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Review Article

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Environmental Impacts of Coronavirus Crisis, Challenges Ahead

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Abstract

Coronavirus disease (COVID-19) outbreak has severely affected the whole world. It has overshadowed all the developmental activities across different countries. The COVID-19 pandemic has negatively affected global economy and has threatened health security of people worldwide. This pandemic have affected environment dynamically. Decrease in economic activities, travelling, transport and traffic restrictions all over the world have led to decreased emissions of greenhouse gases and drop in air and water pollution observed universally. Also more than 40 % of downfall is observed in NO2 concentration in Asia and Europe as compared to 2019. Reduced pollution had a good effect on freshwater aquatic life. The reduction in worldwide aircraft flight directly impact on forecast and decreases 65% of weather prediction. Snow fall was observed even in a summer in India. This pandemic has had a long-term impact, affecting all aspects of human life and halting all developmental processes. Combating the COVID-19 pandemic is currently at the top of the global agenda. Quarantine measures opted

for safety of the public have positively affected the environment. Although it has downturned the economic growth drastically, it has also contributed in lowering the pollution. If there is a silver lining to this horrible situation, it may be that it has given us a whiff of the air we will breathe in a low-carbon future.

Introduction

Novel coronavirus termed "COVID-19" causing respiratory illness has emerged as a serious threat to public health all over the world. It has been announced as a global pandemic by World Health Organization (WHO)[1]. First report for this new virus came from Wuhan, china, where lot of people were depicted with symptoms like pneumonia and admitted in hospital in December 2019. Most of the patients showed similar symptoms, the causative microorganism was isolated from the biological samples and was assigned to genus beta coronavirus and placed along with other deadly viruses viz. Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS) are two respiratory diseases that have recently emerged in the Middle East (MERS). It was once known as the 2019 novel coronavirus (2019-nCoV), but it was recently renamed as Severe Acute Respiratory Syndrome Corona virus 2 (SARS-CoV-2) and the sickness it causes was dubbed coronavirus disease 2019 (COVID-19).. With time this virus spread all over the world and finally WHO declared on 11 March 2020, COVID-19 is a pandemic disease. Number of experiments including RT-PCR (Reverse transcription polymerase chain reaction), cell culture analysis, serum antibody studies are going on and efforts are being made to come up with some remedy for this deadly disease but still no vaccine has been developed to cure this virus. Its transmission occurs from human to human via respiratory droplets during coughing or sneezing [2,3]. Although complete information regarding its spread is still unclear. The one of the best way to combat the virus is by safety and preventive methods. As a preventive measure to contain the virus, government of different countries have announced lockdown in which the public gathering, transport, flights and other transport and economic activities were not allowed except medical and food essentials.

A worldwide lockdown has brought a number of changes in the environment. After few weeks of the lockdown a sudden fall in air and water pollution was observed. More rainy and storm weather was experienced even in the summer in India. According to a study conducted by Stanford University's School of Earth, Energy & Environmental Sciences, increasing deforest ation could contribute to an increase in the risk of diseases like COVID-19.They reported that utilization of forest for agricultural, industrial and urbanization purposes increases the occurrence of zoonotic transmission, or animal-to-human diseases accordingly. COVID-19 is caused by the SARS-CoV-2 virus, which is assumed to have originated in animals. Viruses that pass from animals to humans, like as the one that causes COVID-19, will likely grow more widespread as people continue to convert natural environments into agricultural land and industrial uses, according to a Stanford University analysis. The loss of tropical forests in Uganda increases chances of risk to direct interactions with wild animals and the micro organisms (bacteria, viruses, fungi) they carry (Bloomfield et al. 2020). This review enlights in both detrimental and beneficial consequences of covid-19 on environment health and its future prospects.

Effects on Air Quality

According to WHO approximately 3 million peoples are dying in each year due to air pollution while more than 80% of persons in metropolitan areas are exposed to polluted or contaminated air which is more than from normal or safe limit. In low economic or developing countries, approximately 98% of cities unable to meet with air quality standard of WHO (Fig. 1).

