

# Evaluating and Managing the Effects of Improper Medical Waste Disposal

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## ABSTRACT

COVID-19 (SARS-CoV-2) has caused a global pandemic that infected and killed millions around the world. Scientists are working around the clock to find cures and ways to prevent this disease. Due to this, personal protection equipment (PPE) has become one of the most valued resources in the healthcare industry. It protects doctors and other frontline workers from the virus and is a crucial necessity for all those working with COVID-19 patients. The world is worried about the shortage of these PPE kits as factories race to manufacture more protective equipment, however, not many are concerned about the environmental factors that come with the PPE that is used immensely around the world every day. PPE kits are made out of one main material, polypropylene, which doesn't degrade. PPE is not recyclable or biodegradable, therefore it needs to be treated as waste. Most are disposed of in landfills, creating a bigger threat to our environment. Unsafe recycling of PPE is also a threat to human health, increasing the risk of transmitting the infection. One solution is educating the public about the proper disposal of medical waste and enforcing environmental-friendly health care with optimal priority.

## Introduction

More than 4.5 million people have been reported to have been infected with coronavirus disease 2019 (COVID-19) as of mid-May 2020, with nearly 300,000 people dying as a result. Disposable facemasks, gloves, and other personal protective equipment have been essentials during the Covid-19 pandemic. Since the disease first arose in early 2020, scientists have anticipated the rise in the use of single-use plastic as well as plastic waste across the world. But what does this mean for the environment? The public, as well as health professionals, don't have a clear idea of how much waste they routinely generate nor the environmental impact that comes along with the massive use of disposable protective equipment. The Center for Infectious Disease Research and Policy found that health care facilities generate 6000 metric tons of waste each day, making them the second-largest contributor to landfill waste, next to the food industry. As per the report of BBC, according to the Department of Health and Social Care (DHSC), in the UK itself 135 million masks, 145 million aprons, 1.2 million gowns, and 470 million pairs of gloves were issued and used from February 25<sup>th</sup>, 2020 to April 18<sup>th</sup>, 2020. This adds to 748 million items used in a span of just 53 days period, making an average of 14 million items a day. With such statistics, it is unimaginable how much waste is generated from around the world in the course of just one year.

PPE was one of the most important elements that has been used throughout the current global Covid-19 pandemic. Since the outbreak, there have been multiple shortages of protective equipment throughout the world, leading to an increase in mass production. Even though the production of plastic-based PPE equipment has been brisk, the waste management of the discarded PPE items has not found a proper solution yet. Mounting medical waste is one of the major causes of impacting natural surroundings. Apart from this, they also produce 10 percent of all greenhouse gas emissions and pollutants harming humans and animals. PPE has caused the amount of medical waste to multiply to a great extent making the numbers rise exponentially. It is estimated that 129 billion face masks and 65 billion gloves are used globally each month, and this is not counting the other PPE that doctors use such as disposable face

shields, goggles, aprons, and gowns (CIDRAP 2020). This surge in single used plastics is seen by environmentalists as a catastrophe in the making and can lead to what is known as a “Plastic Pandemic”.



**Figure 1.** Single-use plastics, such as surgical masks and gloves, cause growing plastic pollution in the wake of Covid-19

Waste management is becoming a growing challenge for cities dealing with the fallout of Covid-19. Inadequate handling of health care waste plays a critical role in environmental health protection by posing a significant risk for public health and the environment. It can be well established that disposable PPE is the new plastic water bottle, in that they have become worldwide litter. PPE has become a significant source of public litter; scattered in recreational areas, found outside of stores and hospitals, and thrown across streets and roads. Not only is this harmful to the environment, but it also allows the virus to spread easier. As more people wear personal protective equipment in their daily lives, they're also littering it all over streets, parking lots, and parks. Gloves, masks, and wipes are made from a specific plastic called polypropylene. When that's discarded into the environment, polypropylene travels into sewage systems or drinking water. It breaks down into microplastics, which attract harmful chemicals such as pesticides. Animals can easily mistake discarded gloves or masks for food and end up dying from the dangerous toxins found in Polypropylene. Marine plastic pollution is a critical hassle. It is anticipated that every 12 months, over 8 million tons of plastic enter our oceans. This plastic does not now disappear however as a substitute slowly breaks down into micro-plastic, which enters food chains, with devastating effects. PPE should be used to keep people safe from the current pandemic, not cause environmental damage. At the same time as we fight towards this invisible enemy prepared with masks, respirators, disinfectants, sanitizers, and lots of other clinical devices we must additionally pay attention to the birth of a dangerous environmental problem that will have even more detrimental effects than the virus.

### *Classification of Biomedical Waste*

Not all waste generated by hospitals or clinics is presumed to be dangerous. It can be classified into two categories: hazardous and non-hazardous.

