) proclaimed by USA. Medicines, such Remdesivir (approx. ₹ 6,000/-) were sold in black-market for as high as ₹ 38,000/- (approx.). Therefore, to make sure that health disproportions and incongruences do not botch the United Nations' Sustainable Development Goal-3, which ensures healthy lives and promote well-being for all at all ages, major task before India was to make the essential drugs available to the public at affordable price. The cost of essential drugs and access to medical care was a challenge which required a fine balance between economic gain and social welfare. Besides everything else, there were other challenges in form of supply-chain disruption, lack of cold-storage facility in rural areas, logistic challenges such as counterfeiting of vaccines and test kits, and much more.

Comparison between India and USA (2020)						
Country	Population	Landmass	Population density	COVID-19 Patients	COVID-19 Deaths	Category
India	139.64 crores	32,87,263 sq. km	473 people per sq. km of land area	6,70,000 (approx.)	19,000 (approx.)	LMIC
USA	33.15 crores	98,31,510 sq. km	36 people per sq. km of land area	28,30,000 (approx.)	1,30,000 (approx.)	Developed

Figure 1

It is pertinent to note that India, having population of 139.64 crores, landmass of 32,87,263 sq. km, population density of 473 people per sq. km of land area, was a fertile ground for COVID-19. A cursory perusal of Figure 1 is evident of the fact that things could have gone utterly out of control had India not managed the pandemic properly. Social distancing, which became the mantra to beat COVID-19, appears to be a utopian idea having regard of the population density in India. Moreover, in low-and middle-income country (LMIC) there are many factors which adversely affect the affordability of essential drugs. And lastly, dependency on foreign countries to produce vaccines/drugs often leads to disruption in supply chain. Nevertheless, irrespective of all these factors, India managed the pandemic far better than many other countries, therefore, it warrants introspection what practices did India adopt and what we can learn from her. Therefore, following

discussion is a humble attempt to narrate how India overcame the pandemic and that too with least damage to its human resources.

2. Framework of research

The main body of the research is placed in the Discussion Part [4] which is further divided into three sub-parts, *viz.* Drugs, Vaccines, and Lockdown. The idea was to touch upon the definite contours of a pandemic and neatly encompass the measures necessary to control the spread of COVID-19. The research ends with Conclusion and suggestions [Part 5] which includes general guidelines and suggestions to control such pandemics in the future.

3. Significance of study

Humans have innate tendency to grow and devise solution for future problems, however, it is not always true that humans can predict everything in advance e.g. COVID-19. The pandemic pushed scientific temper to its limits and failed most of the scientific and legislative measures in the face of insurmountable odds, taking lives of millions around the world. This research will help in inspiring scholars and academicians around the world to work on similar issues and contribute to the fraternity.

4. Discussion

4.1 Drugs

In low-and middle-income countries (LMICs), where medicines comprise more than half of the total health spending, affordability of essential drugs becomes difficult to achieve because of low-income households and low-level health insurance coverage. Although, generic medicine markets are very mature in most LMICs but such markets are also infested with substandard and even fake medicines(Towse et al., 2012). This led the Government of India to enact price-regulation legislations, e.g. Drug Price Control Order, 2013, (DPCO), which was proclaimed by the Department of Pharmaceuticals, Ministry of Chemicals and Fertilizers and has touched the pricing of over 348 essential drugs (Selvaraj et al., 2022). DPCO is not a new concept, in fact, India has a long history of DPCOs starting from 1960s. Initially, India used to regulate the price of Active Pharmaceutical Ingredients (API) also known as 'bulk-drugs' but National Pharmaceuticals Pricing Policy (NPPP) 2012 shifted the focus from API to 'formulations.' NPPP also made it clear that drug price control shall be based on 'essentiality' as given under the National List of Essential Medicines (NLEM), 2011[6], which is aligned with WHO List of Essential Drugs (priority healthcare needs). These [DPCO] orders, issued by invoking powers under § 3 of the Essential Commodities Act, 1955 (ECA), empower the government to determine the highest price for essential drugs, by drawing the average market price of the particular drug (produced by different brands having market share of 1% or greater) and adding 16% margin to it, which goes to the retailer(Selvaraj et al., 2022). The DPCO also concedes