Outbreak of coronavirus directly affect the different travel and industry, several areas experienced a sudden fall in the level of air pollution. Centre for Research on Energy and Clean Air reported that, 25% reduction was observed in carbon emission in China by the methods to prevent the spread of COVD -19 disease like as

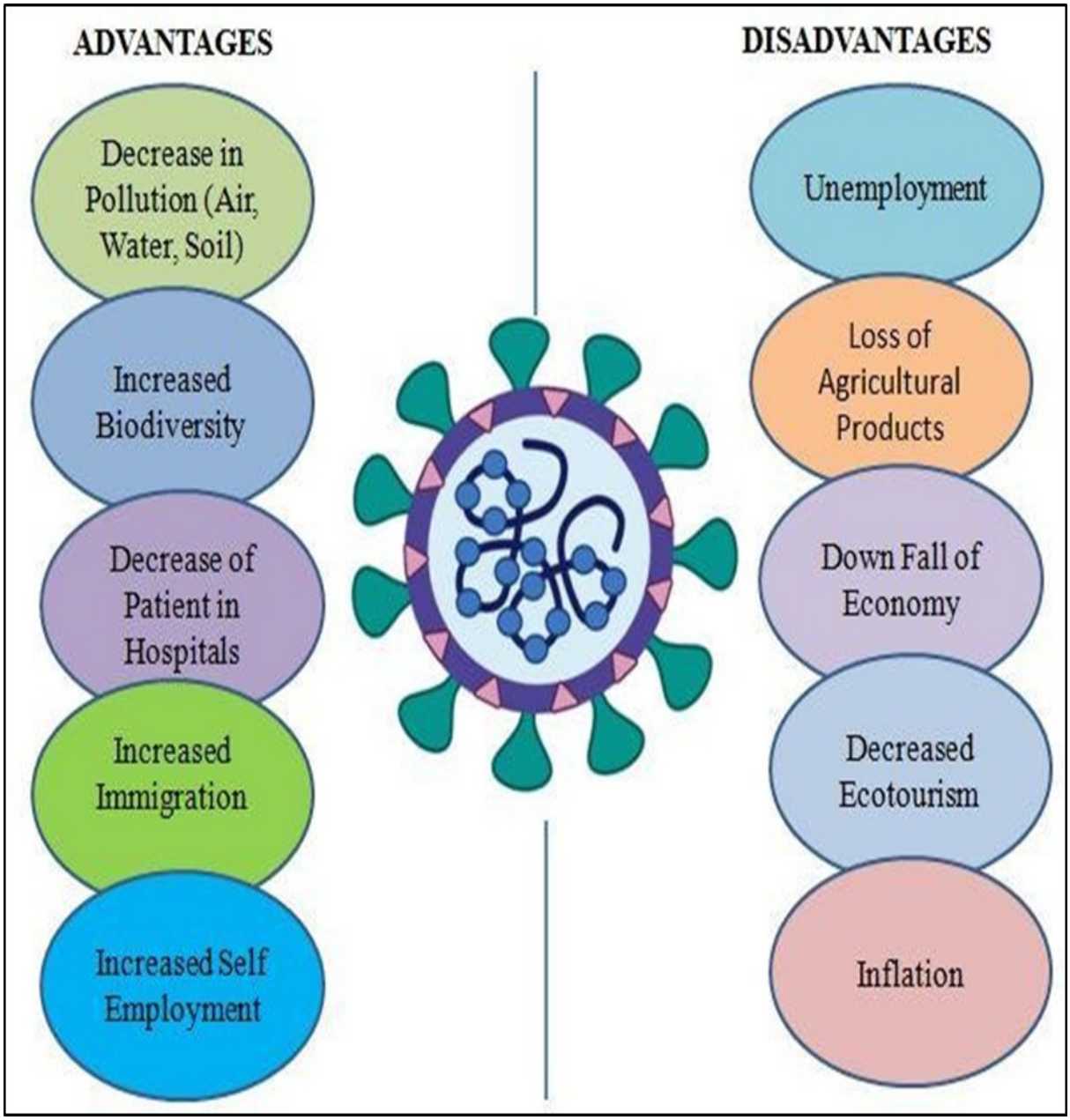

Figure 1. This figure represented the effect of Covid-19 pandemic to all over the world.

