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Repercussions of the COVID-19 Pandemic on the Generation and Composition of Medical Waste at Hospital X City of Jakarta, Indonesia

Aura Dhia Rizki Atthar[1], Mega Muitiara Sari[1], I Wayan Koko Suryawan[1,2]
[1]Faculty of Infrastructure Planning, Department of Environmental Engineering, Universitas Pertamina, Komplek Universitas Pertamina, Jl. Teuku Nyak Arief, RT.7/RW.8, Simprug, Kec. Kby. Lama, Kota Jakarta Selatan, Daerah Khusus Ibukota Jakarta 12220
[2]Department of Natural Resources and Environmental Studies, National Dong Hwa University, No. 1號, Section 2, Daxue Rd, Shoufeng Township, Hualien County, Taiwan 974

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ABSTRACT

The COVID-19 pandemic is a global outbreak that also changes the generation of medical waste at Hospital X, Jakarta City. The increasing number of people infected with the Sars-Cov-2 virus indirectly requires the management of infectious waste from patients to be safe and not have the potential to spread. The purpose of this study was to analyze the generation and composition of medical waste at Hospital X, Jakarta City. This study uses direct observation and uses secondary data in the analysis. Meanwhile, to determine the effect of the population infected with Sars-Cov-2 on medical generation, One Way ANOVA analysis was used. Data from May 2020 shows that medical waste generation increased from 25.6 kg/month to 192.3 kg/month. The ANOVA significance test showed a value of 0.013, this indicates that the number of the infected population significantly affects the generation of medical waste. Medical waste that can be found during a pandemic becomes more complex, including hazmat clothes, masks, gloves, medical headgear, used bandages, injection and infusion equipment, eating and drinking utensils for patients exposed to COVID-19, and used swab and rapid test equipment.

Corresponding Author:

Mega Muitiara Sari
Faculty of Infrastructure Planning, Department of Environmental Engineering, Universitas Pertamina, Komplek Universitas Pertamina, Jl. Teuku Nyak Arief, RT.7/RW.8, Simprug, Kec. Kby. Lama, Kota Jakarta Selatan, Daerah Khusus Ibukota Jakarta 12220
Email: mega.tiarasari1986@gmail.com

1. INTRODUCTION

The global pandemic caused by an outbreak of a disease called Coronavirus Disease (Covid-19) has been announced by WHO on January 30, 2020. Every individual can potentially be infected with Covid-19 which results in death. The city of Wuhan, China was the initial location for the spread of this virus which later spread to more than 190 countries in the world [1]. In Indonesia, positive cases of Covid-19 until January 2021 have reached 1 million cases and until mid-2021 it is still increasing. To overcome this Covid-19 problem, the Government of Indonesia is taking serious action by appointing several hospitals as referral places to treat people infected with Covid-19 throughout Indonesia. The increase in Covid-19 cases in Indonesia has also been accompanied by a significant increase in the amount of medical waste originating from masks, gloves, personal protective clothing, eating utensils and so on [2]–[5]. It can be seen that there is an increase in the supply of PPE

to 40% per month and the Compound Annual Growth Rate (CAGR) is projected at 6.5% [6]. Based on data from WHO, demand for PPE including surgical masks and gloves is expected to continue to increase during the post-pandemic period, which can reach a CAGR of 20% until 2025 [7]. The Ministry of Health recorded the amount of medical waste in August 2018 of 294.66 tons/day for all provinces in Indonesia [8]. In addition, based on data from the Director-General of PSLB3 originating from research from the Indonesian Hospital Association, it is estimated that the volume of waste generated due to the pandemic will increase by up to 30% [9].

The significant increase in the number of regions/countries and people infected with Covid-19 shows that the world will experience another problem, namely Covid-19 waste and this will have a major impact on sustainable waste management in the future [10]. Medical waste, especially Covid-19 waste, contains potentially dangerous microorganisms because it can easily infect other patients, health workers or the general public if not handled and disposed of properly. In 2018, a survey was conducted on the capacity of hospital waste management. It was found that of the 94 respondent hospitals, 71% did not have waste treatment facilities. Exposure to Covid-19 waste has the potential to spread the virus by increasing the reproduction rate with a range between 2.2 and 3.58 [11]. The main route of transmission of the Covid-19 virus is through droplets released during the breathing process or through sneezing from an infected person.

