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IMPACT OF COVID-19 PANDEMIC ON GLOBAL PLASTIC WASTE

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ABSTRACT:

Plastic products have played significant roles in protecting people during the COVID-19 pandemic. The widespread use of personal protective gear created a massive disruption in the supply chain and waste disposal system. Millions of discarded single-use plastics (masks, gloves, aprons, and bottles of sanitizers) have been added to the terrestrial environment and could cause a surge in plastics washing up the ocean coastlines and littering the seabed. This paper attempts to assess the environmental footprints of the global plastic wastes generated during COVID-19 and analyze the potential impacts associated with plastic pollution. The amount of plastic wastes generated worldwide since the outbreak is estimated at 1.6 million tonnes/day. We estimate that approximately 3.4 billion single-use facemasks/face shields are discarded daily as a result of COVID-19 pandemic, globally. Our comprehensive data analysis does indicate that COVID-19 will reverse the momentum of years-long global battle to reduce plastic waste pollution. As governments are looking to turbo-charge the economy by supporting businesses weather the pandemic, there is an opportunity to rebuild new industries that can innovate new reusable or non-plastic PPEs. The unanticipated occurrence of a pandemic of this scale has resulted in unmanageable levels of biomedical plastic wastes. This expert insight attempts to raise awareness for the adoption of dynamic waste management strategies targeted at reducing environmental contamination by plastics generated during the COVID-19 pandemic. Plastics are essential in society as a widely available and inexpensive material. Mismanagement of personal protective equipment (PPE) during the COVID-19 pandemic, with a monthly estimated use of 129 billion face masks and 65 billion gloves globally, is resulting in widespread environmental contamination. This poses a risk to public health as waste is a vector for SARS-CoV-2 virus, which survives up to 3 days on plastics, and there are also broad impacts to ecosystems and organisms. Concerns over the role of reusable plastics as vectors for SARS-CoV-2 virus contributed to the reversal of bans on single-use plastics, highly supported by the plastic industry. While not underestimating the importance of plastics in the prevention of COVID-19 transmission, it is imperative not to undermine recent progress made in the sustainable use of plastics. There is a need to assess alternatives that allow reductions of PPE and reinforce awareness on the proper public use and disposal. Finally, assessment of contamination and impacts of plastics driven by the pandemic will be required once the outbreak ends.

KEYWORDS:

PERSONAL PROTECTIVE EQUIPMENT (PPE), COVID-19, MEDICAL AND DOMESTIC WASTES, PANDEMIC, SINGLE-USE PLASTIC.

INTRODUCTION

The COVID-19 pandemic has wreaked immense misery and across the globe. It has also caused a worrying trend with grave environmental implications – a renewed vigor in the use of plastics. A surge in demand for personal protective equipment (PPE) such as masks, gloves, aprons etc... especially for front-line and healthcare workers threatens to create mountains of plastic litter that activists claim could lead to a major crisis.

A range of personal protective equipment (PPE) made from plastics have played crucial roles in protecting people during the COVID-19 pandemic. However, there is a growing concern over the unprecedented increase in single-use plastics (SUPs) including gloves, protective medical suits, masks, hand sanitizer bottles, takeout plastics, food and polyethylene goods packages, and medical test kits since the coronavirus pandemic began. The management of wastes arising from SUPs is a troubling upshot of the COVID-19 pandemic which has wrecked the global healthcare systems and disrupted the economies of nations. Essential municipal services such as waste collection and treatment have been threatened while there is an unprecedented rise in the amount of medical and domestic wastes generated. Data suggest that COVID-19 virus is highly contagious and could remain viable on plastic surfaces for several days.

Here, we present a framework for estimating the number of facemasks generated daily during COVID-19 pandemic by the global population living in the urban and semi-urban areas. We have also estimated the volume of plastic wastes generated daily, and by the end of 2020. Also, we discuss the impact of COVID-19 pandemic on the consumption and disposability of single-use plastics

generated from healthcare facilities, quarantine facilities, home and hotel isolation facilities, and other sources during the management of COVID-19 patients.

According to a World Wide Fund for Nature (WWF) report, if just one percent of the masks were disposed of incorrectly and dispersed in nature, this would result in as many as 10 million masks per month polluting the environment. Each mask weighs about four grams, so it would lead to the dispersion of more than 40,000 kilograms of plastic.

