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Corona Outbreaks: Environmental Effects, Learning and Possible Strategies of Sustainability

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Abstract

Corona virus disease 2019 (COVID-19) is a worldwide epidemic that is having an impact on all facets of human life, including the natural environment. There are a number of social and economic implications of the COVID-19 lockdown. The natural ecosystem has been somewhat positively impacted by this lockout and the limited human mobility. Additionally, there are certain unfavourable effects of COVID-19, such as a rise in medical waste, careless handling and disposal of disinfectants, masks, and gloves, and a load of untreated wastes that are continuously damaging the environment. Integrity of the environment and human health are related. To safeguard human health, a shift to a sustainable society and economy is required. It is generally known that coronaviruses can undergo genetic recombination, which can result in novel genotypes and outbreaks. Horseshoe bats are a major source of SARS-CoV-like viruses, and southern China's tradition of consuming exotic mammals makes them a ticking time bomb. It is important to be ready for the possibility of the re-emergence of SARS and other new viruses from animals or laboratories. Governments and society must consider what to do differently and what to cease doing completely in order to "build back better."

Keywords: Biomedical waste, Corona virus, COVID-19, Environment sustainability, MERS-CoV, SARS-CoV.

Introduction

Since the 1918 influenza pandemic, with more than 3.8 million fatalities worldwide, the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is the cause of the extremely contagious viral disease known as the Coronavirus disease 2019 (COVID-19). This virus has a terrible effect on the world's demography. When the initial cases of SARS-CoV-2, a predominantly respiratory viral virus, were first reported in Wuhan, Hubei Province, China, in late December 2019, the disease quickly spread throughout the world. The outcome was that on March 11, 2020, the World Health Organization (WHO) was compelled to proclaim it a global pandemic. Since it was declared a global pandemic, COVID-19 has ravaged a number of countries and seriously damaged a number of healthcare systems. Several people have lost their jobs as a result of extended closures brought on by the epidemic, which has had a detrimental knock-on effect on the global economy. Many nations are currently dealing with reoccurrence of SARS-CoV-2 outbreaks, which are mostly related to the introduction of mutant versions of the virus. SARS-CoV-2 continues to cause devastation throughout the world. Limiting the continuous spread of this virus and its variations has become a matter of growing worry despite major improvements in clinical research that have enhanced understanding of SARS-CoV-2 and the therapy of COVID-19.

During different international journeys, the COVID-19 was also brought into Indian borders, where it was then given to the local populace. The first laboratory-confirmed COVID-19 case was a student who had just returned from Wuhan, China, on January 30, 2020.She was enrolled in a course of study in Wuhan when she returned home to Kerala, where she was quarantined and hospitalised before being released after a full recovery. The Ministry of Health and Family Welfare reports that in India, the COVID-19 death rate is roughly half that of the world average. The focus of this review is to describe corona virus, associated pandemic COVID-19 and its impact on environment.

History of Corona Virus

According to the current categorization of coronaviruses, the family Coronaviridae, subfamily Coronavirinae, suborder Cornidovirineae, order Nidovirales, and realm Riboviria collectively include 39 species in 27 subgenera, five genera, and two subfamilies. The huge spike

protein molecules that are present on the virus surface and give the virions a crown-like form gave the coronavirus family its name (Pellett et al. 2014). Based on their evolutionary connections and genomic architecture, the four genera that make up this subfamily are Alphacoronavirus, Betacoronavirus, Gammacoronavirus, and Deltacoronavirus. Only mammals are susceptible to infection by alpha- and beta-coronaviruses. Birds are infected by the gammacoronaviruses and deltacoronaviruses, but some of them can also infect mammals. The Coronaviridae Study Group (CSG), a working group of the ICTV, created the family taxonomy and categorization. SARS-CoV-2 is unique from the first two zoonotic coronaviruses, SARS-CoV and MERS-CoV that were transmitted to humans in the early twenty-first century.

