**Forum: Committee Name**

**Agenda: Assigned Topic: On measures to install and promote sustainable disposability of pandemic equipment**

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**Introduction**

The Covid-19 pandemic has had an unprecedented effect on the global health and the economy. According to current UN estimates, there are over 20.1 million global confirmed cases, with 742 thousand deaths. As a result, the World Bank forecasts that global growth could shrink by as much as 8% in 2020 (9). The pandemic has necessitated the development of novel preventative and in-home measures, such as the usage of masks, gloves, and protective equipment, apart from medical facilities. Additionally, the pandemic has exposed multiple lapses in healthcare and management structure; with sustainable disposal of medical waste is a notable example. The mass stockpiling of protective equipment has created a waste emergency due to mass amounts of production and disposal, leading to environmental damage, and failure to properly manage waste could escalate the spread of Covid-19 via secondary transmission. The challenge for countries stretched thin, is to make use of current facilities to sustainably manage waste while reducing environmental damage, preventing secondary transmission, and mitigating any future risk.

Until now, no specific vaccine exists to combat the spread of disease, and the only viable options are mass testing, isolation measures, social distancing, life-supporting treatments and personal protective equipment (PPE). PPEs comprise surgical/protective facemasks, gowns, and nitrile gloves, to protect individuals from exposure to harmful pathogens. According to Dr. Alverson, director of the UNEP International Environmental Technology Center, there is a shortage of reliable quantitative data on the current stress on medical waste management, representing a key shortcoming of response initiatives. Therefore, any judgments on the current situation of recycling, disposal, and management, will be limited to pre-pandemic estimates on countries’ waste management systems and hypothetical sustainability impacts.

As a result of the limited quantitative data surrounding the current waste management scenario and disposal strategies, assumptions on the extent of waste management and treatment, along with the impact of the pandemic, will be made according to pre-COVID estimates and subsequent future predictions will make use of it as well. As a result of the mass production of PPEs, which is a single use plastic, to reduce the secondary transmission of Covid-19, recycling programs are being pushed aside. This situation has led to mass disposal of Covid-19 PPE plastic waste, which has a massive environmental impact.

The environmental impact of Covid-19 has the possibility of being devastating, through the increase in PPE for personal and healthcare usage, that according to the World Economic Forum, “in China, daily production of face masks [soared to 116 million](https://waste4change.com/understanding-medical-waste-management-to-curb-the-transmission-of-covid-19/" \t "_blank) in February, 12 times higher than the previous month” (Duer 10). Additionally, according to recent guidelines of the WHO, requesting a 40% increase in disposable PPE production, if the global population uses one disposable mask per day, the pandemic could result in monthly global consumption and waste of 129 billion masks and 65 billion gloves (Adyel 2). Moreover, based on recent estimates in Wuhan, which produced more than 240 tons of plastic medical waste, the US could generate a year’s worth of plastic in 2 months (Adyel 3). At the regional and national levels, the priority of human health over environmental health has reduced the effectiveness of policies reducing the amount of single-use plastic (Adyel 6). According to a Northwestern report, the increase in demand of “PPE, packaging for takeout food and water bottles” (Fishman 6) during the pandemic has worsened environmental pollution globally, wherein the rise in single-use plastics in hospitals and the general population has made its way into landfills, and chemicals from these plastics leak into the earth and cause massive environmental damage (Fishman 8). In these situations, the main focus is healthcare waste such as PPEs and related pandemic equipment, which are included under the umbrella of single use plastics. Additionally, the impact of plastic pollution is well documented and future estimates should be made based on pre-pandemic scenarios. According to John Scott, senior chemist at the University of Illinois, while there is no established link between COVID-19 PPE and increased plastic pollution, due to the lack of data, it will undoubtedly have a major impact on the environment. To cope with the effects of pandemic equipment on the environment, along with coordinated approaches to the development of a circular economy are needed, and the enforcement of policies against plastic pollution.

