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Hospital Waste Disposal In Covid / Post Covid Era And Effect On Environment

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ABSTRACT

The pandemic caused by COVID-19 has presented substantial issues to healthcare systems all around the world, especially those pertaining to the management and disposal of hospital waste. As a result of rising demand for personal protective equipment (PPE), medical supplies, and testing materials, the amount of waste generated in the healthcare industry has expanded significantly. In this abstract, the concerns regarding the disposal of hospital waste throughout the COVID-19 and post-COVID eras are discussed, with a particular emphasis placed on the potential environmental effects of these concerns. If it is not adequately managed, the careless disposal of trash linked to COVID-19, such as contaminated personal protective equipment (PPE), medical equipment, and infectious materials, poses threats to the surrounding environment. It is possible for the improper handling of these hazardous items to result in the release of pathogens, poisons, and chemicals into the environment, resulting in environmental pollution and perhaps posing health risks to the surrounding communities. To reduce the negative effects that hospital waste has on the surrounding environment, it is essential to implement efficient waste management techniques. The separation of trash, its treatment, and its disposal in an appropriate manner can help cut down on the amount of dangerous compounds that are released into the environment. In addition, decreasing the amount of trash produced overall and lowering one's carbon footprint may be accomplished through encouraging recycling and reuse practices for certain non-contaminated products. The COVID-19 epidemic, on the other hand, has put a burden on healthcare systems and produced difficulties in the infrastructure governing waste management. The unexpected increase in the production of medical waste has surpassed the capacity of existing disposal methods, resulting in delays and perhaps violations of the norms that govern waste management. Additionally, the adoption of single-use medical equipment and personal protective equipment (PPE) that is disposable has contributed to the overall increase in trash output, which has further burdened the systems that manage garbage. In order to overcome these obstacles, healthcare institutions need to place a high priority on the creation and execution of comprehensive waste management programs. These plans have to incorporate the sorting, treatment, and disposal of various types of hospital waste in order to guarantee conformity with the applicable legislation and recommendations. It is very necessary for healthcare institutions, waste management authorities, and policymakers to work together in order to build waste management systems that are reliable and environmentally friendly.

Keyword: *Impact on the Environment, Regarding the Disposal of Hospital Waste in Covid*

INTRODUCTION

New problems for solid waste management have arisen as a result of the global spread of the SARS-CoV-2 virus and the subsequent COVID-19 pandemic (Purnomo et al., 2021; Richter et al., 2021b; Vu et al., 2021b). These new issues demand urgent answers from policy makers and waste researchers (Purnomo et al., 2021; Richter et al., 2021b). (Hantoko et al., 2021; Torres and De-la-Torre 2021; Valizadeh et al. 2021) These issues are connected to the large growth of personal protective equipment (PPE) and COVID-19–associated medical wastes and hazardous materials. For instance, Silva et al. (2020) emphasized the significance of reevaluating plastic policy during the COVID-19 pandemic due to the increased utilization of single-use plastic and other personal protective equipment (PPE). In their study, Wang et al. (2021b) came to the conclusion that inappropriate disposal of PPE might eventually cause it to infiltrate the marine environment and produce microplastics. These microplastics, when swallowed by aquatic wildlife, form a component of the food chain that ultimately reaches humans. Additional garbage collection services and particular management methods are often necessary during a pandemic in order to safeguard both public health and the environment (Ilyas et al., 2020; Yang et al., 2021). Studies on various approaches to the correct monitoring, processing, and treatment of anomalous patterns of waste streams during the pandemic have recently been described (Purnomo et al., 2021; Richter et al., 2021a; Vu et al. 2021a). These studies were conducted by Purnomo et al., 2021; Richter et al., 2021a; and Vu et al., 2021a.

According to the available research, the effects of the pandemic on the characteristics of municipal solid waste generation and recycling behaviors are likely to vary greatly from one region to the next. This is likely the case because of the significant variations in the regulations and their enforcement, hygiene protocols, living standards, and other socioeconomic and religious factors. In a survey that was carried out by the Association of Cities and Regions for Sustainable Resources management (ACRPLUS 2021), it was found that during the first wave of the COVID-19 pandemic, which lasted from February 2020 through June of the following year, there was an overall decline in the rates at which municipal solid trash was generated in 10 different nations across Europe. Cities in China (Kulkarni and Anantharama 2020) and Canada (Richter et al. 2021b) observed declining patterns during the first wave of the epidemic that were quite similar to one another. On the other hand, Elsaid et al. (2021) conducted a literature analysis on research that examined the impacts of COVID-19 on the environment and reported that the formation of municipal solid waste rose in both quality and quantity as a result of the studies they examined. Penteado and Castro also forecasted that there would be a rise in the amount of garbage produced in Brazil during the COVID-19 epidemic.