Severe acute respiratory syndrome (SARS)

Severe acute respiratory syndrome (SARS), a type of a typical pneumonia, started to spread quickly over the world in November 2002, causing the World Health Organization (WHO 2003) to classify the illness as "a worldwide health danger" (Lau et al. 2005). China was the outbreak's focal point, where SARS infected more than 5,300 people and killed 349 people nationally (Ministry of Health 2003). In February 2003, Liu Jianlun, a Guangdong medical professor who had unwittingly contracted SARS, booked into Room 911 at the Metropole Hotel in Hong Kong, causing SARS to spread from the mainland of China to Hong Kong. Soon after contracting the sickness, the 64-year-old professor went to the hospital where, two weeks later, he passed away. Yet he unintentionally infected a number of other visitors during his brief stay at the motel. They later transported SARS to Singapore, Toronto, and Hanoi. The motel has now changed its name to Room 911 due to the stigma.

Middle East respiratory syndrome (MERS)

Middle East respiratory syndrome coronavirus (MERS-CoV) is a virus that causes respiratory sickness known as Middle East respiratory syndrome (MERS). On June 13, 2012, the first cases of corona virus infection in Saudi Arabia, notably Jeddah, were reported. Following this outbreak, the virus spread to several nations in Asia, Africa, Europe, and America. Since 2012, MERS cases have been documented in 27 different countries around the world, however Saudi Arabia accounts for the majority (around 80%) of cases. As MERS-CoV is a zoonotic virus, most human infections result from infection with an animal (Baharoon and Memish 2019). The WHO states that the most frequent way to contract the disease is through direct or indirect contact with dromedary camels. It seldom spreads to other people, and when it does, it usually happens inside families or in medical facilities. The MERS-CoV virus resembles European bat coronaviruses in some ways.

Genetic Structure of Corona Virus

Among all recognised RNA viruses, coronaviruses have the biggest genomes (26.4–31.7 kb), with G + C contents ranging from 32% to 43%. An enclosed virus called SARS COV-2 has a helical protein capsid and a non-segmented, positive single-strand RNA genome with 29891 nucleotides that code for around 9860 proteins (Chen et al. 2020). Different coronavirus lineages have variable numbers of short ORFs downstream of the nucleocapsid gene and among the various conserved genes (ORF1ab, spike, envelope, membrane, and nucleocapsid). The viral genome has distinguishing characteristics, the spike protein has a distinct N-terminal region. All coronaviruses possess the genes for the essential structural proteins, which appear in the 5′-3′ order as S, E, M, and N5 (Brian and Baric 2005) (Fig. 1).

The SARS-genomic CoV-2's structure has an alignment of the sequences of different CoVs of roughly 89%. The SARS-CoV-2 proteins' translated sequences were obtained from GenBank [Accession ID: NC 045512.2]. The entire SARS-CoV-2 genome encodes a polyprotein of roughly 7096 residues, including both structural and non-structural proteins (NSPs). Two non-structural proteins, ORF1a and ORF1ab, together with structural proteins, hold the bulk of the viral genome's nucleotide content. The ORFs 1a and 1b code for the polypeptides pp1a and pp1ab, respectively, with the ribosomal frame shift mechanism of gene 1b encoding polypeptide

pp1ab. The virally encoded proteinases that further break down these polyproteins into their 16 constituent proteins are substantially conserved across all CoVs in the same family (Naqvi et al. 2020).

