Clinical Case Reports International

Review Article
Published: 16 Sep, 2022

Tragic COVID-19 Second Wave in India

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Abstract

India now experiencing a second wave of COVID-19 infection. India's first peak was in September 2020 and then the number decreased. However, India started vaccine diplomacy but did not arrange sufficient vaccine doses for their people. Lack of social distancing, no use of mask, attending social program fuelled the COVID-19 infection. India got one year to improve the health sector but in reality, all are in a dream now. Lack of oxygen support, vaccines, and capacity in hospital beds are now the bottlenecks to tackle the second wave of COVID-19 India.

Keywords: COVID-19; India; Second wave; Vaccine; First Wave; Economy

Introduction

The biggest threat in humankind is now COVID-19, which is of Zoonotic origin and spreads through aerosol transmission of respiratory droplets. It started from the seafood market in Wuhan, Hubei, China back in December 2019, and within 2 months, it spread worldwide and WHO declared it as pandemic [1,2]. Most common symptoms include dry cough, fever, difficulty of breathing, and tiredness or fatigue [3,4]. It is estimated that transmission of SARS-CoV-2 is occurring mainly by airborne [5]. To tackle the issues, several countries went into a lockdown scheme. During this national lockdown, restrictions were imposed on most of the movement, home confinement was mandatory, and exceptions were given only for essential food shopping [6]. Physical distance, use of mask, hand sanitization, respiratory hygiene, prompt self-isolating, and prompt testing are the so-far worldwide COVID-19 prevention techniques. A recent survey of WHO reveals that globally 90% of countries are still struggling to come back to their pre-COVID-19 condition in terms of health services.

Now, the world is experiencing a second wave of COVID-19 infection [7,8]. Often the second wave from infectious diseases occurs after a relative decrease in the number of patients with the disease. The second wave may increase among specific age groups or populations, or in particular areas of each country and become as widespread as the first wave. The first wave of a pandemic is followed some months later by a second or third wave of infection. This can be severe as experienced previously in the influenza pandemics of 1918 (H1H1), 1957 (H2H2), 1968 (H3N2), and 2009 (H1N1) [9]. It may be a question that why there is always a second wave. Probably the answer is, most often, infected people in one region do not develop herd immunity and they are re-exposed again to the infection from people who got infected from the first wave [10]. After the COVID-19 last year, WHO including all research articles, scientists, and researchers, expected that there could be a second wave from COVID-19. The threat arriving from the COVID-19 second wave was already assumed and reported by researchers [11,12].

Some countries, like South Korea and Singapore, got success to flatten the virus spreading by employing comprehensive testing and tracing regimes. Furthermore, UK, France, Italy, Spain managed to flatten the wave by imposing lockdowns. On June 22nd, 2020, South Korea announced the second wave although the number was low [13]. In this country so far death count was 301 (as of July 31st, 2020). South Korea has conducted 1,295,962 tests since January 3rd, 2020, to detect the illness [14]. On January 23rd, COVID-19 officially hit Vietnam and by the 8th of September 2020, Vietnam had a second wave [15]. The first wave commenced in Spain, from mid-March 2020 and continued for 3 months and again the second wave started in mid-September 2020 which stayed until 2020 Christmas [16]. Sweden's COVID-19 cases peaked during the first wave with 102 reported deaths (7-day rolling average) on April 21st, 2020. On December 20th, 2020, COVID-19 deaths in Sweden had reached more than 8,000 [16]. The second wave from COVID-19 was theoretically studied for Iran, where model validation and the prediction were performed using data from January 22nd to June 25th, 2020. It was predicted that the second wave would be more severe than the first wave. The most effective way to the improvement of weakly immune people is to employ appropriate medical

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Received Date: *10 Aug 2022*
Accepted Date: *12 Sep 2022*
Published Date: *16 Sep 2022*

Citation:
Ghosh A, Nundy S. Tragic COVID-19 Second Wave in India. Clin Case Rep Int. 2022; 6: 1396.

