

## Conference Paper

# Medical Waste Management at the Muhammadiyah University General Hospital of Malang During the COVID-19 Pandemic

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**Abstract.**

Medical waste in hospitals increased during the COVID-19 pandemic. Medical waste management is very important and includes sorting, transporting, weighing, temporarily storing, and handing over waste to third parties. The Muhammadiyah University General Hospital of Malang (RSU UMM) is a referral hospital for COVID-19. This study aimed to evaluate medical waste management at the RSU UMM during the COVID-19 pandemic. This was an observational, retrospective and descriptive study that was conducted from March 2020 until July 2021. The secondary data were taken from the environmental health unit reports at RSU UMM. The collected data included weights of COVID-19 and non-COVID-19 medical waste. Over the study period, there were 1762 COVID-19 patients. The solid waste included disposable waste and personal protective equipment. The medical waste at RSU UMM during the COVID-19 pandemic was more substantial than before the pandemic. The different treatments of medical waste before and during the pandemic were classified by type, weight and frequency of transport. Over the 16 months, 46,649 kg of hospital waste was managed.

**Keywords:** medical waste, COVID-19, weight of waste

## 1. Introduction

The COVID-19 pandemic and governmental policies to contain the spread of virus have cause a global economic recession and have also generated an enormous amount of medical waste. The composition was greatly influenced by disposable plastic based personal protective equipment (PPE) and single use plastics for most of the basic necessity [1]. The use of PPEs and single use plastics during the pandemic not only increases the quantity of medical waste but also alters the average density of the medical waste. Waste generation amid COVID-19, especially discarded PPEs and single use plastics, has been an environmental and public health crisis around the world particularly in the countries with developing economics and those in transition. Safe

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solid waste management is already a matter of major concern to these countries where safe and sustainable practice is scarce and healthcare waste has not been adequately regulated [1].

COVID-19 pandemic leads to increase in patient and healthcare activities, one of the consequences of COVID-19 is its effect on the quantity and composition of medical waste [2]. The medical waste generated during COVID-19 is not only a large amount, but it also has high infectivity risk [3]. In response to COVID-19, hospitals healthcare facilities and individuals are producing more waste than usual, including masks, gloves, gowns and other protective equipment that could be infected with the virus. There is also a large increase in the amount of single use plastics being produced [4].

The study in Wuhan investigates the response of medical waste management to the COVID-19 pandemic and subsequent changes in Wuhan City based on the most detailed data available, including waste generation, storage, transportation, and disposal. The result show that there is a 5-fold increase in the demand for daily medical waste disposal in the peak period [5]. The COVID-19 pandemic has led to an abrupt collapse of waste management chains. Safely a managing medical and domestic waste is crucial to successfully containing the disease. Mismanagement can also lead to increased environmental pollution. All countries facing excess waste should evaluate their management systems to incorporate disaster preparedness and resilience [6].

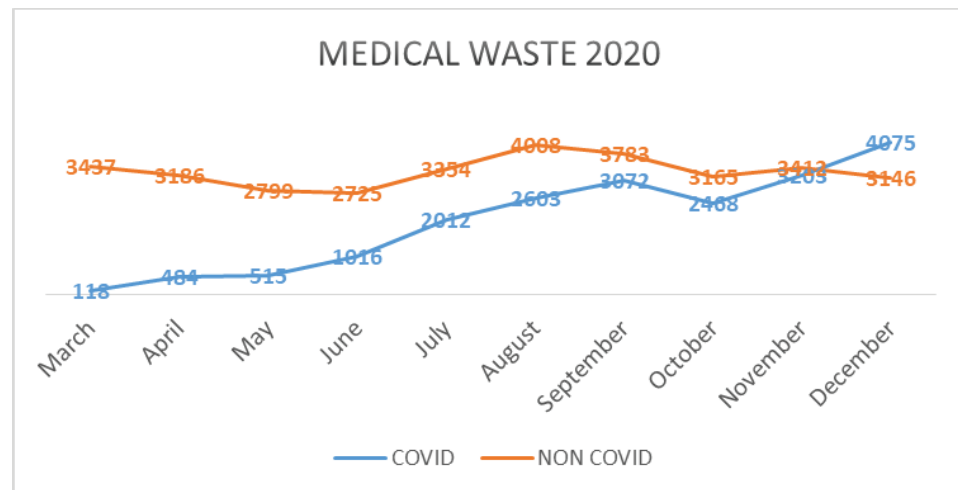
The Muhammadiyah University General Hospital of Malang (RSU UMM) is a referral hospital of the COVID-19 that produces medical waste In RSU UMM. RSU UMM medical waste is mainly managed by third parties organisation, there are PT. PRIA and PT TSA. The latter, including medical waste, is divided into general industrial waste and hazardous industrial waste [7]. PT. PRIA and PT TSA include in hazardous industrial waste.

