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Epidemiology, Pathogenesis and Socio-Economic Impact of SARS-CoV-2: An Investigational Study Across The Board

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ABSTRACT

As per the reports of World Health Organisation (WHO), the first positive case of novel coronavirus infection (COVID-19) triggered on 8th of January 2020 in China and the disease as on 2020 May 13, prevalent over 215 countries. During this period, the virus have claimed over two lac lives and infected over twenty nine lac people around the globe despite substantial prophylactic measures and modernized health-care facilities. The virus causing COVID-19 (Corona virus disease-19) pandemic outbreak was named as severe acute respiratory syndrome coronavirus-2 (SARS CoV-2) and is believed to be transmitted initially from animals to human and later occurrence of person-to-person transmission is reported. India adopted "Lock Down" throughout the country as a strategic measure, well in advance to combat the disease like most of the other foreign countries. As a consequence, all types of large and small industrial sectors have been badly affected, resulting in a major socio-economic impact. The pandemic has created an unprecedented level of risk, causing investors to suffer significant losses in a very short period of time which is the worst crash since 1987 and there is a knock of $1.1 trillion, off the expected growth of global Gross Domestic Product (GDP). The government of India and most of the other countries has declared special packages for the workers of unorganized sectors, women, small and medium sized industries to deal with the situation. This review will focus on the overall information regarding the virus, global transference pattern analysis, socio-economic impact, treatment and management strategies by different countries and strategies to prevent future viral pandemics like this COVID-19 outbreak.

Keywords: SARS-CoV-2, coronavirus, viral transmission, respiratory droplets, pandemic, COVID-19

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INTRODUCTION

The newly detected novel coronavirus belonging to the family Coronaviridae, order Nidovirales, subfamily Coronavirinae[1] emerged from the Chinese city of Wuhan of the Huwei province in the late 2019 has spread around the world, sparking a race to find treatment options and vaccines against it. This is an enveloped virus with a single-strand, positive-sense RNA genome approximately 26-32 kilobases in size and is the largest known genome for an RNA virus[1,3]. Six types of coronaviruses were formerly reported to cause disease in humans and SARS CoV-2 became the seventh member that infects humans[2]. It was on 11th of February 2020, WHO announced a name for the new coronavirus disease: Covid-19. The SARS had a vivid blow on the health care services and also the economies of the affected countries[3]. The outbreak has been so severe that the confirmed cases of infection have reached to 4,179,479 as on 13th of May 2020, including 287,525 deaths globally[4]. The SARS-CoV-2, is contagious in humans and has been declared as pandemic on 11th of March by the World Health Organization[5,6]. Studies at full-length revealed that the virus accountable for causing COVID-19 is a β-coronavirus[7]. In December, 2019, an outbreak of pneumonia of unknown cause in Wuhan city of China, not only raised alarms in China but also internationally. It was by 7th January 2020, the Chinese scientists had isolated a novel coronavirus (nCoV) from the infected patients in Wuhan[8].

Morphology of Coronavirus

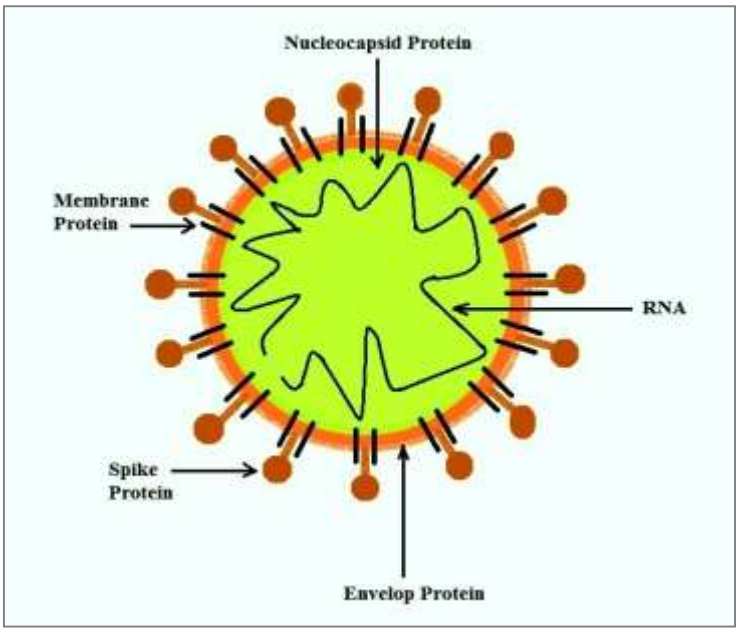


Figure 1: Illustration of SARS-CoV-2 virion

The spherical structure of the virion with a diameter of approximately 80 to 125 nm is portrayed in a number of latest studies by cryo-electron tomography and cryo-electron microscopy. The club-shaped spikes originating from the surface are the defining characteristics of the virion[9,10].

The four major structural proteins that the Coronavirus possess are namely; Spike (S), Membrane (M), Envelope (E) and Nucleocaspid (N) proteins, all of which are encoded within the 3´ end of the viral genome[11]. Figure 1 is clearly indicating the positions of different proteins in SARS CoV-2 virion. The S protein uses the N-terminal signal sequence to achieve entrance to the ER and is greatly N-linked glycosylated. The unique spike structure on the surface of the virus is made up of the Homotrimers which is encoded by S protein[12]. This trimetric S glycoprotein is a class I fusion protein and mediates binding to the receptor of the host. The virus attach to the specific cell of the host which is initiated by the spike protein and its receptors[13,14].

