India Preparedness on Surveillance and Disaster Management on COVID-19

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Abstract

Unprecedented COVID 19 pandemic has resulted in deaths of nearly thirty thousand people globally. Seeing the seriousness of the outbreak, WHO declared COVID-19 as pandemic and employed six phased approaches to combat with this contagion. Various guidelines globally and at national levels are enforced to mitigate community transmission. Pandemic planning and preparedness resources are being issued by health departments for surviving the pandemic attack. Globally collaborative research activities are undertaken to prepare a suitable drug or vaccine for the COVID-19. Towards these herculean efforts have been contributed by the Indian medical and public health community. Fundings have been successfully raised to cope up with a shortage of protective equipment through collaborative, charity and right financial investment budget sanctioning for strengthening the preparedness in India. Hopes are bright that by self-discipline, proper quarantisation and relentless research, flattening of corona curve in India will soon materialize.

Keywords: COVID-19; Preparedness; Vaccine; Statistics; Community transmission; Economic.

Introduction on Covid Intrusion in Society and History

Covid history dates back to the intake of contaminated seafood items in the Huanan seafood market in Wuhan, China with this virus (Zhou et al., 2020). Several hypotheses by renowned scientist personnel confirms that animal any sort of interaction or consumption by a human. It is also recommended by scientists to beware about interaction with the animal kingdom members is as good as surveillance precautionary

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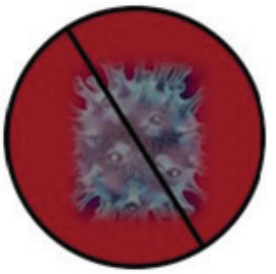
measures. The uniqueness of this coronavirus as compared with other SARS respiratory diseases is capable of infecting both the humans. Corona virus-related illness history dates back to the year 2003, which led to pandemic SARS in China (Li et al., 2005). Second in line is the MERS, Middle East Respiratory syndrome which occurred in Saudi Arabia in 2012. The present scenario sees the upsurge of the new strain of coronavirus. The SARS-CoV, which had unexpectedly spread its web over the world and this led to its reputation as of a notorious pandemic on 11th March, by WHO.

Means of Transmission of SARS-CoV

Close interaction between a person as in gatherings are prone to this infection. Scientific reasoning implicates that while infected person breathes or cough, during his interaction, the tiny droplets spit out in air has an immense probability of being inhaled and ingested by the healthy person in proximity. SARS-CoV like other coronavirus has spike-like structure on its surface, resembling a crown, which substantially facilities tight binding with the human cells.

Undoubtedly the SARS-CoV is contagious, especially at the peak time of the viral cycle in host. A symptom of this infection includes Difficulty in breathing, fever, cough, congested and runny nose, soreness of throat, headache, body ache, chills with shaking, loss/change of taste and smell perception. Usually, these symptoms appear after 2-14 days of infection (Sharma et al., 2020). Recommended guidelines insist on keeping the 6 feet/2 metres safe distance during any interaction. Use of N95 special pore size masks restricting entry of coronavirus and several cloth-based masks are effective in limiting its spread. Regular and long duration (20 sec) of handwashing with alcohol-based sanitisers are good infection preventive tool. Moreover touching any item at public places are strongly prohibited since they can act as agents of infections after being touched by an infected person. Asymptomatic nature of coronavirus is also been detected in a few cases and range about 10 percent. Site of infection of the virus has also ranges from lungs, nose to toes, and eyes. Immunocompromised host, chronic health problems suffering people, heart problems, diabetics, people with blood pressure old people, asthmatic people are more prone and liable to its attack. Day by day active research is going on, which are updating the people about new symptoms and more precaution to be added as a part of a healthy and safe lifestyle. Coronavirus symptoms and the health concerns are more severe and long-lasting than any other illness, especially in regard of death rates, viz., influenza (0.6 percent), SARS (9.6 percent) of cases (Sharma et al., 2020). The scientific reports verify appropriately. Only physical distancing is a most promising measure against the viral infection. Few myths are circulating in various platforms are listed in Table 1.

