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Coronavirus (COVID-19): What could be the environmental effects of disinfectant use in the pandemic? †

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Abstract: The COVID-19 has led to the wide use of different disinfectants to reduce the spread of the virus in homes and public spaces. In particular, more chemical compounds are used in public places than they should be in order to control the epidemic in many parts of the world. However, with this practice, human health, biological diversity and water resources can be adversely affected. Therefore, the possible effects of chemicals used for cleaning and hygiene purposes should be evaluated in an integrated manner. The chemicals effective in deactivating the virus and their possible environmental effects were explored in this article.

Keywords: Biodiversity; COVID-19; Disinfectant; Environmental impact; Hygiene

1. Introduction

One of the natural and unnatural disasters faced by the world is undoubtedly pandemics, and their effects have profoundly affected all societies for centuries [1]. The pandemics of the recent period are listed as SARS 2003, Influenza A H1N5 (bird flu) 2007, Influenza A H1N1 (swine flu) 2009, MERS 2012, Influenza A H7N9 2013, Ebola 2014, and Zika 2015. Pandemic; It is a general name given to epidemic diseases that spread in a wide area in more than one country or continent in the world and according to the definition of the World Health Organization (WHO), there should be three criteria for a disease to be a pandemic. These are the fact that it is a mutated or new virus, can easily infect humans, and can be easily and continuously transmitted from person to person. Coronavirus Disease (COVID-19) first emerged as a new type of coronaviruses in Wuhan, China at the end of December 2019 (Figure 1). Since there are no direct-acting drugs available for the treatment of COVID-19, it has so far spread to 210 countries around the world [2].

While the pressure of factors such as global warming and climate change, overpopulation growth, uncontrolled industrialization, and unplanned urbanization on environmental pollution is increasing, the relationship between humans and their environment has become more valuable than ever before due to the new type of COVID-19 pandemic surrounding the world. Due to the compulsory lockdown and social-economic activities caused by COVID-19, positive effects such as a decrease in water pollution, improvement in air quality (CO_2, NO_2, vehicle emission, etc.), decrease in noise pollution in different parts of the world have been observed in different parts of the world. In contrast, face masks, gloves, disinfectant products, etc. increased use, their haphazard disposal, and the generation of large amounts of hospital waste have had negative effects on the environment. Both positive and negative environmental effects of COVID-19 are present in Figure 2. [3]. The COVID-19 pandemic has led to the wide use of disinfectants (alcohol, soap, cologne, chlorinated compounds, antibacterial agents, etc.) to reduce the spread of the virus in homes and public spaces. However, human health, biological diversity, and water resources can be adversely affected by these chemicals that are used excessively. Within the scope of COVID-19 measures, chemicals are transported directly from soil to groundwater, from sewage systems to treatment facilities, from rainwater collection channels to rivers and seas by practices such as the use of chemicals for personal cleaning in homes, washing the main roads and streets in cities with chemicals, and spraying to open and closed areas. In addition, due to the lethal, toxic, and irritating properties of disinfecting chemicals used for cleaning and hygiene purposes, it has been determined that poisoning incidents due to disinfectants have increased during the COVID-19 process [4,5]. According to the concept of "One Health", it is linked to human health, environment, and animal health. Therefore, the possible effects of chemicals used for cleaning and hygiene purposes should be evaluated as a whole. In this article, chemicals used to inactivate viruses and their possible environmental effects were investigated.