The COVID-19 virus has now reached every region of the planet, which has precipitated a crisis in terms of public health. In December 2019, the disease was discovered for the first time in Wuhan, China. It quickly

spread throughout the country and eventually became a worldwide epidemic (Ali and Alharbi 2020; Zambrano-Monserrate et al. 2020). According to one idea (Brennecke et al. 2020), the coronavirus may have been transferred from bats to humans. The vast majority of human infections were caused by droplets, direct contact, and airborne transmissions. COVID-19 has had a significant influence in many different parts of the world. Nearly every nation on earth is right now directing the majority of their attention on halting the propagation of the COVID-19 illness by passing regulations that prohibit the access of the general public to certain areas (Liu et al. 2021a, b; Muhammad et al. 2020; Naethe et al. 2020). Although these policies or regulations may have a significant impact on the economies of most countries, they may have both positive and negative effects on the environment. For example, they may have led to a significant reduction in greenhouse gas emissions, the likes of which have not been seen since World War II, as a result of a significant drop in vehicle usage and the cessation of production by a large number of industries around the world. Because to these factors, concentrations of nitrogen dioxide (NO2) and particulate matter (PM2.5, with a diameter of less than 2.5 m) fell significantly all over the world.

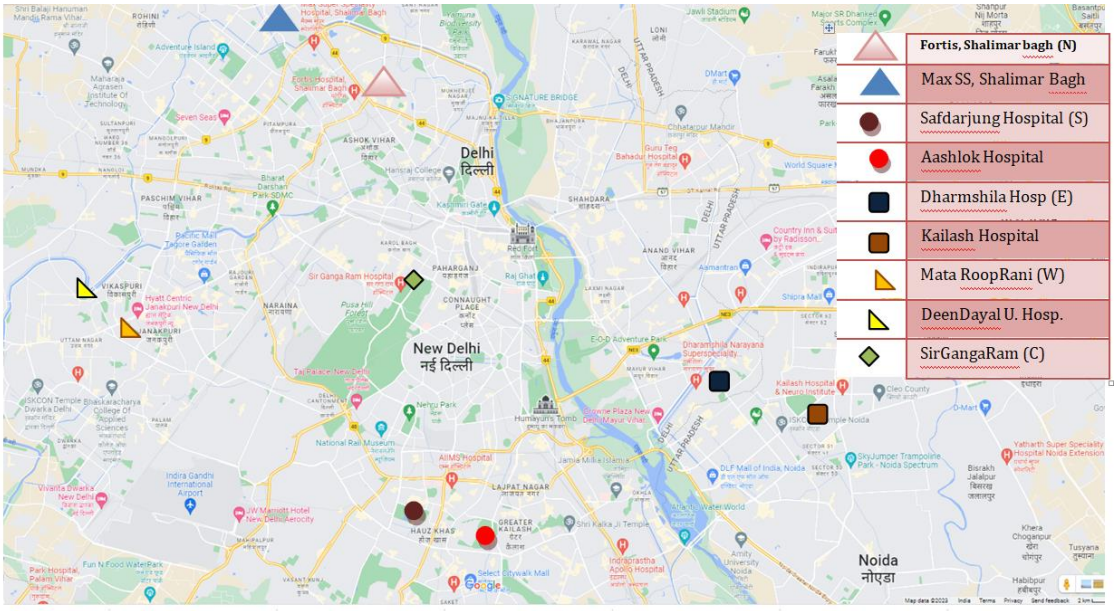
Every nation's government has instituted social distancing measures and ordered its citizens to stay inside their houses in an effort to halt the spread of the coronavirus illness. According to Jairoun et al. 2021, the levels of noise pollution have significantly dropped in the majority of nations as a result of decreasing public and private traffic as well as other corporate operations. There is an essential connection between the management of emergency situations and the enhancement of unspoiled beaches, improvements in air quality, and reductions in environmental noise. On the other hand, other damaging indirect effects, such as a decline in recycling efforts and an increase in the production of effluents, provide an even greater risk of polluting land and water bodies in addition to the air.