Table 1: Myths on Coronavirus

Myths busted on Coronavirus (Yeo et al., 2020; Li et al., 2020; Ray et al., 2020)	
	• Houseflies are not able to transmit or carriers of coronavirus • Thermal scanners can also sense a change in body temperature and not the COVID-19 virus. , • Addition of bleach as a disinfectant is inefficient in killing the COVID-19 virus and is rather poisonous. Moreover, the consumption of methanol or bleach does not affect COVID-19 infection. They are only effective against superficial cleaning of objects surface. Indian immune system can cope better with COVID-19 than west: History has clearly proved that India, was hardest hit during influenza infection. Further justifying this fact lies in its present status of being ranked second in diabetics and the 7th most polluted top cities due to its unhealthy lifestyle and air quality. • 5G mobile networks has no role in the transmission of coronavirus, only transmission via physical contact with an infected person or by inhalation of droplets sneezed by patients is possible. • Hot water bath no role in protection against the coronavirus infection • Existing vaccines against pneumonia, viz., pneumococcal vaccine / Haemophilus influenza type B (Hib) vaccine, has no role in protection against new coronavirus.

Results: Unprecedented Impact on Various Spheres of Life

Economic concerns

Since the lockdown, April month has seen the highest job loss in the youth section. As per the CMIE, the Centre for Monitoring Indian Economy (CMIE) report, 2.7 crore youngsters in 20s have lost jobs in March and about 3.3 crore person in their 30s and 3.3 to 30-40s. Although some improvement in the agricultural sector and reopening of the small scale business in the rural sections of the country have been recorded. The average jobless rate is staggering at 24 percent. Section-wise urban unemployment peaks at 28 percent and for 22.3 percent for rural areas. Declining demographics need special attention from both the government and employers.

Long terms serious repercussions on the country prosperity is also seen. Today's era, where the young generations, their innovative ideas are the beaming beacon of bright future of especially as developing country of ours, loss of jobs of such young people will definitely thrash the dreams and their impeccable courage. Young India people savings dream lies in darkness and serious insecurity in their hearts and minds can prevail for a longer time, if continued. The pandemic impact generated job loss which will make

the present generation lag behind by a year because of surprised disruption in work and other hand competition will be intensified for them with the upcoming young working force. Last financial year shows the employment figure of 3.4 crore and this April, it drastically changed to 2.1 crore (Ray et al., 2020).

Coming to the dilapidated and heart-rendering present scenario of migrants, huge suffering and pain had been added unwantedly into their daily lifestyle. Long hours of walking in unhealthy conditions seem to be inhuman and injustice on their part by nature. Food and cash crisis has severely impacted this section. Seeing and reviewing their difficulties Prime Minister Modi has allotted a major tranche of their 2020 financial budget overwhelming economic package 20 lakh crore (10 percent GDP). Moreover, 15 special trains by name of Shramik special express for helping migrants to reach their native place has been started. Country's economic status depends largely on their export and import variables. Pandemic has made the India trade record to decline due to sealing of the borders to control its spread. Out of the 30 main export items; iron and pharma showed growth of 17.55 and 0.25 percent respectively. Imports shrank to 58.7 percent leading to a trade deficit of 6.8 billion dollars (data from the Ministry of Commerce). Records released by power ministry electricity generation shrank to 6.8 percent and manufacturing output plunged to 20.6 percent. Massive retrenchment in nearly all the valuable goods generating sectors is being noted.

Food Consumption and Health

People with a record of existing coronary or respiratory disease are more prone to illness even with coronavirus in the mild preliminary stage. People with heart disease or if infected with COVID-19 also shows severe complications, Diabetics with high blood sugar levels has weakened immunity and hence increased chances to catch the infection. Nearly 25 percent of corona infected people hospitalised, were the ones who had a history of diabetics (Xu et al., 2020; Sungnak et al., 2020).

Rate of Consumption of household products has shown drastic dropdown. The underlying given chart also depicts the percentage figures in the rural and urban sections of society. Lack of cash is the prime constraint in the purchasing power of food items even the essentials. Second is the health concern which led to boycotting readymade products or restaurant cuisines. Thousands of people could not afford a time meal especially the migrants, labour classes, stray animals. The continuation of lockdown has seriously impacted and distressed migrant workers. Farmers are not able to harvest, sell, or forced to sell agriculture products at lower prices. Taking in consideration the

infectious spread of this virus, harvesting of ripe crops were also suspended, leading to enormous loss of standing crops (Huang et al., 2020).