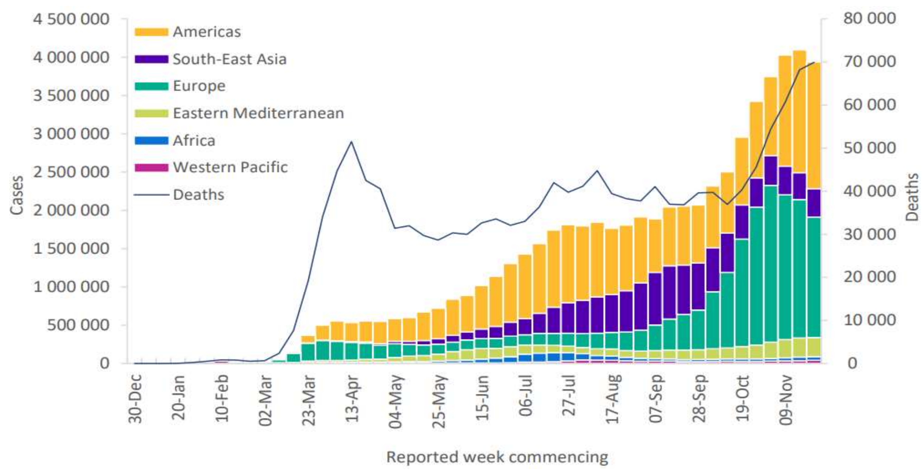

Figure 1. Number of regional COVID-19 cases and total deaths by 29 November 2020 reported weekly by WHO [6].

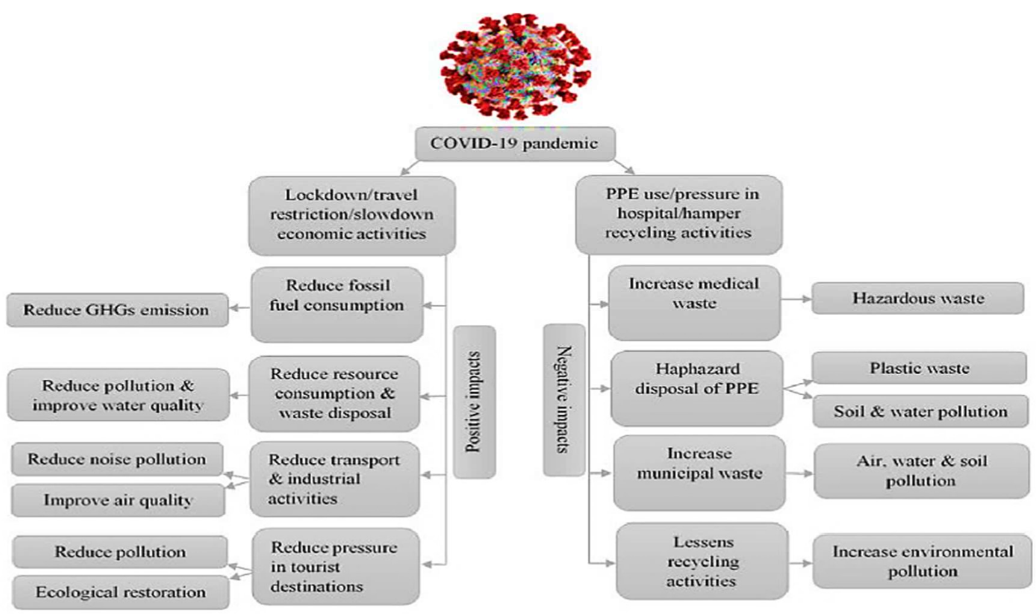

Figure 2. Positive and negative environmental effects of the COVID-19 pandemic [3].

2. Disinfectants in spite of coronavirus

Disinfection with the use of chemicals has been a common practice for years to remove pathogenic microorganisms. Disinfection is a method involving the use of a chemical agent to eliminate almost all recognized pathogenic microorganisms on inanimate surfaces. Today, it is a widely used practice to prevent COVID-19 infection in homes and public areas. In many parts of the world, high concentrations of disinfectant solutions are used by spraying in urban public areas to control the pandemic. In addition, many numbers and types of disinfectant products are applied to protect the health of individuals (hand, face, etc.) (see Figure 3). The useability of existing disinfectants on most surfaces without the need for any mechanical equipment and cost-effectiveness increases the frequency of use. Numerous chemical disinfectants are used in the healthcare and home environment, including alcohol, chlorine and chlorine compounds (bleach), formaldehyde, glutaraldehyde, standard and enhanced hydrogen peroxide, iodophors, peracetic acid, phenolics, and quaternary ammonium compounds. There are a wide variety of EPA approved disinfectants used for disinfection around the world [5,7]. The list of highly effective chemical disinfectants against coronavirus is summarized in Table 1 [5,8].