Methodology

During the COVID era, numerous agencies at various levels of government in Delhi were responsible for enforcing a variety of rules and regulations. The city was placed under lockdown . Additional regulations were implemented in a number of the city's neighborhoods and districts. It is impossible to accurately identify the commencement of the COVID period in Delhi because of the nature of the epidemic. For the purposes of data analysis, the COVID period will begin in April 2020 and continue beyond that. In this analysis, both the pre-COVID period and the COVID period are taken into account.

Data on trash creation and management were gathered from hospitals located in the Central, North, East, South, and West districts of Delhi for the purpose of this study. The acquired data were then checked and

integrated. It was on purposely decided not to include the biomedical waste that was generated in testing facilities and scientific research laboratories. Because trustworthy waste data are not readily available, we did not take into consideration the smaller clinics such nurse-led community clinics and private health facilities. There were a total of 11 large hospitals or health facilities that were chosen, and the data ranges varied anywhere from 25 months to 53 months. During the time period of the research, each of the hospitals and other health institutions that were chosen to participate provide comparable ranges of services and facilities, despite the fact that their respective sizes vary. It is generally agreed that these 11 hospitals are typical of the health care system in Delhi as a whole. The locations of the hospitals are illustrated in Figure 1. Every district consists of at least two hospitals, with the exception of the central district, which is the least populous of the districts. The utilization of data on trash creation at the sources, as opposed to the aggregation of data at the regional level, makes it possible to investigate the features of waste generation as well as recycling behaviors with a greater degree of precision and assurance.



Selected hospitals in five districts in Delhi

The populations of the five districts that were chosen are not comparable to one another. The North District has the most residents, with approximately 7 million, while the Central District has fewer than one million people living there. The North District is the most populous of the five districts. As will be described in further detail in Section 3, the amount of trash that is produced monthly per bed in the selected hospitals is very stable, ranging from 33.4 to 42.0 kg/bed. Similar ranges of 16.4 to 55.4 kg/bed (0.54 to 1.82 kg/bed-day) were recorded by Al-

Khatib et al. (2020) at the three hospitals located in the Jenin area of Palestine. Agamuthu and Barasarathi (2021) have also reported ranges that are very similar to ours. The data starting from January 2017 were included in order to create a baseline and investigate the possible effects that the pandemic may have on the amount of trash produced in hospitals. Table offers specifics of the gathered data, including the name of individual hospitals within each district, the characteristics of the monthly hospital waste generation, and the data ranges. Table also provides information about the obtained data.

Table 1 Hospital waste generation characteristics in five districts in Delhi

	Central	East	West	South	North
District population (in millions)	0.7	1.7	2.5	5.0	6.8
Major hospitals selected in the district	Sir GangaRam Hospital	Dharmshila, Kailash	MataroopRani, Deen Dayal Hospital	Aashlok , Safdurjung hospital	Fortis, Max SS
Average monthly waste during the entire period (kg/month)	19,321	22,087	16,806	16,049	18,511
Number of hospital beds provided in the district	465	602	400	480	462
Beds per million people	664.3	354.1	160.0	96.0	67.9
Monthly hospital waste per bed (kg/bed)	41.6	36.7	42.0	33.4	40.1
Data collection period (months)	Jan 2017–Apr 2021 (52 months)	Jan 2018–Feb 2021 (38 months)	Jan 2019–Jan 2021 (25 months)	Jan 2017–May 2021 (53 months)	Jan 2017–Apr 2021 (52 months)

The study of waste amount by weight can be deceiving because of the heterogeneous nature of hospital solid wastes (dressings, cotton swabs, syringes, dirty gloves, and catheters, among other wastes). This is because of the variances in waste densities and moisture content. As a result of this, the components of the hospital waste were also investigated. At the point where waste is generated, hospital employees separate out the many types of trash. The garbage from each of the 11 hospitals is placed in waste bins that are color-coded, and the historical waste records from each hospital were utilized in order to determine the waste's component parts. Table Table2.2 provides definitions for each of the five main types. In Delhi's hospitals, the most prevalent types of trash are yellow, which refers to biological waste, and red, which refers to disposable medical

supplies. In most cases, they account for between 70 and 80 percent of the waste in terms of weight, as will be elaborated upon more in Section.**Table 2 Hospital waste composition in the five districts in Delhi**