THE EFFECT OF COVID-19 ON PLASTIC POLLUTION AND SUPPLY CHAINS

In December 2019, the SARS-CoV-2 virus began to spread around the world, the first pandemic of such severity in centuries. Given the severity of the respiratory syndrome that results from the novel coronavirus and its highly contagious nature, what began as a health crisis has quickly become an economic, social, political and environmental threat? Initially, the world experienced a global shutdown in international and domestic travel. Consequent to people becoming less mobile were decreased carbon emissions, increased sightings of wildlife in urban areas, and potentially decreased amounts of several types of plastic waste lost to the environment. However, this decrease was counteracted by the tremendous growth in single-use plastic personal protective equipment (PPE) and other medical waste associated with the pandemic. Additionally, there was a proliferation of single-use plastic bags, cups and take away containers associated with the food industry. This demand on plastics for packaging, medical use and other applications is expected to grow. We have also seen plastic industry lobbyists utilize the hygiene and cleanliness concerns of customers to pressure jurisdictions to reverse or delay policies to ban or reduce single-use plastics.

Increasing disruptions to supply chains around the world began in early 2020 when the World Health Organization declared COVID-19 a global health emergency. Supply chain disruptions have occurred for a range of products such as medicines and medical equipment including PPE, fuel, electricity, food, toilet paper and other household goods. Examples of supply chain disruptions have included demand drop (e.g., airline travel), demand surge (e.g., toilet paper, online shopping), reduction in productivity (e.g., retail or restaurant jobs), storage/access restrictions (e.g., storage warehouses, meat production and storage facilities, etc.), a shortage of raw materials (e.g., electronics parts such as memory chips, building materials). These supply chain disruptions are unevenly distributed among countries, industries and communities and highlight the instability within global markets. Countries are seeking to reduce their reliability on global markets by building and strengthening resilient regional and domestic markets. One approach that is seeing an increased focus is the shift to an increasingly circular plastics economy. This focus is heightened by the desire to buffer supply chains from system shocks.

MANY SINGLE-USE PLASTICS AS SARS-COV-2 SPREADS.

Since the outbreak of SARS-CoV-2, there has been a surge in the number of discarded single-use surgical and face masks and latex gloves which are seen littering the streets and roads, medical facilities, parking lots, dumpsites, beaches, gutters, and shopping carts. Over the past few months amid the pandemic, the world has witnessed an unprecedented rise in demand for plastic products such as disposable gloves, masks, bottled water, disposable wipes, hand sanitizers, and cleaning agents. In most countries, the government issued lockdown directives, as well as social and physical distancing measures to curb the spread of COVID-19 virus. However, the COVID-19 pandemic has worsened the plastic pollution problem through consumer's rejuvenescence for single-use products and materials for health and safety reasons. Shops and supermarkets have seen a widespread practice of using single-use materials to wrap vegetables and fruit because of hygiene reasons.

Moreover, given the government and healthcare providers strategy at preventing the spread of COVID-19 virus, health workers are generally advised not to reuse their personal protective equipment (PPE), implying that tonnes of plastic medical waste are generated daily. More so, most countries, World Health Organisation (WHO), US Centre for Disease Control and Prevention, European Centre for Disease Prevention and Control have recommended stringent physical distancing measures, cancellation of mass gatherings, frequent hand washing, and closure of educational institutions to limit the community spread of COVID-19. Besides, almost all countries have recommended and implemented the use of facemasks to reduce the level of human-to-human transmission and protect the most vulnerable and at-risk populations. Therefore, in line with this recommendation and stringent directives, millions of facemasks have been produced, used and discarded daily.

Largely, a lot of single-use PPE used by health workers and the public are being discarded daily. These include masks, gloves, protective aprons, face shields, safety glasses, sanitizer containers, plastics shoes and medical gowns, which are mostly made from non-woven materials

including polymeric substances such as polypropylene. Also, gloves are made from several materials, including chloromethane polymers, neoprene, and vinyl. These plastic products could be categorized as macro- and meso plastics, and can enter the environment through poor waste management or improper discharge into the marine and terrestrial ecosystems.

In general, terrestrial environments are the critical sources for marine plastic debris, which are mainly originated from the anthropogenic emissions. Over the years, our global ocean, seas, and coastal environments have been directly and indirectly riddled with billions of tons of plastic marine debris produced from human-mediated activities. Plastics in our oceans can come from both land-based or marine sources, and are mostly categorized into nanoplastics (particulate size range between 1 – 100 nm), microplastics (MPs) (particulate size range between 1 μm–5 mm), mesoplastics (particulate size range between 2.5 cm–5 mm), and macroplastics (particulate size range >2.5 cm). Approximately 80% of global ocean plastics arise from land-based sources while about 20% are attributed to marine sources. Recent reports of increased anthropogenic inputs of plastic-sorbed pollutants into the marine environment have significantly resulted in elevated levels of contaminants in recent years. These organic and inorganic contaminants are usually accumulated in surficial and bottom sediments.

