Evaluating Medical Waste Management Practices in Health Institutions within the Rajshahi City Corporation, Bangladesh

ABSTRACT

This research delineates the present condition of the medical waste management system within health institutions in Rajshahi City Corporation, Bangladesh. This study aims to investigate the current methodologies employed in the management of medical waste and to evaluate the processes of waste disposal within health institutions located in Rajshahi City Corporation (RCC). The data were gathered through the utilization of questionnaires, site visits, electronic devices, and comprehensive interviews. This survey was undertaken to examine the attributes of six hospitals, namely Rajshahi Medical College and Hospital (RMCH), Islami Bank Medical College and Hospital (IBMCH), Barind Medical College and Hospital (BMCH), Udayan Dental College and Hospital (UDCH), along with Popular Diagnostic Center and Royal Diagnostic Center within RCC. The hospitals under consideration were observed to produce 870 kg of medical waste per day, with approximately 85.57% classified as non-infectious and merely 11.43% deemed infectious. The research revealed deficiencies in workforce availability, technical expertise, and financial resources within hospitals concerning waste management practices. The current study emphatically suggests methods to enhance the awareness of individuals engaged in the collection and disposal system.

KEYWORDS

Medical waste, Management, Health institutes, Rajshahi City Corporation.

INTRODUCTION

In the context of Bangladesh, a country characterized by rapid population growth and an expanding healthcare sector, the management of hospital waste presents multifaceted challenges. This doctoral research aims to provide a comprehensive analysis of the hospital waste management system, addressing the gaps in existing literature and contributing to the development of sustainable practices within the healthcare sector.

Hospital waste management is a critical fact of healthcare infrastructure, integral to public health and environmental sustainability. World Health Organization (WHO) has marked medical wastes as special wastes and it is now commonly acknowledged that certain categories of medical wastes are among the most hazardous and potentially dangerous of all wastes arising in communities (Sawalem et al., 2009), as exposure to hazardous and infectious medical waste can result in disease or injury.

In 2002, the World Health Organization (WHO, 2002) conducted research in twenty-two developing countries, revealing that the prevalence of healthcare facilities failing to adhere to proper hospital waste disposal procedures ranged from 16% to 62% (WHO, 2005). In developing

countries, medical waste is often not regarded as a critical issue. In numerous nations, domestic refuse is often combined with medical waste, which poses significant hazards to both public health and the environment. However, in numerous nations, there exists a more or less systematic approach to waste collection methodologies. In Bangladesh, various research endeavors have been undertaken across multiple institutions, focusing on diverse facets of waste management systems. Significant contributions to the field of medical waste management systems across various medical colleges include the study by Akter et al. (1999), which focuses on hospital waste disposal practices in Bangladesh. Syed et al. (2012) conducted a study on the management of medical waste in Dhaka, Bangladesh, while Alam et al. (2013) focused on the same topic within the Rajshahi City Corporation. Additionally, Datta et al. (2017) examined the management of medical waste specifically in Rajshahi city, Bangladesh. Haque and colleagues (2021a, 2021b, 2021c) conducted a study on the management of medical waste across various medical colleges and hospitals. The present study is an ongoing task to explore the present practices of health waste, and assessment of waste disposal in a few hospitals in Rajshahi City Corporation. Also to recommend the technique this is certainly efficient of the waste management system.

METHODOLOGY

The research methodology was adapted under the approach utilized by Oweis et al., (2005). This research encompasses genuine field observation and the collection of data at the field level through a questionnaire survey, inventory, and personal interviews conducted in both formal and informal manners. Before engaging with the chosen Healthcare Institutes, the study group sought to obtain authorization from the relevant hospital authorities. The medical waste from various wards is initially categorized based on its types, followed by the weighing of the waste materials. Throughout the data collection phase in hospitals, we dedicated considerable time to engaging with chosen ward masters, waste collectors, nurses, and cleaners to compile a comprehensive report.