[6] The first NLEM came in 1996 and then it got revised in 2003, 2011, and 2015. The latest revision is that of 2022.

permission to the National Pharmaceutical Pricing Authority (NPPA), established on August 29, 1997, to supervise and regulate the prices of essential drugs. As a government organization working under the Ministry of Chemicals and Fertilizers, the NPPA's chief task is to create and apprise prices and supply of controlled formulations. To appreciate the objective of DPCOs, it is often proposed that when a drug is regulated through DPCO it will help in improving its sales, which is positively correlated with greater affordability of the drug(Selvaraj et al., 2018). Throughout the emergency of the COVID-19 pandemic, NPPA took the ownership of capping the prices for various medicines[7], ventilators, and other drugs which were essential in handling COVID-19 patients. To proliferate its spread across the country, NPPA also set up Price Monitoring and Resource Unit (PMRU) in various Indian states and union territories. By summoning extraordinary powers, under Para 19 of the DPCO – in greater public interest, NPPA, vide notifications dated 03.06.21/13.07.2021, controlled the Trade-Margin up to 70 percent on Price to Distributor (PTD) level on Oxygen concentrators; Pulse-Oximeter; Blood-Pressure Monitoring systems; Nebulizer; Digital-Thermometer; and Glucometer. It is, however, pertinent to note that not all dosages and forms of molecules are covered under DPCO. The NLEM enlists the essential drugs on different parameters based on dosages, e.g. tablet of paracetamol molecule 500 mg is price controlled whereas 650/1000 mg paracetamol is unregulated, which invariably influences drug manufacturers to shift to unregulated market and discontinue the regulated segments of their drug(Selvaraj et al., 2019). In fact, some scholars contend that because of partial nature of DPCO, i.e. regulating some molecules/dosages while leaving others unregulated, has led to decrease in sale of regulated molecule drugs(Sindhwani, 2018). On the same hand, it is also found that DPCOs have adversely affected manufacturing and supply of drugs which leads to shortage of supply and sometimes even cessation of production and exit from market(Bhattacharjea & Sindhwani, 2014). Besides everything else, DPCO does not have power to regulate non-scheduled drugs. To explain it further, it is pertinent to note that Remdesivir – antiviral medication, sold under the brand name Veklury®, manufactured by biopharmaceutical Gilead Sciences Inc. (USA) and one of the most essential and expensive medications (₹ 6,000/- approx.) for treatment of COVID-19, was beyond the scope of DPCO, since, it fell under Investigational Therapy Category and NPPA could regulate only such medicines which are defined as [Full] drugs under the Drug and Cosmetics Act, 1940. Therefore, the retail price of Remdesivir was subject to the volatility of the market. Nevertheless, major manufacturers of Remdesivir, in 2021, voluntarily reduced the MRP to ₹ 3,500/-. But excessive demand, and low supply of Remdesivir led to black-marketing and exorbitant rise in its price (₹ 38,000/- approx.), therefore, Ministry of Chemicals and Fertilizers issued directions to Drugs Controller General of India (DCGI) to start 24x7 helpline for patients to report complaints about shortage of supply or higher price being charged. In fact, the Nagpur High Court even directed the Centre to include the antiviral drug under the list of scheduled drugs and capable of being regulated under DPCO. But finally, in April, 2021, a ray of hope came in form of voluntary licenses (royalty free) issued

[7] During COVID-19, NPPA capped prices of 355 medicines and 882 formulations, such as Paracetamol, Dexamethasone, Methyl Prednisolone, IVIGs, Enoxaparin, Budesonide, Heparin and Amphotericin.

by Gilead Sciences[8] to its 7 licensees based in India[9], to manufacture Remdesivir with the help of API donated by Gilead Sciences. Resultantly, the price of Remdesivir also got reduced, ranging from ₹ 899/- to ₹ 3,490/- per 100 ml vial.

