
RESEARCH ARTICLE

Benefits of Medical Waste Management in the Facility Health Services

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ABSTRACT

Medical waste is all waste generated from hospital activities in the form of solid, liquid, and gas. The hospital, as a health service facility, is a gathering place for sick and healthy people and can be a source of disease transmission and allows environmental pollution and health problems, also producing waste that can transmit disease. According to the World Health Organization (WHO), waste generated by health service activities includes various kinds of materials, from used needles to soiled sanitary napkins, body parts, diagnostic samples, blood, chemicals, drugs, medical devices, and radioactive materials. To avoid these risks, it is necessary to manage waste in hospitals to protect patients, health workers, visitors, and the community around the hospital from the spread of infection and injury. The aim is to find out the benefits of medical waste management in health care facilities. The method used in writing this article is a literature review by identifying, evaluating, and synthesizing the works of research results and ideas that have been produced by researchers and practitioners. The results of the search process were only taken 27 articles that met the inclusion criteria, namely articles published in the period 2012-2021 and had discussions related to "the benefits of medical waste management in health care facilities and English. Medical waste management is getting rid of and utilizing general waste for other purposes. For general waste, the handling is identical to other domestic waste. Recycling is implemented wherever possible at every opportunity. Uninfected sharps must be properly packaged and will not harm handling workers and can be disposed of like general waste, while infected sharps are treated as hazardous waste.

KEYWORDS

Management, Waste, Service, Environment, Health

ARTICLE INFORMATION

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1. Introduction

Every human activity always produces waste, one of which is medical waste. Medical waste is all waste generated from hospital activities in the form of solid, liquid, and gas. The hospital, as a health service facility, is a gathering place for sick and healthy people and can be a source of disease transmission and allows environmental pollution and health problems, also producing waste that can transmit disease. To avoid these risks, it is necessary to manage waste in hospitals. The purpose of medical waste management is to protect patients, health workers, visitors, and the community around the hospital from the spread of infection and injury. Dust particles in Waste can cause air pollution, which will cause disease and contaminate medical equipment and food.

According to the World Health Organization (WHO), waste generated by health service activities includes various kinds of materials, from used needles to soiled sanitary napkins, body parts, diagnostic samples, blood, chemicals, drugs, medical devices, and radioactive materials (Paudel & Pradhan, 2010). The medical waste produced consists of 75-90% non-media waste and 15-25% medical waste (hazardous). The average production of hospital waste in developing countries ranges from 1-3 kg/bed days, while in developed countries such as Europe and the United States reaches 5-8 kg/bed. Health care waste contains potentially hazardous microorganisms that can infect patients, health workers, and the general public (Wulandari & Kusnopranto, 2015). Medical waste management is still not optimal, especially in developing countries, even though medical waste is included as B3 waste (Hazardous

and Toxic Materials), which is very dangerous for the environment, health, and survival of humans and other living things. Several factors are associated with inadequate planning and monitoring, logistics issues, storage, and accessibility issues (Roland, 2020).

Medical waste management is a requirement for every health facility to ensure human safety and environmental sustainability. According to government guidelines, every health facility, large medical institution, or small clinic must ensure proper biomedical waste management (Dixit et al., 2021). Health service facilities such as health facilities at regional public hospitals, sub-health centers, and private facilities are places where diagnosis, treatment, or immunization is given to humans, regardless of the type and size of the health care system and the research activities associated with it. The existence of health service facilities such as hospitals, clinics, health centers, and the like has become a vital need of the community. The services provided at these locations aim to serve the community and, at the same time, improve the standard of human life in terms of health (Chuks et al., 2013). However, hospitals, clinics, and health centers also have a negative impact, especially from the waste they produce. Therefore, understanding how to manage medical waste produced properly and safely is needed.