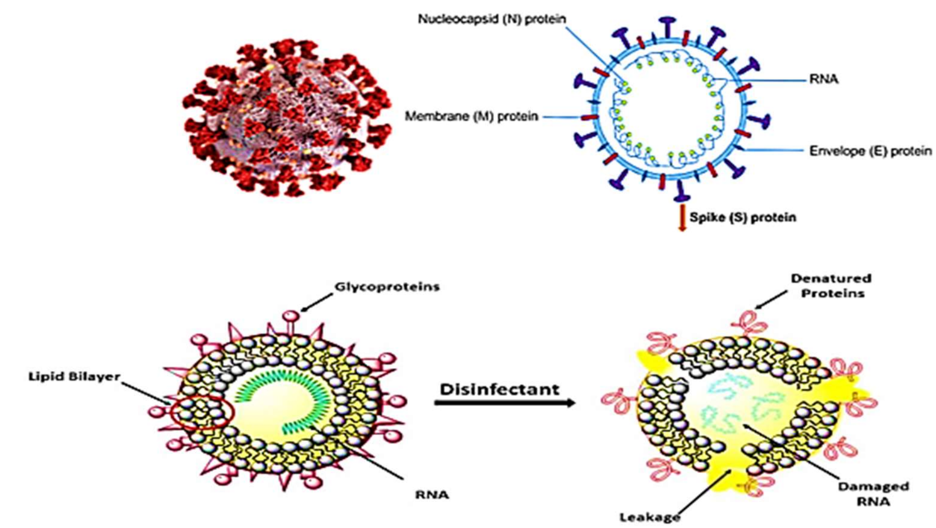

Figure 3. Effect of disinfectants on its structural components [9].

WHO recommends correct and consistent disinfection and environmental cleaning procedures. Surfaces should be thoroughly cleaned with water and disinfectant. The use of disinfectants such as sodium hypochlorite, which are preferred in hospitals, can be an effective method [10]. Disinfection and cleaning of frequently touched surfaces such as doors, toilets, tables, keys, sinks should be done with domestic disinfectants. Different biocidal products such as alcohol, hydrogen peroxide, benzalkonium, or sodium hypochlorite are used worldwide for disinfection [11]. Disinfectants containing 62-71% ethanol or 0.1% sodium hypochlorite have proven to deactivate the presence of coronavirus on surfaces within one minute of exposure [12]. Cleaning should be done after disinfection for contaminated surfaces. Generally, each disinfectant is intended for a specific purpose and should be used deliberatively. Therefore, descriptive information should be read carefully to ensure that the correct product is selected. In addition, care should be taken in the use of these products. Otherwise, different toxicities may be caused by misuse, improper storage, or excessive use. The active ingredients of most disinfectants used are harmful and corrosive chemical compounds, including chlorine releasing agents, oxidizing agents, and quaternary ammonium cations. Although some individuals can avoid contact with these chemicals with lockdown, other living groups are exposed to these chemicals directly or indirectly. During the lockdown period, some animals in the countryside may descend into the city and exposed to these chemicals while exploring empty streets, parks, and waterways [13]. Disinfection in this temporary period can affect a large amount of biodiversity. For example, chlorinated disinfectants are acutely toxic to both terrestrial and aquatic organisms, and can lead to respiratory and digestive lesions and even death (Figure 4). Recently, hundreds of animals belonging to 17 different species are known to have died in Chongqing, China, due to the overuse of disinfectants [14]. As COVID-19 spreads around the world, the increased use of disinfectants can lead to global secondary disasters in human health and ecosystems. Scientific researchers have been conducted on exposure to the most commonly used disinfectant compounds (sodium hypochlorite, hydrogen peroxide, alcohol, etc.) previously [8-12]. All of these, when used regularly, increase the risk of chronic obstructive pulmonary disease, asthma, and eye irritation on healthcare workers and individuals. Chemical residues remaining on a surface can be airborne and inhaled, thus contributing to poor indoor air quality, often with adverse effects for asthmatic, allergic, or sensitive persons. These residues may contain chemicals that can cause cancer, reproductive and respiratory disorders, central nervous system impairment [13,14].

