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Review of environmental challenges and pandemic crisis of Covid-19

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Abstract:

INTRODUCTION: Spread of novel coronavirus (severe acute respiratory syndrome coronavirus 2 [SARS-CoV-2]) has become a global and pandemic crisis. Some measures such as excessive use of disinfectants, increased production of nonbiodegradable waste, and water pollution will be the consequences of fighting against coronavirus disease 2019 (COVID-19), which harms the environment. Due to the fact that these effects will be identified in the long term, they may be neglected in the current situation. Therefore, the aim of this study was to investigate the environmental challenges caused by the SARS-CoV-2 pandemic crisis.

MATERIALS AND METHODS: This was a review study conducted by search in databases, including Scopus, PubMed, and science direct until early May 2020. Keywords included "SARS-CoV-2," "COVID-19," and "Environment." Studies published in English and conducted in different countries were also selected for the analysis. The guidelines published by reputable organizations such as the World Health Organization, the Centers for Disease Control prevention (CDC), and the Ministry of Health have also been used in this study.

CONCLUSION: The results of this study have shown that the COVID-19 virus, in addition to human damage and mortality, also affects the environment, and the damages and losses resulting from this pandemic may be identified later. Water pollution, increasing chemical pollution in the air, and increasing the production of nonbiodegradable waste are of these issues. For this purpose, it is recommended that, in addition to trying to improve the control of this pandemic, other environmental aspects in disinfection methods and disposal of dry and wet contaminated waste should be done more accurately and based on standard protocols. Infectious waste, in addition to the problem of standard sanitation, will become a major challenge that pollutes the environment. Based on this, it can be said that if home quarantine is observed voluntarily, in addition to reducing the risk of the SARS-CoV-2 and reducing the volume of visits to medical centers, it can be associated with another positive achievement, which is the reduction in waste production and protection of the environment.

Keywords:

Corona virus, coronavirus disease 2019, environment, pandemic, severe acute respiratory syndrome coronavirus 2

Introduction

Coronavirus disease 2019 (COVID-19) has appeared in Wuhan, China, in December 2019, and the disease has now become a pandemic disease due to its very fast transmission capability.^[1] The novel coronavirus is a large family of viruses that can be transmitted between animals and humans.^[2] Studies have shown that

COVID-19 was first transmitted from animal to human, and it has then become a pandemic in many countries through human-to-human transmission.^[1] The results of the studies show that mammals are the most likely link between COVID-19 and humans.^[3] Based on the results of genome sequencing and analyzing the evolution of the virus, the bat is suspected to be the source of the virus.^[4] Some other studies have suggested the possibility of existing the intermediate host such

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as snakes and pangolins due to the level of protein sequence and phylogenetic analysis.^[5] Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has distributed in >210 countries, and by the time of this study, i.e., May 2020, more than three million people worldwide have been infected by the disease. Since SARS-CoV-2 is transmitted through contact with respiratory droplets caused by a cough or sneezing of an infected person or by touching objects and surfaces that contain droplets or sneezing of an infected person, frequent handwashing and mask use have been recommended by health institutions.^[6,7] Studies have also shown that SARS-CoV-2 can survive on environmental surfaces and inanimate objects for several days;^[8] thus, the disinfection of high-touch surfaces is essential. Disinfectants such as 62%–71% ethanol, 0.5% hydrogen peroxide, or 0.1% sodium hypochlorite can effectively inactivate the novel coronavirus within 1 min. However, other disinfectants such as 0.05%–0.2% benzalkonium chloride or 0.02% chlorhexidine digluconate were less effective.^[9] In China, in addition to the timely training and information,^[10] the observance of disinfection and sterilization principles and hygienic and safe disposal of contaminated and infectious waste based on standard protocols^[11] have played an important role in controlling this disease, because this virus is spread in indoor and outdoor environments through sneezing and coughing droplets.^[8] According to the latest results provided by Chinese scientists, the SARS-CoV-2 can transfer twice as far as a safe distance of 4.5 m^[12] and stay in the air for 3 h.^[13] The disinfection of the busy streets and alleys by the relevant organizations has been reported to be one of the ways to deal with the novel coronavirus in cities.^[14] General disinfection of all urban thoroughfares has caused damage to the green area so that the residual chlorine leads to dry out the leaves of the trees, and the evaporation of these compounds and the release of compounds in the space will cause the respiratory problems in people.^[15] Studies have also shown that residual chlorine in the environment reacts with environmental compounds and leads to produce toxic compounds such as trihalomethanes and haloacetic acids. Furthermore, the residual chlorine in the effluents of the treatment plant pollutes the water and endangers the life of the aquatic animals.^[15] Humans and the environment interact with each other in such a way that any damage to the environment will indirectly affect human health. Any improper or undesirable action may lead to the contamination of groundwater, natural resources, animals, and the atmosphere; however, potential environmental damage may be overlooked and neglected due to the focus of countries and organizations on the principle of coping with SARS-CoV-2. Therefore, considering the importance of environmental protection and the presence of hidden dangers threatening the environment, the aim of the present study was to

investigate the environmental challenges caused by the novel coronavirus pandemic crisis.