Currently, many health waste facilities have neglected the safe management of health waste (HCWM) because it has not implemented their waste management properly to minimize health risks that may arise. Some adverse health effects have been associated with sarcomas, lymphomas, skin lesions, stomach cancer, biochemical liver-test abnormalities, elevated blood lipids, fatal injuries, immune system, and neurologic effects (S. Irianti, 2013). This occurs due to an imbalance between the generation of medical waste in health facilities and the capacity for processing waste in health facilities, and the weak supervision of the competent authorities, resulting in cases of misuse of medical waste by the public or certain individuals. A number of studies have been conducted to highlight medical waste issues related to sorting at the point of source, scientifically based collection, handling, and their safe and proper disposal as in Poland, Canada, and China due to infection waste directly endanger human health and the environment (Arub et al., 2020). The world health organization has estimated that 21 million people have hepatitis B, two million from hepatitis C and at least 260,000 from HIV infection with contaminated needles (Paudel & Pradhan, 2010).

Health services in health care facilities must be aware of the potential risk of infection due to medical waste; given the magnitude of the negative impact of medical waste generated, the handling of medical waste must be carried out appropriately, starting from the container, storage, transportation, temporary storage and processing (Babanyara et al., 2013). Good medical waste management is also supported by the use of appropriate personal protective equipment (PPE) in carrying out medical waste management tasks and providing training to medical waste management officers to prevent work accidents. According to the research results of Anand M. Dixit (2021), All hospitals (100%) indicated their needs and willingness to participate in future specialized training programs in medical waste management⁴. In developing countries, for example, in Africa, Indonesia, and Timor-Leste, medical waste has not received serious attention from the management of health care facilities. This is due to lack of knowledge, limited human resources, unclear management, no clear regulations, and lack of operational standards, so medical waste is usually mixed with non-infectious waste (Wafula et al., 2019). Therefore, the transmission of infection from health facilities to health workers, patients, and the general public is very high.

In connection with efforts to increase awareness and joint security, the hospital environment as a service facility Public health is a gathering place for the sick and healthy people so that it can become a place for disease transmission and to avoid risks and health problems, it is the necessary implementation of hospital environmental health, one of which is by carrying out waste management in accordance with the requirements and procedures has been established to protect the patient, the patient's family and all personnel health in the hospital environment (Babanyara et al., 2013). In addition, medical waste bins must be provided according to the type of waste, which is not always used as it should be.

The amount of waste generated from health facilities has increased in recent years due to an increase in the number of health facilities and an increase in the population of people who come to health care facilities (FC et al., 2018). Medical waste is important to manage because it is related to environmental impacts, health, and compliance with regulations. Management of the resulting waste depends on the type and characteristics of each medical waste. In general, medical waste management methods include reduction and sorting, warehousing and storage, transportation, processing, burial, and the landfill (Aboelnour & Abuelela, 2019). Medical waste management can be carried out by internal and external parties. Internal parties from health care facilities can collect, sort, and recycle medical waste, to reduce the capacity of medical waste that must enter the incinerator. If health care facilities are unable to manage their waste, the waste will be managed by a third party or certified institution.

Health services in health facilities have positive and negative impacts. The positive impact is an increase in the degree of public health, while the negative impact is the production of medical and non-medical waste and waste that can cause disease and pollution that needs special attention¹². In addition, with the activities or the nature of the services provided, the hospital becomes a depot for all kinds of diseases that exist in the community; it can even be a source of disease distribution because it is always inhabited, used, and visited by people who are vulnerable and weak to disease¹³. In this place, transmission can occur either directly

(cross infection), through contamination of objects, or through insects (*vector-borne infection*) so that it can threaten the health of the general public.

Medical waste management needs to be managed seriously from the source. Building a structured, systematic system from upstream to downstream arranged in such a way will get many benefits. When the discipline of separating solid medical waste starts at the source, it will have a positive impact on the health of paramedics, patients, and the community around health care facilities 14. The reduction in solid medical waste also has an impact on the waste in the *incinerator* to be burned as well; this means that the *pollutant* produced from the combustion will also decrease; thus, the *ambient air quality* will be better maintained, and the environmental risk will be reduced.