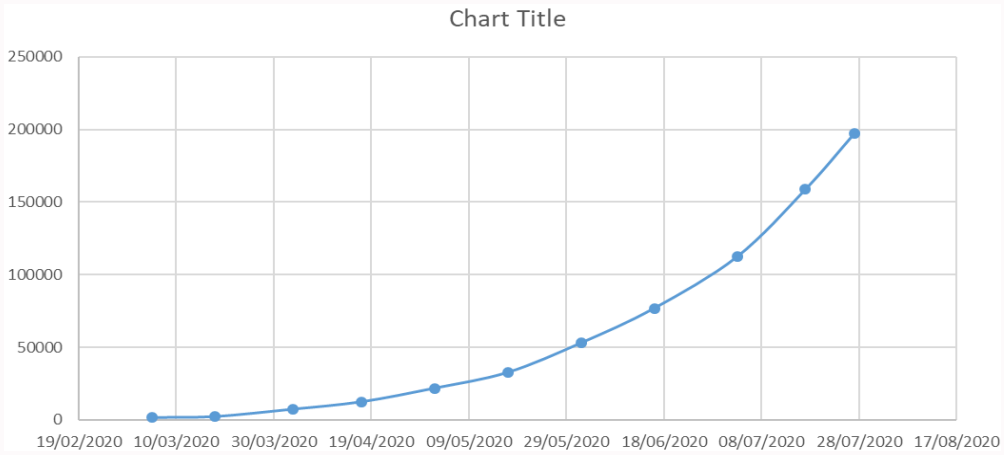

Figure 1: Total confirmed COVID-19 cases between March 25th and June 1st, 2020. Source: COVID-19 INDIA (2020).

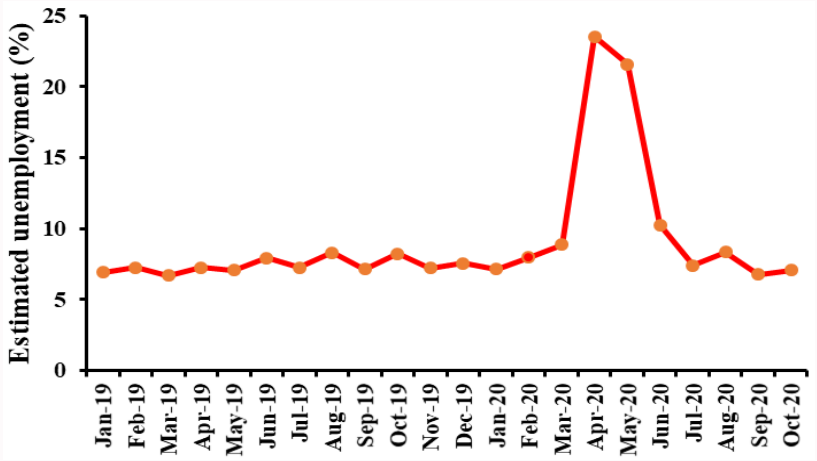

Figure 2: Unemployment in India between January 2019 and October 2020. Source: Consumer Pyramids Household Survey (2020).

facilities [17]. Modeling studies in the UK suggested that the test-trace-isolate program could reduce the chances of the second wave in the UK, as there is a chance to reopen the school from September. The absence of sufficiently broad test–trace–isolate coverage and reopening of schools can result in reproductive number over 1 and would peak up cases in December 2020, which will be 2 times to 3 times the size of the original COVID-19 wave [18]. This has happened in reality and the UK again started lockdown and strict restrictions.

Last year one study revealed that India could face a deadly second wave and in present-day India is facing this enormous life-taking wave. Currently, India is facing another wave, or better to say the second wave, and much more in world discussion. In this work, how Indian is dealing with the second wave of COVID-19 and vaccination and other associated issues are discussed.