**Non-Hazardous BMW:** This type of waste is safe to handle and won't be considered serious. Some items that fall into this category are food items, water and drink containers, tissue and office paper, IV tubing and syringes without blood or body fluid contamination, as well as plastic medication bottles and bags.

**Hazardous BMW:** Hazardous waste can be split into two different categories; potentially toxic and potentially infectious.

- A) Potentially Toxic Waste includes chemical, radioactive, and pharmaceutical waste. This type of waste is not infectious but still proposes a risk to human health.
  - 1. Chemical waste is made from harmful chemicals. Clinical drug or chemical wastes are chemicals and pharmaceutical drugs utilized in clinical areas that are hazardous and require stricter disposal.

2. Radioactive waste includes waste contaminated with radionuclide or waste generated by nuclear medicine, radiation oncology, and PET.
  3. Pharmaceutical waste is any waste that contains medicinal drugs that are expired, unused, contaminated, damaged, or no longer needed.
- B) Potentially Contagious/Infectious Waste includes regulated and non-regulated medical waste, infectious medical waste, and red/yellow bag contaminated waste. Some items that fall into this category are:
1. Used personal protective equipment
  2. Dressings and swabs infected with body fluids
  3. Excised organs and other body parts
  4. Contaminated syringes, feeding tubes, needles, IV tubing, etc.

### *Classification of Personal Protective Equipment*

The type of PPE being used depends on the person and the situation. For example, nurses and doctors on a COVID-19 ward are advised to wear disposable gloves, an apron, a gown, a respirator, and face protection, while community-based caregivers are advised to wear gloves, aprons, and a mask. The general public, on the other hand, was just advised to wear a surgical or reusable mask in public, and gloves if necessary. There are two characteristics of PPE.

#### 1. Single-use (disposable) PPE

Much of the PPE used in COVID-19 treatments, which includes gloves, masks, overalls, shoe protectors, and many others fall beneath this class. Such gadgets must be treated below clinical waste even when disposing. Single-use plastics have the most detrimental effects on the environment. Throughout the pandemic, single-use PPE was more widely used than reusable PPE. It was considered more convenient as well as easier to dispose for many health care professionals. Single-use PPE is not a sustainable way to keep the community safe.

#### 2. Reusable PPE

Reusable PPE is protective equipment that is reusable as well as environmentally friendly. It also prevents PPE shortages and is convenient. Reusable masks were proven to be just as efficient as surgical masks and they also minimize waste and plastic pollution. Reusable PPE is not as prominent as single-use PPE.

| Waste category   | Components                                                                                                                                                                                                                                               |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Tissues          | Human or animal pathological wastes, including tissues, organs, blood, pus, and body parts and fluids                                                                                                                                                    |
| Infectious waste | Blood, blood products and objects that are contaminated with them; microbiological laboratory wastes; quarantine wastes; dialysis wastes; used surgical operating clothes; infectious organ pieces, blood and anything contaminated with these materials |
| Sharp objects    | Needles, syringes, broken glass, blades, and other items that could cause a cut or puncture                                                                                                                                                              |
| Chemical waste   | Hazardous chemicals, heavy metal containing wastes, pharmaceutical wastes, amalgam wastes, cytotoxic wastes, genotoxic wastes                                                                                                                            |
| Medicine waste   | Common medicines that are expired or are no longer required or are discarded; other medicines discarded that could cause cancers or genetic diseases; the discarded vaccine products                                                                     |

**Figure 2.** Classification of medical waste (China Ministry of Health, 2003).

The type of PPE worn is determined by the mission at hand and the surroundings. Nurses on a COVID-19 ward, for example, should wear disposable gloves, an apron, a gown, a respirator, and face protection, while community-based caregivers should wear gloves, aprons, and masks.

## **Effective Ways to Dispose Personal Protective Equipment**

During the pandemic, waste management and resource recycling sectors were not regarded as essential services and were shut down just like the hundreds of other businesses. This caused recycling routines to be disrupted which eventually led to a build-up of excess waste that isn't treated properly. Some countries deployed spontaneous procedures to collect and recycle used PPE. However, improper disposal of it can lead to the transmission of viral pathogens to others. The United Nation's Basel Convention on the Transboundary Movement of Hazardous Wastes and their Disposal has advised communities to properly discard Covid-19 waste to reduce other impacts on the environment as well as the health of others. Hence why countries must adopt safe and efficient techniques to properly dispose of PPE.

