ASLI QoL 2025
Annual Serial Landmark International Conference on QoL 2025
Indexed in Clarivate Analytics WoS

E-B Environment - Behaviour Proceedings Journal

AQoL2025Cherating

e-IPH e-International Publishing House Ltd., United Kingdom

https://www.amerabra.org/

09th Asia-Pacific International Conference on Quality of Life
Holiday Villa Beach Resort & Spa, Cherating, Malaysia, 17-18 Oct 2025

Exploring Changes in Healthcare Waste Management Post COVID-19: A qualitative study in a Maldivian health facility

Fazeela Moosa[1,2], Zamzaliza Abdul Mulud*[1], Mariyam Nazviya[2] Abdul Azeez Hameed[3]
**Corresponding Author*

[1]Centre for Nursing Studies, Faculty of Health Sciences, Universiti Teknologi MARA, Puncak Alam Campus, 42300 Puncak Alam, Selangor, Malaysia

[2]Policy and International Relations, Villa College, Maldives

[3]Dhamanaveshi Urban Primary Healthcare Centre, Maldives

Email of All Authors: fazylamoosa@gmail.com, zamzaliza@uitm.edu.my, m.nazviya@villacollege.edu.m, holhuashi@hotmail.com

Tel: +960 9794966 / +60147102489

Abstract

Healthcare waste management (HCWM) practice is a fundamental activity for all institutions. Improper handling of healthcare waste (HCW) poses health risks and environmental damage. Thus, a qualitative study was conducted using semi-structured interviews with selected participants in a Maldivian health facility to explore HCWM practices before and after the COVID-19 pandemic. The content analysis technique was employed to analyse the data generated. The study results identified significant changes to HCWM, including institutional practices and organisational culture, as well as challenges and key interventions that required proper handling, such as training and education, clear guidelines, and institutional changes. Implications are addressed.

Keywords: Waste management, COVID-19, Health facilities, Maldives

DOI:

1.0 Introduction

Managing healthcare waste (HCW) has been a global concern for decades due to the improper handling and disposal of waste (Aung et al., 2019). Healthcare waste, also known as medical waste (MW), is highly associated with pathogens that can spread communicable diseases among healthcare professionals, waste handlers, patients, their families, and visitors to healthcare facilities (Raji & Adeogun, 2024; Ul Ain et al., 2023). Improper handling of HCW can also result in a harmful impact on the surrounding environment by water contamination, air pollution, and agricultural contamination (Ezeudu et al., 2022; WHO, 2022). Healthcare waste management (HCWM) remains a fundamental activity that plays a vital role in delivering quality healthcare in any healthcare setting (Tanko, 2022). Nevertheless, healthcare providers worldwide face numerous challenges in establishing a well-functioning HCWM system (Raji & Adeogun, 2024).

Over the years, multiple factors have contributed to HCWM practices, including a lack of infrastructure, human resources, training, finance, non-compliance with guidelines, and a lack of relevant Standard Operating Procedures (SOPs) at different levels of the health facilities. The COVID-19 pandemic created additional pressure, with a rapid rise in HCW production (UN Environmental Programme, 2020; WHO & UNICEF, 2020).

DOI:

The selected healthcare facility (HF) served as one of the primary flu clinics in the Maldives during the COVID-19 pandemic. The HF was overwhelmed with high demand for the service, and significantly increased the amount of infectious waste production. This study aims to explore changes in HCWM post-COVID-19 pandemic to identify improvements required for providing a safer environment for all.

2.0 Literature Review

Healthcare waste (HCW) is any by-product generated as a result of healthcare activities. A significant percentage of HCW is produced in hospitals, health laboratories, and health research institutions through various health-related activities (Bopaiah et al., 2020). The World Health Organisation (WHO) (WHO, 2024) reported that approximately 85% of waste generated from healthcare facilities (HCFs) is considered non-hazardous. In contrast, the remaining 15% of the waste is reported as hazardous, yet it remains the most hazardous type of waste, posing health risks and environmental damage (Zand et al., 2022).