Though not in all but in most of the coronavirus the S protein is split into two different polypeptides–S1 and S2 by a host cell.[15] The receptor-binding domain of the S protein is initiated by S1 whereas S2 forms the stalk of the spike molecule[16,17]. A fusion between the cell and the viral membrane is mediated due to the attachment of the virus to the host cell thereby resulting a release of the nucleocaspid into the cell[18]. The most abundant structural protein is the M protein and is the one which is considered to give the virion its shape. Studies suggest that the E protein which is found in very less quantities within the virion is a transmembrane protein and are highly contradictory. However, the E proteins despite being divergent possess a common architecture[19-21]. The Hemagglutinin-esterase (HE) protein binds acids on to the surface glycoproteins and contains acetyl-esterase activity which is considered to boost the S protein mediated cell access and the spread of the virus through the mucosa[22,23].

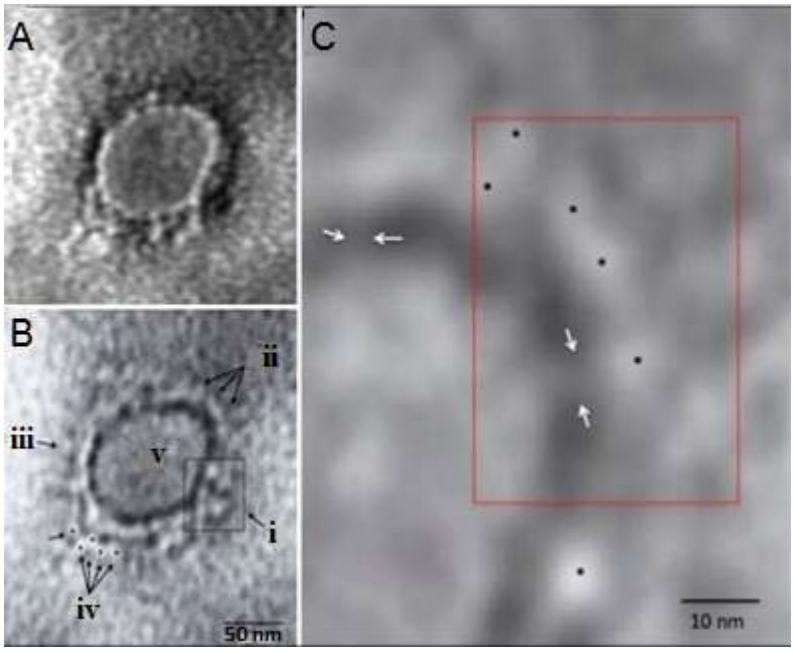


Figure 2: Transmission electron microscopy (TEM) imaging of COVID-19

All over the world, in depth structural analysis is going on to understand the novel corona virus to get specific clue about genetic sequence of the same. A team of Indian researchers has conducted TEM imaging of nCOVID-19 is shown in figure 2, where they have explained that

the notations in part A in the figure is showing morphodiagnostic features of family Coronaviridae of negative-stained COVID-19 particle. The part B shows that the same particle when defocused reveals clear presence of virus envelop glycoprotein with more details. The squared area, part B (i) shows a tetramer-like aggregate of four distinct peplomers (glycoprotein spike on a viral capsid or viral envelope). Coronavirus surface morphological projection has been cited by the three arrows represented by (ii) where the matrix of the virus has been indicated by (v). In the same Part B (iii) area shows a distinct peplomer head and area part B (iv) indicates linear projections targeted with five distinct peplomers. Part C of the image has been highly magnified at about 10 nm which shows a distinct evidence of direct 'stalk' connecting the peplomer to the virion surface. The peplomers are indicated with 'dots' and the stalk with 'arrows'[24].

Accompaniment and Ingress of Corona Virus in Humans

The early attachment of the virion is initiated by interactions between the S protein to specific receptors of the host. This attachment of the virus causes a conformational alteration in the S protein which results a fusion of viral and cellular membranes[25,26]. The spike protein of the coronavirus plays a crucial role in not only the entry of the virus but also cell-to-cell spread and determination of tissue tropism. Generally, the ingress of the coronavirus is not pH dependent and therefore it is believed that the entry of the virus takes place directly at the cell membrane and not through an endosomal route[27,28].

However, quite a few data hints that endosomal route may be used for entry by some viruses and in case of SARS-CoV the entry is repressed by lysosomotropic agents, advocating an endosomal route of entry[29,30]. This repression or inhibition may be undone by protease treatment of the virus attached to cell of the host and entry of such virus at the cell membrane is more well-organized than entry by the endosomal route[31].

The SARS-CoV spike may be cleaved by the protease formed by the inflammatory cells present in the lungs of the SARS patient thereby making the entry of the virus through the more efficient plasma membrane route[32]. The interaction between the S-protein and receptor is the chief determining factor for the coronavirus to contaminate a host and also manage tissue tropism of the virus. Several coronavirus utilizes peptidases as their cellular receptor while many α-coronavirus utilizes aminopeptidases N (APN), SARS-CoV uses angiotensin-converting enzyme 2 (ACE2) as their receptor. Several analysis shows that the SARS CoV-2 like SARS CoV also uses ACE2 as receptor for binding and a structural model analysis reveals that SARS CoV-2 has 10 folds higher affinity to bind with ACE2 receptor in comparison to SARS CoV which is much higher than the threshold required for viral infection[13,33]. After attachment with the receptor, the virus achieve entry to the cytosol of the host which is carried out by acid dependent proteolytic cleavage of the spike protein by protease[34].