Since May 2020, HOSPITAL, which is located in the East Jakarta area, has been one of the referral hospitals for Covid-19 in DKI Jakarta. During the pandemic, there was an increase in the number of patients starting in 2020 at home. the official hospital became a Covid-19 referral hospital, the number of hospital visits was 28,989 patients and the number of inpatients was 6,851 patients, this resulted in another problem, namely a significant increase in medical waste generation to reach a maximum daily average of 192.3 kg/day. The hospital has implemented a solid medical waste management system using a third party as a waste manager, but during the pandemic, there were obstacles caused by the increase in the amount of medical solid waste due to the limited capacity of third parties in managing waste. In addition, it was found that the application of management systems was not appropriate, starting from reduction, packaging and internal transportation, and storage of medical waste. The existence of these problems so that it is necessary to review the medical solid waste management system again so that it can optimize the management system that has been implemented. The purpose of this study was to analyze the amount of generation and composition of medical solid waste during the pandemic that was generated at hospital X, Jakarta.

2. METHOD

The research conducted with this writing is included in the category/type of quantitative qualitative. The specifications in this study are descriptive analysis, namely research that describes in detail the social phenomena that are the subject of the problem. Sources of information in this study were obtained through primary data collection and secondary data. Secondary data in this study were obtained from data other than the selected informants, namely in the form of documentation studies owned by the hospital. Documentation studies are used to support primary data obtained through interviews and observations. The secondary data used is a logbook recording the amount of medical waste by mass (w/w). In addition, a literature review was also carried out to see the ideal conditions and comparison with other cases. The processing method used in this research is the one-way ANOVA method. The ANOVA method is usually used to determine whether two or more population means will have the same value by using data from each population sample. After the one-way ANOVA test, a Linear Regression Test was conducted to determine the COVD-19 average daily cases level for medical waste generation.

3. RESULTS AND DISCUSSION

3.1. Waste Generation

The amount of medical solid waste generation from May 2020 to March 2021, the results obtained as shown in Table 1 show a significant increase in the number of generations up to 38 times. When compared between the highest amount of waste generated during the pandemic period of May 2020 - March 2021 of 5,770 kg/month with the maximum amount of waste generated in 2018 recorded in the waste manifest before the pandemic period, namely in July 2018 of 150 kg/month. In addition, there is also no storage with a room temperature controller wherein the applicable laws and regulations it is stated that the storage of infectious medical waste is a maximum of 2 x 24 hours and a maximum of 90 days chemical before being destroyed. The transporter carries out the transport of waste from the hospital varies from 7 to 12 times. Where in peak conditions with a high number of COVID-19 cases, the number of transports is also higher than usual. Other regulations regarding the implementation of sanitary for domestic solid waste, infectious waste, liquid waste and gas waste in hospitals, are contained in Minister of Health Regulation Number 7 of 2019 concerning Hospital Environmental Health. Medical waste that is not managed properly has the potential to increase the risk of spreading disease, especially during a pandemic outbreak. Careless management will increase the risk

of exposure to hazardous waste for all individuals who work and are active in health care facilities such as patients, medical personnel, administrative and support staff [12].

Table 1. Characteristics of Medical Waste Generation at Hospital X, Jakarta City

No	Time	Medical Waste Generation (kg/month)	Medical Waste Generation (kg/day)	Medical Waste Generation (kg/bed.day)	Amount of transportation to waste management facilities
1	May-20	768	25.6	0.12	7
2	Jun-20	776	25.9	0.12	9
3	Jul-20	984	32.8	0.15	4
4	Aug-20	752	25.1	0.12	2
5	Sep-20	2157	71.9	0.33	7
6	Oct-20	4169	139	0.65	9
7	Nov-20	3798	126.6	0.59	9
8	Dec-20	3506	116.9	0.54	8
9	Jan-21	5770	192.3	0.89	12
10	Feb-21	3139	104.6	0.49	8
11	Mar-21	3432	114.4	0.53	11

The average daily incidence at Hospital X from May 2020 to March 2021 is in the range of 25 kg/day to 192.3 kg/day (Table 1). The highest waste generation of 192 kg/day is a high generation when compared to other type B hospitals RSUD. Husada Bontang Park, each of which has a waste quantity of 100 kg/day and 24.4 kg/day. When compared to Seberang Jaya Hospital in Malaysia, medical waste generation is still high at 120 kg/day with 314 beds, more than Hospital X 1 which only has 215 beds. From the maximum amount of waste generated, the average daily generation per bed is 0.9 kg/bed, this result is following previous research in Wuhan, China with an average daily generation of 0.6-2, 5 kg/bed. UNEP has collected data on the amount of medical waste generated around the world during this pandemic, which was 0.5 kg/bed/day. The full comparison of medical waste generation showed in Table 2.