To cope up and also compensate for the agricultural products and farmers' loss, economic reforms have been executed by the Finance minister under the *Atmanirbhar Abhiyan*. Severe long term policies like waiving off of loans, compensation of crop loss due to COVID-19 are given. She has also announced the deregulation of prices of 5 major food items; pulses, edible oils, oilseeds, potato and onion.

Discontinuation of Transport facilities

India has closed all international flights and domestic flights since March 23 to prevent further community transmission. Thousands of immigrants were forced to stay at foreign places without any prior preparation to deal with the crisis. Public transport was also halted seeing the corona outbreak. It is expected that after 18th May, resuming of public facilities with new rules and restrictions will soon materialise, in green and orange zones only said by public transport Minister, Mr. Nitin Gadhkari. Road ministry has reported that the lockdown. Especially, Road transport showed a decline to 10 percent. Among the road transport, trucking halting had led to the serious disruption of the global supply chain for medical and food facilities.

Our incoming Indian migrants who are been rescued are kept under the quarantine period of 14 days and are suggested to avoid any non-essential travel. A strict instruction has been released by the government for citizens to refrain from travelling to countries like Germany, France, Saudi Arabia, US during this outbreak. Although under the *Vande Bharat Abhiyan*, flights resumed from 17th May, to help our distant people.

Environmental Impact

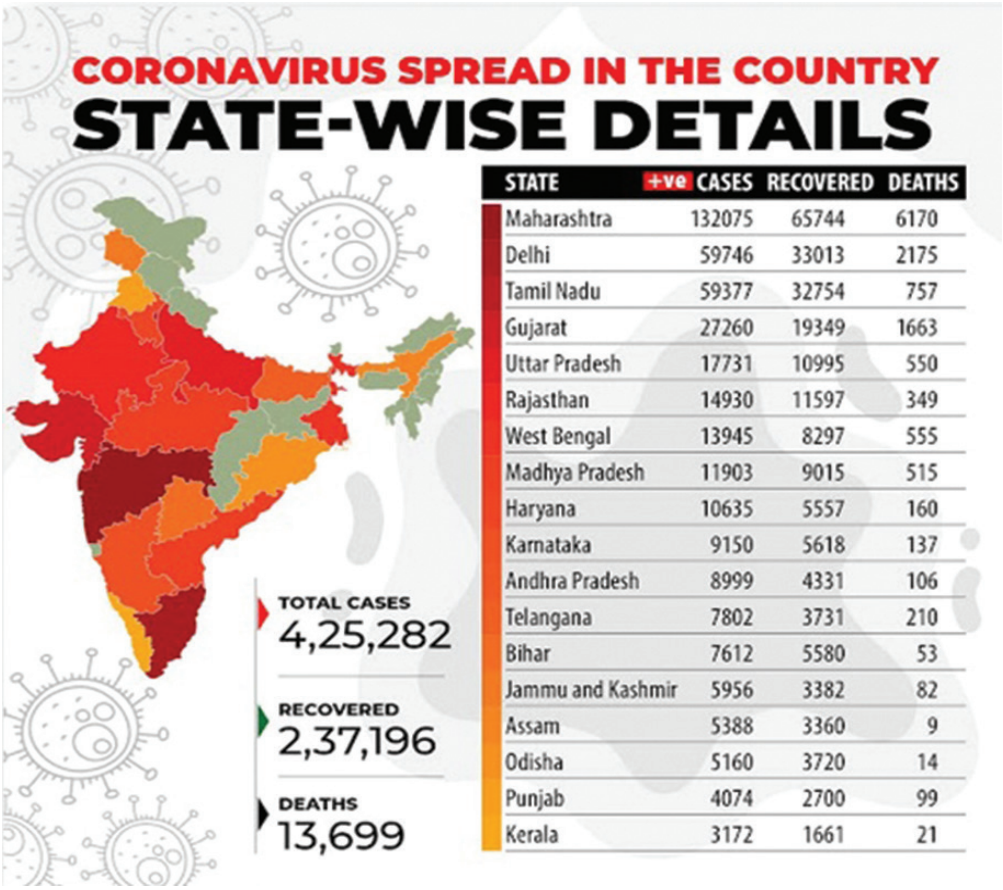
The pandemic crisis has led to clear skies, re-emergence of wildlife in its natural clear waters, butterflies, migratory birds visiting often, is a sheer eye treat. Conservationists debate that nearly 5 percent decline in carbon emissions (25 percent Nitrogen dioxide) has been recorded during this time, although it is not sufficient for effectively solving the environmental issues generated due to human activities (burning of fossil fuels). They also fear that when life retains its normalcy after the post-pandemic, then this recovery will be volatilised in very less time. Likelihood of green future, alternative future will be few days wonder. Points to ponder during this time are to search for means of energy generation which are sustainable. Coronavirus based pandemic economic concern has the direct ravaging effect on the environment green settings. Excessive exploitation