4.2 Vaccines

The broad difference between drug and vaccine lies in the idea of remedy and preventive measures. In contrast to drugs, which are given to ill-patients, vaccines are meant for healthy individuals and are designed to boost immunity to fight against diseases, viruses, and infections and control their spread. This requires robust planning, in terms of pre-clinic R&D, clinical trials, manufacturing, supply-chains, and vaccination-drives, and all this should happen without any disruption. The R&D is the longest phase, which take years, but during COVID-19 genetic/genome sequencing of novel corona virus (SARS-CoV-2) was put in fast-track. Advanced technologies allowed genome sequencing of the corona virus within hours or days. This altogether helped in timely study of evolution in the virus and supply of information to public authorities to manage outbreak of virus(Bown & Bollyky, 2022). Next is the clinical trial stage [I, II, and III]. National regulatory authorities determine the rules of clinical trials, e.g. in India we have the New Drugs and Clinical Trials Rules, 2019 (CT Rules). During COVID-19, clinical development of vaccines, which usually takes 4 – 10 years, was completed within months. According to WHO, as of July, 2021, 291 vaccine candidates were in pipeline, whereas 6 vaccine candidates[10] had already received regulatory approval from their respective authorities, including WHO (Bown & Bollyky, 2022). India's apex drug regulator - the Central Drugs Standards Control Authority (CDSCO) headed by the Drugs Controller General of India (DCGI) approved two COVID-19 vaccines, *viz.* Covishield and Covaxin, for restricted use in emergency situations. A Subject Expert Committee (SEC) was also created having experts in the fields of microbiology; paediatrics; immunology; pharmacology; etc. who approved the restricted use of COVID-19 vaccines during emergency. As far as foreign vaccines are concerned the CDSCO issued guideline upon receiving recommendations of the National Expert Group of Vaccine Administration for COVID-19 (NEGVAC) for approval of such vaccines declared in WHO use-listing.[11] The guidelines made it possible that a foreign vaccine, having prior approval from WHO, can be used in emergency situations. The next big task was to push the manufacturing units to meet the sheer demand of vaccines and establish supply-chains, that too in the middle of pandemic. An optimistic forecast came from the Coalition for Epidemic Preparedness Innovations (CEPI)[12], which conducted a survey in mid-2020 to tap the largest vaccine manufacturing capacity in the world and India stood at the first position, having largest drug substance

[8] See https://www.gilead.com/news-and-press/press-room/press-releases/2021/4/gilead-sciences-announces-steps-to-expand-availability-of-remdesivir-in-india See also https://www.pib.gov.in/PressReleasePage.aspx?PRID=1719307 (last accessed 02/08/2024)

[9] Cipla, Dr Reddy's Lab., Hetero, Jubilant Pharma, Mylan, Syngene and Zydus Cadila.

[10] Pfizer & BioNTech, AstraZeneca & Oxford, Moderna, Sinopharm, Johnson & Johnson, and Sinovac.

[11] DCGI gave approval to AstraZeneca on 3 January 2021, to Sputnik V on 20 April 2021, and to Moderna on 29 June 2021.

[12] in collaboration with Bill and Melinda Gates-Foundation, Clinton-Health Access Initiative, and PATH. See https://cepi.net/cepi-survey-assesses-potential-covid-19-vaccine-manufacturing-capacity (last accessed 02/08/2024).