First Wave in India

India is the 2nd most populated country in the world after China, and a center of attraction because of its diverse variation. India has 28 states and 8 Union Territories. Its population is more than 1.35 billion, of which 2.75 million are below the poverty line. A significant variation is present in India where the smallest state Sikkim has a population closer to Bhutan and the largest one Uttar Pradesh has a population similar to Brazil. Goa which has the highest GDP per capita can be comparable to Jordan while the poorest state Bihar is similar to that of Haiti [19]. Thus, state-wide variation is not surprising. The health care system in India is also a mixture of public and private health care systems, available in rural and urban locations. The government unfortunately spends only 1.17% of its GDP on health care [20]. The overall capacity of private health care is 4 times that of the public sector.

January 30th, 2020, was the day when the first case of COVID-19 was detected in the southern state of India. Within few weeks, COVID-19 spread throughout the country and reached the count of 100 by March and close of 1,600 by end of March. Consequently, the first death from this disease also happened in March. To tackle the spread Indian PM announced a nationwide lockdown without any heads up to the citizen. Initially, the lockdown was until April 14th, 2020, which later was extended to May 03rd, 2020, and then June 01st, 2020 [21]. To understand how the lockdown worked in India, the stringency index was performed which showed that at the starting of lockdown the stringency index was 100 whereas, in other countries which also faced serious lockdown, the index was not satisfactory and appeared low. On April 12th, 2020, Italy scored a stringency index of 93.5, while Belgium and Peru counted 81.48 on March 22nd, 2020, and 96.30 on May 01st, 2020. However, India's score fell to near 82 in May 2020, which evidently indicates that lockdown which was followed

according to the governmental rules at the beginning, did not at the end.

As shown in Figure 1, it is apparent that this lockdown did not help India to stop the spread and India experienced its peak in September 2020. Back in September 2020, India faced 90,000 cases every day including 1,200 deaths. Lockdown had limited success and it drastically impacted the Indian GDP, which fell 23.9% than that of the same quarter in 2019. Sharp unemployment was prominent because of the lack of jobs. Industrial Production (IIP) fell by 36% during the 3 months between April and June of 2020 compared to the previous year [19]. Indian government behavior towards migrant workers was negligent which the world experienced last year. Unnecessary death, due to the impact of COVID-19 lockdown which was not directly related to the COVID-19 occurred, was nearly 600 by late May 2020 [22]. The death of 23 individuals from March 12th to April 11th, 2020, was recorded due to suicide. Fear of isolation or domestic violence was the reason behind these tragic incidents [23]. This noticeably indicates that not only economic issues, social health, and mental issues were also key aspects due to the prolonged lockdown period.

The air quality of India is always in bad shape which got an immensely positive impact due to last year's COVID-19 lockdown. In India, mainly major urban places and cities have poor air quality. Because of the lockdown transport, industries were closed which limited the emission of harmful gases. Compared with the immediate Pre-Lockdown period (PL3), the average PM2.5 and PM10 reduced by up to 51% and 47% respectively during the lockdown periods [24-26].

Second Wave in India

In mid-September, India had a peak of 93,000 cases per day, which started declining, and the Indian government, policymakers, media; politicians thought India is free from COVID-19. Restrictions were less and elections campaigns for five states were announced for 186 million people to cast their vote. In January 2021 Indian started its vaccine diplomacy by shipping vaccines to foreign countries. Interestingly last year, a research study from MIT suggested that without proper treatment or vaccination, India can surge up to 0.287 million cases by early 2021. India reported more than 100,000 new cases on April 04th, 2021, and a new record for the country was observed, a level not seen in its first wave. On April 15th, 2021, new COVID-19 infected cases were 0.2 million in India. On May 4th, COVID-19 cases were more than 20.2 million. The western state of Maharashtra, which has been India's COVID ground zero from the start of the pandemic, is back at the top after briefly reporting a drop in cases. This state, among India, the richest and home to its financial hub, Mumbai, confirmed more than 66,000 cases last night. It is widely agreed among experts that both cases and deaths are being under-reported in India right now. The Lancet COVID-19 commission warned that India could experience recording more than 2,300 deaths every day by the first week of June.