quarantines and travel bans [4,5]. In the first month of lockdown in China, due to reduction in transport, Coal consumption and shut down of industries, China approximately produced 200 million fewer metric tons of CO2 as compare to the same period in 2019. This reduction may save at least 77,000 lives ([6]. Nitrous oxide (NO2) emissions in the Po Valley region of northern Italy decreased between January 1 and March 11, 2020, coinciding with regional lockdowns. The European Space Agency has collected data from power plants, factories, and automobiles [7]. Road transport and power plants are the main source of the NO_2 and causes respiratory diseases like as asthama. It also leads to makes symptoms very worse for those individuals already having heart or lung disease. NO2 emissions have been a major issue in Europe, with many countries exceeding EU restrictions. During late January and early February 2020, the European Space Agency's Sentinel-5P satellite saw a 40% reduction in nitrogen dioxide (NO2) levels across cities and industrial areas in Asia and Europe, compared to the same period in 2019.. Similarly, in UK two weeks after the announcement of nationwide lockdown 60% reduction in NO_2 pollution in some cities was reported with respect to previous year. NASA has reported a 30 percent reduction in NO2 pollution in New York and other North-Eastern US metropolitan areas in the year 2020, compared to the monthly average from 2015 to 2019.

According to the IQAir AirVisual's 2019 World Air Quality Report, India has 21 of the world's most polluted cities, as well as the highest rates of respiratory disease and tuberculosis cases. Such conditions may exacerbate the dangers associated with the coronavirus. However, a sharp drop in pollution and the resulting blue sky indicate a significant shift. PM 2.5, which has a diameter of less than 2.5 micrometres, is particularly hazardous because it can lodge deep within the lungs and spread to other organs and the circulation, posing major health hazards. According to government data, after the lockdown began, the average concentration of PM 2.5 in New Delhi dropped by 71% in a week, from 91 micrograms per cubic metre on March 20 to 26 micrograms per cubic metre on March 27. Anything over 25 is considered dangerous by the World Health Organization.

The Centre for Research on Energy and Clean Air (CREA) compiled data from the Central Pollution Control Board (CPCB), which is part of India's Environment Mi nistry, and found a reduction in nitrogen dioxide levels from 52 per cubic metre to 15 in the same time period. These air pollutant levels have also decreased in cities such as Mumbai, Chennai, Kolkata, and Bangalore. Data shows that dangerous small particulate matter known as PM 2.5 and nitrogen dioxide, which is emitted by auto mobiles and power plants, are already at substantially lower levels in major cities. Even before the countrywide lockdown on March 25, India's creeping shutdowns were having an impact. In the cities of Mumbai, Pune, and Ahmedabad, for example, average nitrogen dioxide levels decreased by 40-50 percent in the first three weeks of March, compared to the same period in 2018 and 2019. This was the least traffic pollution (Air uality and Weather Forecasting And Research (SAFAR) under India's Ministry of Earth Sciences). According to CREA's investigation, India's statewide curfew on March 22 resulted in the lowest one-day traffic pollution levels ever recorded. Other harmful particles, such as PM10, which have a diameter of less than 10 micrometres, have also decreased dramatically, according to the report.In a sense, largest ever global air pollution experiment is being conducted worldwide. Turning off major sources of pollutants such as industrial and transport activities has lead to downfall in pollution level over a short period of time. As a result, in March and April, air quality in the world's major cities improved dramatically. Carbon dioxide (CO2), nitrogen oxides (NO2), and associated ozone emissions from factories and motor traffic (O3) generation, as well as particle matter, all improved air quality (PM). At the height of the outbreak in Wuhan, a million people were under lockdown. China emits more than 30 mega tonnes of nitrogen oxides per year on average, with projections for 2019 surpassing 40 mega tonnes [8].