of natural resources has a positive effect on the economy of the country in short term aspects. EPA reports released clearing mention the pollutants clearing out from all types of ecosystem, air, water and soil. India's *Janata Curfew* observed on march 22 EPA reports tell pollution levels in air showed a significant drop across various parts of the country. Metropolitan cities, Delhi, Kolkata, Bengaluru and Lucknow displayed the AQI, average quality index in two-digit figure. Another trend-setting example is of Punjab state India on 3rd April, when clarity of skies became a retreat for people. For the first time, residents could have a sight of Dhauladhar mountain (213 km from Punjab) scenic beauty. The nationwide lockdown has led to the significant clearance of water bodies, Yamuna and Ganga. CPCB, central pollution control board monitoring data was taken in real-time analysis, also confirms that average water quality improvement of 25 points has been observed, and is now appropriate for the dissemination of wildlife. Globally 0.3 percent slashing in green-house emissions, 25 percent reduction in air pollution was recorded (Tribune report).

State-wise Corona Tally (Data may vary from time to time)

Since the first Covid case in Kerala, the tally is increasing exponentially, which is a prime concern for all. Latest reports issued by the Union health ministry states that 56,316 active cases, nearly 36,823 people successfully cure. Among the 5 major states where maximum corona cases upsurge seen, Maharashtra tops the list and is the hardest hit followed by Gujarat and Tamil Nadu. Goa and Mizoram made their mark by standing at corona free status because of stringent self-discipline among residents and continued to be apt for tourist and tourism, even after lockdown.

Figure 1: Corona statistics for highest cases in the different states over the country



STATE	+ve CASES	RECOVERED	DEATHS
Maharashtra	132075	65744	6170
Delhi	59746	33013	2175
Tamil Nadu	59377	32754	757
Gujarat	27260	19349	1663
Uttar Pradesh	17731	10995	550
Rajasthan	14930	11597	349
West Bengal	13945	8297	555
Madhya Pradesh	11903	9015	515
Haryana	10635	5557	160
Karnataka	9150	5618	137
Andhra Pradesh	8999	4331	106
Telangana	7802	3731	210
Bihar	7612	5580	53
Jammu and Kashmir	5956	3382	82
Assam	5388	3360	9
Odisha	5160	3720	14
Punjab	4074	2700	99
Kerala	3172	1661	21

Source: Ministry of Health & Family Welfare

Surveillance Activities in India

Considering the havoc created by the COVID-19 pandemic, government authorities are keeping no reservations in making people safe and treating the infected ones at its priority. Disaster management ministry issued the curricular highlighting the severity of infection in different zones of the country. Colour code been assigned for different zones and delineated as districts within states as a red, green, orange zone. The red zone shows the highest rate of infection and the doubling rate of merely 4 days are areas where total movement is restricted. An orange depicted zone has fewer cases green zones shows no report of a single case for the past 21 days. Latest health ministry Lockdown 4 release

list states; 130 districts in the red zone, 284 in orange, 319 in the green zone on the latest incident cases reported for corona.

To mitigate the effects of novel coronavirus infections, IoT-internet of things provides the relevant platform for connecting heterogeneous information/variables with the internet for effective outsourcing of e healthcare facilities. IoT also shows potential in predicting infections for a defined location much before the infection has erupted. IoT based smart thermal devices in crowded locations are also effective in monitoring temperature changes, body temperature difference and thus predicting the cases of any possible viral infection (Banach et al., 2009; Sohrabi et al., 2020).