Materials and Methods

The study was conducted as a systematic search on databases, including Scopus, PubMed, and science direct, using the relevant keywords until May 2020. Keywords included “SARS-CoV-2,” “COVID-19” and “environment.” The reference of the final studies has also been investigated for finding the overlooked articles in the previous step. Studies published in English and conducted in different countries were also selected for the analysis. Studies that looked at the unintended consequences and lacked sufficient information for analysis were also excluded. Finally, after removing the duplicate items, the search results were independently reviewed by two authors based on the inclusion and exclusion criteria, and the study data entered the final analysis phase were extracted and analyzed.

Results and Discussion

Although COVID-19 outbreak has led to decrease car traffic, to close working places, to reduce air and noise pollution in cities,^[16,17] and to reduce greenhouse gas emissions,^[18] it has created new environmental challenges, such as increasing the production of municipal and infectious waste and pollution of soil, water, and green area.

Environmental pollution

The use of large volumes of disinfectants and employing general disinfection, in addition to cost loss and little efficiency, will lead to respiratory problems and pollution of soil, green area, and water.^[15] Therefore, it is recommended to perform targeted and centralized disinfection in such a way that special places such as reservoirs and waste disposal stations, waste transportation vehicles, public transport vehicles, public high touch equipment such as ATMs, and busy places such as shops and pharmacies be disinfected in a centralized manner and at regular disinfection intervals.^[19] Schools and hospitals are among the centers of outbreaks and transmission of the disease.^[20] According to the Ministry of Health, 40%–45% of cases of infections with SARS-CoV-2 occur in hospitals.^[21]

Proper disposal of infectious waste, in addition to health care centers, is very important in urban areas and even urban waste. Surgical masks are made for single use. Respiratory masks are also usually discarded after use, but they can be reused for a limited period of time unless there is a risk of contamination by depositing infectious particles on the surface;^[22] this increases the production of infectious waste. Some of this equipment

is made of nondegradable fibers that can remain in the environment for years and contaminate the soil. On the other hand, studies have shown that the used masks have high levels of contamination, and therefore, their reuse is prohibited;^[23] thus, the lack of proper disposal of this waste has a significant role in spreading the disease to other people. Therefore, observance of the social distancing and avoiding the present in public places, in addition to stopping the chain of infection, can be effective in reducing the volume of production waste. Some researchers have recommended the use of a fabric mask, which could be sterilized and reusable. However, based on the results of studies, it does not provide adequate protection against the virus, and long-term use of the mask, instead of reusing a mask, is recommended as an alternative approach in clinical settings during the shortage of the mask;^[24] this will also be as effective as possible in reducing the amount of waste generated. Given that viral epidemics have increased in recent years and the production of masks is essential as a commodity, the best option to protect the environment is to use biodegradable materials in the manufacture of masks and gloves.

Protective gloves are disposable and should be discarded after use. Moreover, a part of them will be more infected due to direct contact with high-touch surfaces or COVID-19 patients, so proper disposal of disposable gloves should be considered.^[25] The number of gloves used will be more than breathing masks, and most of these gloves are made of nitrile or latex or are in the form of nylon gloves,^[2] and their degradation in the environment will take a long time.

Housing health and quarantine and staying at home

If COVID-19 patients with mild symptoms are advised to stay at home and home quarantine, attentions should be paid to disposing of infectious waste such as gloves and masks used when caring for these patients at home, and this waste should be disposed of separately.^[26] An appropriate way to do this is to provide bags for infectious waste to these families and teach them how to properly dispose of contaminated waste, which will prevent the spread of SARS-CoV-2 infection in residential environments and will be effective in collecting municipal waste. In the city of Isfahan (Iran), to inform dustmen about the contamination of waste, the bags with a certain color (red for infectious waste) have been delivered to the families of patients with Covid-19.^[27]