The cleavage of the spike protein occurs at the S2 portion which results in the exposure of a fusion peptide thereby causing an inclusion into the membrane, followed by joining of two heptad repeats in S2 forming an antiparallel 6 helix bundle. This bundle permits the collaboration of the virus with the cell membrane causing a release of the viral genome into the cytoplasm[35,36].

GENESIS OF SARS CoV-2

Though coronaviruses are common in certain species of animals, like cattle and camels, the spread of the virus from animals to humans is rare. It is more likely that the new strain came from bats, whereas other studies suggested pangolins may be the source of origin. However, it is still unclear exactly how the virus first spread to humans[37,38]. There has been a lot of discussion on the origin of the SARS CoV-2, since the first report of novel pneumonia (COVID-19) in Wuhan, Hubei province, China. One of the most controversial topic of discussion that emerged had been laboratory manipulation of a related SARS CoV-like coronavirus[39]. However, if it had been the case then, one of the several reverse-genetic systems presented for β-coronavirus would probably have been used. But the data available revealed that the SARS CoV-2 differed significantly from those already existing coronaviruses and thereby doesn't support the claim of any laboratory manipulation[40,41].

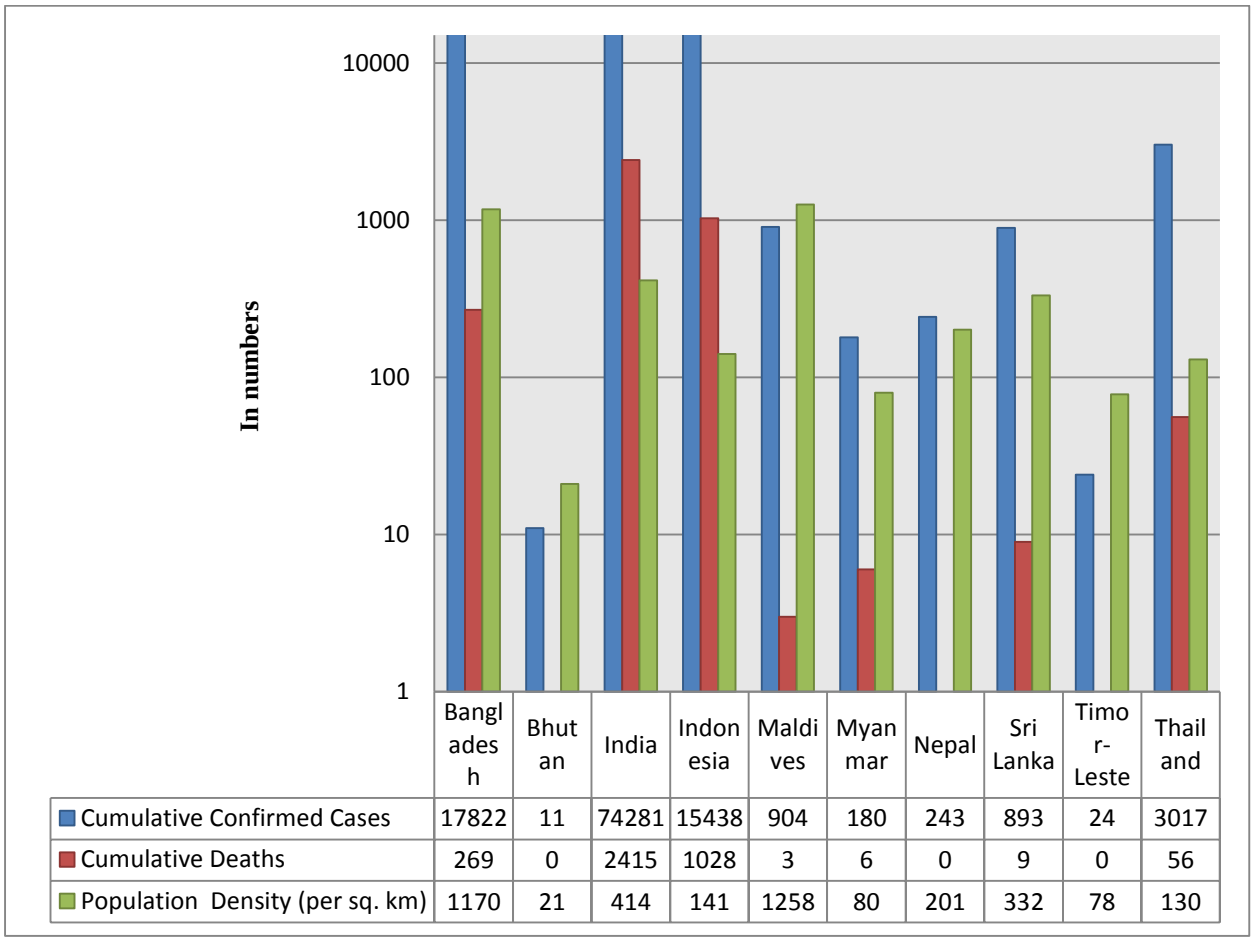
However, Indian Council for Medical Research (ICMR) has conducted a study on Bats available in India by using the pan-CoV reverse transcription-polymerase chain reaction (RT-PCR) targeting the RNA-dependent RNA polymerase (RdRp) gene rectal swab (RS) and throat swab of specimens of Pteropus and Rousettus spp. Bats were screened for coronaviruses. The bat specimen tested positive was performed for Next-generation sequencing (NGS). Sanger sequencing of bat positive coronavirus was conducted as per the Sanger sequencing protocol where partial RdRp sequences of bat corona viruses were repossess from two (out of 4 amplicons) specimens of Rousettus spp. One of the sequences (MCL-19-bat-588/2) showed close identity to bat from china corona viruses HKU9-5-2 (AN): HM211099.1; sequence identity (SI): 99.2 %, whereas the second RdRp sequence (MCL-20-bat-76/10) had an SI of 98.8 % with HKU9-1 (AN: EF065513.1)[42].