(active ingredients) production capacity, while China had the largest 'drug product'[13] production capacity(Bown & Bollyky, 2022, p. 475). However, vaccine manufacturing is a complex two-stage process, it begins with manufacturing of drug substance and ends with its conversion into drug product. The system becomes more complex when the production units need hyper-sanitized rooms, bio-reactors, filtration pumps, skilled personnels capable of transferring the technology developed in laboratories to the production-lines, and lastly, we need to combine the drug substance with other pharmaceutical materials, e.g. excipients, adjuvants, and preservatives. Finally, the drug product reaches the fill and finish stage when the vaccine is transferred into vials, packed, and placed in cold-storage units. But it does not stop there, the next task is to manage the logistics of shipping the vaccines, which also requires cold supply-chain (-70º C to 8º C). When the vaccine reaches the vaccination centre, the skilled personnels, who administer the vaccine, require further material e.g. needles and syringes and even antiseptic-wipes, PPE kits, COVID-19 test kits, etc. (Bown & Bollyky, 2022, pp. 472–473). Besides everything else, there are country-specific logistic problems, e.g. countries like India where temperature can go as high as 50º C, vaccines require refrigeration to maintain the cold supply chain. In fact, any temperature above 10º C degrades the potency of the vaccines very quickly (Rab et al., 2022). However, Covaxin and Covishield, both, could be stored at 2–8º C, which suited Indian climate. The final stage is the actual administration of the vaccines. Although the vaccines were not included in schedule-I of DPCO, nevertheless, COVID-19 vaccination-drive was free of cost at Government COVID-19 Vaccination Centres (CVCs). At Private CVCs, the vaccine was available at a controlled price of ₹ 250/-, in which ₹ 150/- was the vaccine cost and ₹ 100/- was the administration cost (retained by the Private CVC) as per the recommendation made by NEGVAC.[14] India's vaccination-drive, with a network of almost 3,000 vaccination centres throughout India and Information and Communication Technology (ICT), in form of COVID Vaccine Intelligence Network (CoWIN)[15] and Electronic Vaccine Intelligence Network (eVIN)[16], was able to achieve heard immunity and in 2021 there was a steep decline in COVID-19 cases. One issue that India was facing was vaccine accessibility to rural population and to reach them, India entered in a Public-Private Partnership (PPP), i.e. agreement between Government Hospital and Private Hospital.[17] The PPP model played a major role in optimum utilization of India's hospital industry. To comprehend the infrastructure that India had, prior to COVID-19, reference to Figure 2 is imperative. Data in Figure 3 is post COVID-19, which reflects the rise in dedicated COVID-19 infrastructure facility.

[13] e.g. inactive ingredients which improve the functioning of drug substance.

[14] https://sansad.in/getFile/loksabhaquestions/annex/175/AU4456.pdf?source=pqals (last accessed 02/08/2024).

[15] A digital platform to keep track on number of people who have got vaccinated, to collect data (e.g. name, age, address, etc.), to book vaccine shots, to keep track on whether you have met an infected person, etc.

[16] A digital platform for cold storge facility managers, created by Government of India in collaboration with United Nation Development Programme (UNDP), which gathers logistic data pertaining to location of vaccines, number of vaccines used and number of vaccines available. The aim was to create a digitalized network of supply chain network which can provide information in advance and avoid any possible disruptions in supply chain.

[17] See https://www.weforum.org/agenda/2022/09/public-private-partnerships-india-healthcare-ecosystem/ (last accessed 02/08/2024).

Pre-COVID-19 Infrastructure				
Hospital type	Hospitals	Beds	ICUs	Ventilators
Public	25,778	713,986	35,700	17,850
Private	43,486	11,80,000	59,264	29,631
Total	69,264	18,93,986	94,964	47,481

Figure 2(source https://www.institutmontaigne.org/en/expressions/private-healthcare-india-boons-and-banes)

Post-COVID-19 Infrastructure			
	Dedicated COVID Hospitals	Dedicated COVID Health Centers	COVID Care Centers
Hospitals	958	2,313	7,525
Isolation beds	1,67,883	1,33,037	NA
ICU beds	21,614	10,748	NA
Oxygen supported beds	73,469	46,635	NA

Figure 3 (source https://www.pib.gov.in/PressReleasePage.aspx?PRID=1630445)

India also devised an Alternative Vaccine Delivery (AVD) system to reach such rural places having no cold-storage facility and where regular transport could not reach.[18] All these efforts played a major role in reaching target-vaccination and achieving heard immunity. India also made a commitment to save the world from the pandemic and pushed its vaccine manufacturing to its prime and exported 3012.465 vaccines units (in lakhs) to 101 countries around the world.[19] During export some countries (e.g. India, Uganda, and Myanmar) were facing a logistic challenge i.e. the risk of counterfeiting of vaccines and test kits and WHO exemplified the issue with utmost caution and even directed removal of such vaccines from distribution network.[20] Another challenge that India faced was the second wave of COVID-19 which took India by surprise. After the demise of first wave, India declared a premature euphoric sense of winning the war over COVID-19, which was a miscalculation. Multiple factors, such as reduced roll-out of vaccine production, reluctance of getting vaccinated, elections, T-20 cricket match, etc. contributed in spread of infection and there was a rise in flood of patients getting admitted to hospitals(Purushothaman & Moolakkattu, 2021). To make the situation even worse, concentration of raw material production capacity made 'vaccine-nationalism' a possible reality and USA made it on record that their vaccines are meant for their respective citizens and much of the raw material needed to manufacture COVID-19 vaccine got scarce(Bown & Bollyky, 2022, p. 475). Bharat Biotech International Ltd. collaborated with Council of Scientific and Industrial Research (CSIR) to make India self-reliant and produce raw material[21], however, Serum Institute of India, the world's largest vaccine manufacturer,