The increased amount of HCW involved various reasons. An outbreak of a highly infectious disease can overwhelm HFs with a large number of HCW who requires extra precautionary measures to take during handling and managing waste. The outbreak of the COVID-19 pandemic, which killed millions of people, was a critical concern that left healthcare authorities exhausted with resources due to the severity of its impact on human health (WDR, 2022). The Asian Development Bank (ADB) projects a significant increase in HCW generation in selected cities since the outbreak of COVID-19 in 2020. For instance, with Manila HCW increasing from 47 to 280 tonnes/day, Jakarta and Kuala Lumpur are expected to rise approximately from 35 to 210 tonnes/day, Bangkok from 27 to 160 tonnes/day, and Hanoi city in China to increase from 26 to 150 tonnes/day. Hence, the ADB emphasises the need for governments to expand capacity building and effective management to address this surge in HCW (ADB, 2020).

The process of HCWM involves waste generation, segregation, collection, transportation, storage, treatment and safe disposal of waste (Tanko, 2022). Urbanisation and advanced technology in developed countries lead to an increase in the production of HCWs (Ibrahim et al., 2023). Zanad et al. (2022) highlighted that HFs in many developed countries have well-written SOPs that are aligned with regulations and policy guidelines about HCWM practices. Additionally, Singh et al. (2022) affirm that high-income nations employ sustainable methods to handle HCW properly. On the other hand, despite the high HCW production rate, health facilities in the majority of low and middle-income nations handle HCW inappropriately due to inadequate regulations and financial constraints that limit resource allocation (Tanko, 2022).

The COVID-19 pandemic situation became highly challenging for health facilities to manage a large quantity of HCWs produced due to a lack of resources (Raji & Adeogun, 2024). The Low-income countries face more challenges than those of the high-income countries in managing HCW during the outbreak of COVID-19 (WHO, 2020). Resource availability, preparedness, and readiness to endemic and pandemic situations in high-income countries remain more systematic (Bansod & Deshmukh, 2023).

The global pandemic of COVID-19 affected the Maldives, like any other nation, overwhelming healthcare facilities with a larger volume of healthcare workers. The selected HF turned out to be one of the primary flu clinics based in the central city of the Maldives since March 2020. The HF continued to provide healthcare services to the general public, in addition to serving and catering to both COVID-19 positive cases and suspected cases (Wahid, 2020). Consequently, the daily patient flow rate has increased from approximately 60 to around 250 patients (Ahmed & Wahid, 2021).

3.0 Methodology

The study employed a qualitative phenomenological approach to explore changes in HCWM practice during the COVID-19 pandemic in selected healthcare facilities. This approach enabled researchers to focus on understanding the lived experiences of participants regarding the relevant issue. The study was conducted at a healthcare facility located in Male, the capital of the Maldives, where patient turnover ranged from 60 to 250 patients during the COVID-19 pandemic. A total of 8 participants, including nurses and waste handlers, were selected using purposive sampling, based on the established inclusion criteria. A semi-structured interview guide with open-ended questions was used as the primary instrument to collect data through in-depth interviews with selected participants. Data was analysed using thematic analysis, where all six steps of thematic analysis were followed in order to develop a clear narrative considering the aims and objectives of the study.

3.9 Ethical consideration

The initial approval was obtained from the ethical Committee of the Centre for Postgraduate Research Studies at Villa College (Ref No: VC/CPS/2020/E-315), followed by the healthcare facility approval (Ref No: REF/2020/05), and ethical approval from the National Health Research Council at the Ministry of Health was obtained (Ref No: NHRC/2021/027). Additionally, both verbal and written consent were obtained from participants after they had reviewed the information sheet. Confidentiality and anonymity were strictly maintained. Study participants were informed of their right to withdraw from the study at any stage.