India becomes the fifth country to isolate SARS CoV-2 virus strain. The initial samples had a virus sequence similar to what was found in Wuhan, China. The second sequence was similar to the viruses which were circulating in Iran and also has similarities to the Wuhan virus and the third strain had similarities of the viruses which infected the people of the United States or the United Kingdom[43].

Global Transference Pattern Analysis

As many aspects of SARS CoV-2 are yet to be fully understood, it is of utmost importance to evaluate the transmissibility of the virus so as to control its spread. The number of causalities

(both positive cases and deaths) of SARS CoV-2 has already surpassed the other two previously occurred infections namely, SARS-CoV and MERS-CoV in combination indicating the severity of the current outbreak[44]. The WHO has segregated the countries into six different regions, namely, South East Asia region (SEARO), African region (AFRO), European region (EURO), Eastern Mediterranean region (EMRO), Western Pacific region (WPRO) and Region of the Americas (AMRO). WHO is continuously updating the country wise data related to impact of corona virus in different countries as well as regions. The figure 3 represents cumulative confirmed cases of corona positive patients along with confirmed deaths and population density of SEARO region as of date 13 May 2020. On the other hand, figure 4 and 5 are representing the number of confirmed cases versus deaths and comparison study of average confirmed cases per day and percentage of deaths over the period of 77 days, respectively[45].

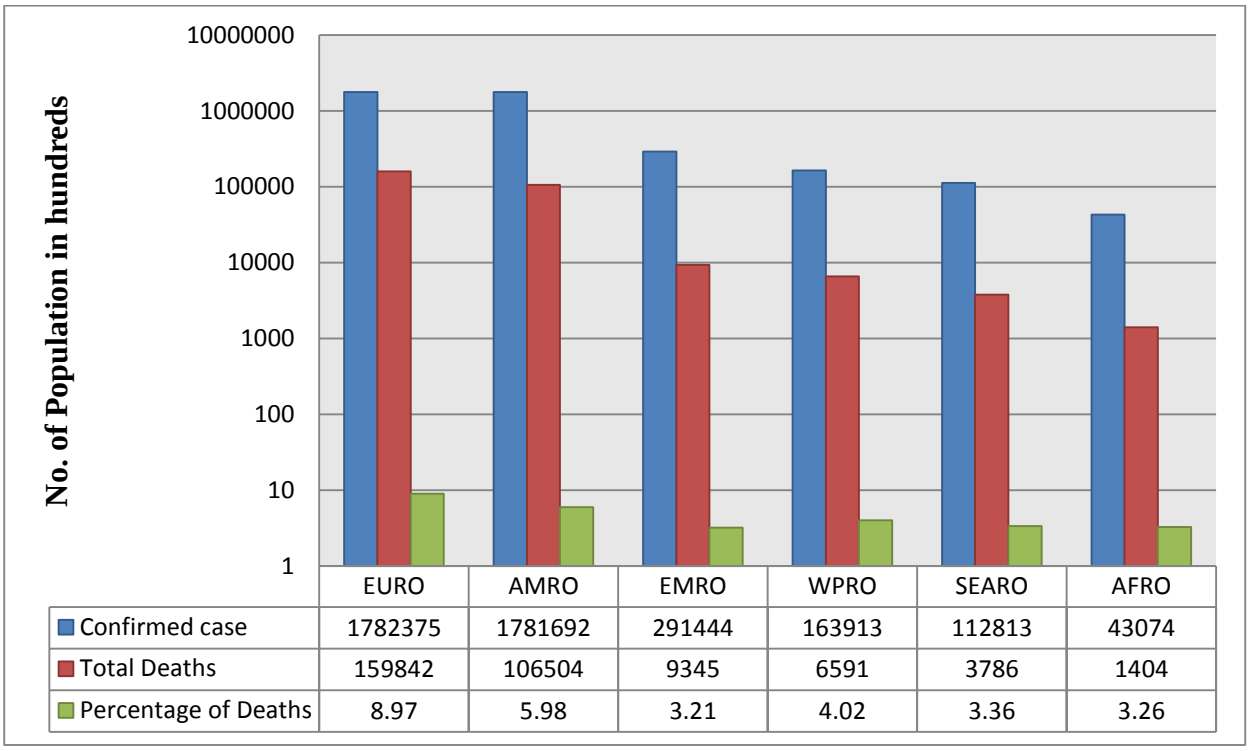


	Bangladesh	Bhutan	India	Indonesia	Maldives	Myanmar	Nepal	Sri Lanka	Timor-Leste	Thailand
Cumulative Confirmed Cases	17822	11	74281	15438	904	180	243	893	24	3017
Cumulative Deaths	269	0	2415	1028	3	6	0	9	0	56
Population Density (per sq. km)	1170	21	414	141	1258	80	201	332	78	130

Figure 3: Status of SARS CoV-2 in WHO SEARO countries

Generally it is considered that viral transmission takes place by direct contact with an infected person or by touching the surfaces on which large virus-containing droplets were expired by any infected person where the virus can remain stable for days[44,46]. Immediately after droplets are expired, the liquid content starts to evaporate, and some droplets become so small that

transport by air current affects them more than gravitation. Such small droplets are free to travel in the air and carry their viral content making the virus airborne[47].