In carrying out their functions and duties, health facilities can: produce and produce waste that has the potential to pollute the environment and ultimately can reduce the quality of the environment; in addition to that, health facilities can also cause various kinds of accidents to cause disease transmission when in medical waste management has not been or is not in accordance with the regulations that have been set. Based on this, it can be concluded that the facilities that do not manage the medical waste it produces properly can hurt environmental health aspects as well as be a source of problems for the environment and health.

2. Methodology

The method used in writing this article is a literature review. That is the literature search both nationally and internationally. But in this writing, the author only looks for international articles in English based on the databases of Google, Google Scholar, PubMed, Emerald Insight, and Semantic Scholar (2012-2021) with the keyword benefits of medical waste management in health care facilities. The total articles obtained are 80 articles. Furthermore, analyzed, there are 15 relevant articles. This review is to identify all articles with new findings related to medical waste management.

The Inclusion Criteria take all articles relevant to the benefits of medical waste management for society and the environment and introduce new data or findings from each article. The Exclusion Criteria excluded articles with old and irrelevant findings. Articles are analyzed using the same theme framework that forms the basis of the search algorithm. For each article, summarize research findings that provide an assessment of the scale of the environmental impact of hospital care and findings that provide an evaluation of the effectiveness of interventions to reduce impacts on public health and the environment.

3. Results and Discussion

The result of the search process was that only 29 articles were taken that met the criteria, namely articles published in the 2012-2021 period and had discussions related to "the benefits of managing medical waste in health care facilities". The information obtained is then grouped into several types of journals. The following are the types of journals that have been successfully obtained:

Table 1. Types of Articles

No.	Writer's name	Article Title	Year
1.	Nkechi Chuks Nwachukwu, Frank Anayo Orji and Ositadinma Chinyere Ugboqu	Health Care Waste Management – Public Health Benefits and the Need for Effective Environmental Regulatory Surveillance in the Federal Republic of Nigeria	2013
2.	Ahmed Ali Hassan, Terry Tudor, and Mentore Vaccari	Healthcare Waste Management: A Case Study from Sudan	2018
3.	Teshiwal Deress Yazie, Mekonnen Girma Tebeje and Kasaw Adane Chufa	Healthcare waste management current status and potential challenges in Ethiopia: a systematic review	2019
4.	Stephen T Odonkor and Tahiru Mahami	Healthcare waste management in Ghanaian hospitals: Associated public health and environmental challenges	2020
5.	Joshi HD	Health care waste management practice in Nepal	2013
6.	Puri Wulandari, Haryoto Kusnoputranto	Medical waste management and minimization efforts at a public hospital. case study: Public Hospital in East Jakarta, Indonesia	2015
7.	Asriyanti Bandaso, Dumilah Ayuningtyas	Management of medical waste in developing countries: A Systematic Review	2019
8.	Olaniyi FC, Ogola JS and Tshitangano TG	A Review of Medical Waste Management in South Africa	2018
9.	Issam A. Al-Khatib & Abdul-Salam Khalaf & Majed I. Al-Sari & Fathi Anayah	Medical waste management at three hospitals in Jenin district, Palestine	2020

9.	Patience Aseweh Abor	Managing healthcare waste in Ghana: a comparative study of public and private hospitals	2012
10.	Qiufeng Gao & Kai Liu & Shuyi Song & Jason Li & Jingchun Nie & Yaojiang Shi & Yaqin Xia & Tina Phillips Johnson & James Cook	Medical waste management of village clinics in rural China	2020
11.	Kennedy Degaulle Gunawardana	An analysis of medical waste management practices in the health care sector in Colombo	2018
12.	Lanyuy Gillian Dzekashu, Jane Francis Akoachere and Wilfred Fon Mbacham	Medical waste management and disposal practices of health facilities in Kumbo East and Kumbo West health districts	2017
13.	Shiva R Adhikari, Siripen Supakankunit	Benefits and costs of alternative healthcare waste management: an example of the largest hospital in Nepal	2014
14.	Vikas Thakur and A Ramesh	Healthcare waste management research: A structured analysis and review (2005–2014)	2015
15.	David O. Olukanni, Dominic E. Azuh, Tunde O. Toogun and Uchechukwu E. Okorie	Medical waste management practice among selected health-care facilities in Nigeria: A Case Study	2014

