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Effects of Mismanagement of Medical and Plastic Waste in Pre and During COVID-19 Outbreak

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ABSTRACT: Many countries already have problems with waste management, but when the COVID-19 outbreak happens, the existing problems are worsened. This review aims to examine how mismanagement of medical and plastic waste affects the environment and people, especially those who work in healthcare facilities. Prior to the COVID-19 pandemic, it was clear that the majority of issues stemmed from mismanagement of plastic waste. For example, plastic waste can be seen in various places, such as the deepest oceanic floor, The Mariana trench, which is proved by microplastics found in amphipods' digestive tract living down there. Apart from environmental effects, the economy is also affected by plastic pollution as the tourism business has decreased in Korea and USA due to the increasing amount of plastic waste. While normal plastic waste can largely affect society, medical wastes seem to pose more severe consequences as medical wastes might be contaminated, pathologic, and radioactive. However, during the pandemic, the usage of both medical and plastic waste has increased in general. Mismanaged waste also carries COVID-19 like other pathogens, and the virus can survive on it for a long period of time, making any mismanaged waste a risk factor. Incinerated ashes from medical waste used for fighting the virus can also cause pollution as they contain heavy metals. In conclusion, mismanaged plastic waste mostly affects the environment, while mismanaged medical waste might carry harmful pathogens, including the COVID-19, putting people at risk. More actions need to be done to improve the effectiveness of waste management procedures.

KEYWORDS: Medical and plastic waste; COVID-19; Mismanagement; Plastic pollution

I. INTRODUCTION

The emergence of a novel coronavirus causes serious negative impacts, such as the reduced amount of food demand and food security, high level of stress and psychiatric symptoms among the population worldwide (Siche, 2020; Xiong et al., 2020). The first recorded case of this virus was reported in late December 2019, in the Huanan Seafood Wholesale Market, in Wuhan, Hubei, China (Wu et al., 2020). The virus then circulated rapidly and globally. On 11 February 2020, the International Classification of Diseases (ICD) declared the name of this virus as "severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)" due to the similarity in some respects with the SARS outbreak of 2003, and the World Health Organization (WHO) named it as "COVID-19 (Coronavirus Disease 2019)" (World Health Organization, 2020). In the end, every part of the world was affected with COVID-19, including Antarctica in December 2020 (Sullivan, 2020).

As of now, global efforts have been made to develop safe and effective vaccines so as to counter the increase of COVID-19 cases (Ong et al., 2020). Fortunately, when Polack et al. (2020) proposed promising mRNA COVID-19 vaccines with high efficacy and safety, the situation seems to be better until the outbreak of the delta variant. Because of its relatively high transmissibility compared to other variants, the delta variant poses a significant and steady rise of new COVID-19 cases in the UK and India, making them unable to lift the COVID-19 restrictions (Burki, 2021; Mahase, 2021).

Not only is the COVID-19 responsible for the strong impacts on health and social relations, such as the lack of connection and interaction with other people, but it also contributes to the unexpectedly high number of plastic products being used and disposed improperly (Singh and Singh, 2020; Khoo et al., 2021; Suppawittaya et al., 2021). From the continuation of the COVID-19 pandemic, this problem remains urgent as there is more demand for plastic products. For example, personal protective equipment (PPE) such as masks and gloves for doctors and other healthcare workers are crucial at this time. Moreover, people

are more likely to use plastic shopping bags to reduce the risk of contamination, and due to the lockdown, plastics are also used as materials for food packaging (Gorrasi et al., 2020).

As for medical waste, it is a type of waste which comes from health care facilities, such as hospitals, clinics, and research facilities (Environmental Protection Agency, 2021). Although most medical wastes are non-hazardous, there are some of them which pose risk to the general public health as they may be infectious or radioactive (World Health Organization, 2018). The hazardous ones should be strictly regulated when they are disposed of and, as a result of COVID-19 pandemic, the production of medical waste has increased significantly (Erdogan and Yilmazoglu, 2020).