	EURO	AMRO	EMRO	WPRO	SEARO	AFRO
Confirmed case	1782375	1781692	291444	163913	112813	43074
Total Deaths	159842	106504	9345	6591	3786	1404
Percentage of Deaths	8.97	5.98	3.21	4.02	3.36	3.26

Figure 4: Number of confirmed cases versus deaths in six WHO regions as of 13 May 2020

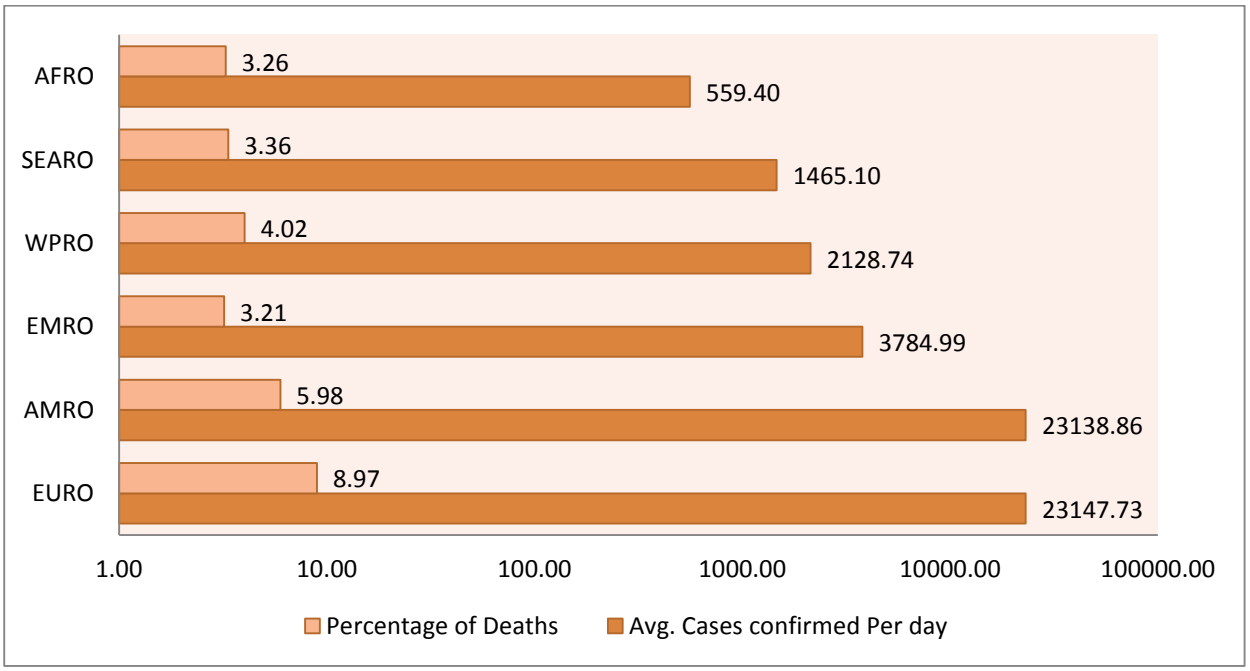


Figure 5: Comparison study of average confirmed cases per day and percentage of deaths in six different regions over the period of 97 days

A study revealed the fact that at high relative humidity (>95%) and comparatively low temperature (28 and 33°C) there was no significant affect on the infectivity of the virus. However, at a high temperature (38°C) and at 80-90% relative humidity 0.25 ~2 $\log_{10}$loss of titter was observed over time. To add to it, the infectivity of the virus was seen to further get

degraded by ~1.5 log at both high temperature and high relative humidity[26,48]. A dynamic transmission model study of SARS CoV-2 revealed that the virus can proliferate at any time of year, with high seasonal variation in transmission but larger recurrent wintertime outbreaks. Moreover the study also suggested that if immunity to the virus is not permanent, it is likely to enter the regular circulation whereas if the immunity is permanent then the virus could disappear for five or more years after causing a major outbreak[49].

MANIFESTATIONS AND COMPLICATIONS

The signs and symptoms of the disease start to show up after an incubation phase of roughly 5 days[50]. The episode of commencement of the symptoms of the disease to death varies from 6 to 41 days and this episode is basically dependent on the age and immune system of the individual in concern[51,52]. The most common symptoms of SARS CoV-2 includes fever, cough and fatigue while other symptoms like diarrhea and vomiting are much exceptional[53-55]. However, in severe cases patients are vulnerable to a wide range of complications which includes acute respiratory distress syndrome, acute heart injury etc. Evidences also show that COVID-19 can cause damage to tissues and organs other than lungs[56].