Table 2. Comparison of Medical Waste Generation at Study Sites and Other Locations

Hospital	Medical Waste Generation (kg/bed.day)	Treatment and Waste Generation	Source
X Hospital, East Jakarta, Indonesia	0.9	The daily average amount of waste generated is 192.3 kg/day with 215 beds processed by third parties	This Study
Husada Bontang Park, East Kalimantan, Indonesia	0.44	The daily average amount of waste generation is 88 kg/day with 202 beds processed by incinerator	[13]
Seberang Jaya Hospital, Malaysia	0.4	The Covid-19 outbreak produces medical waste of 120 kg/day.	[14]
Wuhan, China	2.5	To serve Covid-19 patients, the average waste generated is in the range of 0.6 to 2.5 kg/bed/day with 314 beds.	[15]
India.	7.76	Before pandemic the rate of waste generation is 1.93 kg/bed/day; currently waste generated is 7.76 kg/ bed/day	[16]
Tepi General Hospital, Ethiopia	1.88	Waste generation during Covid-19 is 179,762.5 kg/year processed by incineration	[17]
Ghana	0.95	33% used the uncontrolled combustion process of open burning and dumping	[18]
Worldwide	0.5	The average generation of waste generated from hospitals worldwide is 0.5 kg/bed/day	[19]

Test data in One Way ANOVA must follow a normal distribution and come from similar groups. Table 3 presents the data from the One Way ANOVA test with a significant value less than 0.05. This indicates that

there is a significant difference in the average value of the number of infected residents in the generation of medical waste.

Table 3. One Way ANOVA Test Results from COVD-19 Average Daily Cases on Medical Waste Generation

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	24275.55	3	8091.85	7.542	0.013
Within Groups	7509.877	7	1072.84		
Total	31785.43	10			

In addition, the average daily number of COVID-19 cases is also positively correlated with the generation of medical waste. In addition, the Multiple Linear Regression test as shown in Figure 1 with a significant value less than 0.05. This is also supported by the statement that the handling of COVID-19 patients requires more medical equipment such as masks, glasses, protective clothing and so on. This factor is predicted to increase the generation of medical waste significantly so that better management of hazardous waste management is needed to prevent re-infection from hazardous medical waste produced by health care facilities [20]. The Covid-19 pandemic brought an increased flow of patients to hospitals which in turn led to a high amount of waste generated, therefore, proper waste management practices [17]. Waste processing from cradle to grave needs to be done properly considering the impact on the environment may be leaking. Where the use of open dumping for end-of-life waste needs to be suspended [21] so that there is no wider spread of the virus [22]. So that medical waste thermal processing and disinfection processes are very necessary for the conditions of the Covid-19 pandemic.

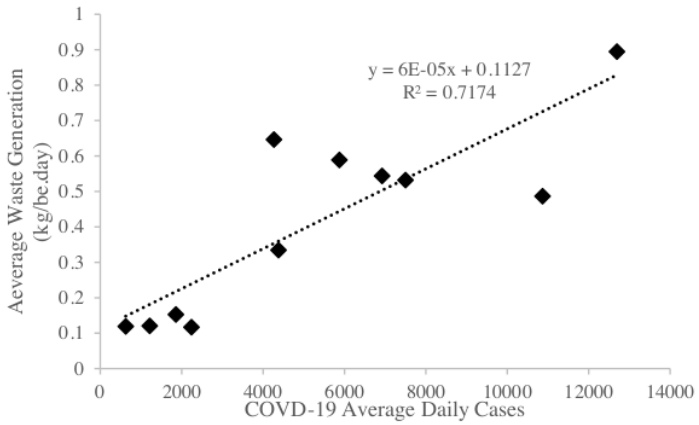

Figure 1. Correlation of COVD-19 Average Daily Cases on Medical Waste Generation

3.2. Medical Waste Composition

The composition of solid waste generation of hazardous and toxic materials in Hospital X that is sent to third parties has changed, especially the composition of infectious medical waste during the pandemic period as shown in Table 4. The percentage of solid medical waste generation in Hospital X is assumed to have uniformity with the research located in one of the houses. COVID-19 referral hospital in Surabaya with the same number of beds as many as 200 units and carried out during the Covid-19 period. From this study, it was quoted that the percentage of solid medical waste generation at home in hospitals consisted of sharp objects by 6.71%, infectious 11.72%, cytotoxic 0.17%, and pharmaceuticals by 4.4% [23].

