

Comparison of COVID-19 Medical Waste Management Strategies For Hospitals in Developed and Developing Country

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Abstract

Introduction: The COVID-19 pandemic has not only caused a health emergency but also an emergency for medical waste, which as the number of COVID-19 infections increases, the generation of medical waste will also increase. **Objective:** This article aims to find out the pattern of handling COVID-19 B3 medical waste from hospitals in developed and developing countries. **Method:** This article is a systematic review using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) model. **Results and Discussion:** There are 13 articles that analyze to find out the management of COVID-19 medical waste originating from hospitals from developing countries as well as developed countries. There are some similarities and differences in decision-making regarding COVID-19 waste treatment. **Conclusions:** Some countries are still adopting waste regulations in the pre-COVID-19 period. The thermal method of exterminating waste is still the best way to be chosen. However, the use of the incinerator method in some developing countries is still small

Keywords: COVID-19; Medical Waste; Hospital;

Introduction

Medical waste is part of the waste generated from medical facilities such as hospitals, clinics, dental practices, blood banks, veterinary clinics, and medical research facilities and laboratories. In general, medical waste is waste that is contaminated with blood, body fluids, or other potentially infectious substances (EPA, 2018). The first time the COVID-19 case was reported was in Wuhan in December 2019, which since then has rapidly increased rapidly, causing a worldwide pandemic (Agamuthu and Barasarathi, 2021).

The COVID-19 pandemic has not only caused a health emergency but also an emergency for medical waste. As the number of COVID-19 infections increases, the generation of medical waste will also increase. There are some significant differences in medical waste management in developed and developing countries. Basically, developed countries can generate approximately up to 0.5 kg/bed/day of hazardous medical waste (Tsai, 2021). Based on WHO data, 30% of health facilities (60% in developing countries) are not equipped to handle the existing waste load, let alone the additional burden due to COVID-19. This can expose health workers to needlestick injuries, burns, and pathogenic microorganisms, while also impacting communities living near poorly managed landfills and airborne waste disposal sites contaminated with burned waste, quality poor water, or disease-carrying pests (World Health Organization, 2022).

Medical waste management is a serious threat, especially in developing countries, where an average of 45% of workers are trained, and many countries still need to increase this number to deal with waste. The segregation of 38.9% of normal medical waste for proper management has been achieved, and much remains to be done. Due to a lack of training and experience, workers get serious injuries during waste management. Most of the medical waste related to COVID-19 is plastic, which needs to be processed for sustainable resource recovery and recycling. The prevailing pandemic situation invites all countries to use collective wisdom and adopt environmentally friendly waste management during and after the pandemic (Singh et al., 2021).

In Korea, all medical waste entities involved in the disposal, transportation, and processing of medical waste in Korea must use RFID (Radio Frequency Identification). Currently, approximately 90,000 disposers, 210 carriers, and 14 incinerators use RFID medical waste management systems for real-time updates of medical waste disposal, transport, and processing details. In Korea, an RFID medical waste management system, which enables real-time management of all processes involved in the disposal, transport, and processing of medical waste, has been in use since 2008 (Yoon *et al.*, 2022).

Before the pandemic, medical waste was still an unresolved problem in management. When a pandemic comes, medical waste management becomes one of the most urgent things that must be completed. The Covid-19 pandemic has resulted in the emergence of Covid-19 B3 medical waste. This article aims to find out the pattern of handling COVID-19 B3 medical waste from hospitals in developed and developing countries.

Method

This article is a systematic review using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis). The inclusion criteria used in this article are the article is the result of research in full text, the article period is from 2019-2022, the article uses English and the object of the article's research is in the hospital. As for the exclusion criteria, namely, articles that are not research results that are not in full text, the period of the article is not in 2019-2022, the article is not in English, and the object of research is outside the hospital.