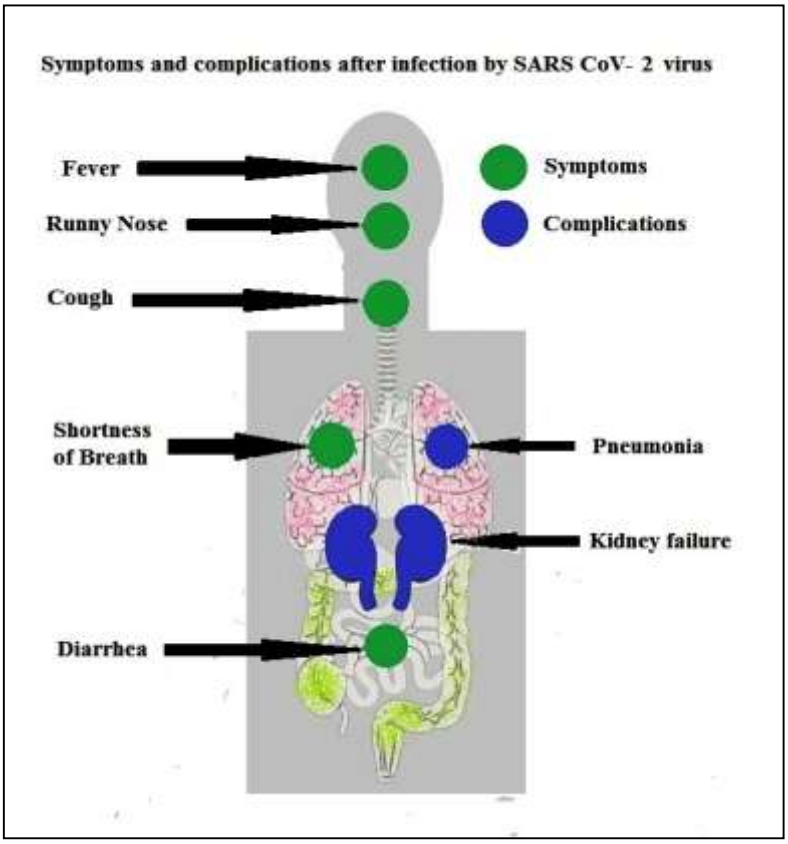


Figure 6: Symptoms and complications associated with SARS CoV-2 patients

Patients infected by SARS CoV-2 showed low oxygenation index in comparison to patients with bacterial pneumonia. Moreover, higher levels of Interleukin-6 and Interleukin-10 in combination with lower levels of CD4+ and CD8+ cells are also observed in COVID-19 patients enhancing the severity of the disease[51,57].

GLOBAL SOCIO-ECONOMIC IMPACT OF COVID-19 OUT BREAK

Societies are in mayhem and economies are in a tumble due to the unparalleled situation that the world is facing today. As it has been the case in some of the countries in West Africa affected by the Ebola outbreak in the year 2014, the current calamity can be a potential cause to result in grievances, doubt and a sense of prejudice over access to health services, jobs and livelihoods of people and thereby causing conflict which could very well destabilize development, peace and most importantly social cohesion. Hence forth, it is the need of the hour to tackle the vulnerability of the situation properly arising from the pandemic[34,58].

The socio-economic affect of coronavirus pandemic have had extensive outcome beyond the spread of the disease itself, with concerns shifting from supply-side manufacturing issues to decreased business in the service sector[59]. The pandemic have already caused the largest global recession with majority of the population placed under lockdown. A UK based research firm, Oxford Economics has predicted that if the pandemic lasts for six month continuously, there is a knock of $1.1 trillion off the expected growth of global GDP[60].Global stock markets witnessed its worst crash[61] in March 2020, due to the quarantine policies employed countries, less spending by consumers, unable to work outside by wagers, tourism and travel dropped sharply and zero investments in share market or other sectors by the investors. On 18th of March 2020, the World Health Organization issued a report concerned with the mental health and psychosocial issues in connection with the COVID-19 outbreak[62].

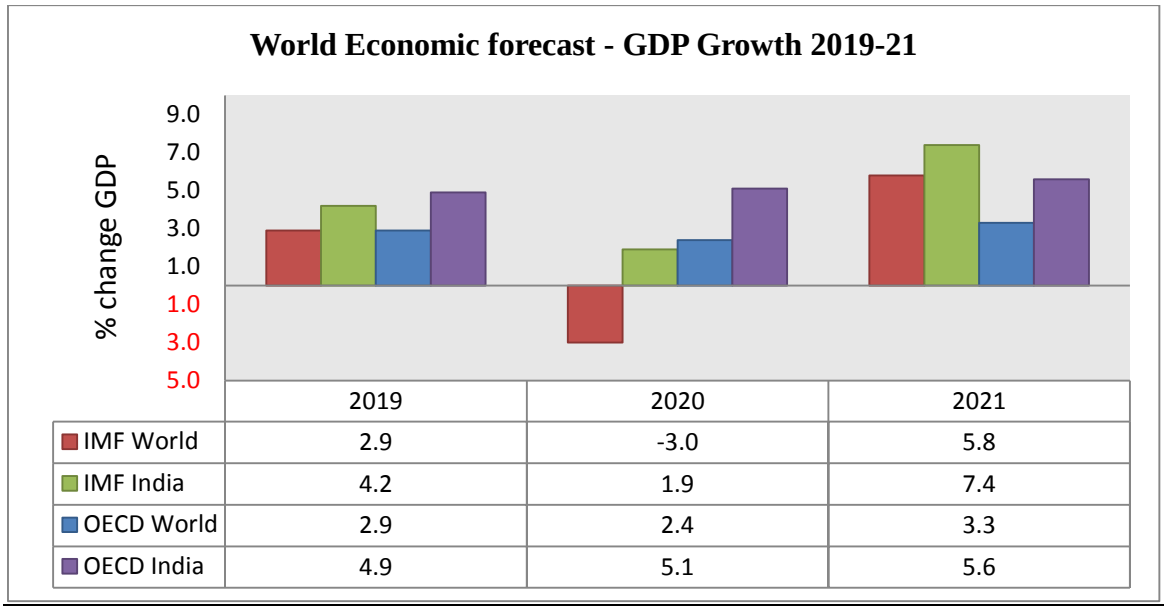
Special emphasis on Indian Economy

In India, the stock market took a bearish mode in response to the pandemic with "BSE SENSEX" falling 2919 and "NIFTY 50" falling 950 points in single day on 12 March 2020[63] Experts in the subject of economy expect the impact to be limited to supply chain of major business organizations especially pharmaceuticals, automobiles, textiles etc on a near term basis. However, a severe impact can be expected on global trade due to disruption of logistics in mainland China and because of the combined risk with regional geopolitical tensions, a wider trade war is what can be expected[50,64].