Category	Waste composition
Yellow	Biomedical waste includes all dressings and bandages with body fluids, blood bags, human anatomical waste, body parts, etc. Cotton swabs used extensively for the real-time polymerase chain reaction (RT-PCR) tests for the SARS-CoV-2 belong to this category
Red	Disposable medical supplies, including syringes (without needles), soiled gloves, used face shields, catheters, IV tubes, etc
Blue	Medical glassware waste; other studies include this category with sharps waste, as they are also capable of inflicting puncture and cutting wounds
Cytotoxic	Any material contaminated with residues or preparations that are toxic to cells and are considered hazardous as these wastes are capable of impairing, injuring, or killing cells and can cause toxic or allergic reactions
White/Sharp	Needles, sharps, blades, or any kind of tool or object that is able to puncture or cut the skin

Stylized facts

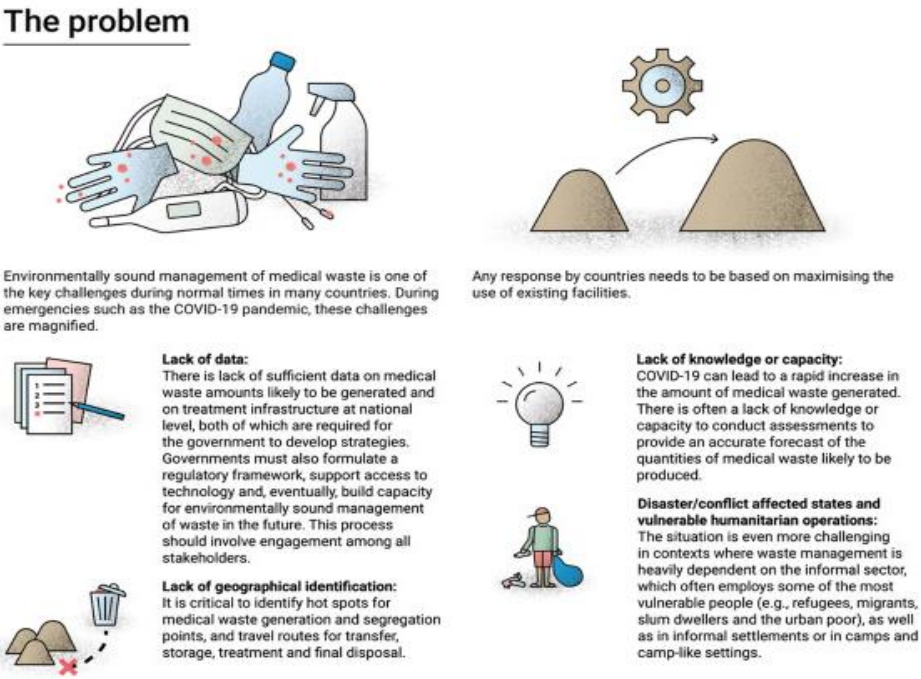
Even before the COVID-19 epidemic, the globe was already suffering difficulties in the field of waste management. According to UN-Habitat 2020, more than two billion people lack access to garbage collection, and more than three billion people lack access to waste disposal. Therefore, the onset of the COVID-19 pandemic and the social distancing measures that it entails add further pressure to a sector that was already struggling under its load (Box (Box2)).2). Rats that lived outside have been forced inside as a result of the lockdown and social distancing measures that have been taken. This includes the closure of hotels, restaurants, and other food-related businesses. It has been reported that there has been a 50% rise in the number of rat infestations inside buildings in metropolitan regions across Canada (SWR Staff 2020). This is reportedly because there is less waste in the streets. The potential of rats to carry disease-causing pathogens like Escherichia coli and salmonella and to transfer them to humans is a major public health risk caused by rat infestations (Nkogwe et al. 2011). Rats may spread these infections to humans. Therefore, effective management strategies for household garbage are required in order to successfully exclude rats from structures and households.

In addition, the COVID-19 epidemic has had an impact on the recycling market as a result of the implementation of social distancing measures such as lockdowns, which has a knock-on effect on people's ability to make a living. As a result of the current low price of oil and the need for recycled plastics, the price of virgin plastics has increased, which has an effect on the competitiveness of recycled plastics (Silpa 2020). As a result of a

temporary prohibition on cross-border movements, developing nations that rely on foreign technology for trash recycling operations are negatively impacted by the epidemic. As a result, the majority of the waste that was produced during the pandemic is thrown away rather than recycled.