However, the current management of infectious waste is not enough to cope with this issue. In Pakistan, even before the COVID-19, Kumar et al. (2015) stated that there are improper practices in managing hospital infectious waste and also insufficient training of healthcare workers on how to properly discard this type of waste. Now, there are more infectious wastes than usual as a result of the COVID-19, but in one hospital located in Ethiopia, COVID-19 related wastes were treated with the same management, increasing the risk of infection to the general public (Mekonnen et al., 2021). Moreover, plastic-based PPEs are emerging in Africa exponentially, and in Iraq, the COVID-19 also increases the consumption of face masks and medical wastes, raising concerns to government plastic management and healthcare workers (Benson et al., 2021; Hossini et al., 2021). Wardani and Azizah (2020) stated that, in Indonesia, there was inappropriate use of Personal Protective Equipment (PPE) by medical waste trolley carriers. For example, only surgical masks and gloves are used without using aprons.

While the number of COVID-19 cases is still rising, the problems coming with the use of plastic, particularly the disposable ones, cannot be overlooked. This review examines the potential causes of plastic waste surged during the pandemic and aims to compare the impacts of pre and during COVID-19 mismanagement of medical waste and plastic waste in this period.

II. GENERAL INFORMATION ABOUT PLASTIC WASTE

Generally, there are many types of plastic that we can see in daily lives, such as plastic water bottles, plastic toys, and plastic packets. However, the real definition of plastic is the polymer that, alongside the producing processes, can be molded, stretched, extruded, or used as a coat due to its hydrophobic characteristic (Thompson et al., 2009). It was publicly introduced by Leo Baekeland in 1907 with the commercial name of “Bakelite” to be the new electrical insulator (Ritchie and Roser, 2018). According to their main role in the manufacturing sector, plastic usages worldwide had not been widespread into household units until the end of World War II in 1945 by changing from reusable containers such as tin and glass to single-use ones (Geyer et al., 2017). The collected information shows that since 1950, plastic production has been significantly increased with a total amount of 8.3 billion metric tons (Auta et al., 2017). About 4 billion of them have been produced in the last decade and most of the commonly used plastics are non-biodegradable and can usually deteriorate, changing to microplastics (Setälä et al., 2014).

When the rate of plastic pollution entering an area is greater than the rate of natural removal processes, plastic pollution builds up in the ecosystem. The natural decomposition rates of plastic are very long since plastics can remain in the environment, ranging from decades to centuries. Many sections of the global ecosystem where plastic accumulates, particularly in isolated areas, are difficult to clean up (Macleod et al., 2021). Thus, plastic waste becomes an environmental burden and a source of pollution in landfill sites (Kumar et al., 2021).

III. MISMANAGEMENT OF PLASTIC AND MEDICAL WASTE BEFORE COVID-19 OUTBREAK

The significant growth of plastic businesses has outrun other material businesses during the recent 6 decades (Geyer et al., 2017). Plastics have been pointed out as a potential source of marine environmental problems 30 years after the change of container usage to non-reusable in 1945 (Napper et al., 2020). Research has found out that approximately 75 percent of oceanic waste is plastic (Obbard at al., 2014). Plastic waste is unremitting and abandoned without any reuses (Varkey et al., 2021). Without the proper management procedures, about 4 - 12 million metric tons of plastic have been found in various surprising places such as the remotest beaches (Nelms et al., 2019) and islands (Barnes, 2005), among sea water in the ocean (Law et al., 2010), or even the deepest oceanic floor, The Mariana trench, which is 10890 meters deep (Jambeck et al., 2015); plastic is also presented in the hindguts of amphipods living down there (Karbalaei et al., 2018).

Mismanaged wastes are either littered or disposed inadequately, which are intended to manage but are insufficient. Inadequate disposing includes open landfills that are poorly managed, which make it possible for the waste to leak into natural environments and oceans (Ritchie and Roser, 2018). Researchers stated that non-biodegradable plastics might be long-lasting pollution to the environment, especially marine ecosystems. Marine creatures which get intertwined with plastic debris tend to have severe injury or even death (Dias et al., 2016).

As a result, plastic wandering in the sea has notably resulted in economic tourism losses in California (Leggett et al., 2014) and Geoje Island in Korea (Jang et al., 2014). Moreover, plastic debris which is commonly known as "hangers-on" or "hitch-hikers" in the sea is becoming the major habitat of invasive alien species coming into the region, increasing risk of the extinction of former residents (Gregory, 2009; Jambeck et al., 2018). Moreover, plastic can deliver chemical substances such as strain dyes, heavy metals, and noncombustible components which are toxic to marine microorganisms (Sharma et al., 2020) that produce up to 10 percent of oxygen for this planet (MIT Technology Review, 2015).