The waste produced from pandemic equipment, specifically through PPEs, has not been managed properly. The stress put on current waste management practices has led to poor strategies such as mobile incineration, landfills, and burnings, increasing its environmental impact and reducing the effectiveness of management. Improper disposal of just 1% of facemasks translates to around 10 million items weighing 30,000 kg to 40,000 kg (Adyel 4), showing the importance of stringent regulation. Covid-19 related plastic has been observed in marine and landfill environments, potentially exacerbating its environmental impact (Adyel 4). Typical waste management and recycling has been suspended due to fears over transmission of the pathogen (Duer 11). Additionally, all around the world, such as in the UK, illegal waste disposal has increased 300%, showcasing the stress placed on current household and medical waste management and the need to strengthen it. The important challenge of enabling healthcare workers to do their job and stay safe, along with helping the public avoid additional infection, involves minimizing the environmental cost of single-use plastics and PPE (Duer 12). Countries all over the world combating the pandemic have produced massive amounts of medical waste, which is potentially exposed to infectious materials and people. According to Stericycle, one of the largest medical waste management companies in the US, handling 1.8 billion pounds of waste in 2018, predicted an increase in that amount during the pandemic. Moreover, in Wuhan, the epicenter of the crisis, the daily output of medical waste reached 240 tons, which was six times normal amounts.

Throughout the report, a distinction will be made between household (Municipal) and healthcare (hospitals) waste management; both use PPEs and pandemic equipment, but there are different circumstances for both.

Thus, there is a clear need for healthcare and household waste management to reduce the environmental impact brought about by Covid-19.

**Key Terms**

Municipal Waste Management: This is a process that includes the transfer, collection, resource recovery, recycling, and treatment of waste. The main goal is to protect population health, promote environmental equality, and develop sustainability and economic productivity (IGI-Global 1).

Healthcare Waste Management: This is the management and proper disposal of the waste that is generated by the healthcare sector, which includes a variety of waste types, and ensures the proper storage and transportation of healthcare waste to minimize health and environmental impact.

Circular Economy: This is an alternative to the traditional linear economy (take, make, waste), and tries to reduce and recover resources at the end of a product’s life and brings them back into production. The benefit is reducing waste, increasing resource productivity, creating a more competitive economy, and reducing the environmental impact.

Sustainable Disposal: This refers to the collection, transportation, and disposal of waste, in a manner that does not hurt the environment, human health, or future generations.

Single Use Plastic: These are plastics that are made from petrochemicals and are disposed of when used. These plastics are commonly used for packaging and service ware like bottles, wrappers, straws, and bags.

Personal Protective Equipment (PPE): This is equipment that protects the user against health risks. It includes items like masks, goggles, eye protection, safety footwear and harness.

**General Overview**

**Municipal Waste Management**

The main component of Municipal Waste Management involved in Covid-19 related PPE waste is Municipal Solid Waste (MSW), which involves the collection, transport, processing, recycling or disposal of waste (Magutu et al. 6). Often, these systems are integrated with local administration. The most common systems of waste management are recycling/reusing, incineration, and landfills (Magutu et al. 8). According to statistics on waste management by the World Bank,

“Some 37 percent of waste is disposed of in some form of a landfill, 8 percent of which is disposed of in sanitary landfills with landfill gas collection systems. Open dumping accounts for about 31 percent of waste, 19 percent is recovered through recycling and composting, and 11 percent is incinerated for final disposal” (8)

Therefore, the most prominent form of disposal is landfills, and will continue through to the Covid-19 pandemic. Experts say that landfills produce more greenhouse gas than incinerators and even the best landfills allow leakage of chemical material into the environment, adding a high cost. The leachate (toxic liquid) can contaminate soil and drinking water. Landfills also require a lot of land space away from urban centers. Incinerators also produce harmful air pollution and greenhouse gases that have proven to potentially increase the spread of Covid-19 (World Bank 10) and typically require high capital investment and costly maintenance. The treatment options should be determined by country situation.

Effect of Covid-19 on Waste Management and Sustainability

The effect of Covid-19 has been a double-edge sword. While it has been reported to reduce air and noise pollution, and other environmental problems in cities (Sarkodie 2), the impact of stay-at-home measures and preventative measures on waste management has been devastating (Sarkodie 2). While there is no official data on the impact of PPEs due to its recent development and unseen end, some estimates of the impact of PPEs, due to ineffective management, on the environment can be made. Oceans Asia and other conservation associations in places like Hong Kong have found many instances of PPEs being littered and appearing in marine ecosystems (Konyn 11), which suggests that the impact of PPEs on the environment will be drastic. These groups recommend initiatives to raise public awareness on how to properly dispose of plastics and inform of the health risks with improper disposal (Konyn 12). Such instances represent the failure of MSW management systems.