Monthly economic reports of India shows that the Growth Domestic Product (GDP) index of fourth quarter (Q) of financial year (FY) 2018 (Q4 FY18) was 8.1%. From this point onward, a negligible fall has been observed in next first quarter of FY 2019 with 8.0%, followed by 7.0% in second quarter, 6.6% in third quarter and with 5.8% of sharp fall, FY 2019 was ended [Figure 7].In the beginning of the FY 2020, same cliffs like falling trend was continued with 5.0% in first quarter and predicted to be 4.5% in second quarter. But third quarter may bring some good news with 0.2% increase in third quarter of FY 2020 with elevated 4.7% of GDP of Indian economy[65].

Figure 7: Graphical representation of Indian GDP index

On 26th of March, 2020, Indian Government had announced 17 lac crore rupees ($22.6 billion) economic incitation plan to give relief to crores of poor people affected by a nationwide 1st phase lockdown over COVID-19 by providing direct cash transfers and food security. Under this initiative, 20 crore women and the elderly will get direct cash transfers, free cooking gas cylinders to 8.3 crore poor families. The Government also decided to extend their help to feed about 80 crore poor people over the next three months during this pandemic segment by distributing 5 kilograms of staple food-grains wheat or rice for each person free of cost along with a kilogram of pulses for every low-income family. The government outlined plans for medical insurance cover of 50 lac rupees ($66,000) for every frontline health worker like doctors, nurses, pharmacists and paramedics. During lockdown Phase-2, started on March 3, Government India announced another second stimulus package for small and medium businesses of worth rupees 1 lac crore ($13 billion) to rejuvenate them after post coronavirus outbreak[66].



	2019	2020	2021
IMF World	2.9	-3.0	5.8
IMF India	4.2	1.9	7.4
OECD World	2.9	2.4	3.3
OECD India	4.9	5.1	5.6

Figure 8: OECD and IMF Economic Forecasts in real GDP growth (in %)

On the other hand International Monetary Fund (IMF) and Organization for Economic Cooperation and Development (OECD) also has projected (Figure 8) Indian as well as Global GDP. The reports clearly indicate that the overall global economy will face strong turbulence and may cause global recession in post COVID-19 phase[67].

TREATMENT AND MANAGEMENT STRATEGIES

With no specific anti-viral treatment and vaccines available the entire health-care system is dependent on broad-spectrum anti-viral drugs for the treatment of COVID-19. A report revealed that Chloroquine a broad-spectrum anti-viral drug have been highly effective and have also been used with a safety track record in the treatment of COVID-19. However, SARS CoV-2 being a RNA virus, the vaccines related to or to be more precise used against other RNA viruses like Polio, Influenza etc can prove to be promising alternatives in the treatment of SARS CoV-2[68]. With several studies supporting the fact that Vitamin C supplementation can be effective in preventing vulnerability to lower respiratory tract infection, hence its use may prove to be of utmost importance in minimizing the vulnerability of COVID-19. Improved personal hygiene, good ventilation, isolation, sufficient nutritional intake and adequate rest could be a way to prevent the pandemic[69].Since patients with diseases especially those with hypertension, diabetes etc are at higher risk of getting infected because of their low systemic immunity[70].

Current status of Vaccine clinical trials [71,72]

Vaccines or other treatment option against SARS CoV-2 virus may take 12-18 months to be available to the common people. The researchers from the whole world are working tirelessly in this regard and few most of the vaccine candidates are currently in phase 1 to phase 3 of clinical trial. The United States, United Kingdom, Germany, China, Canada and India too are

in the process of developing vaccines and treatment by considering the candidates Bacillus Calmette-Guerin (BCG) live-attenuated vaccine for COVID-19, mRNA-1273, Ad5-nCoV, ChAdOx1, INO-4800, BNT162, Formalin-inactivated and alum-adjuvanted candidate vaccine for COVID-19, PittCoVacc, NVX-CoV2373, mRNA-based COVID-19 vaccine, li-Key peptide COVID-19 vaccine, Oral recombinant COVID-19 vaccine, Self-amplifying RNA vaccine, Plant-based COVID-19 vaccine, DNA-based vaccine for COVID-19, Intranasal COVID-19 vaccine; and Remdesivir, Cocktail of Danoprevir and Titonavir, Antibody Treatment, Cocktail of antibodies, Plasma of treated patients, Viral replication inhibitor etc.

Indian Council of Medical Research (ICMR) in association with Bharat Biotech International Limited, has received permission from Central Drugs Standard Control Organization (CDSCO) to conduct clinical trial of convalescent plasma for the treatment of Covid-19. ICMR has initiated fast-track the roll-out of the Solidarity trial launched by the World Health Organization (WHO) to help in finding an effective treatment for COVID-19. There are four treatment protocols has been accounted, namely, (a) Hydroxychloroquine, and Lopinavir (b) Remdesivir (c) combination of Lopinavir and Ritonavir and (d) Ritonavir with Interferon beta-1a. These drugs will be evaluated during the clinical trials in selected 09 hospitals across the country. Among them the most prominent places are AIIMS in Jodhpur, Apollo Hospital in Chennai, B J Medical College and Civil Hospital in Ahmedabad and in Bhopal, the Chirayu Medical College and Hospital.