After the articles were collected and the authors analyzed, it was found that the management of medical waste in health care facilities must start from identification, separation, labeling, transportation, and storage to disposal/destruction. Infectious waste must be separated from non-infectious waste; every room must provide trash cans from materials that are strong, fairly light material, rust resistant, waterproof, easy to clean, and comes with a plastic bag. The Color of the plastic bags must be distinguished for each type of infectious waste using yellow plastic, sharp objects and needles are accommodated in special containers such as bottles before being put into plastic bags, and garbage infectious agents are destroyed in the incinerator.

The impact of inappropriate medical waste is well managed towards the environment, which can spread germs and thrive in a facility environment health, by air, water, floor, food and medical equipment items or non-medical. From the environment, germs can get to the workforce and new patients. While the impact of waste on poorly managed medical workers, namely the occurrence of the carelessness of work like being stabbed by syringe waste, exposed to liquid chemicals, and various pathogenic microorganisms present in the waste causing disease transmission to exposed.

For this reason, the management of medical waste in health care facilities must be carried out in accordance with procedures. Technology in the medical waste treatment process in healthcare facilities must also be able to process properly so that the expected effluent quality standards can be achieved and can protect patients, health workers, visitors, and the community around healthcare facilities from the spread of infection and injury.

4. Discussion

4.1 Health benefits of medical waste management

Medical waste is considered to be a threat to the health of paramedics, patients, and the general public, due to improper management, which can lead to dangerous infections. Medical waste management is carried out by segregation (separation) and identification of waste. Therefore, it is important to have an efficient separation system as well as a designated storage area within a healthcare facility. The most appropriate way to identify medical waste category is by sorting waste based on the color code in the recommendations and guidelines for the World Health Organization (WHO) (Al-Hadlaq et al., 2013), as shown in the following figure:

Figure 1. Bins with different color codes and labeling



Management of medical waste that does not meet health requirements can cause various diseases, including nosocomial infections or infections by micro-organisms obtained during treatment. The occurrence of nosocomial infections is the most difficult thing for clinicians to face in dealing with critically ill patients¹⁶ In developed countries, the incidence of nosocomial infections has become one of the benchmarks for service quality. Considering the magnitude of the problem of nosocomial infection and the losses it causes, control measures are needed that can reduce the risk of nosocomial infection.

According to Irianti S. *et al.* (2013), the generation of health care waste is influenced by factors such as type of hospital, number of infectious disease beds, number of beds, and number of outpatients per day (S. R. I. Irianti *et al.*, 2013). To manage the medical waste generated, the separation and collection based on the color code must be followed by the treatment and disposal unit, using the appropriate methods and technologies related to Waste Management Health. Therefore, the main problem of establishing Safe Health C is W waste Management practices proper waste segregation at the point of generation and containment so that relevant waste treatment methods can be determined effectively.

So the very complex hospital activities have not only a positive impact on the surrounding community but also a negative impact may be in the form of contamination due to the activation process or waste that is disposed of without proper management. Hospital waste management that is not good will trigger the risk of work accidents and disease transmission from patients to other patients as well as from and to the community who visit the hospital. Therefore, to ensure the safety and health of workers and other people in the hospital environment and its surroundings, it is necessary to have policies in accordance with occupational safety and health management by carrying out management and monitoring activities of hospital waste as one of the important indicators that need to be considered and must be followed in accordance with legal provisions (Muliarta, 2016).