[18] See https://www.unicef.org/india/stories/alternate-vaccine-delivery-reaches-indias-most-climate-vulnerable-district (last accessed 02/08/2024).

[19] This is the latest data updated as on June 15, 2023; See https://www.mea.gov.in/vaccine-supply.htm (last accessed 02/08/2024).

[20] See https://www.who.int/news/item/31-08-2021-medical-product-alert-n-5-2021-falsified-covishield-vaccine (last accessed 02/08/2024).

[21] See https://www.csir.res.in/csir-science-stories/covid-19-vaccine-csir-iicts-contribution (last accessed 02/08/2024)

was soon at the receiving end of adverse consequences because of export-ban imposed by USA, since, the 'raw material'[22] needed to produce Covishield came from USA. Resultantly, India experienced disruption in vaccine supply chain and even had to stop its vaccine export drive. Finally, Government of India funded ₹30 billion and ₹15 billion to SII and BBIL, respectively, to increase vaccine manufacturing roll out. In fact, by June, 2021, US withdrew its export-ban as well and thereafter, even SII was able to increase its production capacity.

4.3 Lockdown

24th March to 15th April, 2020, India declared its first nationwide lockdown and only essential goods, such as food, medicine, and electricity, and essential services, such as telecommunications, banking services, and pharmaceuticals, were permitted to operate. Two types of containment zones were declared, *viz.* geographical quarantine (large outbreaks-applicable to whole area) and cluster containment (small zones within large areas). The territorial demarcation of cluster containment was determined, in case of rural area by drawing a 3 km radius of the containment zone[23] and a 7 km radius (5 km in case of urban area) of buffer zone was also draw. District-wise division was also adopted and categorized in terms of red (district having more than 15 cases), orange (district having 0 - 15 cases), and green zone (district having zero cases). Restrictions, from severe (Red) to mild (Orange) to no-restrictions (Green) were graded according to the zones. But some restrictions, in form of social-distancing, sanitization, and wearing of masks, were applicable throughout India irrespective of the zone. Parameter of cluster containment zones was determined with the help of existing geographical boundaries in form of roads, rivers, bridges, etc. and entry and exist points were created. Only essential goods and services were allowed to enter the containment zones and every entry-exist were recorded. The red-zone (hotspot) was determined on the parameters of percentage contribution to the total COVID-19 cases, e.g. a district contributing more than 80 percentage of the total cases in India, or districts contributing more than 80 percentage of total cases for each state in India, or districts where cases have doubled in past 4 days. Active surveillance (house to house visit, questionnaire, report to supervisor, and daily analysis) and testing (symptomatic and asymptomatic signs, SARI[24], and direct/indirect contact with infected person) was carried out in clusters and large outbreak areas. A three-stage model was adopted to divide the infected population depending upon the clinical profile, *viz.* institutional care[25], pharmaceutical intervention[26], and non-pharmaceutical intervention[27]. A dedicated workforce was employed to keep active surveillance on containment zones and numerous governmental agencies were involved in procuring the safety kits necessary

[22] Bioreactor bag, cell culture media, filter, microcarriers beads and lipid nanoparticles.
[23] In case of urban area, it was the administrative boundary of the residential colony.
[24] Fever and cough and/or shortness of breath.
[25] Patient to be admitted to COVID Care Center, COVID health Center or COVID hospital. Any person who came in contact with infected person will be kept in home-quarantine, except in case of high-risk contacts in which case the person will be shifted to institutional quarantine.
[26] Patient to be administer hydroxychloroquine (HCQ) in prescribed dosage.
[27] Social distancing, closure of schools, colleges, etc., hand washing & cough-etiquettes; ban on public-gathering; transport suspended.

for COVID workers (See Figure 4). Besides, active testing, the COVID workers were also involved in spreading awareness, house-to-house, about social-distancing and hygiene.

