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

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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 analyze the data generated. The study results identified significant changes to HCWM, including institutional practices and organizational 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

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1.0 Introduction

Managing healthcare waste (HCW) has remained a global concern for decades due to improper handling and inappropriate disposal (WHO, 2022). Healthcare waste, also known as medical waste (MW), often contains infectious materials that can transmit communicable diseases among healthcare professionals, waste handlers, patients, their families, and visitors to healthcare facilities (Raji & Adeogun, 2024; Ul Ain et al., 2023). Inadequate management of HCW can have a harmful impact on the surrounding environment through water contamination, air pollution, and agricultural contamination (Ezeudu et al., 2022). Hence, effective healthcare waste management (HCWM) is integral to maintaining public health and ensuring the delivery of safe, high-quality care services (Tanko, 2022). Despite its importance, establishing a well-functioning and efficient HCWM system remains a challenge in many countries (Raji & Adeogun, 2024). These challenges include a lack of infrastructure, insufficient human resources, insufficient training and education, financial constraints, and non-compliance. The objective of this study is to explore changes to healthcare waste management practices in a casdivian health facility post-COVID-19 pandemic.

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In the Maldives, these challenges were particularly evident in healthcare facilities designated as flu clinics during the pandemic, which experienced an unprecedented increase in infectious waste. The selected healthcare facility (HF) in this study was one of the primary flu clinics, facing significant operational strain and waste-management pressures. Given this context, this study aims to assess the healthcare waste management practices (HCWMP) at the selected facility and explore how these have changed following the COVID-19 pandemic. In particular, the study seeks to identify gaps, opportunities for improvement, and strategies to strengthen the post-pandemic HCWM system, thereby ensuring a safer and more sustainable healthcare environment. By examining these practices within a Maldivian healthcare context, this study contributes to the limited empirical research on HCWM in small island developing states (SIDS). It provides evidence-based insights to guide national policy development and institutional capacity-building for future health emergencies.

2.0 Literature Review

Healthcare waste (HCW) is any by-product generated during healthcare activities. A significant percentage of HCW is produced in hospitals, health laboratories, and health research institutions through various health-related activities (Ezeudu et al., 2022). 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 HCFs, requiring many HCWs to take additional precautions when 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 production in selected cities since the COVID-19 outbreak in 2020. For instance, with Manila HCW increasing from 47 to 280 tonnes/day, Jakarta and Kuala Lumpur have increased approximately from 35 to 210 tonnes/day, Bangkok from 27 to 160 tonnes/day, and Hanoi city in China has increased from 26 to 150 tonnes/day. Hence, the ADB emphasizes the need for governments to enhance their capacity and effectively manage HCW (ADB, 2020).

The HCWM process involves waste generation, segregation, collection, transportation, storage, treatment, and safe disposal (Tanko, 2022). Urbanization and advanced technology in developed countries have led to increased HCW production (Ibrahim et al., 2023). Zanad et al. (2022) noted that HCFs in many developed countries have well-written SOPs aligned with regulations and policy guidelines for HCWM practices. Additionally, Singh et al. (2022) affirm that high-income nations employ sustainable methods to properly handle HCW. On the other hand, despite the high HCW production rate, health facilities in most 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 made it highly challenging for health facilities to manage a large volume of HCWs produced due to resource constraints (Raji & Adeogun, 2024). Low-income countries face more challenges than high-income countries in managing HCWs during the COVID-19 outbreak (WHO, 2020). Resource availability, preparedness, and readiness to endemic and pandemic situations in high-income countries remain more systematic (Bansod & Deshmukh, 2023).

The global COVID-19 pandemic affected the Maldives, as it did every nation, overwhelming healthcare facilities and straining healthcare workers. The selected HF is one of the primary flu clinics in the Maldives' central city since March 2020. The HF continued to provide healthcare services to the general public, in addition to serving patients with COVID-19 and suspected cases. Consequently, the daily patient flow rate increased from approximately 60 to around 250 patients (Ahmed & Wahid, 2021).

3.0 Methodology

This descriptive study adopted a qualitative phenomenological approach to explore changes in HCWM practice since the COVID-19 pandemic in a selected healthcare facility. This approach enabled researchers to focus on understanding participants' lived experiences, perceptions, and the meanings associated with managing healthcare waste under pandemic conditions, which cannot be explored through a quantitative approach.