## 2. Material and Method

This study is an observational retrospective and descriptive study using data from RSU UMM during the COVID-19 pandemic conducted from March 2020 until July 2021. The secondary data source is taken from the environmental health unit report at RSU UMM. The collected data were the weight of COVID-19 medical waste and non COVID-19 medical waste (in kilogram). Statistical analysis processed with SPSS version 25 using unpaired t-test to compare the data between COVID-19 and non-COVID-19 medical waste weight at RSU UMM.

### 3. Results and Discussion

The result showed that COVID-19 pandemic increased the average medical waste used in RSU UMM. From March until December 2020 COVID-19 medical waste increased, and it was peaked in Desember 2020 (4.075kg). Non-COVID-19 medical waste had stable value during 2020. The minimum amount of non-COVID-19 medical waste was 2725kg in June 2020, while the maximum amount is 4008kg in August 2020.



**Figure 1:** Line Chart RSU UMM COVID-19 and Non-COVID-19 Medical Waste in March-December 2020.

In 2021, the amount of COVID-19 medical waste keep decreased until June 2021 (2.792kg). but in July 2021, COVID-19 medical waste was drastically increased to 5913kg. Non-COVID-19 medical waste tend to be stable with minimum amount was 2779kg in February 2021 but it was increased in July 2021 up to 4413kg.

RSU UMM generated nearly 4 kg in 2020 and 5 kg in 2021 of medical waste per month at the peak of the pandemic, nearly 2 times more than before the pandemic. The peak occurred from December 2020 to January 2021 and July 2021. The increased medical waste in COVID-19 patients and non-COVID-19 patients is likely due to the increase in the number of patients. Evidences showed that during pandemic period, the increase in the number of patients admitted to the hospital affect the increase in total medical waste in RSU UMM. The increase in medical activity is directly proportional to the increase in the amount of waste medical output significantly. Prihartanto (2020) predicts COVID-19 pandemic can cause a lot of infectious medical waste generated from hospitals that reaches 25 tons per day per 10,000 patients, with cumulative 1,250-6,250 tons [8].

Before the COVID-19 outbreak, Malang city has 2 kg a month of medical waste disposal capacity. This capacity was solely based on an incineration plant which normally operated 2 time a week with extra reserved or storage disposal capacity for medical

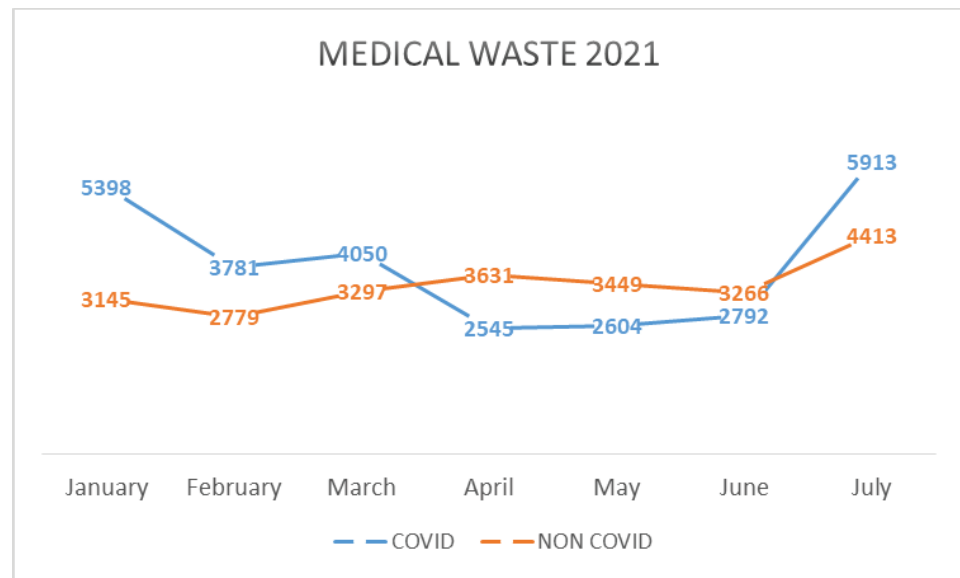


Figure 2: Line Chart RSU UMM COVID-19 and Non-COVID-19 Medical Waste in January-July 2021

waste management and send to third parties (PT. PRIA and PT TSA). Hazardous waste incineration facilities and methods are priority measures for the medical waste treatment of COVID-19 [9]. With the rise in the cases of COVID-19 in the city, the output of the medical waste also increased to 4 kg a month and kept increasing up to 5 kg at the peak of outbreak January 2021, afterward it gradually declined back to normal in April 2021.