Medical waste assessment

When there is an emergency like as the COVID-19 pandemic, the problem of sustainable management of medical waste is intensified and presents additional challenges. Because the worldwide pandemic is so unprecedented, modifying the existing waste facilities in order to control the atypical medical waste and its related influence on the spread of the virus requires appropriate information on the quantity of medical waste created, hot locations for waste creation, and treatment facilities that are now available. Because of the possibility of a significant increase in the volume of medical waste, it will be necessary to develop a number of specialized technical competencies in the areas of sorting, segregation, transport, storage, and environmentally responsible waste management technologies in order to make the most of the infrastructures that are already in place (Sharma et al. 2020). According to Mihai 2020, improper management of medical waste has the potential to endanger patients, health professionals, and waste managers to a variety of risks, including injuries, infections, hazardous repercussions, and air pollution. According to the World Health Organization (2018), the many types of medical waste and its derivatives consist of non-hazardous waste, pathological waste, radioactive waste, infectious waste, chemical waste, cytotoxic waste, sharps waste, and pharmaceutical waste. The unprecedented level of medical waste that has been recorded is a direct result of the worldwide epidemic. For instance, the COVID-19 pandemic in China is said to have resulted in an increase in the amount of medical waste from personal protective equipment such as gloves, face masks, and eye protection as a consequence of an increase in the usage of personal protective equipment coupled with its quick disposal after use (Ma et al. 2020). It is reported that the influx of COVID-19 patients led to the construction of waste plants and the deployment of 46 mobile waste treatment facilities in China (Calma 2020). This was reportedly caused by the overwhelming surge in daily waste (i.e. over 240 metric tonnes) and the increasing levels of hospital medical waste by sixfold. In Barcelona, the amount of medical trash such as overalls, face masks, and gloves grew by 350%, leading to the generation of over 1,200 tonnes of medical garbage in comparison to the typical amount of waste, which is approximately 275 tonnes.