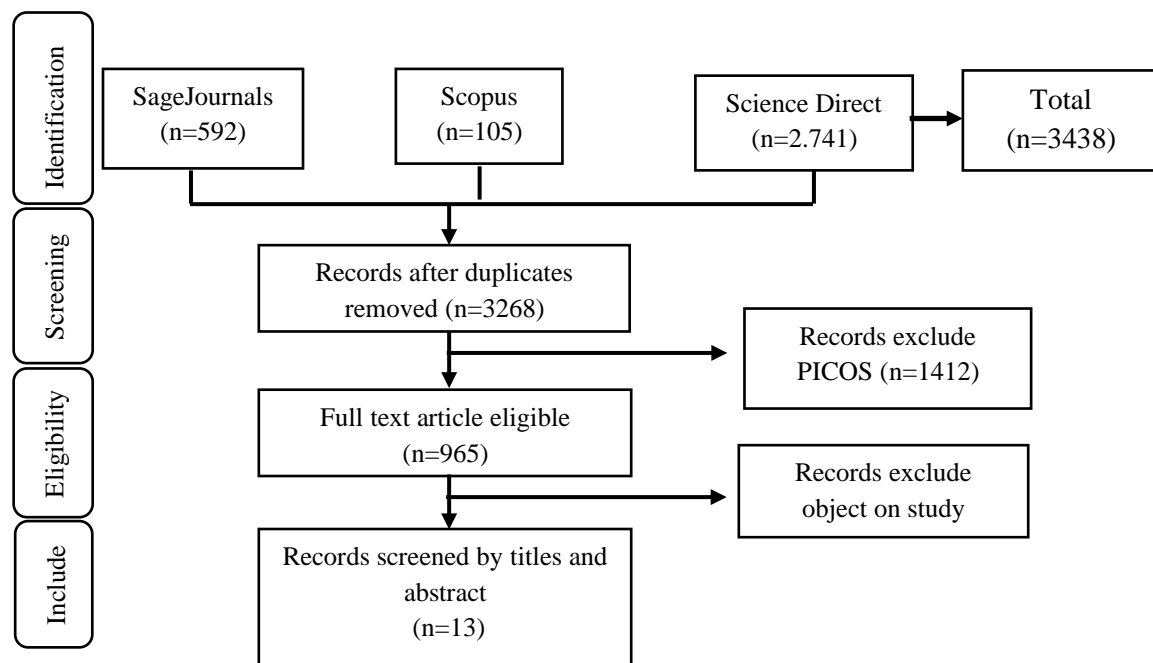


Figure 1 Flowchart of the PRISMA method

The data sources used in this article are SageJournals, Scopus and ScienceDirect. By using search keywords namely “Medical Waste”, “Hospital” and “COVID-19”. The data obtained are 592 journals on the SageJournals data source, 105 on the Scopus data source, and 2,741 on the ScienceDirect data source. The total number of articles obtained is 3438 articles. Next, the researchers filtered the articles based on similarities in as many as 170 articles so that the remaining 3268 articles. Article screening is still continuing based on PICOS, which is 1856 articles, leaving 1412 articles. Furthermore, filtering articles through the availability of the full text of the article, resulted in 965 articles. The next screening is by reading the entire article to assess the suitability of the article with the objectives to be discussed so that the particles obtained are 13 articles.

Result and Discussion

Based on the 13 (thirteen) articles obtained. The following is a description of the management of Covid-19 B3 medical waste originating from hospitals from developing countries as well as developed countries.

Table 1
Articles used

Researcher and Year	Method	Research Place	Result
Wen-Tien Tsai	Study Analytical Descriptive	Taiwan	Medical waste generation in Taiwan shows an increasing trend. Waste management is currently carried out by health facilities, namely janitors who do the separation and recycling. For the extermination process using the high temperature incineration method.
P Agamuthu dan Jayanthi Barasarathi	Qualitative	Malaysia	The composition of medical waste from health facilities is about 20% to 40%. The amount of medical waste generated in Malaysia increased by 17% in February 2020 compared to the previous month. From the case study, it is known that waste management related to COVID-19 medical waste management is regulated by the Waste Regulations in Malaysia under the Environmental Quality Act by the Seberang Jaya Hospital Management Team.
Martins, <i>et.al.</i>	Qualitative Descriptive	Brazil	In terms of medical waste management, hospitals in Brazil have adopted a new protocol for the handling and treatment of waste and must also set priorities in the care of hospital patients. The risk of infection in biological waste is increased by 30 times.
Amani Maaloufi dan Hani Maalouf	Literature Review	Lebanon	The medical waste management system in Lebanon has a broken system in terms of monitoring waste from medical facilities. And there are gaps in the waste statistics.
Chang Chen, <i>et.al.</i>	Quantitative	Wuhan	Wuhan's strategy in dealing with COVID-19 medical waste includes the implementation of a sophisticated medical data system, increasing hospital medical waste storage capacity, developing contingency plans to coordinate resources for disposal capacity over a wide area, and increasing national cooperation and support in managing household waste.
Roshanak Rezaei Kalantari, <i>et.al.</i>	Quantitative and Qualitative	Iran	Hospitals located in Iran use high-capacity disinfection equipment to manage the medical waste generated. It is considered appropriate to reduce the increase in the quantity and potential for infection in the medical waste generated.