Time & Place

The research initiative was conducted from July 2022 to January 2023. The notable healthcare institutions situated within the Rajshahi City Corporation (24°22′26″N 88°36′04″E), in Rajshahi, Bangladesh, encompass Rajshahi Medical College and Hospital (RMCH), Islami Bank Medical College and Hospital (IBMCH), Barind Medical College and Hospital (BMCH), Udayan Dental College and Hospital (UDCH), along with Popular Diagnostic Center and Royal Diagnostic Center, Rajshahi, which were chosen for this research.

RESULTS

The volume of waste produced in health institutes is influenced by a multitude of factors, including the number of available beds, the range of medical services offered, the economic, social, and cultural backgrounds of the patients, as well as the overall condition of the surrounding environment in which the hospital operates. The total amount of waste generated per day from different wards in the selected hospitals is presented in **Table 1**. The findings show that Rajshahi Medical College and Hospital generates a total of 478kg/day of waste, of which 325.04kg/day is general waste, 47.8kg/day is recyclable waste and 105.16kg/day is pathological waste. Islami Bank Medical College and Hospital generate a total of 76.9kg /day of waste, about 52.29kg/day is general waste, 9.23kg/day is recyclable and 15.38kg/day is pathological waste. Barind Medical College and Hospital produces a total waste of about 189kg/day, of which 130.41kg/day is general waste, 18.9kg/day is recyclable and 39.69kg/day is pathological waste. Udayan Dental College and Hospital generates a total of 31.1kg/day of waste, of which 20.21kg/day is general waste, 1.56kg/day is recyclable waste, and 9.33kg/day is pathological waste. Royal and popular diagnostic Centre generates 22.5kg/day and 30kg/day of total waste, from which 15.08kg/day and 17.1kg/day are general wastes, 1.8kg/day and 2.4kg/day are recyclable waste, 5.62kg/day and 10.5kg/day are pathological wastes.

Table 1: Amount of waste (per day) generated in different wards among surveyed hospitals.

Hospital Name	No of bed	The total amount of waste in kg			
		General waste	Recyclable waste	Pathological waste	Total
Rajshahi Medical College Hospital (RMCH)	340	325.04	47.80	105.16	478.00
Islami Bank Medical College Hospital (IBMCH)	115	52.29	9.23	15.38	76.90
Barind Medical College Hospital (BMCH)	175	130.41	18.90	39.69	189.00
Udayan Dental College Hospital (UDCH)	42	20.21	1.56	9.33	31.10
Royal Diagnostic Centre	20	15.08	1.80	5.62	22.50
Popular Diagnostic Centre	25	17.10	2.40	10.50	30.00

The average amount of waste per bed per day of selected wards are calculated and presented in Table 2. It shows that RMCH generate 1.41kg/day/bed of wastes, where the bed number is 340. In IBMCH generate 0.69kg/day/bed, where the bed number is 115. BMCH produce 1.08 kg per day per bed, where the total bed number is 175. In UDCH generate 0.74kg per day per bed,

where the bed number is 42. Popular and Royal Diagnostic Centre generate 1.20kg/day/bed and 1.12kg/day/bed, where the number of beds is 25 and 20.

The amounts of different types of waste in different institutes in percentage are shown in Fig. 1. It shows that 70% of wastes are general wastes, more than 22% are pathological wastes, and only 8% of recyclable wastes among the total wastes.

Table 2: Waste generation rate per bed, per day from the selected ward in surveyed hospitals.

Hospital Name	Waste generation rate		
	No of bed	Kg/day	Kg/day/bed
Rajshahi Medical College Hospital(RMCH)	340	478	1.41
Islami Bank Medical College Hospital (IBMCH)	115	76.9	0.69
Barind Medical College Hospital (BMCH)	175	189	1.08
Udayan Dental College Hospital (UDCH)	42	31.1	0.74
Royal Diagnostic Centre	20	22.5	1.12
Popular Diagnostic Centre	25	30	1.20

Medical Waste accounts for a very tiny fraction, about one percent of the total solid waste generated in Bangladesh. However, when this small quantity is not handled properly, it gets mixed with household solid waste, and the whole waste stream becomes potentially infectious.