Covid Tracking–Aarogya Setu App

The union health ministry has made compulsory for returnees, migrants and returning NRI. Surveillance activities have been ramped up for detection of any respiratory illness symptoms, SARI along with coronavirus in its earliest stage for effective containment. Technology gifted app makes easy and immediate medical help and its intervention, if symptoms arise. Questionnaire and update about the nearest COVID-19 cases are updated at the app to each user.

Other Covid trackers such as AYUSH Sanjivini, an initiative of the Ministry of AYUSH, keep the user updated about preventive measures and remedies for counteracting. Protection against corona, in isolation conditions at home. Health ministry is also focussing on and directing the states for making Covid tracker App compulsory, for adequate serological testing, contact tracing at the earliest stage, on-time treatment, quarantisation required at right time. Special attention to timely testing of returnees at the time of their disembarking to the country is kept in check.

Collaboration Activities to Combat COVID–19 Pandemic

Several local agencies are actively manufacturing face protection mask for corona and distributing to the fellow citizens voluntarily. Thousands of face masks (N95) and rapid detection kits from china were also imported but were not reliable for precise detection purposes as confirmed by Indian doctors. The face masks imported also did not meet the required medical standards. US President Donald Trump has also announced the donation of ventilators to cope up with the situation (Gillim-Ross et al., 2006; Popov et al., 2020). India, being a democratic country and under the headship of Prime Minister extended supports for collaboration in research activities to develop Covid vaccine.

Many renowned indigenous companies have voluntarily denoted a handsome amount in the PM cares fund to speed up the research efforts, to provide food

packages to poor, immigrants. Hundreds of NGOs are also been associated with the volunteering work at this eleventh hour. E-rickshaws are being deployed to provide essential commodities door to door. Medical and testing at home in red zones are also provided.

Figure 2: Present strategies for combatting COVID-19 Pandemic

Indian Institutes at their Best Services

ICMR has already announced guidelines for community-based serological surveys for determining the existence of SARS-CoV2 infection in the population. Other dedicated institutes national centre for disease control, National Institute of Research in Tuberculosis (NIRT) in Chennai, National Institute of Epidemiology (NIE), various state health departments are actively involved and cooperating with Health Ministry. Other institutes National institute of nutrition and NIMHANS joined hands in the Covid testing by performing 5,249 and 3,134 tests respectively. Cumulative Covid tests as per data release from May stood at 1,00,986. Maximum tests were done in densely populated regions as part of surveillance and protective measures.

Various cross-sectional survey sat household level conducted over 4 districts for 24,000 adults for Covid infection. Certain random testing over selected 69 districts and 21 states were also performed under the aegis of ICMR. This survey comprised of collecting the venous blood sample from random individuals (400 per household) from selected 10 clusters in the concerned district. ICMR has increased its tests to 1 lakh in May as compared to 500 tests in April, after considering the seriousness of the situation. AS of now, nearly 1 million Covid-RT PCR tests have been performed. Around 19th April, CDSCO approved the proposal of ICMR for the clinical trial Plasma Therapy for COVID-19 treatment. In Convalescent plasma therapy, antibodies developed as an immune response from the serum of recently recovered patients are administered to the COVID-19 infected personnel. DRDO has also installed a full body disinfectant chamber

unit at AIIMS for personnel sanitisation enclosure along with face protection mask. Various movable lab, vehicle research and development at Ahmednagar, Gujarat for one person at a time sanitisation with installed soap dispenser, mist spray of hypochlorite for a defined time limit and operated on foot pedalling system.

Serum taken from these individuals further tested for the presence of Antibody, IgG, using instant ELISA test kits designed at the ICMR-NIV, National institute of virology, Pune. The resultant survey acts as an indicator for the spreader transmission for SARS-CoV-2 in different areas of the country. Another initiative is, the hospital-based surveillance facility for monitoring changing trends for infection in all targeted districts. Virus doubling rate, of 10.9 (past 14 days), has shown improvement by 2 percent as told by Union Health Minister Harsh Vardhan. Possible hidden infection and timely containment are very well coordinated and conducted by these surveillance measures. *Ayushman Bharat* program on health and wellness centres has been directed for screening diabetics, cancer and also providing the required medicine and immune-boosters at the time of testing. People with Preexisting illnesses as mentioned are quite prone to corona infection, so the parallel screening of such diseases becomes an integral part of testing and surveillance.