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Khadijah Al-Omran, <i>et.al.</i>	Quantitative and Qualitative	Bahrain	There are three predefined medical waste management options, namely through a life cycle assessment approach including TPA (Final Disposal Site), centralized incineration, and decentralization.
Cheol-Woo Yoon <i>et.al.</i>	Literature Review	Korea	Health facilities disposing of medical waste should be located in different locations to transport and store waste until it is treated and should be disinfected at least once a week. Infectious medical waste such as sharp objects is stored for 7 to 30 days in a special bag or container and then disposed of. Food leftovers from COVID-19 patients are also put into infectious medical waste containers and processed on the same day to reduce waste generation.
Besufekad Mekonnen, <i>et.al.</i>	Cross- sectional study and qualitative study	Ethiopia	The medical waste generated is managed as usual before pre-covid.
Andreza de Aguiar Hugo and Renato da Silva Lima	Quantitative study	Brazil	Medical waste management is still not a priority. There are difficulties for hospitals to implement sustainable waste management practices.
Kawai Nguyen and Nakakubo	Qualitative study	Vietnam	Hospitals are responsible for managing their waste. Currently, the COVID-19 medical waste treatment method uses an incinerator for waste disposal.
Shobhana Ramteke dan Bharat Lal Sahu	Literature Review	India	Follow the method recommended by WHO (World Health Organization) and NACO (National Control Organization) by ensuring the biomedical waste storage area is isolated and then sent to the waste treatment agency for proper treatment.
Junias Adusei- Gyamfi, <i>et.al.</i>	Systematic Review	Afrika	Currently, Africa is working to develop solutions for its own waste management. The country chooses to promote the reuse, recycling, and recovery of waste. Just like before the COVID-19 pandemic.

Discussion

There are several different strategies from institutions around the world for the management of COVID-19 waste. This can be seen in table 2. (Ganguly and Chakraborty, 2021)

Table 2

COVID-19 medical waste management strategies from several world institutions

Agency Name	Strategy for handling COVID-19 waste
WHO (World Health Organization)	<ol style="list-style-type: none"> 1. Separate hazardous biomedical waste from its source (hospital) into appropriate colored containers. 2. Medical waste generated during treatment is destroyed by incineration, autoclaving, or incineration methods. 3. COVID-19 medical waste can be stored in a storage room where the waste was previously lined with black bags before being sealed.
EU (European Union)	The EU recommends the use of special bags for patients including infected tissue, face masks, gloves, and so on. The waste bags are collected and stored in regular garbage bags (no special collection method).
OSHA (Occupational Safety and Health Administration, US)	Workers who handle waste must use PPE (Personal Protective Equipment) properly.

In some countries, the management of COVID-19 medical waste also includes various ways and strategies. For waste management in Taiwan, according to government regulations, medical waste disposal companies must be recorded in detail and stored for at least 3 years according to the rules for storage, cleaning, disposal, and equipment operation and supervision. In addition, according to the Air Pollution Control Act in Taiwan, medical waste management facilities that use high-temperature incinerators are required to control emissions of toxic air pollutants (Tsai, 2021). Meanwhile, in Wuhan itself during the peak period of COVID-19, the demand for daily disposal of medical waste was more than five times the normal daily demand. Designated medical institutions should have adequate storage space for waste storage (Chen *et al.*, 2020).

