

Title: Assessment of Hospital Waste Management Practices in Government and Private Tertiary Hospitals in Dhaka, Bangladesh

Abstract

Hospitals in Bangladesh grapple with inadequate waste disposal systems and a lack of effective waste management policies, posing substantial health and safety risks to patients and healthcare workers. This study aimed to evaluate hospital waste management practices in both a government institution, Shaheed Suhrawardy Medical College & Hospital (ShSMCH), and a private tertiary hospital, Bangladesh Medical College (BMCH), located in Dhaka, Bangladesh. A cross-sectional survey was conducted, involving 217 participants chosen via convenience sampling. The study utilized a semi-structured questionnaire comprising sections on sociodemographic information, general institutional characteristics, waste management practices, and the implementation of UN-WHO HCWM (United Nations-World Health Organizations Health Care Waste Management) Rapid Assessment Tools.

Results revealed that a majority of participants (96.4% in ShSMCH and 100% in BMCH) reported practicing waste segregation based on waste category, with 97.4% mentioning the shredding of plastic syringes after use in both hospitals. Additionally, 82% of respondents in ShSMCH and 51.3% in BMCH indicated the maintenance of hospital waste records at their workplace. Most respondents (87.1%) across both hospitals were vaccinated against Tetanus and Hepatitis B. Training on Hospital Waste Management (HWM) was reported by 69.8% in ShSMCH and 29.5% in BMCH. The study further assessed the level of practice in waste management, revealing that 58.3% of respondents in ShSMCH and 89.7% in BMCH demonstrated a good level of practice. Significant associations were observed between the level of practice and age group ($p = .002$) and professional status ($p < 0.001$). Overall, waste management practices were rated as good in ShSMCH and average in BMCH.

Both public and private hospitals encountered challenges including insufficient logistics, funding, training, and policy frameworks. The study recommends the establishment of trained waste management teams, infection control committees, and the formulation of clear guidelines and instructions to enhance the current waste management situation.

Key Words: Hospital waste management, healthcare workers, Bangladesh.

1. Introduction

Medical waste refers to all waste generated from healthcare or diagnostic activities, specifically originating from diagnostic, monitoring, therapeutic, preventive, or palliative procedures conducted in human and veterinary medicine settings. It also encompasses any solid or liquid waste produced during treatment or immunization of humans or animals, scientific research related to these procedures, or the production and testing of biological substances ¹⁻³.

As per WHO guidelines, medical waste is categorized into general medical waste, akin to household waste, and hazardous medical waste, which poses potential health risks (References 4–6). Hazardous medical waste includes infectious materials, pathological materials, sharps, pharmaceuticals, chemical substances, waste with heavy metal content, pressurized containers, and radioactive materials ⁴⁻⁶. Hazardous medical waste includes infectious materials, pathological materials, sharps, pharmaceuticals, chemical substances, waste with heavy metal content, pressurized containers, and radioactive materials ^{7,8}.

Globally, an estimated 7-10 billion tons of waste are generated annually, with only around 2 billion metric tons constituting municipal solid waste, leaving the majority as medical waste ⁹. A WHO assessment in 22 developing countries revealed that 18% to 64% of healthcare facilities did not adhere to proper waste disposal methods, and nearly 80% of medical waste was combined with other waste types in developing nations ^{9, 10}. Worldwide, approximately 2.2 million individuals succumb to workplace-related diseases and injuries each year, while 170 million suffer serious nonfatal injuries ¹¹. In Bangladesh, it's estimated that annually, 5.2 million people, including 4 million children, perish due to diseases associated with improper waste management ^{12,13}.