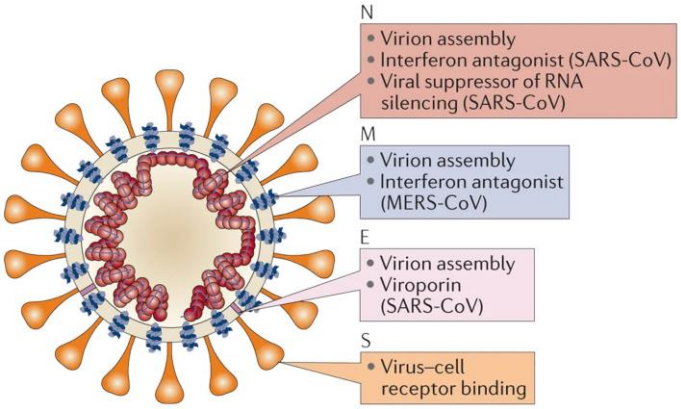

Figure 1. Structure of Coronavirus (Zumla et al. 2016).

Genetic Variants of SARS-CoV-2

All coronaviruses have the capacity to engage in "recombination," a natural process. When two separate lineages simultaneously infect the same cell in a person, recombination can happen. This unusual occurrence may alter the features of the virus, including its capacity to spread, to cause serious illness, or to reduce the efficacy of medications or vaccines. However, recombinant viruses frequently lack the competitive advantages that would enable them to flourish (Naqvi et al. 2020). The SARS-CoV-2 virus is categorised in a variety of ways. Depending on the situation in which SARS-CoV-2 is being conveyed, each classification type may be suitable. Lineages are frequently brought up when talking about SARS-CoV-2 (and sublineages). Pango is the lineage categorization scheme that is most frequently employed. The World Health Organization may classify lineages or groupings of similar lineages using Greek letters (like Omicron) in a larger context. Scientists can explain the similarities and differences between SARS-CoV-2 viruses thanks to these classification techniques. A SARS-CoV-2 Interagency Group (SIG) was established by the U.S. Department of Health and Human Services (HHS), using four classification methods: variation of interest (VOI), variant of concern (VOC), variant of high consequence (VOHC), and variants being watched (VBM) (Table 1).

Table 1. List of Variants (https://www.cdc.gov/coronavirus/2019-ncov/variants/variant-classifications.html)

WHO Label	Pango Lineage	Date of Designation
Alpha	B.1.1.7 and Q lineages	VOC: December 29,2020 VBM: September 21,2021
Beta	B.1.351 and descendent lineages	VOC: December 29,2020 VBM: September 21,2021
Gamma	P.1 and descendent lineages	VOC: December 29,2020 VBM: September 21,2021
Delta	B.1.617.2 and descendent lineages	VOC: June 15,2021 VBM: September 21,2021
Epsilon	B.1.427 B.1.429	VOC: March 19,2021 VOI: February 26,2021 VOI: June 29,2021 VBM: September 21,2021
Eta	B.1.525	VOI: February 26,2021 VBM: September 21,2021

Iota	B.1.526	VOI: February 26,2021 VBM: September 21,2021
Kappa	B.1.617.1	VOI: May 7,2021 VBM: September 21,2021
N/A	B.1.617.3	VOI: May 7,2021 VBM: September 21,2021
Omicron	B.1.1.529	VOC: November 26,2021
Zeta	P.2	VOI: February 26,2021 VBM: September 21,2021
Mu	B.1.621,B.1.621.1	VBM: September 21,2021

Possible Source of Infection

The characteristics and patterns of the ongoing transmission of COVID-19 can be used to forecast how the pandemic will behave in upcoming years.

Animal-to-Human Transmission

It's unclear how COVID-19 spreads between people, although the pandemic is still young, it was determined that the infection is zoonotic, meaning it may spread from animals to humans. Beta-CoV/bat/Yunnan/RaTG13/2013 (bat/RaTG13), a coronavirus from bats, is identical to the COVID-19 virus in people (Wrobel et al. 2020), suggesting that acute human infection is stored in bats. At the complete genome level, the human CoV-2019 and a bat coronavirus are actually 96% genetically identical.