To understand the COVID-19 cases two factors can be considered: (a) Test Positivity Rate (TPR= total infection/total cases); (b) Case Fatality Rate (CFR= total deaths/total infections). The Test positivity rate shows whether testing is enough to limit the virus spread by employing quarantine and isolation. According to WHO, TPR below 5% is good which indicates the health care program is working sufficiently. India had over 5% TPR during the first wave and started declining from August 2020. On April 14th, 2021, TPR was

Table 1: State-wise TPR and CFR in India on April 15th, 2021 [27].

State	CFR	TPR
Maharashtra	1.6	15.7
Nagaland	0.7	8.9
Kerala	0.4	8.5
Chhattisgarh	1.1	7.6
West Bengal	1.7	6.5
Andhra Pradesh	0.8	6
Madhya Pradesh	1.2	5.3
Tripura	1.2	5.1
Rajasthan	0.8	5.1

5.4%. State-wise TPR also varied. Maharashtra had a very high TPR of 15.7% indicating very high transmission. State-wise transmission on April 15th, 2021 is listed in Table 1. As of 11th May India has tested more than 305 M samples. Tests include both, RT-PCR and Rapid Antigen. India's current test positivity rate (7DMA) is 22%. Table 2 shows the current TPR test no in India.

Vaccination and variant

Mass vaccination program to tackle COVID-19 was started in

Table 2: TPR and total test no in India according WHO from March to September 2021.

Date	Tested	TPR	Test
21st September	540	2.10%	RTPCR and Rapid Antigen
15th September	530	2.07%	
8th September	519	2.55%	
31st August	501	2.50%	
24th August	496	1.90%	
17th August	484	2%	
10th August	471	2.40%	
3rd August	460	2.40%	
27th July	448	2.40%	
20th July	436	2%	
13th July	423	2.30%	
6th July	411	2.40%	
29th June	398	2.75%	
22nd June	386	3.25%	
15th June	373	4.38%	
8th June	360	5.93%	
1st June	346	8.60%	
25th May	332	12%	
18th May	318	17.60%	
11th May	305	22%	
4th May	293	21.60%	
27th April	280	20%.	
20th April	269	16%	
12th April	257	10.70%	
5th April	249	7%	
29th March	241 million	5.33%	
21st March	233 million	3.80%	
15th March	703,772	2.87%	

Table 3: List of vaccines with their efficacy [33,34].

Vaccines Name	Country of origin	Efficacy	How they work	Reference
Pfizer /BioNTech (BNT162b2m-RNA)	United States and Germany	95%	Genetic code teaches immune system how to make part of virus that triggers immune response	[35]
Moderna-US National Institutes of Health (mRNA-1273)	United States	95%	Genetic code teaches immune system how to make part of virus that triggers immune response	[36]
Sputnik V (Gamaleya Gam Covid Vac)	Russia	91%		[37,38]
AstraZeneca-Oxford (ChAdOx1 nCov-19)	UK and Sweden	70%	Modified virus tells body how to make part of the virus that triggers immune response	[39]
Johnson and Johnson (Ad26.COV2.S)		72%	Modified virus tells body how to make part of the virus that triggers immune response	

Table 4: Details of two vaccines [41].

Vaccine name	Covishield®	Covaxin®
Manufacturer	AstraZeneca's vaccine manufactured by Serum Institute of India	manufactured by Bharat Biotech Limited
Composition	inactivated adenovirus with segments of Coronavirus, Aluminium Hydroxide Gel, L-Histidine, L-Histidine Hydrochloride Monohydrate, Magnesium Chloride Hexahydrate, Polysorbate 80, Ethanol, Sucrose, Sodium Chloride, and Disodium Edetate Dihydrate (EDTA)	Inactivated Coronavirus, Aluminum Hydroxide Gel, TLR 7/8 Agonist, 2-Phenoxyethanol, and Phosphate Buffered Saline [NKA1].
Temperature for transport and storing	+20°C to +8°C	+20°C to +8°C
Time between two vaccine dose	Four to six weeks or four to eight weeks	Four to six weeks