4.0 Findings

The main concepts identified were: (A) 'key changes to HCWM practices established since the COVID-19 pandemic'. (B) 'Major barriers to effective HCWM practices in terms of integration at the institutional level'. (C) 'Key areas of interventions to establish proper techniques to promote the right practice while managing HCW'. The study results led to important recommendations to the leadership to develop regulations and SOPs regarding HCWM practices at the institutional level.

4.1 Characteristics of the respondents

Nurses and waste handlers working in the selected healthcare facility participated in this study. There were five nurses and three waste handlers working in different areas of the HF. Participants were selected based on the selection criteria. Table 1 shows the classification of the participants.

#	Job title	Area of work
Participant 1	Registered Nurse	Emergency Room
Participant 2	Registered Nurse	Emergency Room
Participant 3	Registered Nurse	General ward
Participant 4	Registered Nurse	Flu clinic
Participant 5	Waste handler	Flu clinic
Participant 6	Waste handler	Emergency Room
Participant 7	Registered Nurse	General ward
Participant 8	Waste handler	Outpatient department and Emergency room

Table 1: Classification of participants

4.2 Key changes to HCWM practices since (POST) the Covid-19 pandemic

The idea was derived from the categories 'Institutional changes towards HCW' and 'Organisational culture about HCWM practices'. These are further elaborated and discussed below.

4.2.1 Category 1: Institutional changes

Segregating waste at the point of generation is the most important step for the proper and safe handling of HCW to avoid spreading infections, prevent accidental injuries, and minimise environmental damage. Staff awareness about the importance of segregation to initiate safe practice has been escalated, said the nursing staff,

“due to the nature of the COVID-19 pandemic, we were advised to separate the waste and label it properly to differentiate by categories" (Participant 3).

Moreover, participants highlighted changes to onsite transportation, including stricter rules, specific timings, and alternative routes. Additionally, a properly trained team from Waste Management Corporation Limited (WAMCO) comes to collect HCW and transports them to the designated point for final disposal. A staff member responded,

“Yes, medical waste transportation is now rigorous since the Covid-19 pandemic. We now have specific timings for moving healthcare waste inside the facility" (Participant 6).

A practice nurse highlighted,

"... many changes like the waste pickers come in with full PPE [personal protective equipment] and infectious waste is transported by a closed vehicle and a separate vehicle for general waste at a different time" (Participant 4).

Respondents in the study also stated that a designated area for collecting HCW has been allocated to minimise accidental exposure to health hazards, to prevent mixing waste, and to introduce strict rules for maintaining proper segregation, packing, and labelling before storage.

About the storage, a participant expressed her views,

“We do not have much space… but now we have a small space [storage] allocated separately…closed with a door and only limited people can have access… before it was open so that everyone could see the bulk of waste collected and kept there" (Participant 3).

4.2.2 Category 2: Organisational culture

Leadership involvement and support are highly effective during the change process of any institutional activity. The COVID-19 pandemic was an alarming signal for hospital leadership to identify what needed to be changed in current practices to minimise the negative impact of the outbreak. In this regard, a focal point has been allocated to oversee the HCWM practices among health professionals and waste handlers throughout the process. The participants strongly believed that a focal point plays a vital role in monitoring, supervising HCWM practices, and guiding staff to safe handling. A nursing staff member expressed her views on this regard,

"After the outbreak, a specific person has been allocated to supervise HCWM practices, and I would now say that proper handling of HCW here in this hospital is significant, and it is going very properly compared to before the pandemic" (Participant 1).

Another crucial aspect of the change identified was the need for financial support to meet the demands of effective HCWM practice following the COVID-19 outbreak. Both healthcare professionals and waste handlers have observed that an adequate supply of resources has been provided to the hospital staff to enable them to run day-to-day activities and handle HCW safely and smoothly. The nursing staff believed,

"Before Covid-19, we did not get adequate resources… but now we get enough resources to manage HCW properly, and I believe that the relevant authorities are spending a lot on safe practice" (Participant 2).