Hurdles in Rolling Out the Vaccine

Asymptomatic and Changed Behaviour

The COVID-19 surprising and discernible findings make this corona pandemic hard to halt down. After a typical incubation period of 14 days also, no symptoms of fever, chest congestion and throat soreness is observed, tests are negative, still, the corona took toll of lives. Pro-active efforts need to be taken, especially physical distancing and regular sanitisation to beat any asymptomatic transmission and infection shown in Figure 3. The first case of such asymptomatic behaviour was reported for 20-year old women in Wuhan. In India (around 18th April), 80 percent of cases showed an asymptomatic response, which made the community transmission faster? Community spreaders are increasing at a very higher pace because of this hidden response observed in people, making the quarantine measures or treatment non-futile (Weingartl et al., 2004).

Figure 3: Accelerated efforts towards the development of Corona Vaccine

Source: Rosfoto, http//:hindu.com

Corona infection arises during the exposure of the human body mucous membrane s of mouth, nose and eyes via respiratory droplets expelled through an infected person. Infection propensity can range from mild to severe symptoms. Along with the regular symptoms and sites of the COVID-19 infection on the human body, certain new sites of infection are also been reported. Covid toes are explained as the clogging of the vessels and subsequent discolouration, especially in kids. A Corona eye shows pink eye symptoms or conjunctivitis (Anand et al., 2002).

Mutation

Every virus shows the tendency of regular mutation as a part of its life cycle. This new coronavirus is a type of RNA virus which is packed with protein. RNA virus responsible for flu measles as compared with DNA virus (smallpox, Herpes, HPV) shows more tendency of getting mutated. Latest reports by dignified researchers estimated 14, such viral strain under the COVID-19. So the vaccine in trial or information should be manufactured keeping such mutative strain. Although this new virus has mutated many times, still because of the slow rate of mutations, chances of effective vaccine preparation are quite high (Ren et al., 2013).

Corona Vaccine Candidates and its Challenges

The reemergence of the SARS virus as SARS-Covid has led to the global emergency and necessity to search for the suitable therapeutic or preventive tools for succumbing of this virus. Still, wait for the coronavirus panacea is in the pipeline. Corona vaccine the ultimate solution lies in testing various forms such as in inactivated coronavirus or S

protein peptides. Vaccines are being undertrials on the animal model. The probable mechanism of transmission is the binding of the virus with the Antibody and Fc receptors to form immune complexes, which can lead to enhanced disease when a titer is low, using S protein peptide. Inactivated virus is also being tested for its efficacy against Covid. Preparation of such a vaccine is essential for biosafety level 4 precautions while handling the high titers of infectious SARS-CoV, poses a high risk to the production workers. Incomplete inactivation is more potent in causing new SARS outbreaks and disruption of immunological response (Czub et al., 2005).

Live Attenuated Coronavirus

At present, vaccine identification is at the preliminary stage of research. Whole-genome sequence of Coronavirus has been deciphered and its CDNA has been generated, still thorough genetic analysis is in progress. Recombination of live attenuated virus and its wild type counterpart is also extensively researched.

S Protein-based Corona Vaccine

S protein is one of the structural proteins of SARS-CoV, helps in membrane binding and fusion process. S protein, an elemental antigenic component is responsible for inducing the host immune response. A vaccine based on such S protein is employed for inducing antibodies to block the Virus binding, its fusion and ultimately neutralising the infection. Although it is quite effective in eliciting the protecting immunity and neutralising Antibody. Its harmful side effects on the liver limits its usage.

DNA vaccines however had been successfully tested in animal models, but human trials still need to be researched. Vectored Vaccine evaluation of using other viruses as vectors for SARS-CoV proteins, such as Rabies virus, Chimeric parainfluenza virus, demonstrates sufficient induction of S protein-based Nab production in animal models. Combination vaccines are primarily useful in augmenting the immune responses towards the SARS-CoV (Hoffmann et al., 2020). Herein, the step protocol is followed; first, the DNA vaccine with S protein is administrated, followed by subsequent immunisation with the inactivated virus. Such a combination vaccine is more potent than using either type of vaccine singly. Various challenges in each probable corona vaccine candidate and still the ultimate protective efficacy of these vaccines are in question.