December 2020 after one year of its first case reported. Emergency Use Listing (EULs) for COVID-19 vaccine was issued by WHO. On December 31st, 2020 Pfizer, on February 15th, 2021, two versions of the AstraZeneca/Oxford, (manufactured by the Serum Institute of India and SKBio), and on March 12th, 2021, Ad26.COV2.S, (Johnson & Johnson) were EUL listed by WHO. According to WHO, the vaccine should be taken if possible and even if you experienced COVID-19. However, it is too early to predict how these vaccines will work and protect and research is continued. It is still advised to take a vaccine because it will develop immunity inside the human body and will probably reduce the risk of illness development. In general vaccine development goes several stages which include pre-clinical (vaccine development in the lab), Phase 1 Clinical trial (8 participants to 10 participants; for vaccine testing safety); Phase 2 clinical trial (50 participants to 100 participants; for testing vaccine immunogenicity i.e. production of antibodies against virus); Phase 3 clinical trial (30k participants to 50k participants; for testing actual protection offered by the vaccine) [28]. However, this COVID-19's dreadful impact forced to development of a vaccine within a year compared to other previous diseases [29]. For example, the development of the polio vaccine took 40 years, 5 years for Ebola, and an average of 15 years for most of the vaccine development [30]. To understand how vaccines are working properly, efficacy is useful term. Efficacy is a degree of relative lessening in threat. To understand it in bête way; if someone has cloned of him/herself which having one version fully vaccinated and other version is not then the vaccinated one will have 95% less risk to get risk. In reality cloning of human being is not possible hence in the lab randomization is employed [31]. According to WHO, vaccine will only is allowed in the market if it has at least 50% efficacy and higher is better [32]. Table 3 lists the vaccines and their efficacy.

India targeted to vaccinate 300 million people by August 2021, and by February 8th, 2021, India was able to vaccinate 6 million beneficiaries countrywide [40]. In India, two different vaccines are available which include Covishield and Covaxin. Covishield® vaccine is the same patent technology developed by the AstraZeneca vaccine and manufactured by the Serum Institute of India. According to the Indian Government website, the choice of vaccine is not an option of public, though it will be made available in various parts of India. The first group includes healthcare and frontline workers. The second group to receive the COVID-19 vaccine will be persons over 60 years of age and persons between 45 and 59 years of age with comorbid conditions. Vaccines are mostly liquid products. As of May 5th, 2021 total vaccination has been done for 16,04,94,188 people.

At the beginning of the vaccination program, vaccines were free from government medical healthcare while private hospitals charged 250 rupees ($3) which were changed later. Serum institute decided to sell shots at 150 rupees to central, 300 rupees ($4) to state, and the private hospital for 600 rupees ($8). Bharat Biotech decided to charge 150 rupees to central, 400 rupees ($5.50) and private hospital for 1200 rupees ($16) [42]. European Union paid $2.15 per dose for the AstraZeneca vaccine. According to them, the price reduction is because of the EU's contribution to vaccine development. This high price for Covaxin is shocking as it is made by an Indian company. On the other hand, Covaxin didn't publish yet its phase 3 clinical trial data in a peer-reviewed scientific journal, and has only announced its interim efficacy data-claimed to be around 80% through a press release. Now Sputnik V vaccines got a green signal to be used and at the first phase, 125 million doses will be distributed. Details of the present two vaccines are listed in Table 4 and Table 5, which show the other vaccines that are under process.

However, there is still doubt that the vaccination plan will not work properly as the COVID-19 virus is mutating and new variants as listed in Table 6. WHO has been tracking mutations and variants since the start of the COVID-19 outbreak. Currently, there is no agreed international naming system for variants. In India, the active variants are B.1.617 and B.1.1.7.3.2.

Current issues in India

COVID-19 patients with severe conditions suffer from respiratory distress [44]. Data from China showed that COVID-19 patient needs oxygen treatment and those who are critical should be taken care with mechanical ventilation [45]. WHO, Welcome Trust, and Unit aid had set COVID-19 oxygen Emergency Taskforce that will deal with $90 million to fund the "immediate emergency response". Initially, they will target 20 low and middle-income countries (e.g. Afghanistan, Malawi, and Nigeria) over the coming year [46]. Oxygen employed for medical purposes should contain 82% pure and contamination-free oxygen and should be generated by an oil-free compressor [45]. Oxygen concentrators, plants that generate oxygen and liquid oxygen in the storage tank are the common sources of oxygen that could be

Table 5: Other vaccines which are under pre-clinical or Phase I or II stages [28].