The study was conducted at a healthcare facility located in Male', the capital of the Maldives, where patient turnover ranged from 60 to 250 during the COVID-19 pandemic. Purposive sampling was used to select participants directly involved in HCWM processes. A total of 8 participants, including nurses and waste handlers, were selected, based on pre-defined inclusion criteria that emphasized direct engagement in healthcare waste handling and management. 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. This approach facilitated rich, detailed data relevant to the study objectives. All interviews were audio-recorded with consent, transcribed verbatim, and analyzed using thematic analysis, following the six-step framework proposed by Braun and Clarke (2006). This systematic approach enabled the identification of key themes and patterns, thereby allowing a coherent narrative to be developed in alignment with the study's aims and objectives.

3.1 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's results led to important recommendations for leadership to develop regulations and SOPs for 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 characteristics of the participants.

Table 1: Classification of 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

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 'Organizational 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 in the proper and safe handling of HCW to avoid the spread of infections, prevent accidental injuries, and minimize 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) collects 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 minimize 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: Organizational 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 minimize 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 and supervising HCWM practices and in guiding staff toward 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 adequate resources have 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 in proper segregation among some waste handlers result in mixing different categories of waste when collected 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 in the hospital, due to infrastructure and resource constraints, remains a significant challenge for maintaining safe practices in 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 of the HCWM process, as it is a fundamental intervention for developing a robust 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).

Similarly, 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 raising staff awareness of the importance of adhering to guidelines encourage safe handling and proper practices 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 must ensure, to ensure staff adopt and maintain best-practice techniques at all times (WDR, 2022). This study confirms that participants had several concerns that could have led to inappropriate HCWM in the selected HF before the COVID–19 pandemic. The participants also highlighted and shared their knowledge of improvements and significant changes to HCWM practices since the outbreak, as well as how staff were encouraged to maintain proper techniques for handling HCWs.

Changes have been observed since the COVID-19 outbreak, resulting from the critical steps taken by the selected healthcare facility to establish an effective HCWM system. However, 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, during transportation, and for adequate storage, as well as sufficient support for conducting 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 categorizing of waste help prevent health risks and minimize accidental injuries. This finding is similar to that of Khan et al. (2019), who noted that separating waste is the most valuable step in proper HCWM. Moreover, Zand et al. (2022) agreed that researchers argued that an adequate supply of resources, staff training, colour-coded systems, 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) emphasized that mixing different categories of waste and transporting them in an uncovered vehicle can double the risk of environmental damage. This finding is consistent with previous studies, which strongly suggest that careless handling of waste poses health risks and raises environmental concerns (Ben Jmaa et al., 2023). The COVID-19 pandemic crisis influenced healthcare providers to allocate a separate space for waste storage. As such, the selected HF has designated a closed area for waste collection since the outbreak. In their study, Sarkar et al. (2022) emphasized the importance of improving hospital infrastructure to ensure staff have adequate space for safe practice. Apart from infrastructure, significant changes in organizational culture have been achieved by appointing a designated person to oversee overall HCWM practices across the facility. Ben Jmaa et al. (2023) believed that assigning a separate person as a focal point to supervise enhances proper HCW management.

The study's findings highlighted that a lack of training, awareness, and education, along with resource shortages 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 in HF remain a significant 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 healthcare event, including the management of HCWs (HPA, 2024; Ministry of Health, 2020).

6.0 Conclusion and recommendations

This study is based on a single health facility with a limited sample size, and the outcome cannot be generalized to the broader concerns of HCWMP across the wide range of HF established throughout the Maldives. Given the different contexts in other HF, the outcomes of this study may not be generalizable to other settings. For instance, geographical differences, resource availability (such as treatment options), human resources, and training and awareness may differ between institutions.

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 for further improving and ensuring safe practice in managing HCW. To strengthen the overall HCWM system, future research can focus on other facilities and incorporate broader perspectives from leadership and policymakers to understand the challenges to effective HCWMPs better and address them.

In conclusion, the findings emphasise that a proper storage area, coupled with facilities to properly treat HCW, results in reduced health risks while minimising the environmental impact of inappropriately handled waste. As highlighted by Ul Ain et al. (2023), the availability of these facts in HFs positively impacts the establishment of a well-managed HCWM system.

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Paper Contribution to the Related Field of Study

The findings of this study provide valuable insights for healthcare settings, policymakers, and those involved in HCWM across hospitals/health facilities.

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