Resources required for active surveillance		
Human resource	Material resource	Risk communication
ANM, AASHA, Anganwadi, NSS, Red Cross, Ayush students NYK Volunteers, PHC, Ayush and CHC doctors, medical college, and private hospital staff.	PPEs/N95 masks etc.	During house-to-house testing/surveillance COVID workers were directed to spread awareness on social distancing and hygiene.

Figure 4 (source: https://delhishelterboard.in/main/wp-content/uploads/2020/05/Collectors-15-4-20-930PM.pptx)

Active surveillance and testing of containment zones helped in limiting the spread of infection. A red zone district (hotspot) could be declared orange zone only if there had not been any case in past 14 days and an orange zone district could be declared green zone only if there had not been any case in past 14 days. Meaning thereby that it would take 28 days for a red zone to convert into green zone. Although India did not have a specific legislation to deal with COVID-19, however, to control the spread of infection certain legislations were interpreted purposefully to deal with COVID-19. Disaster Management Act, 2005 (DMA) provides measures to deal effectively with disasters (natural or man-made) resulting in substantial loss of life, suffering, or damage/destruction of property or environment which is of such magnitude that it is beyond the control of mankind. The DMA was drafted to tackle disasters such as earthquake, flood, or fire and not disease such as COVID-19, however, the Home Ministry declared COVID-19 as a 'disaster'[28] and thus brought it under the ambit of DMA. The DMA worked in tandem with the Epidemic Diseases Act, 1897 (EDA) which provided extensive powers to the administrative agencies to take containment measures and prohibit large gatherings in public. Lockdown, i.e. restriction on free movement, is not a legal term, however, it became possible to declare lockdown by invoking EDA. Only essential services, as provided under § 2, 3, and 4 of EDA, were granted exemption from the lockdown rules. § 188 which relates to disobeying directions given by a public servant, § 270 which relates to malignant act likely to spread infection of disease dangerous to life and § 269 which relates to negligent act likely to spread infection of disease dangerous to life were such provision of the Indian Penal Code, 1860 (IPC) which were also used to make the concept of lockdown get legislative backing. Similarly, the District Magistrate, SDM (Sub-Divisional Magistrate), and Executive Magistrate issued order under § 144 of the Code of Criminal Procedure, 1973 (CrPC) to prevent public disorder, riot, or an affray during Lockdown. Similarly, the concept of quarantine and isolation was adopted from other legislations such as Indian Aircraft (Public Health) Rules, 1954, and Indian Port Health Rules, 1955, and together, these two legislations made it possible to take containment measures and control the spread of COVID-19 by declaring quarantine zones and isolating people who are infected. Although,

[28] https://www.mha.gov.in/sites/default/files/MHA%20order%20dt%2015.04.2020%2C%20with%20Revised%20Consolidated%20Guidelines_compressed%20%283%29.pdf (last accessed 02/08/2024)