## Incineration of PPE

One of the most effective ways to discard medical waste is to burn it. High temperatures destroy viruses which eliminate the likelihood for diseases to transmit. Incineration can also reduce the amount of waste, so it doesn't take up as much space. The heat that is produced from waste incinerators can also be used as a form of electricity by turning it into clean energy. Studies show that the waste from municipal plants contributed to 2% of the UK's energy in 2018. Even though incineration plants have been known to release harmful gasses that contribute to climate change, modern technology uses gas cleaning technologies to remove the substances that harm human or animal health. More recently, questions have been raised about our increasing dependence on incineration and its possible effects on long-term sustainability goals. Incineration as a waste management option is at risk of technical lock-in, where we become dependent on a less effective system due to the long lifetime of the device, due to the expense and difficulty of building and operating plants.

## UV Light Sterilization

As a factor, techniques to prolong the lifetime of medical equipment products as efficiently as possible are important. During the ongoing pandemic, a concerted attempt has been made to find feasible ways to preserve PPE, including post-use decontamination. Pulsed Xenon ultraviolet rays have proved to be capable of destroying bacteria using less time and energy. It works by breaking down individual chemical bonds and the structure of DNA, RNA, and proteins, causing a micro-organism to be unable to increase. When an organism is unable to grow, it is considered dead since it is not capable of reproducing within a host and is no longer infectious. Based on existing evidence, it is believed that ultraviolet light can help prevent the transmission of Covid-19. Few hospitals have been using UV-C light to decontaminate N95 respirators and other PPE, but many don't have the space or facilities to do so.

## Conclusion

To summarize, the Covid-19 pandemic has caused the mounting of medical waste from used PPE kits all over the world by health professionals as well as the general public. While it is important to keep communities and their people safe from the virus, it is also crucial to manage the accumulating waste properly so we can avoid its long-term effects on the environment. The effects of excess plastic waste can be devastating to the environment. When the pandemic is over, there will be time to consider whether existing systems are sufficient or if alternatives should be pursued. Technology that sterilizes wastes and separation methods that minimize the mixing of infectious waste with general waste may be implemented to reduce the risk of infection. More recycling opportunities will become available as more waste is listed as non-infectious. The amount of waste generated could also be minimized by replacing single-use PPE with reusable PPE that is cleaned between uses. Chemical cleaning, on the other hand, can have unforeseen implications for the environment. Since they necessitate new structures and facilities, as well as additional staffing, these options can only be discussed after the pandemic has passed. After that, and only after the immediate priority of patient safety

and infection prevention has been reached. Prevention of PPE waste is just as crucial as managing the waste. That is why communities need to be educated on the proper disposal of PPE. By doing so, we can limit the amount of PPE waste generated in the first place.

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## References

- Davey, P. (2020, June 1). *Facing national ban, plastics re-emerge during pandemic*. Environmental Science & Engineering Magazine. Retrieved February 7, 2022, from <https://esemag.com/news/ban-plastics-re-emerge-during-pandemic/>
- Fletcher, C. (2020, May 13). *How do we dispose of PPE during the coronavirus pandemic?* The National Interest. Retrieved February 7, 2022, from <https://nationalinterest.org/blog/buzz/how-do-we-dispose-ppe-during-coronavirus-pandemic-153441>
- Hashmi MPH Follow Infection Prevention & Control Specialist King Khaled Hospital Najran MOH KSA, A. (2013). *How to manage hospital waste*. SlideShare. Retrieved February 6, 2022, from <https://www.slideshare.net/anjumhashmi61/how-to-manage-hospital-waste>
- Islam, F. (2020, April 20). *Why a billion items of PPE is not enough*. Retrieved February 6, 2022, from <https://www.bbc.com/news/business-52362707>
- Kumar, A. (2020, April 28). *Environmental impact of disposable masks*. Online Clothing Study. Retrieved February 6, 2022, from <https://www.onlineclothingstudy.com/2020/04/environmental-impact-of-disposable-masks.html>
- KUMAR Follow ASSISTANT PROFESSOR DEPARTMENT OF COMMUNITY MEDICINE, D. R. N. A. V. I. N. (2013). *Hazards of Biomedical Waste & its management*. SlideShare. Retrieved February 6, 2022, from <https://www.slideshare.net/dnnavin1998/hazards-of-biomedical-waste-its-management>
- Kurup, D. K. K. (2017, November 23). *Waste Management in Healthcare*. Medindia. Retrieved February 6, 2022, from <https://www.medindia.net/patientinfo/waste-management-in-healthcare.htm>
- Tiwari, D. M. (2020, June 2). *How to dispose PPE safely - The New Challenge to the world*. Online Clothing Study. Retrieved February 6, 2022, from <https://www.onlineclothingstudy.com/2020/05/how-to-dispose-ppe-safely-new-challenge.html>
- Wang, G. W. (2009). *Classification of Medical Waste (china ministry of health ...* Retrieved February 7, 2022, from [https://researchgate.net/figure/Classification-of-medical-waste-China-Ministry-of-Health-2003\\_tbl1\\_23806518](https://researchgate.net/figure/Classification-of-medical-waste-China-Ministry-of-Health-2003_tbl1_23806518)