Different measures adopted by countries to fight against SARS CoV-2

WHO has circulated general instructions to the people around the globe to control[73] the outspread of SARS CoV-2: (1) to ensure washing and cleaning of hands frequently; (2) to maintain social distance of about 1 meter; (3) to Avoid touching eyes, nose and mouth; (4) to Practice respiratory hygiene; (5) Should seek medical care as soon as possible, if someone having fever, cough and difficulty breathing; (6) Stay informed and to follow advice given by your healthcare provider.

Along with this general public information, different countries have taken different measures to protect their countrymen from this deadly virus. Countries under the Europe, North America, South Asia, Latin America and Africa regions had taken few common initiatives like to close their country borders and impose full or partial 'Lock down' strategy throughout the country on prioritized emergency basis[74].

Europe

Geneva closed commercial activities and banned meetings of more than five people and all kind of religious services. Government of France declared no social gatherings and leisure activities will be allowed until mid-July and people should only leave home to buy groceries, exercise or receive medical care and also deployed one lacarmy troops to enforce the new rules.

The United Kingdom imposed lockdown on 23 March during which people allowed to buy food and medicine, once a day exercise, and travel "absolutely necessary" work places. Prime Minister of Ireland re-registered as a medical practitioner, started medical practice, started “Be on call for Ireland” campaign and announced that private hospitals would become part of the public health system. Italy, the second worst COVID-19 effected country, announced more economic measures. A nationwide restriction had been imposed on travel, schools, museums, restaurants and all shops except food stores and pharmacies. The Portugal government has granted citizenship rights to all migrants and asylum seekers so that they can access free social security and health care. The Danish government announced to pay 75% of employees' salaries for private companies till 9th of June 2020[75,76].

North America

The US government initiated stimulus package of $2.2 trillion economic and signed into law on March 27 with measures to support individuals, businesses and the public sector. Government has appealed their citizens to avoid gatherings of more than 10 people. On 20 March, California ordered its 40 million residents to stay at home. On 22 March New York mandated the closing of all non-essential businesses in the state. Till date, New York is the worst COVID-19 affected area in the world. On April 2, US President invoked the Defense Production Act to ensure companies making ventilators receive the supply of materials they need. Canada on 16 March closed its borders to anyone who is not a citizen or permanent resident of the country and approved a portable COVID-19 test, which can deliver results in less than 60 minutes[77,78].

East Asia

Wuhan city of China, was the first city to go into lockdown and huge quarantine zone of around 50 million people, with buses, trains and flights out of the city cancelled in January 2020. On 27 March, government announced a temporary ban on visitors. South Korea had carried out a tabletop exercise for the containment of a fictional disease on 17 December, almost exactly a month before the first patient of COVID-19 appeared, and as a result they were well prepared and today most of the cities are functioning smoothly with few restrictions. Hong Kong, responded strictly with travel restrictions from March 13 onward. Government of Japan announced the postponement of the Olympic Games and taken all safety measures to protect the health and lives of citizen[79,80].

Middle East

Saudi Arabia imposed curfew on 23 March, to keep people indoors between 7 pm and 6 am for 21 days[81].

South Asia

Government of India imposed strict ‘lockdown’ and ‘social distancing campaign’ due to which

1.3 billion people are at home quarantine now. The initiative has been praised by WHO and described it as "fast and aggressive action" to limit the spread of corona virus. India is now on 2nd phase of lock down period upto 3 May 2020. To help millions of poor people the Government of India had declared $22.6 billion economic stimulus plan which include direct cash transfers and food security measures[82].

Asia Pacific

Government of Australia declared a national human biosecurity emergency on 18 march and announced new measures including an indefinite new ban on indoor groups of 100 people or more, with exemptions for schools, public transport, universities, prisons, courts, supermarkets and worksites. New Zealand, announced lockdown on 25 March and closed Schools, businesses like non essential enterprises[83].

Latin America

Panama has banned entry of non-resident foreigners and Honduras closed its borders to passenger traffic for a week. Argentina and Peru also announced border closures on 15 March to curb coronavirus, while Government of Venezuelan ordered a "collective quarantine"[84].

Africa

The government of South Africa declared COVID-19 as national disaster on 15 March and banned travel to the most-affected countries, amid concerns that virus will derail economic recovery. Kenya has also imposed sweeping travel restrictions[85].

CONCLUSION

The novel coronavirus disease which is caused by SARS-CoV-2 with bat being the most likely source has posed a huge hazard not only to the global health and safety but also the economy. No specific medication available for treatment right now and also the mechanism of attachment and infection of the virus unknown by far. Hence, to have a control over the spread of the pandemic is a burning issue as of now. Countries have undertaken several steps such as lockdown, imposing travel ban (both domestic and international) to control the spread of the disease but it is also important to endeavor for the development of specific medication and vaccines in order to improve the safety of the people around the globe. Researchers are trying to develop effective vaccines as early as possible. Along with the above, researchers must have to focus study on animals that may carry high risk pathogens. State authorities must ensure the continuous health check up for those people who comes in contacts of wildlife animals due to their profession or survival and finally at international level, strict rules and regulations must be introduced regarding wildlife trade. The 'One Health Approach' initiated by the Centers for Disease Control and Prevention (CDC), USA might be going to only option to save mankind.

Thus the aforesaid measures may help to prevent future pandemics likely today, the SARS CoV-2.

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