Human-to-Human Transmission

According to recent evidence, given that the COVID-19 coronavirus may move from person to person, this suggests that it is the main means of disease transmission during the current pandemic. In order to stop the pandemic from spreading further, strict surveillance and testing are therefore required. Those who have COVID-19 symptoms will typically infect individuals who are near to them. Yet, a lot of COVID-19 patients have symptoms and can inadvertently spread the virus by acting as carriers. This might be the cause of how quickly and dramatically COVID-19 cases have risen in some nations that have relaxed social segregation and isolation laws, as well as in households with infected members who are asymptomatic (Rume and Islam 2020).

Environmental Impacts of COVID-19 Pandemic

The COVID-19 global disruption had a variety of impacts on the ecology and climate.

Positive Environmental Impacts

Reduced Emissions of GHGs and Air Pollution

Emissions of greenhouse gases (GHGs) have abruptly decreased as a result of the closure of businesses, transportation, and industry. The viral control measures implemented have resulted in a roughly 50% reduction in air pollution readings in New York compared to this time last year (Henriques 2020). According to estimates, the suspension of China's heavy industries led to a nearly 50% drop in N_2O and CO emissions (Caine 2020). Another important measure of global economic activity is NO_2 emissions, which show a sign of decline in numerous countries (including the US, Canada, China, India, Italy, Brazil, and others) as a result of the lockdown (Biswal et al. 2020, Somani et al. 2020). It is estimated that the main sources of emissions are cars and aeroplanes, which account for around 72% and 11% of the GHG emissions in the transportation sector, respectively (Henriques 2020). The aviation industry is being significantly impacted by the global efforts to contain the virus. International travellers have entry and exit restrictions in several nations. Worldwide flights are being cancelled by commercial aviation firms as a result of fewer passengers and limitations.

Water Pollution Reduction

With domestic and industrial trash being deposited into rivers without being treated, developing nations like Bangladesh and India frequently experience water pollution (Islam and Azam 2015, Islam and Huda 2016). The primary industrial sources of pollution have diminished or stopped altogether during the lockdown, which has contributed to a decrease in the reduction in the pollutant load (Yunus et al. 2020). Because of the lack of industrial contamination throughout India's times of shutdown, the rivers Ganga and Yamuna, for instance, have attained a high level of cleanliness. The 36 real-time observational sites along the Ganga were determined to have water that was within acceptable limits at 27 of the stations (Singhal and Matto 2020). According to the Uttarakhand Pollution Control Board (2020) of India's real-time water quality monitoring data, the river Ganga's physicochemical parameters, including pH (7.4-7.8), dissolved oxygen (DO) (9.4-10.6 mg/L), biochemical oxygen demand (BOD) (0.6-1.2 mg/L), and total coliform (40-90 MPN/100 mL), were found to be within the country's surface water quality standard.

Noise pollution reduction

Noise typically has a bad impact on physiological health, coupled with heart disease, high blood pressure, and inadequate sleep in people (Kerns et al. 2018). According to reports, noise pollution puts 360 million individuals at risk of hearing loss worldwide (Sims 2020). According to the World Health Organization, nearly 100 million individuals in Europe alone are exposed to noise levels that are too high (WHO 2012). The noise levels at Delhi's Govindpuri Metro Station have dropped from 100 dB to 50-60 dB as a result of the reduction in vehicle traffic during the lockdown (Gandhiok and Ibra 2020). The Central Pollution Control Board (CPCB 2020) of India asserts that Delhi's residential neighbourhoods have a high degree of noise that has decreased from 55 dB (during the day) and 45 dB (during the night) to 40 dB (during the day) and 30 dB (during the night), respectively. As a result, residents of the city are enjoying the bird tweeting, which typically runs from 40 to 50 decibels (Gandhiok and Ibra 2020).