In Bangladesh, a study conducted in 2012 concluded that many healthcare establishments lacked a standard waste management policy or plan, had no formal waste handling procedures, and did not provide pre-treatment of hazardous waste before disposing of it in nearby recycling bins ¹⁴. Another study conducted in Bangladesh found that improper oversight by the hospital administrative authority concerned was one of the major factors along with lack of awareness, inadequate supply of equipment such as waste bins, protective gear, unhygienic materials e.g., non-disposable gloves or contaminated packaging are responsible for the poor waste disposal systems ¹⁵. Proper and efficient medical waste management is imperative during healthcare services

provision, as improper disposal can lead to the transmission of diseases such as hepatitis B, hepatitis C, HIV/AIDS, and other viral infections ¹⁶.

In Dhaka, with its rapid population growth, improper medical waste management poses severe health and environmental threats. Incorrect handling of infectious waste can endanger healthcare workers, patients, waste handlers, and visitors, underscoring the necessity for correct storage, handling, and disposal methods to prevent the spread of diseases like AIDS and hepatitis ¹⁷.

Despite numerous studies in Dhaka, limited research exists in tertiary hospitals. Hence, conducting an extensive investigation to gather baseline data is crucial for the formulation of healthcare waste management rules, regulations, guidelines, and policies in Dhaka. This study aimed to assess the current state of hospital waste management practices, covering waste generation, segregation, collection, transportation, storage, treatment, and disposal in both tertiary private and government hospitals in Dhaka.

2. Methodology

2.1 Study design and settings

A cross-sectional survey was conducted to assess hospital waste management practices in a tertiary private and government hospital in Bangladesh from July 1st, 2019, to December 31st, 2019. Shaheed Suhrawardy Medical College Hospital, Dhaka, with 375 beds, ranks third among government-run hospitals, and Bangladesh Medical College Hospital, Dhanmondi, Dhaka, regulated by the Directorate General of Health Services (DGHS), has 300 beds. Eligible participants included doctors, nurses, medical technologists, and sanitation staff (ward boys, aya, cleaners/sweepers) with a work tenure exceeding six months.

2.2 Study population and sampling

Participants were selected from Shaheed Suhrawardy Medical College Hospital and Bangladesh Medical College Hospital using convenience sampling methods. This approach was chosen for its practicality in enrolling willing participants based on their accessibility. The sample size of 217 individuals was determined based on the existing pool of healthcare workers at the chosen hospitals, with a 10% allowance for potential non-response or incomplete responses.

2.3 Data collection procedure

Data collection involved face-to-face interviews using a semi-structured questionnaire and Rapid Assessment Tools (RAT). The questionnaire, adapted from the UN-WHO HCWM Rapid Assessment Tool, comprised 20 questions assessing hospital waste management practices. Practices were scored arbitrarily, with "1" denoting a correct answer and "0" for incorrect

responses, categorized into Poor (≤ 7), Average (8-14), and Good (≥ 15) practice scores. The questionnaire was pre-tested on 15 respondents in Bengali, modified accordingly, and used for data collection after finalization. Prior to data collection, participants were briefed about the study's objectives.

Hospital waste materials were identified and segregated in different colored containers, as per "Medical waste (Management & Handling) Rules-2008" ¹⁸as follows Black - Non-hazardous / general waste. These categories are as follows: Yellow denoting hazardous waste, Red for sharps waste, Blue representing liquid waste, Green for reusable/recycled general waste, and Silver indicating radio-active waste. During data collection privacy was maintained, and respondents were assured about the confidentiality of the information provided by them.

2.4 Ethical consideration

Ethical approval of the study was obtained from the ethical committee of AFMI (Armed Forces Medical Institute). Permission for data collection was taken from the administrative head of Shaheed Suhrawardy Medical College Hospital, Dhaka and Bangladesh Medical College Hospital, Dhanmondi, Dhaka. Written informed consent was taken from each respondent. Information of the participants was kept confidential and was not used for any other purpose except research.

2.5 Data analysis

Data analysis was done by Statistical Package for Social Science (SPSS) V.23 and excel V.13. Descriptive statistics were calculated using means and standard deviation for continuous variables while frequencies and percentages were calculated for categorical variables. Chi square (χ^2) test were carried out for inferential analysis.