The personal protective equipment (PPE), testing kits, surgical facemasks, and nitrile gloves are the major contributors to waste volume. Discharge of waste medical COVID-19 is of great global concern to public health and environmental sustainability if handled inappropriately. It may cause exponential spreading of this fatal disease as waste acts as a vector for SARS-CoV-2, which survives up to 7 days on COVID-19-waste [9]. One of the innovation to reduce medical waste COVID-19 in RSU UMM, PPI create procedural recycle some PPE. PPE that can be recycled is cover all, google, face shield, and N95 mask.

TABLE 1: Independent t-test between COVID-19 and non-COVID-19 medical waste.

	t-test for Equality of Means	
	Sig. (2-tailed)	Mean Difference
Medical Waste	.147	-608.58824

P value between average medical waste in both group (COVID-19 and non-COVID-19) at RSU UMM is more than 0,05 (0,147). Therefore, no significant difference between

the weight of COVID-19 medical waste and non-COVID-19 medical waste. It probably happened because the non-COVID-19 medical waste has not been separated from outpatient unit and the other units. COVID-19 ward in RSU UMM is separated from other wards and called COVID-19 and infectious installation. In the studied hospitals, by separating COVID-19 ward from other wards, the waste produced in this ward was generally considered as infectious waste and entered disinfection stages. Although these conditions can be effective in reducing the risk of transmission of the virus to medical waste mass and finally to the environment, there are some reports that in COVID-19 pandemic all generated waste in the hospitals is considered as infectious waste [2].

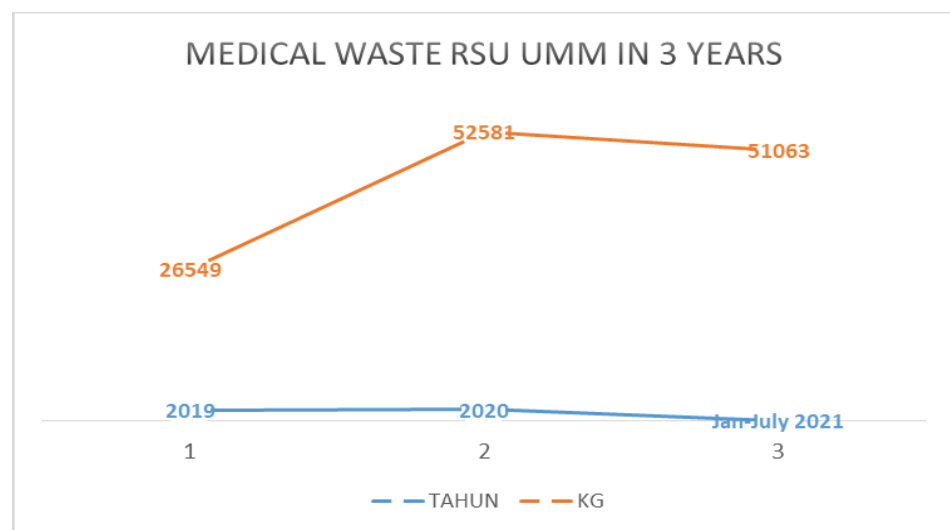


Figure 3: Line chart medical waste RSU UMM in 3 years.

Total Medical waste during early pandemic era (March 2020 until December 2020) in RSU UMM was 52581 kg, it increased twice the value before pandemic in 2019 (26.549 kg) and it keep increasing until up to 51.063 from January 2021 until July 2021. The same thing happened at study in Iran, that the epidemic COVID-19 leads to increased waste generation on average 102,2 % in public hospitals. In addition, the ratio of infectious waste in the studeied hospitals increased by an average of 9 % in medical waste composition and 121 % compared with before COVID-19 pandemic [2].

The adoption of waste management strategy COVID-19 medical staff must adapt to the latest developments of the COVID-19 pandemic and updated information on the characteristics of SARS-CoV-2 that have been studied. For example, information on the resistance of SARS-CoV-2 on the surface of objects with different materials was only known after a few months since Covid-19 was declared as global pandemic [10].

Medical waste RSU UMM send to third parties, they are PT PRIA and PT TSA. Cost for medical waste a year in 2020 about nearly 900 million rupiahs, it increasing 2 time before pandemic in 2019 (500 million). Administrative approach also needed in handling of infectious and non-infectious waste. Labels and signs need to be attached to provide instructions for the use of certain containers for the collection of suitable waste according to its designation. Awareness of the importance of waste separation as well can be improved by putting up posters, socializing work procedures applicable standards, and carry out monitoring (monitoring) strictly and periodically [11], [12].