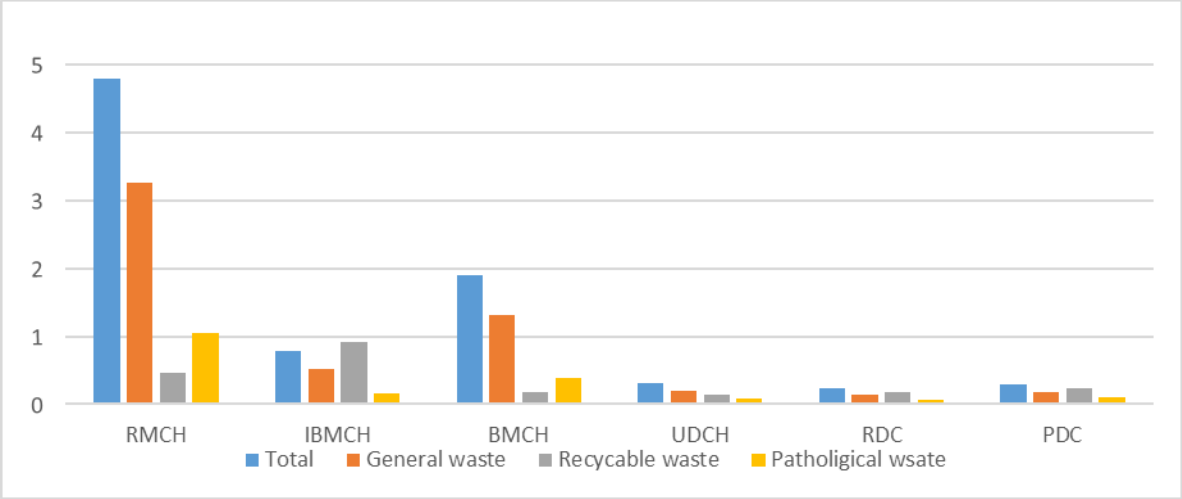

Fig 1: The percentage Waste products in the surveyed hospitals.

Segregation of Hospital Waste:

It was found in different surveyed institutes that most of them maintain a segregating system of different waste. But where it was not maintained they were requested to maintain this procedure. Implement of color-coding system for waste bins to facilitate easy and effective segregation. Different colors represent various categories of waste (Fig 2). For example:

Fig 2: Different types of waste containers found in the surveyed hospitals. (Red: Infectious waste, Yellow: Sharps and pathological waste, Blue: Pharmaceutical and chemical waste, and Green: Non-hazardous general waste.)

Waste collection and disposal:

Medical waste generated in the hospital was collected daily by hospital staff and transported to temporary storage by RCC and PRISM Bangladesh staff. Wheeled trolleys and carts were used for on-site transportation from the site of production to the temporary storage area. Collectors and workers handling waste were rarely seen wearing protective boots, masks, and gloves.

The place where the hospital waste is kept before transporting to the final disposal site is termed as a temporary waste storage area. This area must be well-sanitized and secured in a such a way that is should be accessible only to authorized persons (Pruss et al., 1999).

There are many ways to final disposal. Such as…

- Landfill
- Burning inside primases
- Discharge into sewer

The final disposal waste is done by RCC and PRISM Bangladesh authority (Table 3). Medical waste collected every day by RCC and PRISM Bangladesh pickup van due to hazardous nature. Every day early morning, the collected waste is finally dumped by RCC and PRISM Bangladesh registered workers to these sites. The work schedule of waste collection and dumping in different institutes is presented in **Table -3**.

Table 3: The treatment of wastes from the surveyed hospitals.

Hospital Name	Treatment and Disposal	Collection Frequency
Rajshahi Medical College (RMCH)	Incineration	Two days per week
Islami Bank Medical College Hospital (IBMCH)	Waste collected and disposed of by PRISM Bangladesh vehicles	Everyday
Barind Medical College Hospital (BMCH)	Waste collected and disposed of by RCC vehicles	Everyday
Udayan Dental College Hospital (UDCH)	Waste collected and disposed of by PRISM Bangladesh vehicles	Everyday
Royal Diagnostic Centre	Landfill	One day per week
Popular Diagnostic Centre	Landfill	One day per week

DISCUSSION

In Bangladesh, several significant studies on waste management elucidate the following findings. Akter et al. (2005) conducted a comprehensive survey on the management of medical waste within the Rajshahi City Corporation. A total of 8 hospitals, 47 clinics, and 22 diagnostic centers were meticulously observed within the RCC area, as documented in the RCC register. The volume of medical waste gathered by the RCC ranged from 2 to 2.5 tons per day. However, this research indicates that the quantity is approximately 4 to 4.5 tons per day.