3. Result and discussion:

3.1 Socio-demographic and professional information of respondents

Overall, BMCH demonstrated a higher level of practice in Hospital Waste Management (HWM) at 89.7% compared to ShSMCH at 58.3%. Among the 139 distributed surveys in ShSMCH, respondents had a mean age of 32.84 years (SD ± 9.14). Females comprised 72.7% of respondents in ShSMCH and 48.7% in BMCH. Finding was similar to studies to Musa et al ¹⁹, Nagaraju et al ²⁰, and Woromogo et. al ²¹ and equal percentage of both male and female found in the study conducted by Chudasama et. al ²².

This could be attributed to the current study's exclusive focus on two hospitals compared to broader studies conducted across multiple Indian hospitals.

Females comprised 72.7% of respondents in ShSMCH and 48.7% in BMCH. In ShSMCH, nursing (39.6%) was the most common profession, while in BMCH, doctors (34.6%) were dominant. This finding was dissimilar to study of Rajesh k Chudasama et al. ²², where 123 (43.61%) doctor, 92 (32.62%) nurses, 13 (4.61%) lab technicians and 54 (19.5%) were sanitary staffs. Due to the fact that the present study was conducted exclusively at two hospitals, in comparison to the previous study that was conducted in multiple hospitals in India, this difference of finding was caused.

More than half of the responders had less than five years of service experience, and most of them cited mutilated or shredded syringes following usage as evidence of HW segregation. in both hospitals. During the generation of syringes, disposable needle cutters should be used to mutilate them after use so that those can be reused ²³. Half of those who responded to ShSMCH (49.6%) mentioned that the hospital waste is stored in colour-coded containers, and 70.5% of those who responded to BMCH mentioned that hospital waste is stored in plastic dustbins with lids, where ShSMCH said the hospital waste is collected from the department three times daily. This study is nearly identical to Rajesh K Chudasama et al. (2013) ²² study conducted in India, where 247 people (87%) used proper storage facilities for collecting workplace hospital waste. Study conducted by Wazir M. et al (2005) ²⁴, demonstrated that sweepers in CMH Rawalpindi collect waste twice daily in the morning and in the evening. Dehghani MH et al. (2008) conducted another study in Iran with waste collected three times daily, at the end of each shift ²⁵. Proper management of waste in hospital wards is crucial for ensuring a safe and hygienic healthcare setting. In order to adhere to infection control protocols, maintain safety standards, address environmental issues, and comply with regulations, it is highly recommended that waste from hospital wards be collected on a daily basis or as often as deemed necessary ^{26,27}.

Over half of respondents (51.3%) in BMCH indicated that waste records are not kept at their workplaces. The only hospital records not available for injuries related to HWM were mentioned by 25.2% in ShSMCH and by 17% in BMCH. According to Rajesh K Chudasama et al. (2013) ²², the present study conducted in India found that (82.6%) didn't know if there were any records of injuries resulting from heavy equipment. A higher percentage of respondents in BMCH had

been vaccinated against Tetanus and Hepatitis B than in ShSMCh, and two thirds of respondents had undergone training regarding hospital waste management.

[Please insert Table 1 near here]

3.2 Distribution of Hospital workers by level of practice on HWM and characteristics

Table 2 illustrates that ShSMCH had average (41.7%) and good (58.3%) HWM practice levels, while BMCH had a higher proportion (89.7%) with good HWM practice.. Almost the same outcome was found in a study conducted in Ethiopia by Deress T et al. (2013) who found that (77.4%) health care workers practiced at a good level or adequate level ²⁸. Healthcare facilities should implement safe healthcare waste management practices through the prevention of hazardous medical waste generation as one of their overall objectives. Accumulation of medical waste in hospitals, however, indicates that healthcare waste management (HCWM) does exist, but that it is not properly implemented or developed.