According to guidelines set by the CDC, European Commission, and IWCA, most waste management procedures are to be kept constant through the pandemic. However, in developed countries such as the US, a World Economic Forum report finds that “many waste-management services have not been operating at full capacity, owing to social-distancing rules and stay-at-home orders” (Duer 11) and because of the emphasis on public health over environmental protection, the usage of single-use plastics has increased, with PPEs being among them.

A guide by the Asian Development Bank (ADB) shows that Asian countries, and likely in most countries around the world, are rescheduling MWM collection according to the workforce availability and assigning more resources to healthcare waste management (11). Also, countries are reducing recycling initiatives to reduce human contact with potentially infectious waste and all municipal waste will be treated as non-recyclable and disposed of in landfills or incineration (ADB 12). The ADB also highlights that transport and disposal elements of the system are the first to be overwhelmed and should be addressed.

According to an IFC report, the MWM sector has felt massive impacts from Covid-19. The safety of workers have been compromised because of dangerous working conditions, and the majority of waste sources has moved to commercial areas. Medical waste volume has increased by 40% in total and has also seen growth in the healthcare and pharmaceutical sectors (IFC 3). The current hazardous waste production has exceeded many countries’ capacity for managing waste, leading to waste frequently being mismanaged (IFC 3). Additionally, a reduction in recycling in MWM, due to increased needs for protection, has led to challenges in effectively and efficiently collecting and managing waste, leading to further environmental and sustainability issues. Adding onto this, disposal at landfills have increased because of the increased volume of single-use plastics, or waste accumulates at temporary landfills. Municipal budgets have also been strained due to the increased healthcare and social costs of Covid-19, and containment measures have led to

In low-income countries, according to a report by the International Finance Corporation (IFC), a World Bank group, “developing countries spend $35 per ton on waste management compared to over $100 per ton in high-income countries. The consequences are significant.” (IFC 2) From poor waste management, the risk of disease could increase, as “Poor waste management practices are estimated to result in between 400,000 and 1 million deaths annually in developing countries” (IFC 2), suggesting that these countries are in greater need of support and assistance. The IFC estimates that Covid-19 will have amplified the human and environmental costs in developing countries, requiring urgent assistance. Moreover, the IFC report shows that low-income countries rely more on the informal sector, who make a living selling waste to waste aggregators, and an estimated 15 million people globally fit this group (IFC 2), and are likely still doing so during the pandemic. Moreover, according to a report on the global waste management market,

“Inadequate knowledge of healthcare professionals and sanitation health workers on biomedical waste regulations and medical waste management protocols is causing improper segregation of waste which is leading to increased hazardous waste” (WM 7)

Therefore, the problem of low awareness in low-income countries is compounding the problem and reducing the effectiveness of waste management and hurting sustainability efforts through improper sorting.

It is also imperative for these systems to minimize the environmental impact of

Because of the stress of existing facilities and practices, brought by Covid-19, sustainable disposal has been hindered. To cope with this, it is necessary for countries to continue to strengthen existing management systems and potentially adopt new systems of management to cope with the increased single-use plastic load.

Existing Solutions

According to UNEP guidelines, at the household level, waste should be segregated before it is transported, and not doing so can increase hazardous waste and increase environmental damage when improperly disposed (2). If chemicals are used in segregating waste, they should be used carefully. In terms of the process, the UNEP recommends proper sorting of waste that minimizes human contact, and strong hygiene standards for waste collection, and should avoid overburdening existing systems. In terms of transportation, waste companies should have trained workers with PPE, that use designated vehicles and equipment to minimize the risk of secondary transmission. These companies should also help inform the public on how to properly sort and store waste. Open dumping should be avoided and the treatment option should depend on the locally available options. Further treatment technologies are discussed later.

**Healthcare Waste Management**

Effect of Covid-19 on Healthcare Waste Management and Sustainability

According to a study done on the effectiveness of waste management measures in Wuhan, which likely impacts the rest of the world, “The current rapid surge in healthcare waste due to the COVID-19 pandemic is further exacerbating the problem and there is an immediate threat that the impacts of unsafe disposal of healthcare waste will spill over into a crisis of environmental pollution.” (Singh et al. 1) This demonstrates the current problem of healthcare waste management and the stress of Covid-19 on existing systems.