Alam et al. (2013) investigated the management of medical waste. The study aimed to delineate the various categories of waste, evaluate their generation rates, and critically assess the current waste management practices across different healthcare establishments. The study was conducted across 14 distinct HCEs that contributed significantly to the generation of MW. The surveyed healthcare establishments were found to produce a total of 1495 kg/day of medical waste; of this amount, approximately 1328.6 kg/day (88.87%) is classified as non-infectious, while around 166.4 kg/day (11.13%) is deemed infectious. The mean waste generation rate for the surveyed healthcare establishments is 1.54 kg per bed per day, or 0.30 kg per patient per day. It was also noted that there exists a lack of proper and systematic management regarding medical

waste. Their research indicates that insufficient awareness, financial backing, and readiness contribute to the inadequate management of municipal waste.

Earlier, a similar observational study was undertaken by Haque et al. (2021) in the city of Rajshahi. The study's findings revealed that certain hospitals have implemented a systematic approach to color coding, segregation, and treatment, particularly in areas where PRISM Bangladesh oversees waste management. While the hospital waste management authority and PRISM Bangladesh endeavor to adhere to WHO standards, there exists a degree of deviation from the established guidelines. The staff at the hospital exhibit a limited understanding of the appropriate disposal methods. While a portion of the waste collectors don safety masks, the majority neglect to do so. It is noteworthy that there appears to be a scarcity of waste collectors equipped with hand gloves, boots, and appropriate safety attire. It has also been observed that certain waste collectors are transporting waste in buckets instead of utilizing the designated color-coded containers. The waste collectors from all hospitals ought to utilize trolleys for the transportation of waste; however, there are instances where they resort to carrying and transporting the waste by hand. The personnel at the hospital require enhanced training and a comprehensive understanding of clinical waste and its management practices.

The hospital ought to adhere to the WHO guidelines regarding color coding and segregation practices. Temporary storage is distinctly allocated for general waste and hazardous waste. PRISM Bangladesh oversees the management of treatment and disposal processes of hospital waste (PRISM Bangladesh, 2005). The incineration method is employed for treatment purposes. Medical waste is incinerated merely twice a week. They will endeavor to adhere to the guidelines set forth by the WHO with precision. General waste generated by the hospital is directed to the open dumping site.

Waste Segregation: Segregation is very useful since it prevents the contamination of non-hazardous waste by infectious waste and makes the whole waste stream hazardous. Thus, this technique will decrease the toxicity and the volume of the waste stream. Moreover, segregation makes it easier to transport medical waste from the hospital to the final disposal site. Waste is segregated depending on the amount, composition, and disposal system of the waste stream.

Separating Different Categories of Medical Wastes: In hospitals infectious waste, pathological waste, and sharps waste are placed in different colored containers. The containers are marked as biohazard, closed, watertight, and of uniform color for each type of medical waste throughout the hospital. The size of the containers depends on the volume of waste produced and the containers used are easy to handle and transport to disposal sites.

Incineration: This is the process of burning of waste materials in temperatures ranging from 2000°F to 2200°F (1093°C to 1204°C). PRISM Bangladesh burned waste materials in disposal site two days in a week. Before burning waste materials sharps and bottles are segregated from medical waste.

Non-incineration: This waste includes 4 basic processes: thermal waste, chemical waste, irradiative waste, and biological waste. After separating non-incineration from incineration waste treatment technology is to sterilize waste by destroying pathogens.

Autoclaving is also known simply as steam decontamination. It is the most frequently utilized alternative to incineration. This method is less costly and easy. In this method, wastes are disinfected prior to disposal in a landfill. Waste bags are placed in a chamber of machine and steam is introduced for a determined session of time at a specific temperature and pressure. This method presents the destruction of microorganisms. About 88% of regulated medical wastes are suitable for autoclaving, mainly microbiological wastes. Autoclave is not sustainable for pathological waste, cytotoxic waste, or other toxic chemical wastes.