Despite a temporary drop in global carbon emissions, the International Energy Agency has warned that the economic uncertainties caused by the corona virus pandemic could prevent or delay businesses from investing in renewable energy [9,10,11]). Extended quarantine periods, on the other hand, have promoted the adoption of remote work practises [12,13]. As a result of the unprecedented use of disposable face masks, largequantities of disposable face masks are entering the natural environment, adding to the worldwide burden of plastic waste [8].

Slashed Greenhouse Emissions

Although, this pandemic has caused a drop in activities associated with global production, consumption and employment as well have inflicted substantial shock at social and economic front. It has significantly reduced air pollution. Emission of various pollutants have been declined majorly due to reduced economic activities during the crisis and will continue to remain low until the activities resume after the crisis is over. A drop of 60% in global air traffic and a temporary dip in CO2 emissions have been observed during the crisis period which arises hope for reduced greenhouse gas emissions and imminent climate change.

However, this would not be a long term improvement as emissions will again reach to higher levels once the economic activity starts and crisis get resolved. Therefore, environmental campaigners demand bailout packages for industrial manufacturers and transportation companies which involve their future operations to result in reduced emissions. This may further be helpful in controlling emission levels and pre crisis levels to go forward.

Inaccuracy in Forecasting

Due to the pandemic there is a worldwide reductions in aircraft flights. The European Centre for Medium- Range Weather Forecasts (ECMWF) has stated that this reduction may have an impact on weather prediction accuracy, noting commercial aircraft' usage of Aircraft Meteorological Data Relay (AMDAR) as an important contributor to forecast accuracy. Because of the decline in commercial aircraft, the ECMWF estimated that AMDAR coverage will drop by 65 percent or more. [14] According to US National Oceanic and Atmospheric Administration, a similar situation occurred in 2010.

Improving Air Quality for the Long Term

China is responsible for more than half of Asia's nitrogen dioxide emissions. Per tonne of NO2 emitted that has been reduced as a result of the outbreak is the equivalent of removing 62 automobiles from the road each year. As a result, we may estimate that a 10% reduction in NO2 emissions over China is equivalent to removing 48,000 cars from the road. However, in some regions, the 40% reduction in NO2 from 2019 levels in January and February translates to the removal of 192,000 cars.That suggests that if cars were phased out and replaced with electrically driven mass transit in the future, air quality would improve. Increasing the number of electric automobiles and charging stations, as well as electrifying transportation services, will reduce overall tailpipe emissions of air pollutants like NO2. However, the electricity that powers electric vehicles is only as clean as the electricity that powers them. The recent gains in air quality might be maintained by substituting renewable energy and other low-carbon sources for fossil fuel generation. The equivalent of turning off 500 coal power plants for a year would be reducing monthly NO2 emissions from electricity output by 10%. Although this is not the most ideal method for reducing air pollution, it does demonstrate that air pollution is caused by humans. When the pandemic is over, it will be interesting to see whether we invest in a cleaner future, expand existing fossil fuel-intensive businesses, or pursue more sustainable solutions. The pandemic may either demonstrate how a future with less air pollution would look, or it could simply demonstrate the magnitude of the challenge ahead. At the very least, it should prompt governments and businesses to investigate how things could be done differently in the aftermath of the epidemic

in order to preserve transient improvements in air quality.

Effect on Water Quality and Water Bodies

Due to less interference of anthropogenic activity during this global crisis, water quality and water ecosystem has been improved. During the lockdown period, water canals in Venice were cleared and presence of increased number of fishes and waterfowls were marked this could be possible due to the settling of the sediment which is otherwise disturbed by boat traffic. Decrease in pollutant levels have also been observed along the waterways [15].