Animals

Some reports suggest that after applying the quarantine in cities, animal behavior has changed and these animals have expanded their habitat and entered urban

environments.^[28] If infected waste is not transported from urban areas properly and regularly, it may be dispersed by animals in the city and attract insidious animals and insects.^[29] According to studies, insects such as houseflies and cockroaches have the potential to mechanically transmit pathogens such as viruses, bacteria, and parasites;^[30] thus, the role of these insects in the transmission of COVID-19 becomes important. Improved environmental sanitation such as placing waste in closed bags and waste bins with lids, sanitary landfill sites, hygienic toilets, proper sewage disposal systems, and prevention of livestock manure accumulation in the vicinity of residential areas is important as control methods of houseflies and cockroaches.^[31]

SARS-CoV-2 is zoonotic; this means that they are transmitted between animals and humans.^[2] There have been reports that the novel coronavirus test of some animals, including two dogs of different breeds and one cat in Hong Kong, was found to be positive.^[32] A tiger in a US zoo has also infected with SARS-CoV-2.^[33] Considering that the initial hypotheses indicate that the animal is the origin of this disease and studies have shown that mammals (e.g., bats), as a primary reservoir,^[4] and anteater, as the intermediate host, have been involved in the transmission of this disease from animal to human,^[5] The WHO also recommends avoiding contact with wild and domestic animals.^[34] Therefore, it can be said that respecting the rights of animals and wildlife and avoiding their slaughter, as well as avoiding the breeding of wild species in unnatural environments, can prevent the transmission of common diseases between humans and animals, which are sometimes unknown.

Wastewater

Some studies have shown that the novel coronavirus has been found in the fecal sample of a patient with COVID-19, and it is possible to find new routes of transmission.^[5] The results of some studies have shown that SARS-CoV-2 is present in the stool sample for about 5 weeks after the patients' respiratory samples tested negative, and the virus is actively multiplying in the gastrointestinal tract, and the possibility of oral-fecal transmission can be possible even after the patients' respiratory samples tested negative.^[35]

Therefore, another environmental consequence of the novel coronavirus is the increase in the loading of biological pollution, especially in hospital wastewater, the COVID-19 patients' rehabilitation centers, and the mortuaries of SARS-CoV-2 patients. The persistence of the virus in sewage, which is a sign of an epidemic in an area, can be a major source of catastrophic infectious disease during floods and other crises, and this requires special guidelines for disinfection and decontamination

of wastewater in the face of epidemic crises. According to the World Health Organization, wastewater from bathrooms, sinks, handwashing points, and laundry should be properly treated before entering the sewage collection network.^[2] Stabilization ponds have been an effective method because the retention time for >20 days with sunlight destroys the pathogens, and if no action is taken to eliminate the virus, a final disinfection step is performed; for this purpose, hygienic principles must be observed to prevent the infection of the treatment plant workers. The workers of treatment plant should wear appropriate personal protective equipment (protective clothing, gloves, boots, goggles or face shield, and masks), wash hands frequently, and avoid touching the eyes, nose, or mouth with unwashed hands.^[25]

Groundwater, surface water, and sea pollution

Due to the fact that in the case of the novel coronavirus pandemic conditions, more frequent washing of hands has been emphasized,^[25] this has led to more use of detergents and soap and more consumption of water, which naturally resulted in more wastewater production containing chemicals and detergents; this will further challenge the capacity of urban and rural treatment plants. If the process of eliminating chemical compounds and quality wastewater treatment does not comply with the standards, the environmental and groundwater pollution will be expected.^[36] It may be necessary to more focus on biological wastewater treatment methods in hospitals and care centers for SARS-CoV-2 patients, in the mortuaries of COVID-19 patients, and more efforts for providing an accurate solution and monitoring in this area. An unhygienic burial of infected bodies will be an environmental challenge. High groundwater levels in some areas can lead to pollution from unhygienic burial.^[37]

Studies have shown that the saliva and secretions of an infected person are highly contaminated for up to 25 days after recovery.^[38] Disposing of masks, gloves, and contaminated wipes in the city and recent rains can spread the pollution to the canals and eventually, groundwater. Studies have shown that 19% of passengers and crew on DIAMOND PRINCESS are infected.^[39] Therefore, it is necessary to pay attention to wastewater treatment and sanitary disposal of ships' waste because releasing it into the sea without treatment and disinfection will also pollute aquatic organisms in future.