Reduction in soil pollution

Crop output and quality will decrease as a result of soil contamination brought on by anthropogenic activities, particularly urbanisation. Moreover, it will alter soil biodiversity, organic matter, and groundwater quality. There have been indications of a considerable drop in solid waste during the pandemic. By implementing a plan for collecting, storing, and consuming leftovers, 85% of respondents in a Tunisian poll indicated favourable changes in the prevention of food waste (Jribi et al. 2020). According to several reports, there was less municipal, industrial, commercial, and grey water waste generated during the epidemic. Moreover, there were more green spaces and less soil erosion. In order to reduce household trash and make the environment healthier, consumer cooperation is essential. It would be quite beneficial to utilise eco-friendly items and put the "reduce, reuse, and recycle" principle into practise.

Negative Environmental Impacts

Increased Production of Biomedical Waste

Globally, there has been an upsurge in the generation of medical waste since the COVID-19 outbreak, which poses a serious risk to both the environment and human health. Hospitals produce large amounts of infectious and biological waste as a result of patient sample collection, diagnosis, treatment of numerous patients, and disinfection purposes (Somani et al. 2020, Zambrano-Monserrate et al. 2020). For example, Around 240 metric tonnes of medical waste were created every day in Wuhan, China, during the outbreak (Saadat et al. 2020), which is over 190 metric tonnes more than the regular time (Zambrano-Monserrate et al. 2020). Likewise, during the first phase of shutdown, the production of medical waste in Ahmedabad, India, risen from 550-600 kg per day to about 1000 kg per day.

Safety Equipment Use and Haphazard Disposal

People currently use face masks, hand gloves, and other safety devices to protect themselves from viral infections, which increase the volume of medical waste. According to reports, the

amount of waste in the USA has increased as a result of more PPE being used at home (Calma 2020). People are currently utilising face masks, hand gloves, and other safety equipment to protect themselves from viral infections since the outbreak, which increases the amount of medical waste. Worldwide manufacture and use of PPE made of plastic has expanded since the COVID-19 outbreak (Singh et al. 2020). For example, China boosted daily manufacturing of medical masks to 14.8 million since February 2020, a significant rise from earlier levels (Fadare and Okoffo 2020). Yet, most people discard things (such as face masks, hand gloves, etc.) in public areas and occasionally with domestic rubbish due to a lack of information about how to manage infectious waste (Rahman et al. 2020). Such careless disposal of these wastes clogs waterways and exacerbates environmental contamination.

Municipal Solid Waste Production, and Reduction of Recycling

Pollution of the air, water, and soil is a direct and indirect result of increased municipal garbage creation (both organic and inorganic) (Islam et al. 2016). In response to the epidemic, quarantine rules put in place in many nations have increased the desire for online shopping with home delivery, which has increased the quantity of household garbage produced by sent package material. Recycling rubbish, on the other hand, is a practical approach to protect the environment, save energy, and reduce pollution. Yet, many nations delayed garbage recycling initiatives owing to the pandemic in order to stop the spread of viral infections. For instance, USA government stopped recycling programmes in numerous places (almost 46%) due to concern over the possibility of COVID-19 spreading in recycling facilities.

Possible Environmental Sustainability Measures

All of these environmental effects are assumed to be momentary. So, it is imperative to develop a good strategy for managing the environment sustainably and achieving long-term success. As a result of the COVID-19 pandemic, there has been a global response and cooperation to eradicate the virus. Similar to that, Nations should be required to cooperate in order to maintain our planet, which serves as the home of humanity (Somani et al. 2020). As a result, a few potential techniques for maintaining the global environment are suggested.

Sustainable Industrialization

Industrialization is necessary for economic progress, but sustainability should also be taken into account. Switching to less energy-intensive industries, implementing strong energy regulations, and employing cleaner technology and fuels efficiency regulations are all necessary for sustainable industrialization (Pan 2016). Also, it is advisable to locate enterprises in certain areas because waste from one business can be repurposed as a source of raw materials for another (Hysa et al. 2020). Industrial zones ought to have been shut down gradually over time to minimise emissions without hurting the economy of the country. For the purpose of preventing the spread of any infectious contagious disease, appropriate distance and a clean atmosphere must be maintained.