In Malaysia, medical waste is divided into 5 (five) categories namely clinical waste, radioactive waste, chemical waste, pressurized container waste; and general waste. The amount of medical waste in Malaysia increased by 17% in February 2020 from the previous month. This waste comes from various medical institutions, hospitals, clinical activities, and research during the COVID-19 pandemic. Monitoring of medical waste management in Malaysia is carried out by relevant agencies who are responsible for all aspects of medical waste management from the collection, transportation, processing, and disposal using an online system called the Electronic Schedule Waste System. COVID-19 medical waste management in Malaysia is dumped in black bags. All bags and drums used for disposing of medical waste must be marked with the biohazard symbol. There are 7 companies that have licenses for the collection, transportation, disposal, and disposal of waste. Hospitals in Malaysia store the resulting medical waste in cold rooms until the waste collection trucks arrive. The collection is done every day or three times a week

depending on the amount. For disposal, almost all medical waste in Malaysia is burned at high temperatures. All ash generated from the combustion process is transported to an integrated B3 waste treatment center and cemented before being disposed of in a special landfill (Agamuthu and Barasarathi, 2021).

The steps taken by the Hospital in Brazil are also similar to other hospitals around the world, namely: the implementation of new protocols, a special team assigned to manage the action, and professional training. Total medical waste generation in Brazilian hospitals will increase to almost 5% by 2020 (Martins *et al.*, 2021). However, on the other hand, research by Andreza de Aguiar Hugo and Renato da Silva Lima (2021), states that some hospitals have not made the management of medical waste a priority. There are difficulties for hospitals to practice sustainable waste management (de Aguiar Hugo and Lima, 2021).

The management of COVID-19 waste from hospitals in Vietnam shows that the sources of COVID-19 waste are growing. To minimize the impact of viral infection, it is necessary to include a description of the waste containing the virus from this source. The COVID-19 waste responsibility is managed by the existing health facilities. The city government is responsible for the waste management of the centralized quarantine facility. The eradication of COVID-19 waste by burning using a medical waste incinerator is currently limited in Vietnam (Nguyen, Kawai and Nakakubo, 2021). Hospitals in Iran do the same, they use high-capacity disinfection equipment to manage the medical waste generated. It is considered appropriate to reduce the increase in the quantity and potential of infection in the medical waste generated (Kalantary *et al.*, 2021).

In the management of COVID-19 waste in Lebanon itself, environmental guidelines have been included, but they are still lacking. Most of the medical waste produced is collected and processed (autoclaved) by private parties. Waste management resulting from COVID-19 cases has been managed in accordance with existing regulations. Around 80%-85% of Lebanon's infectious medical waste is managed through the National Infectious Health Waste Disposal Application, which Arcenciel manages in collaboration with the Ministry of Environment, Ministry of Public Health, Hospital Association, and the General Society (Maalouf and Maalouf, 2021).

In Korea, health facilities that dispose of medical waste must be placed in different locations to transport and store waste until it is processed and must be disinfected at least once a week. Infectious medical waste such as sharp objects is stored for 7 to 30 days in a special bag or container and then disposed of. Food leftovers from COVID-19 patients are also put into infectious medical waste containers and processed on the same day to reduce waste generation (Yoon *et al.*, 2022). Meanwhile, so far medical waste management in Ethiopian hospitals is still being handled as usual (pre-covid) and so far there is still no different waste management method (Mekonnen, Solomon and Wondimu, 2021).

South Africa produces the most medical waste per day (1578 tonnes), followed by Morocco and Tunisia with 500 tonnes and 379 tonnes, respectively. As a bloc, South and

North African countries generate the most amount of medical waste per day while Central African countries produce the least amount of medical waste at 776 tons/day. Currently, Africa is working to develop solutions for its own waste management. The country chooses to promote the reuse, recycling, and recovery of waste. Just like before the COVID-19 pandemic (Adusei-Gyamfi *et al.*, 2022). On the other hand, the Government of India recommends that hospitals follow the method recommended by WHO (World Health Organization) and NACO (National Control Organization) by ensuring biomedical waste storage areas are isolated and then sent to waste treatment agencies for proper treatment (Ramteke and Sahu, 2020).

Conclusion

The COVID-19 pandemic has not only caused a health emergency but also an emergency for medical waste, and as the number of COVID-19 infections increases, the generation of medical waste will also increase. Various countries have devised guidelines for managing healthcare waste with health and safety in mind. Some countries are still adopting waste regulations in the pre-COVID-19 era. The thermal method of exterminating waste is still the best way to be chosen. However, the use of the incinerator method in some developing countries is still small. This is due to the high cost of procurement and cannot simply be adapted due to the economic challenges of most countries, especially after the current pandemic.