Guidelines set by the IWCA call for the treatment of Covid-19 waste as normal medical waste, because during times of disease, there is an overwhelming stress placed on medical waste sorting, as a lot of PPEs are placed there. According to a Northwestern report, “In the U.S., [90% of medical waste](https://www.redbags.com/medical-waste-pollution-problem-u-s/) is autoclaved, or placed in a large machine that uses steam heated to 300°F to sterilize the waste before it is brought to a landfill. The other 10% is incinerated and converted into energy.” (Fishman 14) Furthermore, a National Geographic report finds that specifically for single use plastics, of 6.3 billion tons of waste, only 9% is recycled (Parker 6). The report finds that 8,000,000 tons of plastic ends up in oceans every year (8). These statistics can be applied to most countries around the world, which means that since recycling is now reduced and all healthcare waste is considered infectious, that landfill dumping and incineration rates will increase drastically.

The UN conference on training development estimates that global PPE sales in 2020 will increase buy 200 times to $166 billion from around $800 million dollars in 2019. A problem with disposing of PPE is its hazardous nature: it is impossible to dispose of it without risking exposure to infection. Additionally, only around 15 to 20% of medical waste is uncontaminated when disposed. For the time being, many countries have resorted to burning waste, which opens up the possibility for a second tree transmission and the release of harmful toxins. Further adding to the problem is the presence of micro plastics in gloves, which can take 20 to 30 years, to decompose. If left in landfills or littered in oceans, because of the small particles present in micro plastics, they can remain within the environment for very long time and cause further harm to plants and wildlife. The best example of this issue is with a recent report by the French nonprofit Opération Mer Propre, is warning of a surge in Covid-19 waste in the Mediterranean. Because of the spike in PPE sales, for healthcare and personal use, the organization has estimated that, “there will be more masks than jellyfish in the ocean.” (4).

If current procedures are followed, and there is a continued emphasis on public health over environmental consequences, the UN environmental program estimate that uncontrolled dumping of single use plastics, including PPEs, will continue to occur (5).

Therefore, as a result of the public health concern and the demand for PPE, the solution should look forward to managing and prescribing stronger waste management guidelines in low income countries and affected areas. Additionally, it should also focus on slowly introducing better treatment and recycling innovations and procedures to better mitigate future environmental concerns.

Existing Solutions

There are already stringent and successful waste management procedures that the majority of healthcare systems use. According to a study of the healthcare waste management process in a hospital in Wuhan, which can be applied to most hospitals around the world, follows WHO guidelines by designating all Covid-19 waste as medical waste. For storage, infectious waste is double-bagged and sterilized with chlorine, following WHO guidelines, and then subject to high steam sterilization at 121 degrees Celsius for 10 minutes before putting them in a temporary waste bucket (Peng et al. 4). Temporary storage should be kept separate and should not exceed 24 hours (Peng et al. 5). Like household waste, medical waste should be handled by specially trained staff in special vehicles, and should take the shortest route possible (Peng et al. 6). In terms of treatment, in most developed countries, Covid-19 waste is treated by incineration, which causes air pollution (Peng et al. 7), and has proven to be the best way of getting rid of medical waste. For areas without incineration, such as many developing countries, medical waste can also be disposed of in a sanitary landfill after steaming and boiling (Peng et al. 9).

According to a study that found effective measures that worked in Wuhan, the three main changes that helped streamline management processes were moving from decentralization to centralization, from irregular to regular management, and from mostly incineration to non-incineration disposal technologies such as autoclave steam, dry heat, chemical disinfection or microwave (Singh et al. 6)

**Treatment**

When selecting treatment options, technology is not always the answer. The World Bank suggests that countries that choose locally appropriate options make the best advance in waste management effectiveness (5).

Incineration

Incineration is the preferred method for disposal of pandemic equipment, but it comes at a high environmental cost. Although the harmful greenhouse gases produce can be treated to be less harmful, as incinerators become more widespread, it could be inefficient and take up too much space, which is a problem in countries that lack space, and hit the hardest.

Pyrolysis

A potential alternative is pyrolysis, which uses heat to break down plastic in a deoxygenated environment, turning it into liquid oil that can then be burned for energy. Researchers said it was the most common and most promising method for degrading polypropylene, a main ingredient in N95 respirators, surgical masks, and single-use protective gowns. Compared to landfilling and plastic incineration, they called chemical recycling an “environmentally friendly” alternative (Winters 5). Experts call it an efficient and economical method of recycling polypropylene and can prevent plastic pollution. Additionally, it can also create clean liquid fuel to meet global energy demand (Winters 6). However, critics from the Global Alliance or Incinerator Alternatives (GAIA) point out that this process is not completely sustainable. Once it’s thrown and burned as a fossil fuel, the plastic cannot become another plastic product like a mask, bag, or bottle. GAIA states that this chemical recycling contributes to climate change by releasing toxic chemicals into the atmosphere, which have been linked to leukemia, reproductive malfunction, lung problems, and neurological degeneration. Since this fuel is typically burned at facilities in low-income, nonwhite neighborhoods, it could affect them negatively. Therefore, more research and testing is needed to determine a balanced usage to avoid these scenarios.