The statewide lockdown in India, which brought 1.3 billion people to a halt, appears to have had a good impact on the environment, at least temporarily, as seen by clearer skies and cleaner river water than before the crisis. Kanpur and Varanasi have both released images depicting a cleaner Ganga. The absence of major industries has resulted in clean water. In the lack of crowds and in the presence of clean water, fish have resurfaced near Varanasi's ghaat steps, which is unusual to see. In most sections of Delhi, the Yamuna River's water has also began to appear clearer. However, the significant amount of harmful foam that is seen this time of year in southeast Delhi's Kalindi Kunj is still present. The hazardous foam is made up of sewage, detergents, and chemicals from industrial waste. Water quality has improved significantly as a result of the removal of industrial pollutants and garbage. However, water testing is essential to determine the extent of improvement. Unseasonal rains and snowfall in some areas have resulted in higher water flow, which has accompanied the lockdown. Religious activities have diminished, particularly in Varanasi, where there are fewer cremations. Our future approach to minimising Industrial effluents in water bodies should be shaped by the current scenario(https://www.ndtv.com/india-news/cleaner river-water-better-air-quality-positive-effects-of-lockdown-2206553).

Negative Impact of Covid-19

However, the crisis' environmental effects were not entirely favourable; in fact, the majority of them were negative. Some of them includes increase in quantity of nonrecyclable waste products, restrictions in import and export services, lack of monitoring and maintenance of natural ecosystems and halt of tourism activity. Delay in recycling activities by municipalities due to covid-19 has emerged into local waste problems. Plastic bags once banned have been resumed by food retailers at checkout points which may cause serious health issues. Furthermore, people's compulsion to stay at home has boosted their consumption of take-out food in single-use packaging. All these changes occurred during coronavirus crisis have created massive waste generation organic as well as non recyclable which challenges the waste management industry. Products with far too large volumes are difficult to be managed in local markets which may further cause its decay and lead to substantial increase in inorganic waste levels. Decaying of products is also responsible to bring sharp increase in levels of methane (CH_4) emissions, a greenhouse gas. Decline in export of agricultural and allied products has led to plummet ion of production levels causing increased unemployment in both sectors. Post harvest processing workers particularly womens with low income and supporting their households are facing extreme problems due to this crisis (Table 1).[15, 16, 17, 18, 19]

Ecosystems at Risk

Nationwide lockdown has lead to mis management of land and marine conservation zones, national parks due to confinement of workers in their homes which expose natural ecosystems and protected species toward major risk. Leaving these areas un monitored has brought an increase in illegal activities like poaching, fishing and deforestation. Risk of encroachment and illegal activities in natural ecosystems have further been elevated by stoppage of ecotourism activities. In addition, due to crisis lack of ecotourism, a major income source for many people have raised unemployment which may force many households to harvest natural resources for food and income in an unsustainable manner. Many of

Table 1. List of different pandemic diseases causes large number of death worldwide. [15, 16, 17, 18, 19]