4.3 Challenges in the integration of the HCWMP in the HF

This broad concept is outlined from the categories 'Staff training and education regarding HCWM practices', 'Institutional challenges regarding proper HCWM practices' and 'Implementing an effective HCWM system'. The categories are further elaborated here.

4.3.1 Category 1: Staff training and education

The study participants have expressed their knowledge on different categories of HCW produced in health facilities. However, the lack of awareness and inadequate skills regarding proper segregation among some waste handlers result in the mixing of different categories of waste by collecting them in a single bag. This finding clearly understands the need for staff training and awareness regarding HCWM practices. A nursing staff member expressed,

"… they [the waste handlers] unintentionally collect all types of waste in one big garbage bag…they are not aware of the seriousness in mixing healthcare waste [so] I believe that lack of knowledge and awareness remain as one of the biggest challenging factors to handle HCW in here [hospital] properly" (Participant 7).

Moreover, in her interview, a waste handling staff member expressed her views,

"Because there is no specific training or awareness regarding waste handling…to understand the importance of segregating waste and the risk it [healthcare waste] poses to people's health has been a challenge to proper practice" (Participant 8)

4.3.2 Category 2: Institutional challenges

The limited space of the hospital, due to its infrastructure and resource constraints, remains a significant challenge in maintaining safe practices for managing HCWM. Financial restrictions play a key role in every shortage within the system. A waste handling staff member expressed,

"In this place [hospital], the lack of resource availability remains as one of the significant challenges that we face every day (Participant 5).

Another respondent added,

"The shortage of staff is a huge challenge for us in this hospital…and available things are very few. We also do not have proper facilities to treat waste in this hospital" (Participant 5).

4.3.3 Category 3: Implementing an effective HCWM system

Respondents have identified several factors contributing to the ineffective implementation of the HCWM system in the facility. For instance, non-compliance with standard guidelines, the absence of standard operating procedures (SOPs), and inadequate training on the correct procedures all hinder the implementation of a well-functioning HCWM system.

"*We do not have enough people to establish a good system… so it is also a difficulty… we also face challenges in implementing the right policies in the hospital because of staff shortage and lack of expertise in this area" (Participant 7)*

4.4 Interventions to improve

This broad concept emerged from three main categories: ' training and education', 'Policy guidelines and Regulations' and 'Institutional changes'.

4.4.1 Category 1: Training and education

Participants have highlighted that nurses and waste handlers must have adequate training and awareness regarding the HCWM process, as it is a fundamental intervention for enhancing and developing a good system.

A nurse participant explained,

"…seniors can arrange some in-house training for all [those who handle waste] in this place [hospital] to help staff manage waste, we can also display information at allocated points where everyone can read and understand easily" (Participant 3).

Moreover, another nursing staff member states,

"I do not witness that some staff are provided with proper training, especially newly joined nurses and waste handlers do not get any training at institution level, I think they have no idea about the importance of this [manage waste properly] … for me, I think proper education to the staff is the first step in this process" (Participant 4).

4.4.2 Category 2: Policy guidelines and regulations

Written policy guidelines and proper SOPs must be developed in healthcare institutions. Training and spreading awareness among staff about the importance of adherence to guidelines encourages safe handling and proper practice in managing HCW. Moreover, hospital standard procedures regarding HCWM practices should align with national HCWM guidelines, some participants have highlighted.

"In our hospital, we have our own hospital waste management policy, which would of course be in line with the healthcare waste management policy… a guideline that the Ministry of Health has developed for healthcare institutions to follow" (Participant 8)

5.0 Discussions

Proper handling of HCW is an essential activity that every healthcare provider requires to ensure that staff adopt and maintain best practice techniques at all times (WRD, 2022). This study confirms that the participants had several concerns that could lead to inappropriate HCWM in the selected HF before the outbreak of the COVID–19 pandemic. The participants also highlighted and shared their knowledge about the improvements and significant changes made to HCWM practices since the outbreak, as well as how staff were encouraged to maintain proper techniques for handling HCWs.