Green and Public Transportation Usage

Encouragement to utilise public transportation instead of private vehicles is required to reduce pollution. Also, Short-distance bicycling should be promoted, and a public bike sharing system should be implemented similar to that in China should be readily available for usage by the general public because it is not only healthful but also considerate of the environment.

Utilising Renewable Energy

Reduced reliance on fossil fuels like coal, oil, and natural gas can be achieved through using renewable energy sources, which can help to significantly lessen the emissions of green house gases (GHGs). Because of the COVID-19 epidemic, there is a decrease in the world's energy demand, which lowers emissions and improves ambient air quality in many places. Yet, unlike a pandemic, the demand for energy cannot be completely eliminated in order to sustain basic needs and global economic expansion. Hence, by using renewable energy sources like solar, wind,

hydropower, geothermal heat, and biomass, the need for energy can be met while lowering GHG emissions.

Treatment and Reuse of Wastewater

To counteract the issues related to water contamination, industrial and municipal wastewater should both be properly treated before release. Reusing treated wastewater in non-production activities like road cleaning and toilet flushing can further alleviate the impact of excessive water withdrawal.

Reusing and Recycling Waste

To reduce waste and environmental damage, it is important to recycle and use both industrial and municipal waste. Circular economy or circularity systems should be incorporated into the manufacturing process in order to decrease raw material consumption and waste production. Also, it is important to manage dangerous and infectious medical waste according to the regulations (WHO 2020). Nowadays, it is abundantly clear that the vast majority of people, especially in underdeveloped countries, are ignorant of the problems with garbage segregation and disposal. Thus, the government needs to launch a comprehensive education campaign about proper waste processing, segregation, and disposal through various public media.

Ecotourism and Ecological Restoration

Tourist attractions should regularly close after a set amount of time for ecological repair. Moreover, ecotourism practises need to be improved to support cultural preservation, sustainable livelihoods, and biodiversity preservation (Islam and Bhuiyan 2018).

Behaviour Modification in Daily Life

Making compost from food scraps, turning off or unplugging electronics when not in use and opting to travel short(er) distances by bicycle instead of car are just a few examples of the changes that need to be made in our everyday lives, and resource usage to lower our carbon footprint.

International Collaboration

A coordinated international effort is necessary to fulfil sustainable environmental objectives and protect vital resources for the environment, such as the world's climate and biological diversity (ICIMOD 2020). As a result, a competent international organisation, such as the United Nations Environment Programme (UN Environment), should take an active part in formulating time-sensitive policies, creating international agreements, and bringing together world leaders to ensure successful implementation.

Conclusion

The COVID-19 epidemic has since become one of the most deadly illnesses. Zoonotic illnesses are becoming more prevalent due to an increase in human population and anthropogenic activities. Despite being destructive COVID-19 pandemic also resulted in some positive and negative impact on environment. Reduction in greenhouse gases, N_2O, CO emission results in better air quality index. Reduction in water and noise pollution brings a positive effect on environment during lockdown in pandemic. But it is not a long-term approach to reduce environmental pollution. Furthermore, this pandemic brings other environmental issues, biomedical wastes and their disposal became a new matter of concern. Already, COVID-19 has had a considerable impact on our day-to-day activities, our businesses, as well as global trade and transportation. This virus has a tremendous impact on both the world economy and the daily lives of people. International organisations and governments from various nations should collaborate to develop sustainable strategies to combat such circumstances. The use of appropriate surveillance methods and cutting-edge biotechnological/molecular technologies is required to monitor the advent of novel zoonotic pathogens and to continue monitoring genetic alterations in those pathogens that are currently known to exist. The health ecology must be greatly enhanced, and unplanned urbanisation must be stopped to prevent system overload.

Instead than shifting blame, it's crucial to accomplish the SDGs (sustainable development goals) of 2030.

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