Disease	Time	Spreaded region	Symptoms
Athens	430 B.C.	Disease passed through Libya, Ethiopia and Egypt	Fever, thirst, bloody throat andtongue, red skin and lesions
Antonine Plague	165 A.D.	Huns, German, Roman	Fever, sore throat, diarrhea and, if the patient lived long enough, pus-filled sores
Cyprian Plague	250 A.D.	Ethiopia, Northern Africa, Rome, Egypt, Britain and northward	Diarrhea, vomiting, throat ulcers, fever and gangrenous hands and feet
Justinian Plague	541 A.D.	Egypt, Palestine and the Byzantine Empire, and then throughout the Mediterranean.	It is believed to be the first significant appearance of the bubonic plague, which features enlarged lymphatic gland and is carried by rats and spread by fleas.
Leprosy/ Hansen's disease	11th Century	Europe	The disease mainly affects the skin, the peripheral nerves, mucosal surfaces of the upper respiratory tract and the eyes. Causes sores and deformities
The Black Death	1350	Possibly started in Asia and moved west in caravans, it spread throughout Europe rapidly	Blood and pus seeped out of these strange swellings, which were followed by a host of other unpleasant symptoms— fever, chills, vomiting, diarrhea, terrible aches and pains—and then, in short order, death.
The Columbian Exchange	1492	America, West Africa	Arrival of the Spanish in the Caribbean, diseases such as Smallpox, measles and bubonic plague were passed along to the native populations by the Europeans.
First Cholera Pandemic	1817	Russia, Spain, Africa, Indonesia, China, Japan, Italy, Germany and America	Small intestine infection. Watery diarrhea, Rice-water stools, Fishy odor to stools, Vomiting, Rapid heart rate,Loss of skin elasticity, Dry mucous membranes (dry mouth) Low blood pressure
The Third Plague Pandemic	1855	Starting in China and moving to India and Hong Kong	Abdominal pain, diarrhea, nausea and vomiting, fever and chills, extreme weakness, bleeding (blood may not be able to clot) shock, skin turning black (gangrene)
Fiji Measles Pandemic	1875	Britain	A rash starts a few days after these symptoms and spreads all over the body, include fever, often greater than 40 °C (104 °F), cough, runny nose, and inflamed eyes.
Russian Flu	1889	Siberia and Kazakhstan, traveled to Moscow, and made its way into Finland and then Poland, where it moved into the rest of Europe.	Sudden chills and headaches, followed by sore throat, laryngitis and bronchitis
Spanish Flu	1918	First observed in Europe, the United States and parts of Asia before swiftly spreading around the world	Sore head and tiredness, followed by a dry, hacking cough; a loss of appetite; stomach problems; excessive sweating, affect the respiratory organs, and pneumonia could develop.
Asian flu	1957	Starting in Hong Kong and spreading throughout China and then into the United States, the Asian flu became widespread in England	Fever, body aches, chills, cough, weakness, and loss of appetite
HIV/ AIDS	1981	Kinshasa, Africa, Asian countries, America	Those infected by the HIV virus encounter fever, headache, and enlarged lymph nodes upon infection. When symptoms subside, carriers become highly infectious through blood and genital fluid, and the disease destroys t-cells
Severe Acute Respiratory Syndrome (SARS)	2003	Syndrome is believed to have possibly started with bats, spread to cats and then to humans in China	Respiratory problems, dry cough, fever and head and body aches and is spread through respiratory droplets from coughs and sneezes.
COVID-19	2019	Started from China now spreaded all over the world	Fever, dry cough tiredness, aches and pains, sore throat, diarrhea, conjunctivitis, headache, loss of taste or smell a rash on skin, or discolouration of fingers or toes

the environmental problems produced by the corona virus crisis will gradually go away after the crisis is over and economic activity returns to pre-crisis levels.However, this crisis has given a better understanding to human beings about environmental sustainability, public consumption patterns, and how environmental degradation can be reduced in future.

Need for Action

Coronavirus pandemic have threatened environmental and natural resource bases and it has also caused a severe impact on social and economic status of the society all over the world. All this calls for attention. Most of the population whether rural or urban is dependent on sustainable utilization of available natural resources. They may include small or medium-sized enterprises, involved in various activities such as ecotourism services, biotrade, fisheries and forestry. Covid -19 crisis had a huge negative impact on global trade resulting to a great loss in market. Rural producers, especially womens who are looking their entire households are no more able to carry out their business and livelihood. Prolonged crisis will compel people to disturb sustainable production in order to make their income further leading to over exploitation of natural resources and poverty.

Conclusion

COVID-19 a pandemic situation, forced all over world for nation wide lockdown. Halt in traffic and industrial operations dramatically decreased the environmental pollution from critical level to normal level. Different government agency reported that air and water quality betterment have been seen with increase in lockdown duration. The fauna and flora population increased because of the decrease in pollution level. Now it is clear that most of the environmental pollution is created by anthropogenic activity. This pandemic situation also gives a message that playing with nature could take our life many years back economically as well as could decrease the age of life. It also suggests that whole world should have to plan to follow the same kind of pattern at least in a year for betterment of our future. But there is no clue how long will this positive effect remain and how strictly human race follows the lesson learned during the pandemic because as soon as outbreak is over people will run for compensation of economic loss and resume industrial activities and globalization will again speed up and may worsen the environmental condition. However, once things are under control, we must accelerate our transition to renewable energy and long-term sustainability.

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Author Contributions

Saurabh Gangola and Samiksha Joshi planned and drafted the original manuscript.

Declaration

Conflict of Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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