Source: Reproduced from UNEP

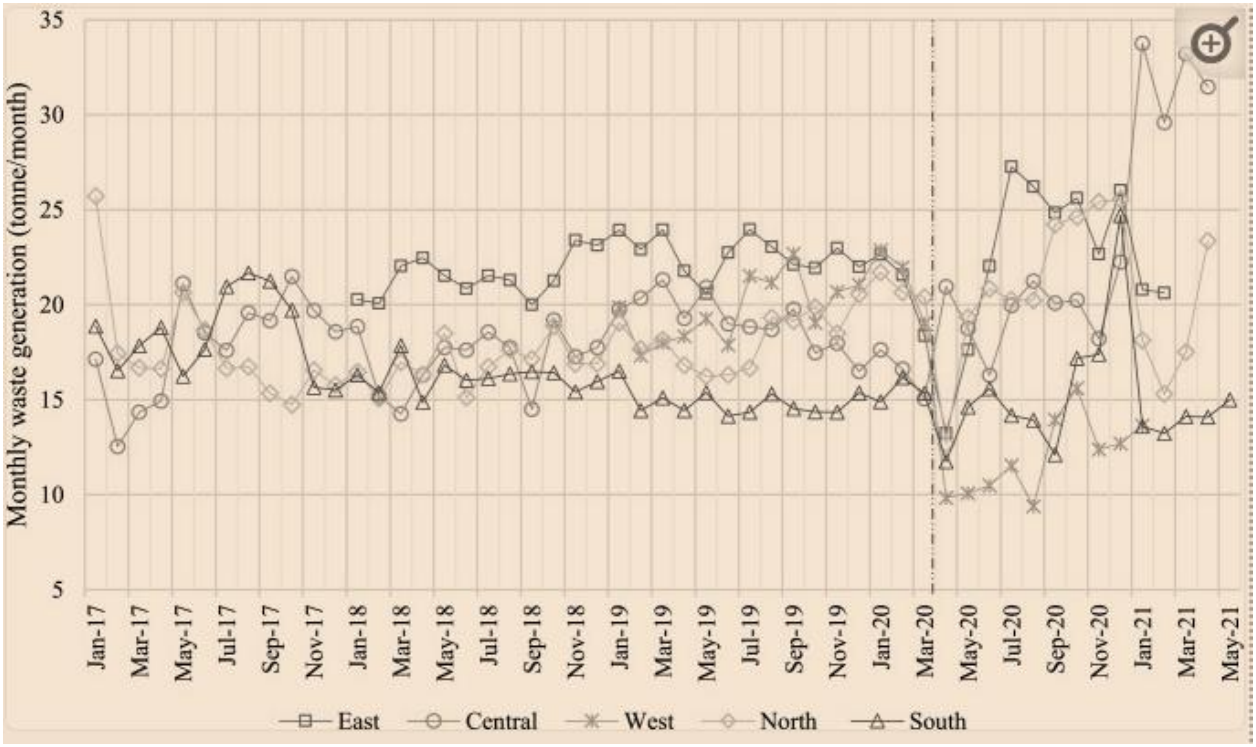
Non-medical and household waste

As a result of the implementation of lockdowns, stay-at-home policies, and other preventative measures to limit the spread of COVID-19, there has been an increase in the production and consumption patterns of non-medical and household-related products such as masks, gloves, thermometers, sanitizers and cleaning products, toilet papers, and foodstuffs. The sudden lockdown and the concern that the virus might spread led to an increase in the purchase of single-use goods and a general sense of panic purchasing (Sarkodie and Owusu 2020b). According to reports, the unprecedented usage of masks to decrease exposure to COVID-19 has resulted in an increase in its manufacturing, which has therefore resulted in an increase of worldwide sales of US$166 billion (UN 2020). It appears that efforts to reduce plastic pollution have been hampered as a result of the COVID-19 epidemic because of the function that protective equipment like disposable masks and gloves play in the present day. The World Health Organization forecasts that a monthly worldwide expenditure of 1.6 million plastic-based protective eyewear, 76 million plastic-based examination masks, and 89 million plastic-based medical masks will be necessary to control the spread of COVID-19 (Andersen 2020). This spending will occur on a global scale. According to W4C 2020, China's daily manufacturing of masks made of plastic climbed by 116 million in February, which is twelve times greater than it was in January. There are several reports that large amounts of plastic garbage are skyrocketing from 1500 to 6300 tonnes everyday in Thailand as a result of food

goods being delivered to houses. On the other hand, during the lockdown time in the UK, there was a 300% increase in the illicit dumping of rubbish.

Results and discussion

Alterations in the amount of garbage produced by hospitals over time in each of the five districts. The date ranges of the curves are not constant; this is owing to the availability of partial data that the generation rates were very consistent throughout the pre-COVID period from January 2017 to March 2020; the generation rates were between 15 and 23 tonne/month. throughout this time, the generation rates were between 15 and 23 tonne/month. Prior to the implementation of COVID, the east district had a rate of production of hospital waste that was consistently higher than that of the other districts, averaging 21.94 tons per month. One possible explanation for this is that the number of hospital beds in the east district is the greatest of all the districts. Despite a tenfold difference in the number of beds per capita, waste generation rates in the center and northern regions are comparable prior to the implementation of COVID.Based on these findings, it appears as if the ratio of hospital beds to residents of Delhi is not a substantial contributor to the total quantity of garbage produced by hospitals in Delhi. This is significant since a large number of the COVID healthcare waste modeling studies employed beds per capita as a dependent input. Prior to the implementation of COVID, the south district generated the least amount of garbage on a monthly basis, averaging 16.39 tons.



Hospital waste generation rates in the five districts from 2017 to 2021

CONCLUSION

The epidemic caused by COVID-19 has posed substantial issues in terms of the disposal of hospital waste, which in turn poses possible threats to the environment. The rise in the amount of trash produced in healthcare, particularly contaminated personal protective equipment and infectious materials, calls for the implementation of efficient waste management systems in order to reduce negative effects on the environment and preserve public health. Methods of waste segregation, treatment, and disposal that are up to par are very necessary in order to reduce the amount of dangerous compounds that are released into the environment. In addition, decreasing trash output and lowering one's carbon footprint may be accomplished through encouraging recycling and reuse practices for items that are not polluted. When it comes to designing comprehensive waste management strategies that are in accordance with legislation and norms, collaboration between healthcare institutions, waste management authorities, and policymakers is very necessary. The load that has been placed on healthcare systems as a result of the pandemic has revealed flaws in the infrastructure that manages waste, causing delays and perhaps leading to violations in regulations. In order to address these difficulties, it is necessary to make long-term investments in the infrastructure of waste management and in sustainable practices. By putting an emphasis on effective waste management, healthcare systems can increase their resistance to the effects of future pandemics while simultaneously reducing the negative impact that their operations have on the surrounding environment. It is very necessary to acknowledge that the disposal of medical waste in the post-COVID age will still call for a high level of attention to detail. The lessons that may be gained from this epidemic should be incorporated into future preparedness strategies, with a particular emphasis placed on the need of having effective waste management systems. Healthcare systems may make a positive contribution to a cleaner environment and safeguard the health of both their employees and the communities they serve by adopting environmentally friendly business practices and taking preventative safety precautions.

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