Landfills

In terms of treatment, only 9% of that waste is recycled, and 12% is incinerated for energy, which releases poisonous fumes such as dioxin. The rest end up in landfills where the toxic chemicals leap into groundwater or the environment, which damages the soil and kills animals. This trend of landfills and incineration also follows globally in many developed nations, but anecdotal evidence from Mark Benfield, professor of. According to Benfield “Because many kinds of PPE are made of plastic and related polymers, they break down and affect natural ecosystems in a way similar to traditional plastic waste, Benfield says. So besides its potential infection risk, the increased medical waste released into the environment is primarily an aggravation of the preexisting problem of plastic pollution.” (16)

While these are not the only treatment options, and many others do exist, they are the most common options and policies should be made to strengthen existing treatment options instead of investing into new technologies.

**Timeline of Events**

31-DEC-2019:WHO’s Country Office in the People’s Republic of China picked up a media statement by the Wuhan Municipal Health Commission on cases of ‘viral pneumonia’ in Wuhan, People’s Republic of China.

20-JAN-2020: WHO publishes guidance on home care for infected patients

24-JAN-2020: First confirmed novel coronavirus cases in Europe

11-FEB-2020: The WHO announces the name of the virus: Covid-19

7-MAR-2020: To mark the number of confirmed COVID-19 cases surpassing 100,000 globally, WHO issued a [statement](https://www.who.int/news/item/07-03-2020-who-statement-on-cases-of-covid-19-surpassing-100-000)calling for action to stop, contain, control, delay and reduce the impact of the virus at every opportunity.

11-MAR-2020: Covid-19 is classified as a pandemic

13-MAR-2020: Europe declared as epicenter of pandemic

25-MAR-2020: UN Global Humanitarian Response Plan is launched

4-APR-2020: WHO reports 1 million confirmed cases worldwide

16-APR-2020: Guidance on large-scale movement restrictions or lockdowns, are released

5-JUNE-2020: WHO published updated guidance on use of masks for controlling spread of disease

**UN Involvement, Relevant Resolutions, Treaties and Events**

Basel Convention (2020):

* The safe handling, and final disposal of this waste is therefore a vital element in an effective emergency response.
* Separate collection and disposal of household waste by Covid-19 patients

CDC (Center for Disease Control) (2020):

* Observe social distancing and PPE usage
* Strong hygiene and sanitation standards
* Clear information on Covid-19 risks
* Ensure PPE usage
* Provide and facilitate sanitation of hygiene material and surfaces

European Commission (2020):

* No evidence to infer that standard waste management procedures are unsafe or insufficient in terms of the risk for COVID-19 infection,
* The safe management of household waste is also likely to be critical during the COVID-19 emergency. Medical waste should not be mixed with household waste, and be treated as hazardous waste, and separately stored.
* Ensure social distancing measures
* Specific guidelines for managing and collecting waste are provided.
* Proper usage and disposal of PPE

ISWA (International Solid Waste Association) (2020c):

* Ensure the continuity of waste management
* Strict hygiene and procedure for waste workers and reduce contact, through proper storage, as much as possible.
* Household Covid-19 waste should be collected and kept separate until incineration or landfill
* Discontinue manual sorting of waste or commingled recyclables
* Provide adequate information on Covid-19.
* Maintain adequate segregation of recyclable waste
* Consider long-term recyclable storage
* Enhanced personal hygiene requirements

USEPA (United States Environmental Protection Agency) (2020):

* Prioritize waste prevention when possible
* Separate collection and disposal
* Consider long-term storage of recyclables
* Adequate segregation of Covid-19 waste

WHO (World Health Organization) (2020c):

* Enhanced personal hygiene standards
* Separate and manage household waste

WHO (2020d):

* Ensure household waste generate by Covid-19 is destined to sanitary landfills

WIEGO (Women in Informal Employment: Globalizing and Organizing) (2020d):

* Observe social distancing
* Use of PPE
* Sanitizing objects and surfaces regularly
* Enhanced personal hygiene standards
* Provide adequate information on Covid-19 risks

**Possible Solutions**

Possible solutions will revolve around allocating money, resources, expertise, and revising current regulations to better suit the pandemic. Moreover, it will also involve developing new protocols for treatment and management of waste.

