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Original Research Article

Hospital Waste Management in Dhaka City during COVID-19 Pandemic

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Abstract: ***Background:*** Medical waste has received less attention in underdeveloped nations like Bangladesh and poses a severe threat to public health. The management of medical waste therefore, has been of major concern due to potentially high risks to human health and the environment. Notwithstanding this, Bangladesh has no standards governing the management of medical waste. As a result, the focus of this research was to gather information about the waste management in several hospitals in Dhaka city, Bangladesh. ***Methodology:*** This descriptive cross-sectional study was conducted among five different types of hospitals in Dhaka to find out the waste management methods of the hospital. Purposive sampling technique was used for selecting the study place. A checklist was used to observe the current medical waste management in all the hospitals. In addition, every hospital's record regarding waste management was reviewed to extract information in this regard. A simple descriptive statistic was applied for data analysis. ***Results:*** The Mean ± SD age for the participants were 26.63± 4.18 years where female (52%) was more than male (48%). Among the participants, the highest (40%) were medical officer and maximum (77.3%) had working experiences ≤ 3 years. According to the checklist, it was found that United and Lab aid hospital had almost all the indicators related to placement of container. In regards to the segregation of wastes according to color code, all the selected 5 hospitals had seen to observe the protocol except liquid wastes. Unfortunately, Al-Basar, Al-Manar and city hospitals' waste handler did not use safety gear during waste transportation despite they were provided safety stuff. ***Conclusion:*** This study concludes that in order to create an effective waste management program, the government should conduct periodic oversight by establishing strong provisions in this regard.

Keywords: Hospital waste, Hospital waste management, Health care providers, Dhaka, COVID-19.

INTRODUCTION

Globally waste management is considered as a matter of serious concern in the health-care sector, as numerous sorts of hazardous wastes or contaminants are generated on a regular basis, and improper disposal of these wastes may lead to critical environmental and occupational health risks which have a potential risk to cause disease or infirmity [1, 2]. It may be possible to categorize environmental and occupational hazards associated with improper disposal of wastes into very few divisions i.e., communicable disease (e.g.,

Gastrointestinal disorders, diarrhea, respiratory infection), non- communicable disease (e.g., Poisoning, hearing defects/loss), injury (e.g., Occupational injury by sharp objects, needles, glasses, metals, wood, violence) and aesthetics (e.g., Odor, visibility, dust) etc. [2].

Mismanagement of hospital waste implies combination of inadequate waste handling during generation, collection, storage, transportation, and treatment. Improper handling includes a variety of dangerous activities, including handling without personal protective equipment (PPE), poor storage (e.g., high temperatures combined with long storage times before treatment), manual transport over longer distances, and the use of open containers rather than closed plastic bags [3].

Disposal of medical waste, on the other hand, may pose severe complications on health indirectly by releasing germs and harmful and noxious contaminants into the environment. For example, if untreated medical wastes are disposed of in poorly planned landfills, it can cause contamination of drinking surface and ground waters. Additionally, if chemical disinfectants are not handled, stored, and disposed of appropriately, using them to treat medical wastes may cause the release of chemicals into the environment. Waste management practices in developing countries such as Bangladesh threaten the environment, public health, and other socioeconomic aspects due to insufficient effective adaptation mechanisms of the country's national waste management policy, a lack of clear standards on the responsibilities of generators and governmental entities, and the subsequent economic incentives; and a lack of consistent and comprehensive solid waste management policies [3]. As such waste management has become a major challenge where the health care staffs and surrounding population i.e., patients and their attendants are exposed to risks that may results in a hospital-acquired infections (nosocomial infections) or occupational health hazards [4, 5].

In Dhaka City, the expanding number of hospitals, clinics, and diagnostic laboratories in order to supply adequate healthcare facilities for the city’s growing population has a significant impact on public health and the environment [6]. Large number of different medical wastes (e.g., sharp and non-sharp metallic items, human body fluids, dressing materials, surgically removed body parts, chemicals, pharmaceuticals, medical devices and radioactive materials, as well as various types of plastics, glass, and other materials) are generated every day, all of which pose a significant risk to doctors, nurses, technicians, hospital visitors, and patients due to amateurish administration [6, 7]. According to the report of Asian Development Bank (ADB) in 2008, hazardous waste inventory, and medical waste contributes to the country's second-largest volume of hazardous wastes. In Dhaka city, about 13.5 tons of medical waste is collected every day from hospitals, clinics, and healthcare facilities (Dhaka South City Corporation and Dhaka North City Corporation). According to a Dhaka South City Corporation report, both Dhaka North and Dhaka South City Corporations collect around 50 tons of total solid garbage everyday [7]. Despite the severe health risks, poor scavengers, women, and children collect some medical waste (e.g., syringe-needles, saline bags, blood bags, and so on) for reprocessing. It has long been known that the re-use of syringes could be a potential cause to spread disorders like AIDS and hepatitis [6]. The collection of disposable medical items (notably syringes), its re-sale and potential re-use without sterilization could result in a significant disease burden [6, 8].