Product Name	Indian Manufacturer + Collaborator
ZyCoV-D (DNA vaccine)	Cadila Healthcare Ltd, Ahmadabad (Zydus Cadila) + Dept of Biotechnology, India
Sputnik V (Human Adenovirus vaccine)	Trialed and manufactured in India by Dr. Reddy Lab. + Gamaleya National Center, Russia
NVX-CoV2373 (Protein Subunit)	Serum Institute of India, Pune + Novavax
Recombinant Protein Antigen based vaccine	Biological E Ltd, Hyderabad + MIT, USA
HGCO 19 (mRNA based vaccine)	Genova, Pune + HDT, USA
Inactivated rabies vector platform	Bharat Biotech International Ltd, Hyderabad + Thomas Jefferson University, USA
Vesiculo Vax Platform	Aurobindo Pharma Ltd, Hyderabad + Aurovaccine, USA

Table 6: Variants of concern or under investigation [43].

Variant	The names by which this variant may be known	Lineage	Country in which first detected
VOC-20DEC-01	VOC-202012/01	B.1.1.7	England, UK
VOC-20DEC-02	VOC-202012/02	501Y.V2 B.1.351	South Africa
VUI-21JAN-01	VUI-202101/01	P.2	Brazil
VOC-21JAN-02	VOC-202101/02	P.1	Japan ex Manaus, Brazil
VUI-21FEB-01	VUI-202102/01	A.23.1 with E484K	England, UK
VOC-21FEB-02	VOC-202102/02	B.1.1.7 with E484K	England, UK
VUI-21FEB-03	VUI-202102/03	B.1.525 (previously designated UK1188)	England, UK
VUI-21FEB-04	VUI-202102/04	B1.1.318	TBC
VUI-21MAR-01	VUI-202103/01	B1.324.1 with E484K	TBC
VUI-21MAR-02		P.3	TBC
VUI-21APR-01		B.1.617	India
VUI-21APR-02		B.1.617.2	India
VUI-21APR-03		B.1.617.3	India

used.

In India, during this current second wave, hospitals are facing a shortage of medical oxygen. However, the director of Inox Air Products, which supplies 50% of the oxygen demands in the country, claims that India has sufficient oxygen to deal with the present condition. India produces more than 7,000 metric tons of liquid oxygen per day. Uneven supply and logistical issues have led to an oxygen crisis in some states. Some other major oxygen manufacturers in India include Indian Linde India, Goyal MG Gases Pvt. Ltd., National Oxygen Limited [47]. In India, the health care sector consumes 15% of total produced oxygen while the rest are consumed by industry. During this pandemic, 90% of oxygen is now supplied to the medical sector and still, the situation is critical. The allocated amount for health care service in India is the lowest in the world and India has insufficient doctors, nurses, and beds to tackle an unprecedented COVID-19 situation [48].

To tackle the situation, 64,000 beds were deployed using 4,000 railway coaches at various railway stations. The Indira Gandhi Athletic Stadium, in Guwahati, Delhi's Radha Soami Satsang Beas Campus, Bangalore's Koramangala Indoor Stadium have been converted to the COVID-19 treatment center.

To support India, globally 40 countries agreed to send oxygen support. UK sent equipment, which can generate 500 liters of oxygen per minute [49]. Singapore sent 7,511 oxygen concentrators, 516 BiPAP ventilators. Ireland agreed to send 700 Oxygen concentrators. France decided to send relief in two phases. The first phase will include oxygen generating plant, liquid oxygen, and respiratory materials while the liquid oxygen content will be in the second phase. Germany promised to send oxygen production plants and protection gear. Australia's commitment includes ventilators (500), surgical masks (1 million), P2 and N95 masks (500,000), goggles (100,000), 100,000 pairs of gloves, and 20,000 face shields. Russia, Kuwait has also promised to provide help. Saudi Arabia will send 80 MT of liquid oxygen. 800 Oxygen concentrators from Hong Kong and four cryogenic oxygen containers from Thailand respectively. UAE will send six cryogenic oxygen containers [50]. Indian government revised the Foreign Trade Policy and allowed to import of oxygen for personal use until July 2021. Indian rail (oxygen express) transporting liquid medical oxygen across the country in the name of Oxygen Expresses to fight COVID-19.