Lack of widespread quantitative data

A major shortcoming of the environmental response to the pandemic is the lack of quantitative data on waste management of PPEs, which severely limits a country’s ability to respond. Thus, future efforts should include data collection to determine the effectiveness of current waste management systems on reducing PPE pollution, increases in PPE waste due to the pandemic, and the current environmental impacts of single use plastic being disposed of.

Developing plastic-alternative trade policies

Apart from sustainability innovations, a study by Pew Charitable Trusts finds that, “if no action is taken, the amount of plastics dumped into the ocean will triple by 2040, from 11 to 29 million tonnes per year.” However, the study also finds that around 80% of the plastic pollution could be reduced during the same period, through the combination of modifying inadequate regulation, recommending different business models, and initiatives to reduce the amount of plastic produced. Part of this includes designing Products and packaging that can be better recycled, and expanding waste collection measures and guidelines, mostly in developing countries. Furthermore, UNCTAD is urging governments to promote non-toxic, biodegradable or easily recyclable alternatives, such as natural fibres, rice husk, and natural rubber. These products would be more environmentally friendly and, as developing countries are key suppliers of many plastic substitutes, could provide the added benefit of providing new jobs. Bangladesh, for example, is the world’s leading supplier of jute exports, whilst, between them, Thailand and Côte d’Ivoire account for the bulk of natural rubber exports. In its July analysis of plastics, sustainability and development, UNCTAD came to the conclusion that global trade policies also have an important role to play in reducing pollution.  Many countries have introduced regulations that mention plastics over the last decade, an indicator of growing concern surrounding the issue, but, the UNCTAD analysis points out, for trade policies to be truly effective, coordinated, global rules are needed. The way countries have been using trade policy to fight plastic pollution has mostly been uncoordinated, which limits the effectiveness of their efforts. There are limits to what any country can achieve on its own. Therefore, UN agencies can facilitate cooperation and the development of trade policies to facilitate the economic viability of plastic substitutes

Sustainable Alternatives to Pandemic Equipment

More research into environmentally friendly methods of disposal could help reduce the impact of waste management. According to a study in the journal *Biofuels*, plastic from PPEs can be transformed into renewable liquid fuels, which can be equal to fossil fuels (3). Once plastic from PPEs are disposed of, they usually end up in landfills or oceans and natural degradation needs decades (5). According to the study’s findings, “the PPE waste [can] be converted into fuel using pyrolysis. This a chemical process for breaking down plastic at high temperature – between 300-400 degree centigrade for an hour – without oxygen.” (12)

Assistance and Guidance on policymaking

Additionally, providing guidance and assistance to countries on transitioning to a circular economy should also be part of the solution. UNEP and UN Habitat have provided detailed

Education and training

Another aspect of a solution should be to increase awareness of proper waste management practices in low and high-income countries.

Difference between low and high-income countries

Distinctions must be made between low and high-income countries when designing policies and strengthening existing ones.

Circular Economy

For future sustainability, future guidelines should be enacted and current ones should be strengthened to develop a circular economy with a recycling rate and high resource efficiency.

**Country Positions**

Australia: The Australian government has embraced the usage of single use plastics and PPEs during the pandemic. According to a Guardian report, the government has postponed bans on single use plastics and overturned over plastic bag bans, in order to allow for greater preventative measures. However, the government has also announced a $130 million investment into a Recycling Modernisation Fund, transitioning to a circular economy, where waste management is more self-sufficient and effective (Thornton 4). While no data is currently available on the status of PPEs, according to Queensland Health’s guidelines, Covid-19 related waste is treated as medical waste and disposed like single use plastics. Since no data is available on the impact of PPE waste, previous WWF estimates show that 85% of Australian seabirds are hurt by plastic pollution (1), and Australia recycles around 12% of its plastic, and the rest is dumped in landfills (Arim 3). These statistics suggest that the low level of recycling and high levels of plastic pollution is detrimental to the environment, but the government has shown its willingness to a greener future.