Medical waste management has always been a danger in Bangladesh, even before the COVID-19 situation arose [9]. Medical waste generation in Bangladesh is expected to be roughly 0.5 kg/patient/day in typical conditions. In the COVID-19 circumstance, however, waste output increases to 3.4 kg/patient/day, which is 6.8 times greater than typical. One COVID-19 patient in Bangladesh spends 7–8 days in the healthcare facilities [3]. Failure to implement adequate medical waste management in the COVID-19 issue could jeopardize Bangladesh's biodiversity and wildlife. The medical waste created by this pandemic is projected to have a significant influence on the environment, which Bangladesh has yet to find. Approximately 40,000 informal waste collectors working across the country are at high risk of getting infected by COVID-19 because they work without adequate protection. There might be a serious risk of spreading COVID-19 if the wastes are not segregated according to color code and collected and transported properly. Since the medical waste management with safety measures could be an important way to control the source of infection, standardization, and strict implementation of the management of COVID-19 related medical waste should be placed with careful consideration to reduce the risk of epidemic within the hospitals in Dhaka city.

In 2003, the Directorate General of Health Services (DGHS) launched an operational strategy for hospital waste management in 20 Upazilas as

part of the Health and Population Sector Program (HPSP), which was later expanded to 133 Upazilas' health institutions in order to control the risks of hospital wastes [7]. On the other side, in 2003 PRISM (Project in Agriculture, Rural Industry, Science and Medicine) Bangladesh, a reputed national NGO in collaboration with Dhaka City Corporation (DCC), started to operate medical waste management throughout Dhaka city [6]. Both DGHS and PRISM as the part of medical waste management had launched several programs and provided guidelines. Training for doctors, nurses, and cleaners on proper segregation, collection, storage, and dumping of hazardous parts of hospital waste, waste segregation on color-coded bins, waste collection using trolleys, and provision of protective devices for waste handlers, waste storage in a separate room outside the hospital building, and keeping infectious and sharp materials in a double-chambered concrete pit constructed within the hospital premises for 3-5 years before disposal were among significant of these [6, 10].

Since there are no regulations governing healthcare waste management in Bangladesh [6], there is no government monitoring or evaluation authority in place to keep track of how hospitals are doing with relation to handling medical waste. In order to minimize the spread of infections and lower the risk of injury or harm to personnel, patients, visitors, and the community in general, this study attempted to identify the waste management systems in various hospitals in Dhaka. By doing so, it may be possible to inform the relevant authority about the current situation in this regard.

METHODS

A descriptive cross-sectional, questionnaire-based on survey conducted over 4 months (from September 2021 to December 2021) among healthcare personnel in the selective hospitals in Dhaka, Bangladesh including doctors, nurses, and hospital staffs from different academic background. This study was carried out in five selected hospitals in Dhaka city of Bangladesh and sample size was done by simple random sampling.

Data was collected through observation technique and reviewing hospital record on waste management. An observational checklist was used to extract information on hospitals current waste management system. This checklist had 7 questions on placement of waste according to protocol, waste segregation according to color code, waste collection, waste transportation, waste storage, safety measures, and waste related machineries'

Ethical clearance and research authorization were obtained for this study from all the concerned hospitals. Informed consent was written and submitted to healthcare personnel who have read before agreeing to participate in this study. The ethics committee of the State University of Bangladesh had approved the study.

RESULTS

Table 1: Socio-demographic status of respondents (n=75)

Variables	Category	Frequency	Percentage
Age (in years)	21-25	26	34.7
	26-30	31	41.3
	31-35	18	24.0
	Mean ± SD	**26.63 ± 4.18 years**	
Gender	Male	36	48.0
	Female	39	52.0
Designation	Medical officer	30	40.0
	Nurse	26	34.7
	Ward boy	15	20.0
	Cleaner	4	5.3
Educational status	Class 8	2	2.67
	SSC	7	9.33
	HSC	12	16
	Diploma in nursing	21	28
	Master's	3	4
	MBBS	25	33.33
	FCPS Part-1	5	6.67
Job Experience (in years)	≤ 3 years	58	77.3
	> 3 years	17	22.7
	Mean± SD	**2.307±1.48 years**	
Annual Family income (in BD TK)	<150000-300000	32	42.6
	300001-600000	28	37.3

Variables	Category	Frequency	Percentage
	>600000	15	20.1
	Mean ± SD	**399733.33 ± 242747.357**	
Marital status	Single	39	52.0
	Married	36	48.0
Family members	Up to Four members	57	76.0
	More than Four members	18	24.0
	Mean± SD	**3.55±1.18**	

Table 1 illustrates that out of 75 participants, maximum 31 (41.3%) respondents' age was in the group of 26-30 years and the Mean± SD was 26.63 ± 4.18 years. Among all the participants, female (52%) was higher compared to male (48%) respondents. The highest 40% of participants had the designation of medical officer followed by 34.7% of nurse, 20% of ward boy and 5.3% of cleaner. In regards to the educational status, the outmost 33.33% participants had MBBS degree and the lowest 2.67 % had completed class 8. Besides, 28%, 16%, 9.33%, 6.67% and 4% had diploma in nursing, HSC, SSC, FCPS Part-1 and master's degree, respectively. The maximum 77.3% of study subject had ≤ 3 years of job experience and the Mean ± SD job experience was 2.307±1.48 years. On the other hand, the Mean ± SD for annual family income was 399733.33 ± 242747.357 BD TK where the highest 42.6% of participants' income was <150000-300000 BD TK. In the case of marital status, 52% was single and 48% was married. The maximum 76% of respondents had up to four members in their family where the Mean ± SD was 3.55±1.18 in this regard.