In respect of age group, it was found that no age group had poor level of practice. Majority of health workers of 29 to 38 years age group (79.2%) and above 39 years (75.8%) had good level of practice. In respect of professional status, it was found that all medical technologist (100%) had good level of practice. Almost all the respondents from doctor and medical tech had good level of practice rather than the others. These differences of practice level on (Hospital Waste Management) HWM were statistically significant by age and profession which is similar to a study conducted in Bhutan ²⁹. This is because, when a health worker ages, he or she will generally gain more experience and gain more knowledge in their careers ³⁰.

[Please insert Table 2 near here]

3.3 Assessment of HWM using UN-WHO HCWM Rapid Assessment Tools

The following results were obtained using the Rapid Assessment Tools (RAT) of WHO: (1) profile of the (a) health care facilities in terms of services, beds available, bed occupancy, and outpatient admissions, and (b) medical staff in regards to HCWM training, awareness, vaccination, and staffing; (2) Results of HCWM practices reports from the respondents in terms of generation, segregation and handling, storage containers, storage areas, collection and on-site transport, off-site transport, treatment, final disposal, regulations, policy and budget, and

sanitation and wastewater, as shown in table 3 and table 4. The waste generated by both hospitals is general, recyclable, infectious, sharps and pharmaceutical.

Study results revealed that the amount of waste generated in ShSMCH was 1.09kg/bed/day and in BMCH, it was 1.48kg/bed/day. Similarly, the rate of waste generation is comparable to that observed in developing countries with a total hazardous waste generation rate of around 0.85 kilograms per bed per day, and also in Iran with a rate of 4.45 kg per bed per day ^{31,32}. This rate is contradicted with some other studies conducted in Taiwan where estimated daily waste generation rate at NTUH was 4,600 kg/day and in Serbia where the average annual waste generation per institution at secondary healthcare level amounted to 29,606.71 kg and at tertiary healthcare level amounted to 73,419.49 kg ³³.

The decrease in waste generation might be directly related to a more effective waste management system. The amount of medical waste generated by hospitals located in large communities and providing tertiary care is greater than that produced by hospitals in smaller, less populated areas, and so the number of healthcare services users and medical waste produced are directly proportional to the number of inpatient days. Furthermore, statistical testing revealed a significant association between the type of hospital and pharmaceutical waste generation ³³.

*****[Please insert Table 3 near here]*****

The UN-WHO HCWM Rapid Assessment Tools indicate that the overall state of waste management is good (weighted result of 63%) and that BMCH is average (weighted result of 58%) where ShSMCH excelled in the following areas: staff and training, equipment for waste handling, waste storage, HCW collection, onsite and offsite transport, particularly with the use of the City Corporation for general garbage collection and Hazardous medical waste has been handled with precision by PRISM and commendable efforts have been made in handling, separating and disposing of waste. Similarly, according to study participants in Botswana's tertiary hospitals, waste management is often poor and they are rarely involved in making waste handling policies ³⁴.

*****[Please insert Table 4 near here]*****

Among the main factors that correlate to the better quality of medical waste management, the particularly important ones are: the number of beds, the number of hospital days, the number of outpatient services and the number of trained professionals for HCWM³³. Providing high quality services to the community is the main responsibility of health care establishments; this cannot be accomplished without a proper waste handling policy that meets international regulations.

Waste handling equipment, hazardous medical waste collection, onsite and offsite transport were among BMCH's strongest pursuits, in particular through City Corporation's garbage collection and PRISM's hazardous medical waste collection. Personnel involved in handling healthcare waste should familiarize themselves with the main categories of healthcare waste, as defined in national or local regulations on waste classification, and with safe disposal procedures³⁵. Thus, it is extremely important to provide special training within the healthcare waste management sector, including medical waste management topics, in order to improve HCWM's capacity for safe management.