Hazards of Healthcare Wastes:

Risk to the general public: Prospective health effects from exposure to healthcare waste are numerous. Infection can be spread by contact with hospital patient excretions or body fluids contained in the waste. Pathogens can also be transmitted by small animals and insects that come in contact with unsafely stored waste. Mismanagement of healthcare waste is also suspected to contribute to nosocomial hazards when the waste contaminates patient's items.

Risk of the Environment: When medical waste is stored and disposed of on an open place or roadside or river side then that is responsible for environmental pollution. If wastes are disposed of too close to water sources, the water bodies may become contaminated with infectious microorganisms. When medical waste is burned openly that time dioxins, furans, and other toxic air pollutants can be produced. WHO has marked tolerable intake limits for dioxins and furans.

CONCLUSION

In Bangladesh disposal and management of healthcare waste is a concern issue. There is an absence of proper technical support from the government in this sector and needs more investment. Until recently, the management of healthcare wastes has received little attention despite their potential environmental and public health risks. Healthcare waste is infectious and hazardous which is very harmful to animal health. It poses serious threats to environmental and human health and requires specific treatment and management prior to its final disposal of waste. So, it may say that, scientific waste management method is needed to ensure human health and environmental safety. In the recent past medical waste was sometimes mixed with domestic waste and disposed of in municipal solid waste landfills. But recent times, increased concerns over mismanagement of disposal of medical waste have led to a movement to manage the waste more systematically. Efforts have to be made for minimization and recycling of some medical waste prior to final disposal, if not infected or contaminated. Incineration could be used in medical waste treatment until another common treatment system and steam sterilization is available. Sometimes toxic substances such as dioxin emissions at medical waste incinerators should be closely monitored to reduce potential risks to humans and the environment. Other

wastes can be kept in containers that are made of plastic or corrugated cardboard. The absence of awareness, appropriate policy and laws, and apathy are responsible for the mismanagement of medical waste at selected hospitals in Rajshahi City Corporation. There is no doubt that problem in irregular segregation of healthcare waste and general waste is a common problem in medical waste management worldwide. However, it is still important to keep the waste segregation process according to the standard way to establish the safety and health of the people and environment.

RECOMMENDATION

Recommendations for improving hospital waste management systems in Bangladesh, including in Rajshahi City, should address various aspects of waste generation, segregation, collection, transportation, treatment, and disposal. Below are some broad recommendations that can contribute to a more effective and sustainable hospital waste management system in the country:

Strengthen Regulatory Framework: Enhance and enforce existing regulations related to hospital waste management. Regularly update guidelines to align with international best practices and emerging technologies.

Capacity Building and Training: Conduct comprehensive training programs for healthcare professionals, waste management staff, and other relevant stakeholders. The training should cover proper waste segregation, handling, and disposal practices, as well as the use of personal protective equipment (PPE).

Promote Waste Segregation at Source: Encourage healthcare facilities to implement effective waste segregation practices at the source. Provide clear guidelines on color-coded bins for different types of waste, including infectious waste, sharps, pharmaceutical waste, and non-hazardous waste.

Invest in Infrastructure: Invest in the development of waste treatment and disposal infrastructure, including autoclaving and incineration facilities. Ensure that these facilities are accessible to healthcare facilities of varying sizes and capacities.

Implement Innovative Technologies: Explore and implement innovative technologies for waste treatment, such as waste-to-energy systems or on-site sterilization technologies. These technologies can improve efficiency and reduce environmental impact.

Community Engagement and Awareness: Conduct awareness campaigns targeting healthcare professionals, waste management staff, and the general public. Promote the importance of responsible waste disposal practices and the potential health and environmental impacts of improper disposal.

Public-Private Partnerships: Foster collaborations between public health institutions and private waste management entities. Public-private partnerships can enhance infrastructure, resource availability, and the overall efficiency of hospital waste management systems.

Regular Audits and Inspections: Conduct regular audits and inspections of healthcare facilities to ensure compliance with waste management regulations. Provide constructive feedback and support for facilities that require improvement.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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