Coronavirus disease 2019 in the air

Airborne transmission of the novel coronavirus has also been the subject of controversy, which WHO announced that SARS-CoV-2 could be suspended for 2 h.^[40] This is still alive 3 h after being spread through tiny droplets, according to recent research from the American Institute for Allergy and Infectious Diseases Research. In simpler

terms, very small particles that come out of the mouth and nose with sneezing or coughing can carry the virus and the disease for 3 h.^[13] Examination of the room of three patients in Singapore shows that there is no virus in the air room with a proper ventilation system, which can indicate that the virus is not transmitted in the form of airborne. However, more samples are needed. In spite of severe contamination, the routine cleaning and disinfection of the patient's room are usually sufficient to kill the virus.^[41] In hospital settings, a suitable ventilation system should be used to eliminate microbial contamination for reducing the density of the virus in the care rooms of COVID-19 patients to avoid the exposing of staff working in the hospital to the virus because more limited and closed space will lead to the higher density and concentration of the virus.^[42]

Food safety

Researches have shown that COVID-19 is sensitive to heat and stays at room temperature for 9 days but is less resistant at temperatures above 30°C.^[9] However, freezing bread does not affect the elimination of the virus, and the virus can survive for several years up to -60°C, and in fact, the cold condition strengthens the virus.^[43] Bread is one of the main components of the family's food basket; since there is a possibility of contamination of bread in traditional bakeries due to contact with contaminated hands, it is recommended to heat the bread before consumption. Other foods, such as fruits, should be cleaned and disinfected after entering the house if they can be washed. Eating raw and uncooked foods should be avoided.^[44]

Disinfection of cities

Although disinfection is carried out in public environments to reduce pollution and the visual pollution of cities may reduce, a new study in the *Nature* journal showed that global disinfection of cities does not have a significant effect on virus eradication.^[44] Fogging and fumigation type has been carried out for high-touch surfaces in China.

However, there is still no consensus on the transmission of the virus through the asphalt of the street floor to shoes and to the home, but some cities wash the streets. According to the results of general disinfection studies, all urban thoroughfares have caused damage to the green area so that the residual chlorine causes to dry out the leaves of the trees, and the evaporation of these compounds and the release of compounds in space will lead to respiratory problems in people.^[15] On the other hand, providing the standard and correct disinfection conditions such as sufficient amount and sufficient contact time is not possible; therefore, it will not provide suitable effectiveness.^[19] Studies have also shown that residual chlorine in the environment

reacts with environmental compounds to produce toxic compounds such as trihalomethanes and haloacetic acids.^[15] Researches have shown that the high use of chlorine compounds for disinfection affects the human respiratory system, and the residual chlorine in wastewater treatment plants pollutes water and endangers aquatic life.^[15] This sanitization may even cause a false sense of being safe in users, as if even immediately after disinfection, the high-touch surfaces may be contaminated by the infected hand of the patient or the disease carrier. Therefore, its efficiency is low, and it is recommended to give the solutions used in various sprays to the residents for disinfecting the door handles and other high-touch surfaces immediately after entering and exiting. In some cases, disinfectants have destroyed ATMs in some cities of Iran.

The interaction of temperature, humidity, and climate on the progress of severe acute respiratory syndrome coronavirus 2

So far, no reliable evidence has been found about the effect of warming up the weather on killing this virus or reducing its spread. As in this pandemic, the countries of the Southern Hemisphere, which are now in their warm season, are not immune to this global epidemic, and these countries also have patients. However, in terms of the extent and comparison of these patients with the countries of the Northern Hemisphere, it can be seen that the countries of the Southern Hemisphere have a small number of patients.^[45] According to a research, high levels of air pollution may be “one of the most important contributors” to deaths from Covid-19. In a recently published study, Yaron Ogen has evaluated the relationship between NO₂ levels, with Covid-19 deaths being evaluated. He has found that 78% of the 4443 deaths were in four regions in Northern Italy and one around Madrid in Spain. These five regions had the worst combination of NO₂ levels and airflow conditions that prevented dispersal of air pollution.^[46]

Conclusion

The results of this study showed that the COVID-19 virus, in addition to human damage and losses, also affects the environment, and perhaps, the damage and losses caused by this pandemic become apparent later. For this purpose, it is recommended that, in addition to trying to improve the control of this pandemic, other environmental aspects in disinfection methods and disposal of dry and wet contaminated waste should be considered more accurately and based on the standard protocols. Furthermore, placing solid waste bags for the infectious waste of patients who are quarantined at home and educating families to properly dispose of contaminated and infectious waste should be also considered. Therefore, it can be said that if home

quarantine is voluntarily observed, in addition to reducing the risk of novel coronavirus and the number of visits to medical centers, will lead to another positive achievement, i.e., the reduction of waste production and environmental protection.

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Conflicts of interest

There are no conflicts of interest.

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