Relentless Efforts for Vaccine Creation around the world

Globally, Covid cases have touched he 4.8 million marks, in India, it has crossed 100 thousand cases. Empirical cure or the suitable vaccine for this life-threatening disease is

still under trials. Current therapeutic strategies are being focused on relieve patients with pneumonia and maintain oxygen levels. Covid disrupts the functioning of vital organs, lungs, blood vessels, and intestine. The virus primarily targets the pneumocytes, (mucous lining lungs) leads to stress and collapse of the respiratory tract, leading to death. It also interferes with the binding of the heme protein of haemoglobin making the oxygenation process inside blood cells to a halt. Moreover, reports confirm that preexisting illness patients especially with heart disease and diabetes are most susceptible to corona. Patients with heart disease and diabetes are more susceptible to this disease.

Keeping these facts in mind, scientists and medical officials are actively involved in synthesizing the appropriate medicine and vaccine for this contagion. Initially, the two anti-viral drugs like Lopinavir and Ritonavir used in the treatment of HIV were also employed in the Covid treatment. Later the combination of drugs like chloroquine, an anti-malarial medicine for corona was also proposed by scientists as immediate relief (Wang et al., 2020). The approved and safe drug requires undergoing thorough research and long clinical trials (years) before it comes in the market.

Collaborative initiatives for Development of Vaccine

Collaborative attempts were undertaken by the Serum Institute of India and Sanofi Pasteur, France by using antibody generating approach. RNA based vaccine approach was employed by the German Enterprise, Cure Vac. Nearly 6 Indian companies are actively engaged in chalking out COVID-19 vaccine. About 70 vaccine probable candidates have been tested on a global scale and only three has been chosen for clinical trial stages. Biggest upset has come with the incapacity of oxford vaccine ChAdOx1 nCoV-19 in controlling the Covid pandemic. Still, the studies are in different phases of trials mandatory for human use. Around 2021, we can see some light in the form of COVID-19 vaccine (Lescure et al., 2020). A brief overview of the different clinical trials and attempts in progress around the world is clearly mentioned in the table given.

Table 3: The Companies clinical trials and attempts to develop vaccine

Company	**Approach**	**Stage**	**Strategy**
Gilead Sciences	Treatment	Phase 3	Remdesivir
AscletisPharma	Treatment	Phase 1	Cocktail of Danoprevir and Titonavir
Moderna Therapeutics	Vaccine	Phase 1 RNA	vaccine (mRNA-1273)

Arcturus Therapeutics	Vaccine	Preclinical	Engineering RNA with nanoparticle
CureVac	Vaccine	Preclinical	man-made mRNA
Eli Lilly	Treatment	Preclinical	Antibody Treatment
GlaxoSmithkline+ Clover Biopharmaceuticals	Vaccine	Preclinical	Engineering adjuvants with proteins
Inovio Pharmaceuticals	Vaccine	Preclinical	DNA Vaccine
Johnson & Johnson	Vaccine and Treatment	Preclinical	Deactivated virus
Regeneron Pharmaceuticals	Treatment	Preclinical	Cocktail of antibodies
Sanofi	Vaccine and Treatment	Preclinical	Chimera of RNA viruses, Kevzara drug
Takeda	Treatment	Preclinical	Plasma of treated patients
Vir Biotechnology	Treatment	Preclinical	Viral replication inhibitor

Future hope and Conclusion

Globally, the numbers of COVID-19 cases showed an exponential increase in over 130 countries except in lockdown period. Various data released around the world states that COVID-19 pandemic has led to the loss of over 10 trillion dollars, accounting to 0.8 percent of total GDP as an economic burden to the global economy. In India only, over 43 lakh corona cases have been reported. Lockdown measures adopted have effectively curtailed the Covid cases, except April month where cases mounted to 1 lakh. Incidence of COVID-19 is also a reminder of interconnectivity between the world and animals. Diseases can easily transmit from animal to humans and so taking care of animals also becomes a responsibility, if a harmonious life is dreamt or expected. The ramping-up strategy has been adopted by various developing countries which involves deliberately infecting volunteers with coronavirus antigen. Furthermore, its immunological response is checked and volunteers serum shows the production of viral-specific antibody. The major limitation of this initiative lies in ethical perspective and high probability of unwanted and unaware community spread. Still, the prime hit is the developing countries due to major hurdles of inadequate funding, scarcity of protective equipment for supporting the population through its fragile health care industry. Collaborative

attempts at a global scale and large database of volunteers findings can effectively help us in cope up with this pandemic. Moreover, new therapies based on monoclonal antibodies can speed up the trials and specificity of treatment. As a responsible citizen, abiding by the government rules for community transmission can be quite helpful.