Brazil: In terms of global coverage, Brazil is the fourth biggest producer of plastic rubbish, including single use plastics and likely PPE coverage (France24 3). But Brazil only recycles 1.28% of the 11.4 million tonnes of plastic, below the national standard of 9%, displaying its low environmental coverage. More government investment in infrastructure is needed to better equip Brazil to deal with the waste management of Covid-19. According to a report by the International Labor Organization (ILO), most of Brazil’s recycling sector is informal waste pickers and make up 90% of the recycling sector (2). These groups have mobilized during Covid-19 and have still been active. In MWM, many municipalities have suspended manual collection and sorting to reduce risk. Additionally, Latin American countries have opportunities to transition into a circular economy.

Canada: In Canada, less than 10% of all plastics are recycled (van Reenen 2), and 3 million tonnes are disposed of in landfills. 1/3 of plastic in Canada is meant for single use plastic, currently including PPE, and has become one of the largest sources of plastic in freshwater. According to studies done in residential sectors, the pandemic has disrupted waste diversion practices and reduced the effectiveness. The Canadian government still has to develop stronger educational resources, invest in research and innovation, and develop sustainable plastic waste management systems (van Reener 5).

China: The initial epicenter of Covid-19, in Wuhan, produced five times its normal waste capacity (Chen 1), and reports show 22 cities were operating over-capacity (Chen 1).

Costa Rica: While Costa Rica has gained a reputation for being an environmentally friendly country and a leader in sustainability, it has a bad habit of recycling and effectively disposing of waste. In the province of Guanacaste, 122,000 people live in municipalities that do not have garbage collection (NCA 3). Most families have to resort to burning their trash, throw it into a river, or take it into an open dump (NCA 4). Thus, due to the increase in PPE, the lack of waste management will threaten Costa Rica. Currently, it only recycles 0.4% of its total waste (NCA 5), which highlights the lack of waste management practices that have already been stressed by PPE increases. Because of Costa Rica’s reliance on tourism, and due to the decline in the industry, its economy has shrunk and been unable to meet sustainability targets (OECD 7). More development into the healthcare and waste management industry is needed, and the government is clearly sustainability focused.

Germany: The German market for municipal waste treatment has been stable following Covid-19, while the recycling sector has been deeply affected (EUWID 1). However, many analysts predict that Germany’s situation will worsen (EUWID 2). Germany has been a shining example of developments towards a circular economy, and focuses on waste prevention instead of waste management. Federal reports show that 14% of raw materials used in the economy come from recovered waste (5). The government also has strong waste education and has a strong culture of recycling (8). However, the country’s recycling systems are stressed due to the risk posed by PPEs. Germany has pre-pandemic recycling rates of 67% for household waste and 70% of commercial waste (5). Therefore, the future of sustainability should be focused on strengthening existing systems that have proven to be ahead of other countries.

Haiti: According to reports published by the International Trade Administration, “Waste collection in cities is not provided in many municipalities.  Almost all of the waste is sent to illegal dumps (rivers, drainage canals) by households without any prior treatment and without development of receiving sites. In some areas, solid waste is burned or buried in the ground, contributing to pollution and emission of greenhouse gases.” (1) Moreover, Haiti lacks a widespread waste management system, and has few proper landfills or dumpsters, leading to waste piling up in the streets (Borgen 2). The environmental impact is also huge, as the methane gas produced from the garbage hurts the air quality and people (Borgen 4). US Environmental Protection Agency reports show that waste generation rates will double in low-income countries such as Haiti, over the next 20 years (3). It is likely that the increase in PPE usage all over Haiti has worsened this problem, leading to devastating environmental consequences.

India: The pandemic has overburdened India’s already depleted waste management system. According to data by the Central Pollution Control Board, India produced over 18,000 tonnes of Covid-19 waste between June and September (1). For India to reduce waste, waste industry experts suggest that India can manage the crisis by defining Covid-19 waste, identifying waste generators, and educational programs (Ahuja 8). Additionally, experts also suggest increasing recycling and sorting efforts to reduce the burden of waste on incineration and landfill treatment. India generates 26,000 tons of single use plastic waste daily, which usually ends up as litter, and the government has set a goal of eliminating them by 2022 (C&EN 1).

Indonesia: According to the Indonesian Environmental Scientists Association, “Indonesia has 2,852 hospitals, 9,909 public health centers, and 8,841 health clinics. But less than 100 medical facilities that have their own medical waste treatments.” (Renaldi 8) Furthermore, “While the government has issued regulations and guidelines in handling the waste, some of the third-party waste management companies have often violated them.” (Renaldi 10) Indonesia is clearly struggling to contain medical and municipal waste and it could worsen the spread of infection. Also, illegal dumping continues to occur with no sorting of waste, which increases environmental damage.