4.2 Benefits of medical waste management on the environment

Public health service facilities such as hospitals can also be a source of environmental problems. Therefore, hospital environmental sanitation efforts are needed that aim to protect the public from the dangers of environmental pollution originating from garbage and hospital waste. Hospital waste can pollute the environment of residents around the hospital and can cause health problems. This is because hospital waste can contain various microorganisms that cause disease in humans, including typhoid fever, cholera, dysentery, and hepatitis, so the waste must be treated before being discharged into the environment

Based on a study conducted by Kennedy Degaulle Gunawardana from the Department of Accounting, University of Sri Jayewardenepura, Nugegoda, Sri Lanka, in 2018 identified that, although the government provides legal and regulatory support, organizations of all sizes must have positive attitudes, awareness, capabilities, and technology to get started improvements to waste management processes and be prepared to adapt to new trends. The development of positive attitudes and increasing knowledge about changes in waste management technology will help encourage organizations to invest in this area (Gunawardana, 2018).

Environmental pollution is a major contributor to Healthcare Acquired burden Infections (HAI). It is estimated that 40-60% of HAI is transmitted in the hands of health workers, and an additional 20% is caused by environmental pollution. For this reason, the importance of medical waste management is to prevent Health care Acquired Infections (Anderson *et al.*, 2021). Based on a review conducted by McGain and Naylor (2014) shows that several countries (especially the UK) have started investing systematically in

understanding the environmental impact of hospitals. Similarly, there is a research base being developed regarding devices and technologies used in hospitals to reduce the environmental impact of health care activities in hospitals (McGain & Naylor, 2014). When viewed from the volume of solid medical waste originating from health care facilities, it is estimated that it will increase over time. The cause, namely number of hospitals, health centers, medical centers, medical laboratories, and health clinics is increasing. Therefore, the home of every hospital (all health care facilities) should perform a sorting process based on medical and non-medical waste bins medical; all trash cans are labeled, so staff knows they will dispose of waste by type.

In addition, all personnel assigned to handle hospital waste need to be adequately trained and know what steps to take in the event of inoculation or body contamination. All staff must also wear adequate protective clothing.

Figure 2. Using Personal Protective Equipment



By managing medical waste in accordance with existing procedures, the environment becomes clean and healthy and does not endanger public health, especially health workers on duty in health care facilities and the community around health service facilities (hospitals) and the environment. For this reason, in the future, it is necessary to have environmental sustainability, which includes: the idea of using natural resources in a sustainable manner way and increasing resistance to change anticipated to the natural environment (Naylor & Appleby, 2013). An important component of green health care will continue encouragement for evidence-based care at all levels.

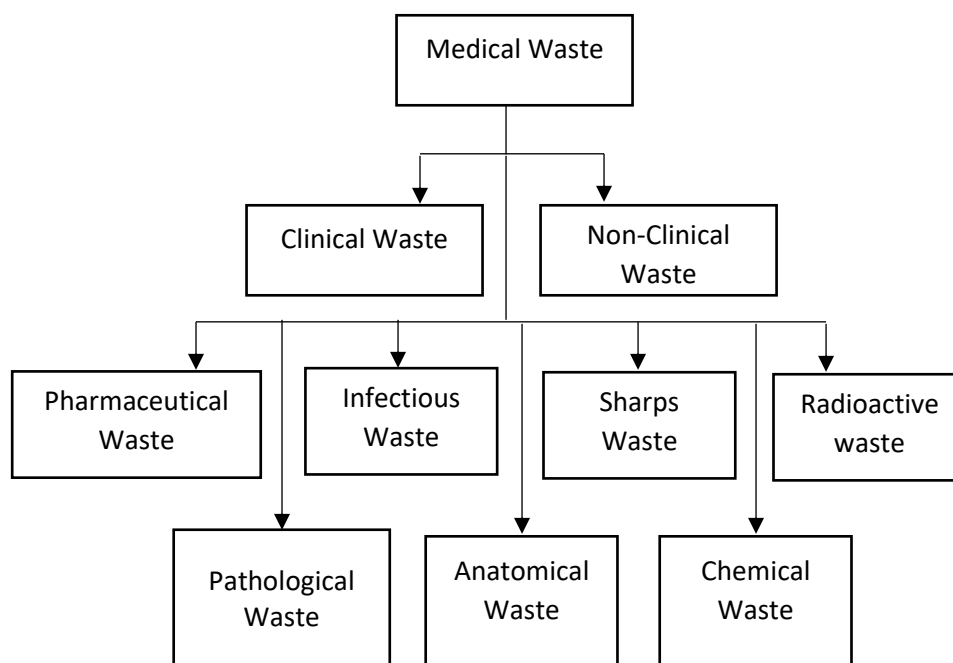
The provision of health services creates significant negative environmental effects, and mitigation is moderately pursued in a variety of ways that vary from country to country in line with different policy priorities and availability of resources (Ryan-Fogarty et al., 2016). To develop an appropriate medical waste management strategy, it is important to characterize the amount of waste and the composition of the waste stream. However, projecting the amount of waste is mandatory, whenever possible, to increase management capacity (Çetinkaya et al., 2020). The amount of medical waste depends on several factors, such as the size of the health facility, the medical waste segregation program, and the type of medical activity.