However, there is a growing concern that discarded surgical masks, medical gowns, face shields, safety glasses, protective aprons, sanitizer containers, plastics shoes, and gloves arising from the current coronavirus pandemic could end up in our aquatic ecosystems. In March 2020, there was an avalanche of COVID-19 cases worldwide and health care facilities around the world were confronted with shortages of gloves, surgical masks, face masks and other PPE. Commonly available and recommended types of PPE include N95 and KN95 respirators and surgical masks, that are designed for maximum filtration of aerosols and infectious airborne particles, to protect the user from respiratory diseases including COVID-19, by filtering infectious airborne particles.

Notably, the N95 are tightly fitted respirators while the surgical masks are loose-fitting medical masks designed in varied thickness and water percolation abilities. Both types are wearable devices that are meant to be disposed of after a single-use. According to the Centers for Disease Control and Prevention (CDC) recommendation, the respirators, surgical and face masks are labelled as “single-use” disposable medical or respiratory protective devices and should be discarded in a “plastic bag” after use and then dumped in trash. This recommendation is a necessary measure but could worsen the plastic waste problem as more single-use plastics are added to our environment and the global oceans, especially in situations where the PPEs are not adequately recycled. The unprecedented rise in the number of disposable surgical masks and hand gloves can contribute to the plethora of plastic pollution. This could potentially exacerbate the existing plastic pollution challenges created by over 10 million tonnes of plastic that have been estimated to threaten the health of our environments, our global oceans, and the marine organisms.

THE ENVIRONMENTAL IMPACTS OF BIOMEDICAL PLASTIC WASTES.

In general, land-based anthropogenic activities such as unregulated disposal of biomedical wastes have been regarded as potential sources of toxic, infectious and radioactive pollutants (WHO, 2018). Typically, healthcare wastes include cytotoxic, chemical, pathological, pharmaceutical, sharp, radioactive, and general wastes. Most of these wastes are made using plastic materials, especially for sharp and general wastes, such as syringes, and scalpels, gloves, surgical masks, surgical and isolation gowns, face shields, shoe covers, sanitizer containers, and waterproof aprons. The COVID-19 pandemic has created more biomedical waste in the form of waste plastics. According to the WHO, on the average, about 0.2 and 0.5 kg/day of hazardous biomedical wastes are generated by low-income and high-income countries, respectively. In China where the COVID-19 was first reported, the Emergency Management Office of the Ministry of Ecology and Environment documented a 23% increase in the amount of medical waste generated and treated. Thus, China has witnessed an accumulated 142,000 tonnes of medical wastes with the national medical waste treatment capacity increasing from 4902.8 tonnes/day before the SARS-CoV-2 outbreak to the current 6022 tonnes/day.

METHODS

In this paper, the daily facemasks generated by each country was calculated as a product of the total population of a country and an arbitrary percent of facemask acceptance rate by the urban population. The daily and monthly facemask generation were computed as a product of an estimated single facemask use by an individual per day and for thirty days average, respectively.

RESULTS AND DISCUSSION

The amount of plastic wastes generated worldwide since the outbreak is estimated at 1.6 million tonnes/day (Table 1). We estimate that approximately 3.4 billion single-use

facemasks or face shields are discarded daily as a result of COVID-19 pandemic. China, with the largest population, is estimated to generate nearly 702 million discarded facemasks daily, and could potentially produce approximately 108 million tonnes of plastic wastes by the end of 2020. Our estimate shows that Asia is projected to generate the highest quantity (1.8 billon) of discarded facemasks per capita per day. This is followed by Europe at 445 million, Africa at 411 million, Latin America and the Caribbean at 380 million, North America at 244 million, and Oceania at 22 million facemasks per day (Figures 2 and 3). In view of existing policies and COVID-19 protocols by many countries, the mandatory use of single-use facemasks (face shields) will potentially boost PPE wastes generation. For instance, in China (1.4 billion population), India (1.3 billion population), United States (331 million inhabitants), Brazil (212 million people), Nigeria (206 million population) and United Kingdom (67 million population), it is estimated that the daily facemasks generated if all their citizens wear and discard a facemask or face shield per day, could result in the generation of at least 702, 386, 219, 140, 75, and 45 million of contaminated masks per day. Once the masks are discarded into the environment and are not properly managed, they could be degraded into smaller sized particles which invariably tends to exacerbate the already plastic pollution problems. These discarded PPE could form the bulk of mismanaged wastes that would litter or terrestrial environments and coastal shorelines. In addition, our estimate indicates that by the end of the year 2020, about 585 million tonnes of plastic wastes would be generated by over 7.7 billion people globally, with about 82% of those plastic wastes coming from the top 35 countries. Notably, most of them are low- and middle-income countries where facilities for effective waste management are not available. This implies that the percentage of mismanaged plastic wastes would likely increase, resulting in disposal in open landfills or uncontrolled dumpsites with a glut of plastic wastes ending up in polluting the waterways, streams, rivers and oceans.