Changes have been witnessed since the COVID-19 outbreak as a result of the critical steps taken by the selected healthcare facility to establish a proper HCWM system. However, on the other hand, Görçün et al. (2023) argued that a well-managed HCWM system remains a challenge in developing countries. Proper techniques for segregating waste at the point of generation, transportation, and adequate storage space, as well as sufficient support to conduct daily activities, budgetary support, a selected waste management committee, and allocating staff as a focal point to oversee daily activities, have been observed and maintained since the COVID-19 crisis. Further in the discussion, participants agreed that proper labelling and categorising waste helps prevent health risks and minimises accidental injuries. This finding is similar to Khan et al. (2019), who underlined that separating waste is the most valuable step in the process of proper HCWM. Moreover, Mohamed et al. (2018) agreed that researchers argued that the availability of an adequate supply of resources, staff training, colour-coded, and proper labelling are essential for health professionals to exercise the right practice.

To reduce the transmission of infectious diseases, HCWs can be transported from one place to another using a separate pathway and avoiding peak hours to reduce risks. Nevertheless, Görçün et al. (2023) emphasised that mixing different categories of waste and transport through an uncovered vehicle can double the chance of environmental damage. This finding is consistent with previous studies, which strongly suggest that careless handling of waste contributes to health risks and environmental concerns (Sahiledengle, 2019; Shamnanj et al., 2018). The COVID-19 pandemic crisis influenced healthcare providers to allocate a separate space for waste storage. As such, the selected HF has managed to designate a closed area for waste collection since the outbreak. In their study, Sarkar et al. (2022) emphasised the importance of improving the overall infrastructure of hospitals, which enables staff to have adequate space for safe practice. Apart from infrastructure, significant changes in organisational culture have been achieved by appointing a specific person to supervise overall HCWM practices in the facility. Ben Jmaa et al. (2023) believed that assigning a separate person as a focal point to supervise enhances proper handling of HCW.

The study's findings highlighted that a lack of training, awareness, and education, as well as a shortage of resources and inadequate leadership support, are significant challenges within the system. A study conducted by Marfe et al. (2022) found that enhancing staff knowledge through regular in-house education programs on HCWM increases the effectiveness of proper handling and the quality of work. Inappropriate treatment techniques within the HF remain a considerable challenge for waste handlers. Regarding this, the World Health Organisation and UNICEF (2020) have strictly stated in their fact sheet that HFs are required to treat infectious waste onsite before final disposal. Hence, respondents firmly believed that the HFs must establish proper treatment options to regulate and manage HCWs effectively.

Non-compliance with guidelines and inappropriate SOPs about HCWM delays the establishment of a proper, well-functioning HCWM system. Healthcare providers are required to follow national and institutional guidelines during any event of healthcare service, including managing HCW (HPA, 2024; Ministry of Health, 2020).

6.0 Conclusion and recommendations

The study findings show that continuous staff education programs, including on-the-job training to enhance HCW handling skills, establishing strict guidelines and SOPs regarding HCWM, and ensuring adequate resource availability, including treatment options and storage space, have been identified as key factors to improve further and ensure safe practice while managing HCW. Moreover, the findings emphasise that a proper storage area, coupled with facilities to treat HCW properly, results in health risk reduction while minimising the environmental impact of inappropriately handled waste. As highlighted by Ul Ain et al. (2023), the availability of the aforementioned facts in HFs has a positive impact on establishing a well-managed HCWM system.

Acknowledgements

The authors would like to convey heartfelt gratitude to all parties involved in this study. To the Centre for Nursing Studies, Faculty of Health Sciences, Universiti Teknologi MARA, for facilitating the authors' presentation and submission of the research paper. Special thanks to the Ministry of Health and the Maldives National Defence Force for their continuous support and encouragement.

Paper Contribution to the Related Field of Study

The findings of this study provide valuable insights for healthcare settings, policymakers, and those involved in the process of HCWM in every hospital /health facility.