4.3 Medical Waste Management

Medical waste is considered a link in the chain of transmission of infectious diseases; waste can be a place for disease organisms to accumulate and become a nest for insects and rats. In addition, medical waste also contains various toxic chemicals and sharp objects that can cause health problems. Therefore, the management of medical waste from Health Service Facilities is intended so that medical waste is produced as little as possible and even strives for zero, which is done by reducing and/or eliminating hazardous and/or toxic properties (Bucătaru et al., 2021).

In particular, Zamparas et al. (2019) showed excellent scores in the medical waste management criteria were further improvements in staff awareness (such as the development program to increase sensitivity) and environmentally friendly, as well as being handled continuously and based on the type of waste generated as shown in the following figure (Zamparas et al., 2019).

Figure 4. Types of Medical Waste (Author's Source)



Handling of medical waste is based on the type of waste generated, making it easier for officers to transport and treat medical waste at the final disposal site (TPA) (Mahasa & Ruhiiga, 2014). The amount of medical waste classified as infectious waste requires special treatment so as not to cause disease transmission to health workers, patients, the general public, and the environment. In hospitals and other healthcare facilities, waste should generally be sorted into color-coded bins or bags, with each container indicating different waste streams or types of waste. The color chosen for each type of medical waste varies from health care facility (Windfeld & Brooks, 2015).

The challenge facing today's health facilities is that they are not adequate for the temporary storage of medical waste until the final disposal of the waste (FC et al., 2018). These challenges must be addressed and the practice improved to prevent the adverse effects of medical waste that is not managed properly by health care facilities. Therefore, it is also necessary to develop a medical waste policy to assist in the management of medical waste in every health care facility.

In the future, medical waste management facilities in every hospital must carry out waste reduction starting from the source and must manage and supervise the use of hazardous, toxic chemicals, and every piece of equipment used in the management of medical waste from the collection, transportation, and destruction must go through certification from the third party. Authorized. Several important parts in hospital waste management, namely: waste reduction, labeling, and packaging, transportation, storage, treatment, and disposal of waste. Process This management must use the right way and pay attention to aspects of health, economy, and preservation environment.

5. Conclusion

Hospital waste management is handling hazardous waste, getting rid of and utilizing general waste for other purposes. For general waste, the handling is identical to other domestic waste. Recycling is implemented wherever possible at every opportunity. Uninfected sharps must be properly packaged and will not harm handling workers and can be disposed of like general waste, while infected sharps are treated as hazardous waste.