This study underscores the critical need for implementing comprehensive waste management policies and educational initiatives to ensure effective waste segregation, storage, and disposal within healthcare settings. Conducting specialized training sessions for healthcare professionals can significantly enhance their understanding and implementation of proper waste management practices. Addressing discrepancies in waste generation rates among different hospitals calls for tailored resource allocation based on each facility's size and type. Collaborative efforts between healthcare institutions, city corporations, and waste management agencies are essential for successful waste management strategies. The research emphasizes successful collaborative areas, offering a model for other hospitals to emulate. Implementing proper waste management practices, including eco-friendly disposal methods and recycling initiatives, holds promise for substantially reducing the environmental impact of medical waste.

The study's strength lies in its comprehensive evaluation of waste management practices in both government and private tertiary hospitals in Bangladesh. With a robust sample size of 217 participants and employing a cross-sectional design, this research yielded reliable data on waste management practices. Diverse perspectives within the healthcare sector, represented by various professionals such as doctors, nurses, and support staff, enriched the study. The utilization of UN-WHO HCWM Rapid Assessment Tools alongside a semi-structured questionnaire ensured systematic data collection with credibility. Moreover, ethical considerations, including proper approvals and informed consent, upheld the study's rigor and credibility.

However, this research has several limitations. The cross-sectional design restricts establishing causal relationships or assessing temporal changes between variables. Additionally, convenience sampling may introduce selection bias, potentially affecting the generalizability of findings to broader populations. Reliance on self-reported data might introduce response bias and recall errors among participants. Focusing solely on two hospitals within a specific region might limit the generalizability of these findings to diverse healthcare settings globally. Moreover, calculating sample size based on a single population proportion formula overlooks the heterogeneity among healthcare workers across different contexts.

4. Conclusion

Both hospitals demonstrate satisfactory practices in segregating, collecting, and transporting waste on-site. However, concerns arise regarding the security of temporary storage areas and containers, which lack proper safeguards against unauthorized access. Additionally, both hospitals dispose of wastewater and hazardous liquid waste directly into sewer systems, lacking designated systems for handling these waste types. Importantly, neither hospital maintains records of injuries related to hospital waste, highlighting the absence of a reporting mechanism for such incidents. Inadequate maintenance of waste records at the workplace and insufficient reporting activities further underscore areas for improvement.

Government hospitals offer satisfactory training programs for staff in hospital waste management, whereas private hospitals lag behind in providing comprehensive training opportunities. Both hospitals ensure staff vaccinations for Hepatitis B and Tetanus, alongside supplying personal protective equipment by waste management authorities.

Effective waste management necessitates adequate supplies and equipment across all hospital departments. The establishment of an injury reporting mechanism within hospitals is imperative. Additionally, to promote and reinforce Hospital Waste Management (HCWM) regulations and procedures, it is essential for government hospitals to prominently display safety reminders, posters, and related policy statements. Budgeting and planning HCWM facilities should be integral components of short- and long-term operational plans for both hospitals and local government units. These efforts will facilitate the establishment and maintenance of compliant HCWM initiatives, ensuring the availability of necessary personnel, supplies, materials, and equipment.

A strict monitoring framework and adherence to standard rules throughout the waste management process—starting from waste generation, collection, handling, temporary storage, transport, to final disposal—are crucial. These measures are essential for preventing injuries, infections, contaminations, and health risks associated with improper waste management practices.

Declaration of interest

The authors declare that they have no competing interests.

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Informed Consent Statement

Written informed consent was obtained from all subjects.

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Author Contributions

MAKM: Conceptualization, Research design & Methodology, Writing- Original draft preparation. MTA: Research design, Writing- Original draft preparation, Reviewing, and Editing. AF and MMH: Visualization, Validation and Writing- Reviewing & Editing. ZAA: Formal analysis, Writing- Original draft, Reviewing & Editing. MSR: Visualization, Validation and Writing- Original draft. MAT, ASR & AS: Writing- Original draft, Editing & critically revised the manuscript for intellectual content. The submitted version of the manuscript has been read and approved by all authors.

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