References

ADB. (2020). *Managine Infectious Medical Waste during the COVID-19 Pandemic*. https://www.adb.org/sites/default/files/institutional-document/691766/adb-annual-report-2020.pdf

Ahmed & Wahid. (2021, June). *Hospital monthly report January-June*

Aung, T. S., Luan, S., & Xu, Q. (2019). Application of multi-criteria-decision approach for the analysis of medical waste management systems in Myanmar. *Journal of Cleaner Production*, *222*, 733–745. https://doi.org/10.1016/J.JCLEPRO.2019.03.049

Bansod, H. S., & Deshmukh, P. (2023). Biomedical Waste Management and Its Importance: A Systematic Review. *Cureus*, *15*(2), 1–7. https://doi.org/10.7759/cureus.34589

Ben Jmaa, M., Ben Ayed, H., Ben Hmida, M., Maamri, H., Limam, M., Trigui, M., Ketata, N., Yaich, S., Feki, H., & Damak, J. (2023). Effectiveness of a Training Intervention about Healthcare Waste Management on the Knowledge and Practical Skills of Healthcare Professionals in a Teaching Hospital of Southern Tunisia. *Hospital Topics*, *101*(2). https://doi.org/10.1080/00185868.2021.1969307

Bopaiah, S. K., Suga, S., Myneni, S., Ravikumar, D., Sivagananam, P., Kumar, M. R., Krishnan, M., Balu, P., Sundharesan, N., James, K. M., Kumaravel, K., Sargunan, Y., Kamineni, S. R. T., Vishnu Priya, V., & Mohan, S. K. (2020). Assessment of the knowledge and attitudes regarding biomedical waste management among the health care professionals in a tertiary care teaching hospital in Chennai. *Journal of Critical Reviews*, *7*(9), 578–586. https://doi.org/10.31838/jcr.07.09.115

Ezeudu, O. B., Ezeudu, T. S., Ugochukwu, U. C., Tenebe, I. T., Ajogu, A. P., Nwadi, U. V., & Ajaero, C. C. (2022). Healthcare Waste Management in Nigeria: A Review. In *Recycling* (Vol. 7, Issue 6). https://doi.org/10.3390/recycling7060087

Görçün, Ö. F., Aytekin, A., Selçuk Korucuk, & Tirkolaee, E. B. (2023). Evaluating and selecting sustainable logistics service providers for medical waste disposal treatment in the healthcare industry. *Journal of Cleaner Production*, *408*, 1–13. https://doi.org/10.1016/j.jclepro.2023.137194

HPA. (2024). *National Health Care Waste Management Guideline*. Health Protection Agency. www.health.gov.mv

Ibrahim, M., Kebede, M., & Mengiste, B. (2023). Healthcare Waste Segregation Practice and Associated Factors among Healthcare Professionals Working in Public and Private Hospitals, Dire Dawa, Eastern Ethiopia. *Journal of Environmental and Public Health*, *2023*, 1–7. https://doi.org/10.1155/2023/8015856

Khan, B. A., Cheng, L., Khan, A. A., & Ahmed, H. (2019). Healthcare waste management in Asian developing countries: A mini review. *Waste Management and Research*, *37*(9), 863–875. https://doi.org/10.1177/0734242X19857470

Marfe, G., Perna, S., & Hermann, A. (2022). Challenges in Healthcare Waste Management of the UN 2030 Agenda in the COVID-19 Era. *American Journal of Environmental Sciences*, *18*(1). https://doi.org/10.3844/ajessp.2022.20.41

Ministry of Health. (2020). *Environmental and social management framework: Maldives covid-19 emergency response and health systems preparedness project*. https://www.trade.gov.mv/dms/696/1589671619.pdf

Minoglou, M., Gerassimidou, S., & Komilis, D. (2017). Healthcare waste generation worldwide and its dependence on socio-economic and environmental factors. *Sustainability (Switzerland)*, *9*(2). https://doi.org/10.3390/su9020220