However, the effective management of medical and domestic wastes is a major challenge, especially in developing countries. Improperly discarded plastic-based wastes and other non-biodegradable synthetic substances are capable of floating around in the environment, accumulating various toxic pollutants and pathogens on their surfaces, which could pose harmful health risks to humans and marine organisms. According to a study by the World Wide Fund for Nature (WWF), if only 1% of the surgical and face masks are improperly discarded into our terrestrial and marine environments, it could potentially lead to unprecedented littering of our environment by as much as 100 billion masks every month. The implication is that this may result in over 405 Mt of SUPs being added to the already deplorable plastic pollution problem. However, this rapid increase in plastic wastes is happening at a time when some recycling programs in many countries are being suspended because of concerns about the virus spreading. Therefore, COVID-19 pandemic can worsen the global plastic waste problem.

The presence of SARS-CoV-2 RNA in untreated wastewaters and sewage was detected as a result of the sorption and stability of coronavirus on surfaces of improperly discharged single-use medical wastes. Epidemiological data on the surface stability of SARS-CoV-2 and SARS-CoV-1 indicate that once a fomite is contaminated, the infectious viral particles remain viable on a range of surfaces for several minutes and up to several days. According to recent studies, SARS-CoV-2 was found to be more viable and stable for 2–3 days on plastics and stainless-steel surfaces than on cardboard, wood, banknotes and copper.

HOW REDUCE PLASTIC POLLUTION POST-COVID-19 PANDEMIC.

The overwhelming consequence of COVID-19 pandemic coupled with strategic response measures taken by governments and healthcare providers around the world have created more challenges for combating plastic pollution. There is no doubt that COVID-19 will reverse the momentum of a years-long global battle to cut down single-use plastics. If we want to keep the benefit of plastics without compromising our planet, we need to understand how to manage them. As the world focuses its attention at finding the solution to coronavirus, this review attempts to draw the attention of the world to adopt stricter waste management strategies aimed at reducing environmental contamination by coronavirus-generated plastics during this pandemic and after the lockdown period.

This can be achieved by proper disposal and strict adherence to approved hazardous medical waste management procedures for single-use medical gloves, surgical masks, surgical suits, face shields, and aprons. The development of a robust conservation strategy for proper sterilization and disinfection of surgical gowns and masks should be carried out while taking into consideration the reduction of risks such guidelines could pose to healthcare workers and the COVID-19 patients. As recommended by the US FDA, healthcare providers could implement the use of reusable surgical gowns in place of disposable

single-use PPE. Surgical gowns are usually made of either single-use or reusable materials and worn as a barrier to microbial and fluid transmission during medical procedures. In addition, extended use of PPE for multiple patients may be prioritized by healthcare providers. This would ultimately lead to a drastic reduction in the amount of plastic waste generated. In order to address the existing problem of environmental plastic pollution, used personal protective equipment should be disposed of appropriately in well-labelled clinical waste bins, followed by recycling at designated biohazard waste management facilities.

CONCLUSIONS

In view of the recent global efforts geared at combating the highly contagious SARS-CoV-2, the environment might have made some gains in terms of reduction in carbon footprint and improved air and surface water quality. However, there has been an unprecedented need, consumption, and release of single-use plastic products since the coronavirus outbreak. According to our estimates, enormous amount of single-use plastic wastes has been generated globally since the outbreak of COVID-19. Current worldwide estimate of daily generated single-use PPE (facemasks) is 1.6 million tonnes per day implying that approximately 3.4 billion single-use facemasks or face shields are discarded daily due to COVID-19 pandemic. Regional estimates indicate that Asia with the highest population is projected to generate the highest quantity (1.8 billon) of discarded facemasks per day, followed by Europe, Africa, Latin America and the Caribbean, North America, and Oceania at 445, 411, 380, 244, and 22 million facemasks per day, respectively. China (1.4 billion population), India (1.3 billion population), United States (331 million inhabitants), Brazil (212 million people), Nigeria (206 million population) and United Kingdom (67 million population), it is estimated that the daily facemasks generated if all their citizens wear and discard a facemask or face shield per day, could result in the generation of at least 702, 386, 219, 140, 75, and 45 million of contaminated masks per day. Given these estimates, there is a growing danger of single-use plastic and PPE which are directly attributed to COVID-19 pandemic. This is capable of exacerbating the existing plastic pollution problems and could constitute an impending threat to our collective existence and the survival of marine organisms. Not only is there a potential environmental risk of improperly discarded non-biodegradable PPE made from plastics, but there are also human health risks from minute particulate sized plastics through consumption of seafoods which is a choice source of protein for many around the world. More so, macro-, meso-, and micro plastics in the environment and marine ecosystems could serve as potential vectors of pathogens. Marine organisms such as fishes, turtles, beach seabirds, sea turtles, whales, and other marine mammals might be at risk of entanglement and intentional, accidental or indirect ingestion of latex gloves which could lead to severe injuries and death.

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