Libya: Libya’s political instability is contributing to the lack of waste management and sustainable policies. In the capital city Tripoli, waste piles up on city streets and garbage trucks no longer collect waste because the city’s landfill is on a war frontline (News24 7). Citizens have also turned to burning trash because of its bad smell, which creates massive amounts of smoke. Activists also say that no long-term solutions exist because of the instability and no recycling or waste management practices exist (News24 10). Covid-19 will worsen this scenario and increase the environmental burden of open dumping and burning.

Madagascar: Even though Madagascar is a country with low waste production, it still has existing challenges that will worsen with the addition of Covid-19. In the country, only 30% of waste is managed in disposal sites (Madagascar 4), and almost all waste is sent to centralized landfills, with no instances of incineration (Madagascar 3). The lack of government regulation is clearly a problem, but pre-pandemic, the government was committed to making amends to fit the Basel Convention (Madagascar 6).

Malaysia: While Malaysia has expressed commitment to sustainable waste management practices, due to Covid-19, they set to miss their sustainability targets (Ng 2). Currently, 90% of waste is disposed into sanitary landfills and only 10.5% is recycled. Local authorities have largely privatized waste management and let other companies manage waste. These companies often illegally dump waste in order to earn money faster (Ng 10).

New Zealand: New Zealand has been largely successful dealing with the impact of Covid-19, so the impact on waste management has not been as devastating. The government has also announced investments to developing a domestic recycling sector (Seadon 2). This investment has the potential to divert 1.3 million tonnes of waste from landfills, if implemented properly (Seadon 3). However, during Covid-19, recycling has becoming sporadic and single use plastics have not been paid attention to.

Nigeria: Nigeria has been hit hard by the pandemic, and around a million people work in the informal waste collection industry, and the pandemic has exposed them to infectious diseases (Nzeadibe 2). Earlier this year, the government released its first comprehensive waste plan (Nzeadibe 3), but it still does not recognize informal workers. The lack of policymaking needs to be addressed.

Peru: Peru is a country fraught with bad sustainability and waste management policies. According to the WWF, “Lima, the largest city in the country where almost 10 million people live, about 8,468 tons of garbage are generated daily, which corresponds to 47% of the total produced. Whereof, only 4% is recycled.” (WWF 2) Thus, recycling initiatives are clearly needed, where most of the plastic pollution ends up littered. The Covid-19 impact on waste management is likely disastrous.

South Africa: According to UN environment reports, most of the waste ends up in unmanaged landfills and household burning, and there is little data to fully estimate the scale (4). Additionally, it has a large informal waste sector that receives little support. These problems are likely to be compounded by Covid-19.

South Korea: While South Korea at one point had a 60% recycling rate, some of the highest in the world, China’s decision to stop importing waste has hurt South Korean waste management, further burdened by the waste management requirements of Covid-19 (Soh 2). In order to recover, they have initiated a new scheme: the Green New Deal, which aims to increase resource and energy efficiency (Soh 5).

Spain: According to local Spanish media, “in Madrid and Catalonia, the country’s two worst-affected regions, healthcare waste has increased by 300 and 350%” (Arevalo 4). Additionally, the only incineration facilities in Madrid and Catalonia have become overburdened with waste and are forced to resort to quick incineration, due to the pileup of medical and household waste (Arevalo 8).

Thailand: According to a Deloitte report on waste management, “ the Thailand Environmental Institute found that 1.5 million face masks are being disposed of every day in the country – with 150 tons of waste being produced each day in Bangkok alone. This is likely having a major impact on Thailand’s efforts to reduce plastic waste.” (Rodak 7)

United States: The US has a robust waste management system called the “cradle-to-grave” system that can adequately handle medical and household waste (EPA 1). However, recycling has been stopped due to the risks of secondary transmission and local authorities have faced challenges there. According to a University of Michigan study, “In 2017, 52% of MSW generated in the U.S. was disposed of in 1,269 landfills” (6) and “in 2017, 12.7% of MSW generated in the U.S. was disposed of through waste incineration with energy recovery” (8). From this, while there is a clear and strong environmental impact, the US is equipped to deal with the waste management of Covid-19, but should focus resources on developing a circular economy.

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