lockdown rules helped in controlling the spread of infection, however, it also had a negative impact on mental health and many experienced stress, depression, anxiety, insomnia, anger, denial, and fear. In fact, the fear of getting infected acted as a catalyst and triggered relapse or worsening of mental disorders. Moreover, mental health issues were not limited only to those living inside their homes (24x7), it extended even to frontline workers, e.g. doctors, nurses, policemen, etc. who had to take difficult decisions in stressful conditions, at the cost of risking their life, to save others. In addition to this, frontline workers, who were always at high-risk of infection, were also at the receiving end of stigmatization and often discriminated by public. Besides everything else, lockdown had the worst impact on children and elderly people. Children who were yet to experience the outside world, which invariably helps in their mental development, were forced to live within the four walls. Online education models were not so developed which could help in cognitive learning among children. Elderly people also experienced a sea-change in their daily routine and could not cope up with the new way of life (online) that COVID-19 forced them to adopt. Old age, which is positively correlated with cognitive challenges, such as dementia, loneliness, etc., placed the elderly population at a greater risk of confusion and mental illnesses. To tackle these issues Ministry of Health and Family Welfare – Government of India issued a toll-free helpline (Psycho-Social helpline) for people seeking help to deal with mental health issues. Institutions such as National Institute of Mental Health and Neuro-Sciences (NIMHANS), Indian Psychiatric Society, and All India Institute of Medical Sciences (AIIMS) all took the responsibility of managing and promoting mental health with the help of telemedical services and online services(Roy et al., 2021). To substantiate the claim that COVID-19 had a negative impact on the mental health reference to certain surveys is imperative. One survey of 1871 people, conducted from 6th – 24th April, 2020, found that approximately 38% had anxiety, 10% had depression, 40% had either depression or anxiety, 74% reported moderate stress, and 71% reported poor well-being(Grover et al., 2020). The gravity of the situation can be gauged by referring to National Mental Health Survey (2016) according to which an alarming 83% of people suffering through mental-health issues did not have access to mental health treatment. Moreover, the Union-Budget for 2021-22 allocated ₹ 71,269/- crore to the Ministry of Health and Family Welfare (MoHFW) of which only ₹ 579 crore was assigned for mental health care, which is just 0.8% of the total budget allocated to MoHFW.[29] Along with mental impact, COVID-19 also affected the economic structure of India. India's GDP suffered badly because of COVID-19 and 2020Q2 there was -24.4 % year-on-year impact; 2020Q3 it was -7.4 %, 2020Q4 it improved to 0.5%, and 2021Q1 it improved to 1.6%., nevertheless, to protect its human resources, on 26/4/2020 India declared 1.7 lakh crore relief package for poor.[30] On 31/4/2020 an ordinance was also promulgated to give extension and relaxation from paying taxes.[31] Reserve Bank of India (RBI) also directed banks and financial-institutions to permit 3 months moratorium on payment of loan instalments. RBI also increased the loan Ways and Means Advances (WMA) limit, to states

[29] See https://projects.iq.harvard.edu/aia/news/overview-mental-health-crisis-covid-19-india (last accessed 05/08/2024)

[30] Under Pradhan Mantri Garib Kalyan Yojana.

[31] The Taxation and Other Laws (Relaxation of Certain Provisions) Ordinance, 2020.

and union territories, 30% above the existing limit. A report published by Centre for Economic Performance (CEP) while referring to a survey conducted by Centre for Monitoring Indian Economy, titled Consumer Pyramids Household Survey (CPHS), contends that during the first national lockdown, individual income fell by 40% (approx.) and some 230 million people fell below poverty line (line is ₹ 1,600/- for rural and ₹ 2,400/- for urban). The year-on-year urban-unemployment rate jumped from 8% (approx.) in April-June 2019 to 20 % (approx.) in April to June 2020. According to data provided by CPHS rural poverty increased by 14.2% and urban by 18.1% (August 2019 – August 2020). COVID-19 struck youngsters (aged 18 – 25 years) the hardest and almost 45% were having no work or no pay. This led to huge migration of workers, from urban to rural, and even after the demise of first wave, most of them showed reluctance, fearing transmission of infection and death, to return to urban areas and rejoin employment. Learning from the past, when the second wave caused havoc, India refrained from declaring a nationwide lockdown and opted for local lockdowns. Some reports also content that India did underreporting of COVID-19 related deaths, but it is rightly said that underreporting was not limited to India, in fact, it became a global phenomenon.[32]

5. Conclusion and suggestions

It is trite to mention that nationwide lockdown declared by India had a negative impact on the economic structure but it is also true that India gave more importance to human resources and made every effort to save it from greater evil. It is true that on some grounds India could have done better, however, we must not forget that India is one of the most populated countries in the world and still it managed to control the epidemic. To begin with, following are some policy guidelines which could be adopted in future. Moreover, they are not limited to COVID-19 but could be adopted under any pandemic-like situation:

- Latency effect: More often than, our mode of thought is limited to treating an illness from present-day perspective and thus we forget about its latency effect. COVID-19 had numerous latency effects, e.g. mental illnesses, weight-gain (because of sedentary lifestyle), cognitive impairments, learning disorders, etc., which missed the scrutiny of policy makers. Future policies should focus on targeting the population even after the demise of pandemics and curing these latency effects.
- Vaccine Development Program (WHO): As a permanent measure WHO should start a fully funded vaccine development program, promoting countries around the world to produce vaccines, especially designed to boost immunity. These vaccines should become part of annual vaccination-drive to maintain immunity of world population. The proposed WHO Vaccine Project (fully-funded) should inculcate the idea of International Interdependency in a positive manner and should promote global trust among the WHO members to share their technology to save human resources from pandemics. Future scientific research should also focus on developing thermos-stable vaccines (to fight against infections), which do not require refrigeration. With thermos-stable vaccines it will become possible to store vaccines, and reach every corner of a country, even if there is no

[32] See https://cep.lse.ac.uk/pubs/download/cp619.pdf (last accessed 05/08/2024).

cold-storage facility. Thermo-stable vaccines will also benefit such countries where temperature can get very hot.

- Blockchain technology: The issue of vaccine counterfeiting can be resolved by adopting blockchain technology. In fact, SUKU, a blockchain ecosystem in partnership with Smartrac, an Avery Dennison (NYSE: AVY) company, on May 2020 gave a digital solution to keep a check on authenticity of vaccines and test kits with the help of NFC Radio-frequency identification (RFID) tags and since it is based on blockchain technology the chain of manufacturer-to-consumer cannot be tampered.[33]
- Non-Pharmaceutical Intervention (NPI): Measures such as wearing of masks, hand sanitization, hygiene, and cleaning drives, etc. should become permanent measures around the world. Many studies have shown that NPI helped in controlling the transmission of COVID-19. In fact, countries where mask-wearing was compulsory showed lower mortality rate in comparison to such countries where mask-wearing was optional(Zhang et al., 2023).
- Population control measures: In *Essay on Principle of Population*, Malthus proposed that humans lack self-control when it comes to sexual desires and only means of controlling population-growth are late marriage and self-control, but Malthus could not appreciate contraceptive procedures to cap population-growth. Malthus also failed to understand that advancement in technology will certainly help in regulating population growth. Many research findings are evident of the decline in fertility-rate where contraceptive measures have been adopted(Vedi, 2017, p. 429). The Family Planning Health Services Project, Matlab (Bangladesh), started in 1977, promoted use of contraceptives, which led to fall in fertility-rate from 6.92 births-per-woman, in 1972, to 2.17, in 2014(Phillips et al., 1982, pp. 131–134). If we continue to promote contraceptive measures around the world it will certainly help in controlling the transmission of infection and social distancing will become a possible reality even when there is no emergency/pandemic.
- Mock drills of lockdown: To make the public and coming generations clued-up about the concept of lockdown, countries around the world should schedule three mock drills (of 1 week) every year. These drills will make us attuned to the nuances of lockdown and in case of early signs of warning it will not take much effort to declare lockdown. These mock drills should be accompanied by social distancing, compulsory mask in public, door-to-door community service delivering immunity booster diets, and promotional ideas to make households self-sustainable.
- Pandemic Accord: At the cost of repetition, it is pertinent to note that no country was prepared for COVID-19 and neither was India. India had to interpret its already existing legislations to control the spread of COVID-19. Therefore, it is imperative that countries around the world should draft legislation to specifically deal with pandemics such as COVID-19. In fact, in December, 2021, WHO member States requested WHO Director General to convene Intergovernmental Negotiating Body (INB) meeting to draft a Pandemic Accord, which shall bind all the [194] member states. So far, nine INB meetings have been convened and the Health Assembly has decided to finalize the draft

[33] See https://rfid.averydennison.com/en/home/news-insights/press-releases/smartrac-and-suku-leverage-nfc-and-blockchain.html (last accessed 08/08/2024).

by May, 2025, and submit the same at the 78th World Health Assembly. The objective of Pandemic Accord, *inter alia,* is to address the gap which highlighted during COVID-19, such as human-animal interface and spread of infection, preparedness of world to respond to dangerous pathogens; and secure global trust among the member States.

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