The characteristics of medical solid waste produced before and after the pandemic period are sharp objects, body tissues, cytotoxics, chemical waste, medical waste as stated in the cooperation agreement between Hospital X and a third party waste processor. During this pandemic, there were differences in the amount of generation, especially in the characteristics of infectious waste [24]. With an estimated increase in infectious waste of up to 30%. The composition of infectious medical solid waste is experiencing a change in generation trends which include PPE (hazmat clothes), masks, gloves, medical head protection, used bandages, injection and infusion equipment as well as eating and drinking utensils for patients exposed to

Covid-19 made of plastic and paper. and used swabs and rapid test kits. The increased composition mainly came from the isolation rooms of patients exposed to Covid-19.

Table 4. Composition of Medical Waste Before and During the COVID-19 Pandemic

Infectious Medical Waste Before the Pandemic	Infectious Medical Waste During a Pandemic
Sharp object Cytotoxic Chemical and pharmaceutical waste Infectious Waste	Hazmat shirt Mask Gloves Medical headcover Used bandage Syringes and Infusions Eating and drinking utensils for patients exposed to Covid-19 Used swab and rapid test tools

Pharmaceutical medical waste and chemicals produced at Hospital X do not require alternative processing because they will be returned to the supplier to prevent any use by irresponsible parties. In addition, the return of pharmaceutical and chemical waste is one of the efforts to reduce medical waste. The handling method for the destruction and disposal of pharmaceutical waste can be done by returning it to the drug distributor. Furthermore, to find out the uniformity of the composition of infectious waste that has increased during the pandemic period, comparisons are made with several locations as shown in Table 5.

Table 5. Comparison of Medical Waste Composition in Several Locations

Location	Composition	Source
Indonesia	Waste from health facilities (health care facilities) that handle Covid-19 patients, including used masks, used gloves, used bandages, used tissues, used plastic for drinks and food, used food and beverage paper, used syringes, used infusion sets, protective equipment Used self (PPE), patient food leftovers and others.	[25]
King Abdullah University Hospital, Jordan	The compositions produced during March 2020 include gloves, glasses, face shields, toilet paper, shoes	[26]
Taiwan	covers, N95 masks, face masks, head protection, PCR test kits and swabs, gowns, PPE	[27]
Tepi General Hospital, Ethiopia	All medical infectious wastes such as sharp materials (syringe, needles, blades, and other anatomical wastes, used face masks, and paper towels, used batteries, broken thermometers, radioactive waste, and PVC plastic-like IV bags were not separated and disposed of properly in the vicinity, silver and X-ray films from radiotherapy.	[17]

From the composition of the generation, a comparison was made with the condition of the composition of medical solid waste in other hospitals as shown in Table 5 to see the uniformity of waste generation produced in Hospital X. When compared with the waste from health facilities produced in Indonesia, the composition of infectious waste during the pandemic can be seen. has a uniform composition, this indicates that the waste generation in Hospital X has a trend that is following the composition of the average generation in Indonesia. Furthermore, when compared with the composition of medical solid waste generation at King Abdullah University Hospital, Jordan, it is known that the generation is in the form of gloves, glasses, face shields, toilet paper, shoe covers, N95 masks, face masks, head protection, PCR test kits and swabs, gowns, as well as PPE from the generation, it is also seen that there is uniformity in the composition of medical solid waste generation, but for the composition in that place there is more diversity because the study has sorted out the type of composition so that the resulting generation is more accurate. The composition of the waste produced by hospitals is based on the classification of the type of material, so it is known that these wastes come from PVC, cellulose, polypropylene, and polyester.

4. CONCLUSION

Based on the analysis of medical waste at Hospital X City of Jakarta, it shows that there is a correlation between the number of daily cases of COVID-19 and the generation of medical waste. In low case conditions, medical waste generation tends to only reach 0.1-0.2 kg/bed/day, while in peak COVID-19 cases it can reach 0.9 kg/bed.day. This is of course estimated from changes in the composition of medical waste and the need for handling COVID-19 patients. Changes in composition can occur from the use of hazmat shirts, masks, gloves, medical head covers, used bandages, syringes and infusions, eating and drinking utensils for patients exposed to covid-19, and used swabs and rapid test tools.

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