Mohamed, S. A., Hassan, N. E., & Ali, N. M. (2018). Assessments case of medical waste management in hospitals in Iraq waste management Medical waste treatment Incineration and autoclaving Safety disposal of medical waste. *International Journal of Advanced and Applied Sciences*, *5*(1), 130–135. https://doi.org/10.21833/ijaas.2018.01.017

Raji, M. O., & Adeogun, A. G. (2024). Healthcare Waste Management: An Overview. *ABUAD Journal of Engineering Research and Development*, *7*(1), 14–27. https://doi.org/10.53982/ajerd

Sahiledengle, B. (2019). Self-reported healthcare waste segregation practice and its correlate among healthcare workers in hospitals of Southeast Ethiopia. *BMC Health Services Research*, *19*(591), 1–11. https://doi.org/10.1186/s12913-019-4439-9

Shamnani, G., Kumar Verma, D., & Singh Bhartiy, S. (2018). Knowledge, awareness, attitude, and practice regarding biomedical waste management among health care workers in tertiary care setting. *International Journal of Medical Science and Public Health*, *7*(8), 611–615. https://doi.org/10.5455/ijmsph.2018.0412425042018

Sarkar, S., Khati, P., Choudhury, S., Saha, A., Das, R., Mandal, G., Mondal, N., Barman, K., Banerjee, O., Khatun, S., Das, S., Mondal, P., Sinha, P., Parveen, N., & Sabnam, S. (2022). A study to assess the knowledge regarding bio-medical waste management among the staff nurses working in selected hospital, Siliguri. *International Journal of Research in Medical Sciences*, *10*(11). https://doi.org/10.18203/2320-6012.ijrms20222853

Singh, N., Ogunseitan, O. A., & Tang, Y. (2022). Medical waste: Current challenges and future opportunities for sustainable management. In *Critical Reviews in Environmental Science and Technology* (Vol. 52, Issue 11). https://doi.org/10.1080/10643389.2021.1885325

Tanko, J. A. (2022). Assessment of the Effectiveness of Healthcare Waste Management Practices in Major Town of Niger State, Nigeria. In *Journal of Environment* (Vol. 2, Issue 2). Online. www.carijournals.orgwww.carijournals.orgwww.carijournals.org

Ul Ain, Q., Panezai, S., Saqib, S. E., & Ain, Q. U. (2023). Hospital Waste Management Practices in Pakistan: A Systematic Review HOSPITAL WASTE MANAGEMENT PRACTICES IN PAKISTAN: A SYSTEMATIC REVIEW SHAHAB E SAQIB. *Journal of Jilin University (Engineering and Technology Edition)*, *42*(03), 630–647. https://doi.org/10.17605/OSF.IO/VXHRK

UN Environmental Programme. (2020). *Waste management an essential public service in the fight to beat COVID-19*. BASEL CONVENTION. https://www.basel.int/Implementation/PublicAwareness/PressReleases/WastemanagementandCOVID19/tabid/8376/Default.aspx

WDR (2022). Chapter 1. The economic impact of the COVID -19 crisis. Retrieved September 18, 2025, from https://www.worldbank.org/en/publication/wdr2022/brief/chapter-1-introduction-the-economic-impacts-of-the-covid-19-crisis

World Health Organization. (2022). *GLOBAL ANALYSIS OF HEALTH CARE WASTE IN THE CONTEXT OF COVID-19*.

World Health Organization. (2024). *Healthcare waste*. https://www.who.int/news-room/fact-sheets/detail/health-care-waste

World Health Organization, & UNICEF. (2020). *Water, sanitation, hygiene, and waste management for the COVID-19 virus*. https://iris.who.int/bitstream/handle/10665/331846/WHO-2019-nCoV-IPC_WASH-2020.3-eng.pdf

Zand, A. D., Heir, A. V., & Khodaei, H. (2022). A survey of Knowledge, attitudes, and practices of Tehran residents regarding solid waste management in the COVID-19 era. *Journal of Hazardous Materials Advances*, *8*, 1–8. https://doi.org/10.1016/j.hazadv.2022.100203