References

Anand, K., et al. (2002). Structure of coronavirus main proteinase reveals combination of a chymotrypsin fold with an extra-helical domain. EMBO J. 21, 3213–3224

Banach, B. S., et al. (2009). Human airway epithelial cell culture to identify new respiratory viruses: coronavirus NL63 as a model. J. Virol. Methods. 156, 19–26.

Czub, M., et al. (2005). Evaluation of modified vaccinia virus Ankara based recombinant SARS vaccine in ferrets. Vaccine. 23, 2273–2279.

Hoffmann, M., Kleine-Weber, H., Schroeder, S., Kruger, N., Herrler, T., Erichsen, S., Schiergens, T.S., Herrler, G., Wu, N.H., Nitsche, A., Müller, M.A., Drosten, C., and Pöhlmann, S. (2020). SARS-CoV-2 cell entry depends on ACE2 and TMPRSS2 and is blocked by a clinically proven protease inhibitor. Cell 181, 271–280.

Huang, C., et al. (2020). Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 395(10223), 497–506.

Laura Gillim-Ross, et al. (2006) Emerging Respiratory Viruses: Challenges and Vaccine Strategies. Clin. Microbiol. Rev. 19(4), 614– 636.

Lescure, F. X., et al. (2020). Clinical and virological data of the first cases of COVID-19 in Europe: a case series. Lancet Infect. Dis. 20, 697–706.

Li, Q., et al. (2020). Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. New Engl. J. Med.382, 1199–1207.

Li, W., et al. (2005). Bats are natural reservoirs of SARS-like coronaviruses. Science, 310, 676–679.

Popov, Dimitar (2020). Treatment of COVID-19 Infection.A Rationale for Current and Future Pharmacological Approach. EC Pulmonology and Respiratory Medicine. 9(4), 38-58.

Ray, D., and Subramanian, S. India's lockdown: an interim report. *Ind. Econ. Rev.* (2020). https://doi.org/10.1007/s41775-020-00094-2

Ren, Z., et al. (2013). The newly emerged SARS-like coronavirus HCoV-EMC also has an 'Achilles' heel': current effective inhibitor targeting a 3C-like protease. Protein Cell 4, 248–250

Sharma A, Tiwari S, Deb MK, Marty JL. Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2): a global pandemic and treatment strategies. *Int J Antimicrob Agents*. 2020;56(2):106054. DOI:10.1016/j.ijantimicag.2020.10605

Sohrabi, C., Alsafi, Z., O'Neill, N., Khan, M., Kerwan, A., Al-Jabir, A., Iosifidis, C., and Agha, R. (2020). World Health Organization declares global emergency: a review of the 2019 novel coronavirus (COVID-19). Int. J. Surg. 76, 71-76.

Sungnak, W., et al. (2020). SARS-CoV-2 entry factors are highly expressed in nasal epithelial cells together with innate immune genes. Nat. Med.26, 681–687.

Wang, M., et. al. (2020). Remdesivir and chloroquine effectively inhibit the recently emerged novel coronavirus (2019-nCoV) in vitro. Cell Res. 30, 269–271.

Weingartl, H., et al. (2004). Immunization with modified vaccinia virus Ankara-based recombinant vaccine against severe acute respiratory syndrome is associated with enhanced hepatitis in ferrets. J. Virol. 78, 12672–12676.

Xu, Z., et al. (2020). Pathological findings of COVID-19 associated with acute respiratory distress syndrome. Lancet Respir. Med.8, 420–422.

Yeo, C., Kaushal, S., Yeo, D. (2020). Enteric involvement of coronaviruses: is faecal-oral transmission of SARS-CoV-2 possible. Lancet GastroenterolHepatol, 5(4), 335–337.

Zhou, P., et al. (2020). A pneumonia outbreak associated with a new coronavirus of probable bat origin. Nature, 579, 270–273.