Infectious medical waste must have a different collection container and non-infectious medical waste must be separated from the infectious medical waste collection container. This strategy can suppress risk of virus transmission from infectious waste to non-infectious waste and the environment. If necessary, infectious medical waste is wrapped in two layers to prevent leakage of the packaging container which can cause the infectious agent to be released into environment [14]. Other aspects to consider in medical waste collection are related to the retention time or storage time of medical waste. Infectious medical waste, especially waste contaminated with COVID-19, must be handled immediately to prevent waste collection containers become new reservoirs for viruses and infectious agents other. Therefore, the waste-resistant time during the COVID-19 pandemic must be designed shorter than before. Commonly applied policies are waste should not be stored for more than 24 hours. To overcome this, the strategy that can be applied is to increase the frequency of waste transportation [13], [14].

The increase in the amount of medical waste during the pandemic is not only a matter of quantity, but also the potential risks it carries. Medical waste can be new reservoir for the virus. Therefore, appropriate waste management becomes important to prevent transmission and cross-contamination of viruses from infectious medical waste.

## 4. Conclusion

With the increasing spread and impact of COVID-19 pandemic on health outcomes, there is an urgent global call for medical waste management from RSU UMM. This will in effect mitigate the potential threats of COVID-19 pandemic on environmental sustainability and health outcomes.

1. There led to new challenges which should be managed properly by change in routine activities, such as separated beetwen medical waste in ward, outpatient, and other units

2. COVID-19 Medical waste increased twice than medical waste before pandemic
3. The result suggest, it is important to evaluate procurement or buying of incinerator in RSU UMM by comparing cost of medical waste before and during COVID-19.

## References

- [1] Singh YTZZCZN. Covid-19 waste management: Effective and successful measures in Wuhan, China. *Resources, Conservation & Recycling*. <https://doi.org/10.1016/j.resconrec.2020.105071>.
- [2] Kalantary AJMMGMAJJNHSFMHAJTRR. Effect of COVID-19 pandemic on medical waste management: A case study. *Journal of Environmental Health Science and Engineering*. 2021;19. <https://doi.org/10.1007/s40201-021-00650-9>.
- [3] Mostafizur Rahman BD. Biomedical waste amid COVID-19:persepectives from Bangladesh. 2020;8.
- [4] Samuel ASPA. Impact of COVID-19 pandemic on waste management. *Environment, Development and Sustainability*. vol. 23, p. 2020.
- [5] Chang Chen JC. What medical waste management system may cope with COVID-19 pandemic: lessons from Wuhan *Resources* [p.]. *Conserv Recycl*. 170.
- [6] S.C.O.Y.S.Y. S. "Covid-19's unsustainable waste management," *Science*. vol. 368, p. 2019.
- [7] Tsai WT. Analysis of medical waste management and impact analysis of COVID-19 on its generation in Taiwan. *Waste Management & Research*. 2021;39. <https://doi.org/10.1177/0734242X21996803>.
- [8] P. Prihartanto. Prediction of medical hazardous waste generation from Covid-19 patient handling hospitals. *Jurnal Sains dan Teknologi Mitigasi Bencana*. 2020; 15(1):12–1.
- [9] Ilyas RR. Disinfection technology and strategies for COVID-19 hospital and bio-medical waste management. *Science Total Environment*. 2021;749.
- [10] Van Doremalen E, Morris N, Holbrook DH, Gamble MG, Williamson A, Tamin BN, et al. Aerosol and surface stability of SARS-CoV2 as compared with SARS-CoV-1. *The New England Journal of Medicine*. 2020.
- [11] Das AK, Islam MN, Billah MM, Sarker. Covid-19 pandemic and healthcare solid waste management strategy – A mini review. *Science of the Total Environment*. 2020;778:146220.

- [12] J. Kalantary RR, Jamshidi A, Mofrad MMG, Jafari AJ, Heidari N, et al. Effect of Covid-19 pandemic on medical waste management: a case study. *Journal of Environmental Health Science and Engineering*. 2021.
- [13] Hadi DMI, Widiyanti M, Kumalasari MLFK, Alamudi MY, Suprayogi. Management of SARS-CoV-2 medical waste against a Covid-19 pandemic in Indonesia: a literature review. *Jurnal Kesehatan Lingkungan*. 2020.
- [14] Peng J, Wu X, Wang R, Li, Cui, Zhang Q, Wei. Medical waste management practice during the 2019-2020 novel coronavirus pandemic: experience in a general hospital. *American Journal of Infection Control*. 2020.