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References

- [1] Aboelnour, A., & Abuelela, M. H. (2019). Increase adherence to waste management policy at healthcare facilities in Egypt. *Bulletin of the National Research Centre*, 43(1). <https://doi.org/10.1186/s42269-019-0065-2>
- [2] Adu, R. O., Gyasi, S. F., Essumang, D. K., & Otobil, K. B. (2020). Medical Waste-Sorting and Management Practices in Five Hospitals in Ghana. *Journal of Environmental and Public Health*, 2020. <https://doi.org/10.1155/2020/2934296>
- [3] Al-Hadlaq, A., Huneitib, Z. A., & Balachandranc, W. (2013). Bio-Medical Waste Handling and Management in Riyadh, Saudi Arabia. *International Journal*, 4(6).
- [4] Anderson, D. M., Cronk, R., Fejfar, D., Pak, E., Cawley, M., & Bartram, J. (2021). Safe healthcare facilities: A systematic review on the costs of establishing and maintaining environmental health in facilities in low-and middle-income countries. *International Journal of Environmental Research and Public Health*, 18(2), 1–22. <https://doi.org/10.3390/ijerph18020817>
- [5] Arub, S., Ahmad, S. R., Ashraf, S., Majid, Z., Rahat, S., & Paracha, R. I. (2020). Assessment of waste generation rate in teaching hospitals of metropolitan city of Pakistan. *Civil Engineering Journal (Iran)*, 6(9), 1809–1821. <https://doi.org/10.28991/cej-2020-03091584>
- [6] Babanyara, Y. Y., Ibrahim, D. B., Garba, T., Bogoro, A. G., & Abubakar, M. Y. (2013). *Poor Medical Waste Management (MWM) Practices and Its Risks to Human Health and the Environment: A Literature Review*. 7(11), 757–764.
- [7] Bakui, R., & Durmisahaj, S. (2018). SF Journal of Environmental and Earth Science Medical Waste Effects and Management: Overview and Future Directions. *Science Forecast Journal of Environmental and Earth Science*, 1(5), 1–13.
- [8] Bucătaru, C., Săvescu, D., Repanovici, A., Blaga, L., Coman, E., & Cocuz, M. E. (2021). The implications and effects of medical waste on development of sustainable society—a brief review of the literature. *Sustainability (Switzerland)*, 13(6). <https://doi.org/10.3390/su13063300>
- [9] Çetinkaya, A. Y., Kuzu, S. L., & Demir, A. (2020). Medical waste management in a mid-populated Turkish city and development of medical waste prediction model. *Environment, Development, and Sustainability*, 22(7), 6233–6244. <https://doi.org/10.1007/s10668-019-00474-6>
- [10] Chuks, N., Anayo, F., & Ugbogu, O. C. (2013). Health Care Waste Management – Public Health Benefits, and the Need for Effective Environmental Regulatory Surveillance in Federal Republic of Nigeria. *Current Topics in Public Health*. <https://doi.org/10.5772/53196>
- [11] Dixit, A. M., Bansal, P., Jain, P., Bajpai, P. K., Rath, R. S., & Kharya, P. (2021). Assessment of Biomedical Waste Management in Health Facilities of Uttar Pradesh: An Observational Study. *Cureus*, 13(12), 1–11. <https://doi.org/10.7759/cureus.20098>
- [12] FC, O., JS, O., & TG, T. (2018). A Review of Medical Waste Management in South Africa. *Open Environmental Sciences*, 10(1), 34–45. <https://doi.org/10.2174/1876325101810010034>
- [13] Gunawardana, K. D. (2018). An analysis of medical waste management practices in the health care sector in Colombo. *Management of Environmental Quality: An International Journal*, 29(5), 813–825. <https://doi.org/10.1108/MEQ-02-2018-0032>
- [14] Hassan, A. A., Tudor, T., & Vaccari, M. (2018). Healthcare waste management: A case study from Sudan. *Environments - MDPI*, 5(8), 1–16. <https://doi.org/10.3390/environments5080089>