Table 1. List of EPA-certificated disinfectant product ingredients against COVID-19 [8]. .

Ingredients	Effective Contact Time (min)
Quats	10
Hydrogen peroxide	10
Isopropanol	0.5
Sodium hypochlorite	10
Octanoic acid	2
Phenolic	10
Ethanol	2
Triethylene glycol	5
L-lactic acid	10
Peroxyacetic acid	1
Glycolic acid	10
Citric acid	1
Hypochlorous acid	10
Ammonium carbonate	6

Homes, quarantine centers, and hospitals have been generating large amounts of biomedical waste (BMW) worldwide since the COVID-19 pandemic. Personal protective equipment, test kits, surgical face masks, and nitrile gloves are the biggest contributors to waste volume. Described as COVID-19 waste, BMWs are a major global concern for public health and environmental sustainability when discarded improperly. These wastes must be disposed of after being disinfected with appropriate disinfection conditions and methods. The first step of strategies for the disinfection of COVID-19 waste is the classification of hospital waste. Classification of waste at its source is both efficient and the best practice to prevent the virus from spreading to other environments by waste. COVID-19 waste needs to be collected in separate bags, disinfected with specific solutions, and sealed. While it is possible to control these processes in hospitals, disinfection processes cannot be performed adequately because the control of COVID-19 wastes in home quarantines is difficult [13]. Disinfection is an effective manner to remove pathogenic microorganisms that cause infectious diseases. There are scientific norms for the selection and proper use of disinfectants in hospitals, laboratories and homes that take into account their efficiency, suitability and health risks. However, disinfectants used in outdoor environments to control infectious diseases such as COVID-19 do not have comparable guidelines or monitoring mechanisms. Considered the toxicological effects of disinfectants on both terrestrial and aquatic animals [15], this practice is likely to pose a serious threat to the urban environment, wildlife and biodiversity in general. For example, the application of such high volumes of disinfectants can contaminate food and water supplies [16] or living spaces of free-living animals [17,18]. Therefore, it is important that disinfectants used to control COVID-19 in urban areas are selected and applied in a way that prevents unnecessary environmental pollution [6,15,19-21].

Figure 4. Disinfection applications carried out in open areas within the scope of COVID-19.

3. Conclusion

Since there is no legislation for the large-scale use of disinfectants in urban areas settings, it is very important to develop strategies to minimize the environmental pollution caused by this practice. Several possible strategies can be proposed to respond to public health issues such as COVID-19 without harming the urban environment, individuals and biodiversity.

1. First, public health and environmental safety should be considered when deciding on when, where and how disinfection should be carried out and which disinfectant to use. For example, rather than indiscriminate spraying of high volumes of disinfectants in biodiversity-rich areas such as urban parks, wetlands and green spaces, it may be preferable to suspend human activities in such places.
2. Second, as information on the ecological consequences of excessive application of disinfectants in cities is limited, further research on the potential threats of these practices to the environment and to biodiversity is urgently needed.
3. Third, disinfectants should be developed as soon as possible which are low-risk, non-toxic, intervenable with in a sudden and unexpected situation and suitable for common application in open urban environments.
4. Fourth, antibacterial products (soap, wipes, gels etc.) should not be preferred especially in hand disinfectants. Because these products cause the death of beneficial bacteria in the human skin, the immune system of the individuals may be adversely affected.

To summarize, biological and environmental safety assessment and prevention system needs to be laid out, especially when managing future pandemic provisions.

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