To destroy the COVID-19 transmission, different states and UT have imposed either night curfew, mini lockdown, restriction until 8 pm, or just keep open the essential kinds of stuff and close the non-essential shops. For example, Delhi (1st till 19th April 2021 and later till May 1st, 2021), Maharashtra (till May 15th, 2021), Uttar Pradesh (till May 4th, 2021), Jammu Kashmir (April 30th to May 3rd, 2021), Karnataka (from April 27th, 2021, 14 days), Telangana (May 8th, 2021), Jharkhand (May 6th, 2021), Goa (May 3rd, 2021), Haryana (May 31st, 2021), Gujarat (29 cities till May 5th, 2021); Kerala (from April 20th, 2021), Bihar (May 15th, 2021), West Bengal (start from May 6th, 2021) already have imposed such restriction.

From May 1st India had a plan to start vaccinating the entire adult which could be around 660 million people. However, vaccine shortage is now prominent and only 12 state out of 36 states including UT have enough stock to vaccinating over 18s [51]. Right now in India, three key bottlenecks for the vaccination process are the unavailability of the vaccine, efficacy of the vaccine, and penetration (registration). As

Table 7: Total COVID-19 vaccination as of 10th May (source from MoHFW).

Type	1st Dose	2nd Dose
Health care workers	95,63,406	65,05,072
Front line workers	1,40,49,681	78,51,075
People aged 18-44 years	25,52,843	
People aged ≥ 45 years	5,54,97,658	71,73,939
People aged 60 years	5,38,00,706	1,56,39,381
Total	13,54,64,924	3,71,69,467

of May 10th total vaccination in India is listed in Table 7.

From last year lockdown, Indian education sector suffered a lot. When there was a plan to school student's returning to school, this second wave created and made the plan delayed again. Indian government made announcements regarding promotion of student to the next classes without any examination, based on their assessments, class tests and projects. Additionally, various states cancelled their state board examinations during serious pandemic situation, directly and severely affecting the education system and standards [52]. It's unclear when situation will be clear again. Because of the closure of education sector, approximately 320 million students have been affected. It can be argued why India didn't move towards digital education. For 2017-18 years, National Sample Survey office reported that only 23.8% Indians have internet access with 42% in urban and 14.9% in rural. According to economic times, during lockdown one in four students in India can't use the online study because they don't have laptop or desktop. Thus, in quality and inconsistency of education in digital medium is evident. Even developed country like USA faced challenges to offer equal online education because of the presence of black, Hispanic and low income family student. On other hand, it is also evident that the way students learn in school (offline education), it is not possible to achieve through online because online education can't replace the interpersonal interactions, essential social skills for holistic growth and development.

Discussion

To tackle this COVID-19 situation, no medication is available now and no one knows fully how to deal with this. Isolation probably one of the best ways to limit at least the spreading of this virus. Lockdown probably the best way to limit transmission [53]. According to WHO, to lift the lockdown, proper health system capacities for testing, trace every contact and isolate and treat every case; maintain social distancing at schools and other essential places, workplaces; minimizing importation of new cases from countries or areas that have not yet contained the outbreak; community willingness to continue social distancing wherever possible and community engagement in all measures are required. It is evident that the lockdown for the first wave in India did not stop the spread of COVID-19 and the economy suffered a lot. However, now the COVID-19 Task Force (set up by the government) and the Supreme Court asked the Indian government to impose again nationwide lockdown to break the transmission. Probably from last year's experience, the Government is trying to use all efforts and keep the lockdown for the last option. However, according to the Centre for Monitoring Indian Economy, this localized lockdown already created a job loss which is around 70 lakhs in various states across the country. Though it is not announced, but, from May 2021, 98% of Indians are under some kind of restriction to break the COVID-19 second wave transmission.