- [15] Irianti, S. (2013). Current Status and Future Challenges of Healthcare Waste Management in Indonesia. *Media Litbangkes*, 23(2), 73–81.
- [16] Irianti, S. R. I., Prasetyoputra, P., & Herat, S. (2013). Determinants of Hospital Waste Management in Indonesia: Focusing on the Importance of Segregation at Source and Color-Coded Collection System. *Journal of Applied Sciences in Environmental Sanitation*, 8(2), 135–144.
- [17] Kuchibanda, K., & Mayo, A. W. (2015). Public health risks from mismanagement of healthcare wastes in Shinyanga municipality health facilities, Tanzania. *Scientific World Journal*, 2015. <https://doi.org/10.1155/2015/981756>
- [18] Mahasa, P. S., & Ruhiiga, T. M. (2014). Medical Waste Management Practices in North Eastern Free State, South Africa. *Journal of Human Ecology*, 48(3), 439–450. <https://doi.org/10.1080/09709274.2014.11906815>
- [19] McGain, F., & Naylor, C. (2014). Environmental sustainability in hospitals – a systematic review and research agenda. *Journal of Health Services Research and Policy*, 19(4), 245–252. <https://doi.org/10.1177/1355819614534836>
- [20] Muliarta, I. N. (2016). Study of Medical Waste and Its Management at Wangaya Hospital in Denpasar. *International Research Journal of Management, IT & Social Sciences*, 3(5), 94–102. <https://doi.org/10.21744/irjmis.v3i5.21>
- [21] Naylor, C., & Appleby, J. (2013). Environmentally sustainable health and social care: Scoping review and implications for the English NHS. *Journal of Health Services Research and Policy*, 18(2), 114–121. <https://doi.org/10.1177/1355819613485672>
- [22] Paudel, R., & Pradhan, B. (2010). Health care waste management practice in a hospital. *Journal of Nepal Health Research Council*, 8(2), 86–90.
- [23] Roland, C. A. (2020). Assessment of healthcare facilities location and medical waste generation and handling in Nigeria. *Journal of Public Health and Epidemiology*, 12(1), 50–62. <https://doi.org/10.5897/jphe2020.1204>
- [24] Ryan-Fogarty, Y., O'Regan, B., & Moles, R. (2016). Greening healthcare: Systematic implementation of environmental programmes in a university teaching hospital. *Journal of Cleaner Production*, 126, 248–259. <https://doi.org/10.1016/j.jclepro.2016.03.079>
- [25] Wafula, S. T., Musiime, J., & Oporia, F. (2019). Health care waste management among health workers and associated factors in primary health care facilities in Kampala City, Uganda: A cross-sectional study. *BMC Public Health*, 19(1), 1–10. <https://doi.org/10.1186/s12889-019-6528-4>
- [26] Windfeld, E. S., & Brooks, M. S. L. (2015). Medical waste management - A review. *Journal of Environmental Management*, 163, 98–108. <https://doi.org/10.1016/j.jenvman.2015.08.013>
- [27] Wulandari, P., & Kusnopranto, H. (2015). Medical Waste Management and Minimization Efforts At Public Hospital. Case Study: Public Hospital in East Jakarta, Indonesia. *Jurnal Kesehatan Masyarakat (Journal of Public Health)*, 9(2), 77–84. <https://doi.org/10.12928/kesmas.v9i2.2127>
- [28] Yazie, T. D., Tebeje, M. G., & Chufa, K. A. (2019). Healthcare waste management current status and potential challenges in Ethiopia: A systematic review. *BMC Research Notes*, 12(1), 1–7. <https://doi.org/10.1186/s13104-019-4316-y>
- [29] Zamparas, M., Kapsalis, V. C., Kyriakopoulos, G. L., Aravossis, K. G., Kanteraki, A. E., Vantarakis, A., & Kalavrouziotis, I. K. (2019). Medical waste management and environmental assessment in the Rio University Hospital, Western Greece. *Sustainable Chemistry and Pharmacy*, 13(April), 100163. <https://doi.org/10.1016/j.scp.2019.100163>