All plastic pollution mentioned above, the most severe source of plastic waste is medical waste generated by medical centers, such as hospitals, clinics, and all medical-related places which can produce hazardous waste that may contain infectious, pathologic, or radioactive substances. Since medical centers and facilities' providers around the world have significantly increased because of the improvement in medical technology, infectious medical wastes also increase from such improvement, resulting in a higher risk of hospital patients, health workers, general public, and especially waste collectors in contacting lethal diseases (Cesaro et al., 2017; Padmanabhan and Barik, 2019).

IV. MISMANAGEMENT OF PLASTIC AND MEDICAL WASTE DURING COVID-19 OUTBREAK

The outbreak of COVID-19 has increased the amount of mismanaged waste because plastic waste has been used more in general. For example, Thailand's Department of Health (2021) reported that the country had an average of 294 tons of infectious waste per day during early August of 2021, and it has continued to increase since then. Meanwhile, Bangkok alone had produced 63 tons of infected waste per day on average from January to June and increased to 100 tons per day in August. With the incinerators being at 99.2 percent of its theoretical managing efficiency, it created a problem of more than 760 tons of infected waste which remained unmanaged from previous days as of Aug 13, 2021. This resulted in the piling of unmanaged infected waste every day. (Thai PBS, 2021)

There are existing mismanagement problems such as containers' conditions being poor and unsterilized (Bazrafshan and Mostafapoor, 2011), or storing waste in open containers without lids within the hospitals which can cause waste spillage (Manga et al., 2011). From the study of hospitals in Bangladesh, wastes are gathered without any segregation, and 11% of them is treated by dumping. Such wastes are collected by the municipalities' waste collectors which are untrained on how to manage infected waste (Hossain et al., 2021). Not only in Bangladesh, but various developing countries also dump their wastes in the open landfills which are terribly managed. Such treatment may expose more people to COVID-19 and other diseases (Nzediegwu and Chang, 2020).

One of the ways to manage infected waste during the outbreak of COVID-19 is incineration. However, incineration also has drawbacks of mismanaged pollution caused by incinerators. A study of bio-medical waste incinerated in India shows that the process produces health threatening pollutants the most compared to other methods, especially cadmium (Thind et al., 2021). Another study conducted in Iraq also found that incinerated ashes from bio-medical waste contain high concentrations of heavy metals (Jaber et al., 2021). If the ashes are mismanaged, it can spread heavy metals into the environment causing pollution.

The direct effect of mismanagement during the outbreak comes from the fact that the virus can survive for a long period of time on various surfaces. Even after applied with 70% ethanol, it can survive 5 minutes on most surfaces (Noorimotlagh et al., 2021). Thus, mismanagement of infected waste can lead to more COVID-19 infection. Mixing infected waste among normal wastes puts waste collectors and normal people at risk. Littered waste is also a risk factor of increased COVID-19 cases.

V. CONCLUSION

In normal circumstances, mismanagement of plastic waste affects the environment by polluting the ocean, land field, and air. Plastics entering the ocean are likely to carry invasive species from several regions. When it reaches the shore, native species can be affected from this invasion and may lead to extinction. Also, landfill pollution poses a long-lasting land pollution, as plastic needs a large amount of time to fully deteriorate, and garbage chutes are not enough to take up all plastic waste. Moreover, the wandered plastic garbage patches in the ocean are responsible for the death of the sea's microorganisms that produce large amounts of Oxygen for this planet. The mismanaged plastic waste can also result in the loss of tourism. Apart from the environmental problems, humankind is also affected by this mismanagement. As the most severe source of plastic waste comes from medical centers and they are usually contaminated with severe pathogens, mismanagement can result in a higher risk for those who need to contact with this kind of waste, such as waste collectors, healthcare workers, and researchers. The effects can potentially become worse during the outbreak of COVID-19 such that the spillage from littering and open land fields of infected waste has put more people, especially waste collectors, at risk of catching the virus due to its ability to survive on surfaces. Furthermore, mismanaged incinerated ashes of medical waste can cause pollution to the environment. This article

therefore serves as a voice to raise environmental concerns posed during the global pandemic, calling for responsible use of plastic from both medical, business and public sectors so that no further "plastic pollution pandemic" could be spread after this deadly viral pandemic.

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