References

- Adusei-Gyamfi, J. *et al.* (2022) 'Post COVID-19 recovery: Challenges and opportunities for solid waste management in Africa', *Environmental Challenges*, 6(November 2021). doi: 10.1016/j.envc.2022.100442.
- Agamuthu, P. and Barasarathi, J. (2021) 'Clinical waste management under COVID-19 scenario in Malaysia', *Waste Management and Research*, 39(1_suppl), pp. 18–26. doi: 10.1177/0734242X20959701.
- de Aguiar Hugo, A. and Lima, R. da S. (2021) 'Healthcare waste management assessment: Challenges for hospitals in COVID-19 pandemic times', *Waste Management and Research*, 39(1_suppl), pp. 56–63. doi: 10.1177/0734242X211010362.
- Chen, C. *et al.* (2020) 'Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID- 19 . The COVID-19 resource centre is hosted on Elsevier Connect , the company ' s public news and information ' , (January).
- EPA (2018) *Medical Waste, United States Environmental Protection Academy*.
- Ganguly, R. K. and Chakraborty, S. K. (2021) 'Integrated approach in municipal solid waste management in COVID-19 pandemic: Perspectives of a developing country like India in a global scenario', *Case Studies in Chemical and Environmental Engineering*, 3(November 2020), p. 100087. doi: 10.1016/j.cscee.2021.100087.
- Kalantary, R. R. *et al.* (2021) 'Effect of COVID-19 pandemic on medical waste management: a case study', *Journal of Environmental Health Science and Engineering*, 19.
- Maalouf, A. and Maalouf, H. (2021) 'Impact of COVID-19 pandemic on medical waste management in Lebanon', *Waste Management and Research*, 39(1_suppl), pp. 45–55. doi: 10.1177/0734242X211003970.
- Martins, M. A. *et al.* (2021) 'Generation of infectious waste during the COVID-19 pandemic: The case of a Brazilian hospital', *Waste Management and Research*, 39(10), pp. 1245–1255. doi: 10.1177/0734242X211049301.
- Mekonnen, B., Solomon, N. and Wondimu, W. (2021) 'Healthcare Waste Status and Handling Practices during COVID-19 Pandemic in Tepi General Hospital, Ethiopia', *Journal of Environmental and Public Health*, 2021. doi: 10.1155/2021/6614565.

- Nguyen, T. D. T., Kawai, K. and Nakakubo, T. (2021) 'Estimation of COVID-19 waste generation and composition in Vietnam for pandemic management', *Waste Management and Research*, 39(11), pp. 1356–1364. doi: 10.1177/0734242X211052849.
- Ramteke, S. and Sahu, B. L. (2020) 'Novel coronavirus disease 2019 (COVID-19) pandemic: Considerations for the biomedical waste sector in India', *Case Studies in Chemical and Environmental Engineering*, 2. doi: 10.1016/j.cscee.2020.100029.
- Srivastava, V. *et al.* (2015) 'Urban solid waste management in the developing world with emphasis on India: challenges and opportunities', *Reviews in Environmental Science and Biotechnology*, 14(2), pp. 317–337. doi: 10.1007/s11157-014-9352-4.
- Tsai, W. T. (2021) 'Analysis of medical waste management and impact analysis of COVID-19 on its generation in Taiwan', *Waste Management and Research*, 39(1_suppl), pp. 27–33. doi: 10.1177/0734242X21996803.
- World Health Organization (2022) *Tonnes of COVID-19 Health Care Waste Expose Urgent Need to Improve Waste Management Systems*. Available at: <https://www.who.int/news/item/01-02-2022-tonnes-of-covid-19-health-care-waste-expose-urgent-need-to-improve-waste-management-systems>.
- Yoon, C.-W. *et al.* (2022) 'A Review of Medical Waste Management Systems in the Republic of Korea for Hospital and Medical Waste Generated from the COVID-19 Pandemic', *Sustainability*, 14(6), p. 3678. doi: 10.3390/su14063678.

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