India is dealing with a huge vaccination program for COVID-19 and many people even in rural areas were able to have those doses free of cost. However, it has to be remembered that temperature control is essential for the safety and efficacy of the vaccine. Even unwillingly or due to lack of infrastructure, if vaccines are kept at different temperatures, they will be deadly [54,55]. The first wave of COVID-19 affected hugely in urban areas and also for the second wave it is evident that hotspots (and the emerging hotspots) are everywhere in urban areas [56,57]. To have the better result from vaccination it could be the strategy to vaccinate urban areas first and then rural areas or areas where population density is less. However, now there is no scope as COVID-19 second wave also covered the small towns and rural areas in India.

It is heartbreaking to see that when India facing this tragic pandemic and suffering from the second wave; pharmaceutical companies are charging a price for vaccines. Indian government failed to stockpile vaccine at an early stage while other countries such as the USA, UK, and Israel started this measure in back September 2020. India first purchased 15 million doses and later administered over 140 million doses. However, it is not officially revealed how it will be fulfilled. On February 1st, India's finance minister announced Rs 35,000 crores ($4.69 billion) for COVID-19 vaccines. Without a free vaccine, India may move towards another economic downtown if lockdown possess again. Increase COVID-19 cases can create a situation again which requires the forced shutdown, closure of industry which will derail the economy again. Economist believes that Indian government could support the free vaccination scheme, which could only take 0.3% of GDP. By simple calculation, it can be shown that 966 million people should be vaccinated twice which indicates the requirement of 1.93 billion doses. If dose cost Rs 150 total cost will be Rs 28,980 crores (close to 0.14% GDP) and if the cost is Rs 400; total cost will be Rs 77,280 crores (close to 0.38% GDP) [58].

It is evident that India's claim of beating the epidemic and younger population are free from this disease, immunity has been developed, and overall victory on the COVID-19 is fully hogwash. Currently, administrative arrogance, lack of doses, hyper-nationalism, and population created a grave burning issue [59]. Probably it can be said that the people of Indian are also equally liable for the occurrence of the second wave. Early letting down the protection (use of mask; sanitization; maintaining social distancing); started attending weddings and socializing, religious gathering, and no strict restriction norms from government; all added the fuel in this situation. It seems like Indians were in a parallel universe while the rest of the world was experiencing a second wave. As the infection rate was low, people were not in the mood to take the vaccine. India could slow down the rate by imposing strict vaccination rules, maintaining social distancing, and follow strict COVID-19 restriction measures set by WHO. The government had one-year time to increase the health sector capacity and a complete failure is visible now. People are paying thousands and lakhs of money in the health sector if they are lucky enough to be admitted to hospital. According to the Institute for Health Metrics and Evaluation, by August 1st, India can experience a staggering 1 million deaths from COVID-19 [60]. To avail herd immunity, India should implement safe, effective, and robust vaccination [61]. Currently population of India is 135 crore. 94.5 crore people must be vaccinated to obtain herd immunity which is only possible if 189 crore vaccine doses are available. With India's current vaccination rate, herd immunity is feasible only in 3.5 years.

Conclusion

The second wave of COVID-19 infection was under the radar from last year still it could not be stopped. India is facing the second wave of COVID-19 infection. In this work, how India dealt with COVID-19 first wave and now suffering from the second wave is documented. National lockdown is still not imposed. Last year lockdown could not limit the COVID-19 transmission but due to the closure of industry India faced serious economic down. Pure medical Oxygen is essential for COVID-19 patients but lack of oxygen created the scenario more complex. Vaccination programs started but the price of vaccination is a serious issue. It will take several weeks to vaccinate a large population. Free vaccination could help the Indian economy as a new national lockdown can create another economic dip. Education sector is now another large sector which suffered significantly. It is still unsure how India will manage to tackle this second wave.

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