Table 2: Distribution of hospitals according to the status of medical waste management system

Aspects of Monitoring	Indicators / Activities/ Observation	Existing Status				
		United Hospital	Al-Manar Hospital	Al-Basar International Foundation	Lab aid Hospital	City Hospital
Placement of container according to protocol	Placement of different colored container in different places as per need	No	No	No	No	No
	Kept in such distances that easily accessible to patients	Yes	No	No	Yes	No
	Number of containers as per need	Yes	Yes	Yes	Yes	Yes
	Containers are covered properly	Yes	Yes	Yes	Yes	Yes
	Containers are labeled with number	Yes	NO*	Yes	Yes	NO*
	Containers are clean	Yes	Yes	Yes	Yes	Yes
	Surroundings of the containers are clean	Yes	Yes	Yes	Yes	Yes
Segregation of wastes according to color code	Segregated general wastes are in Black container	Yes	Yes	Yes	Yes	Yes
	Segregated hazardous wastes are in yellow container	Yes	Yes	Yes	Yes	Yes
	Segregated sharp wastes are in red container	NO*	NO*	NO*	NO*	NO*
	Segregated recyclable general wastes are in Green container	Yes	Yes	Yes	Yes	Yes
	Liquid wastes are disposed properly	Yes	No	Yes	Yes	No
Waste Collection	Proper planning for waste collection	NO*	NO*	NO*	NO*	NO*
	Wastes are collected according to planning	NO*	NO*	NO*	NO*	NO*
	Collection of same types of waste from different places in same container	No	No	Yes	No	Yes
	Proper recordkeeping for waste collection	Yes	No	No	Yes	No
	Waste collection is properly supervised and monitored	Yes	Yes	Yes	Yes	Yes
	Waste handlers wearing safety dress during waste collection	Yes	Yes	Yes	Yes	Yes
	Waste containers are cleaned regularly	Yes	Yes	Yes	Yes	Yes

Waste Transportation	Trolley is used for waste transportation	Yes	Yes	Yes	Yes	Yes
	Containers are covered properly during transportation	Yes	Yes	Yes	Yes	Yes
	Waste handlers wearing safety dress during waste transportation	Yes	No	No	Yes	No
	Specific rout is used for waste transportation	NO*	NO*	NO*	NO*	NO*
Waste Storage	Specific room for temporary storage	NO*	NO*	NO*	NO*	NO*
	Floor of the store is smooth	NO*	NO*	NO*	NO*	NO*
	Adequate water supply in storage area	Yes	Yes	Yes	Yes	Yes
	Sun light is restricted in storage room	NO*	NO*	NO*	NO*	NO*
	Not accessible for general people	Yes	Yes	Yes	Yes	Yes
	Not nearer to kitchen	Yes	Yes	Yes	Yes	Yes
Safety measure	Protective equipment's are supplied (Boot, Gloves, Apron, mask Etc.) to waste handlers	Yes	Yes	Yes	Yes	Yes
	Adequate knowledge on waste management among the concerned staff	Yes	Yes	Yes	Yes	Yes
	Cleaners wash their hand after their work	Yes	Yes	Yes	Yes	Yes
	Record keeping for any incident	NO*	NO*	NO*	NO*	NO*
Management of waste management machineries	Number of containers is ok	Yes	Yes	Yes	Yes	Yes
	Protective equipment's are supplied are adequate by number (Boot, Gloves, Apron, mask etc.)	Yes	Yes	Yes	Yes	Yes
	Number of needle cutter are according to need	Yes	Yes	Yes	Yes	Yes
	Adequate instruments are in store	NO*	NO*	NO*	NO*	NO*
	Record keeping for equipment	NO*	NO*	NO*	NO*	NO*

*= NO (Not Observed)

Table 2 illustrates the presence of medical waste management system in five different hospitals namely United hospital, Al- Manar Hospital, Hospitals run by Al-Basar International foundation, Labaid Hospital and City Hospital.

Through question 1, the issue of whether containers are placed in hospitals according to the color code was explored and the following findings among different hospital regarding placement of waste container according to protocol; United and Lab aid hospital had followed almost all the indicators that are relative to the placement of waste container such as kept in such distances that easily accessible to patients, number of container as per need, containers are covered properly, containers are labeled with number, containers are clean and surroundings of the containers are clean, except "placement of different colored container in different places as per need". The protocol related to "placement of different colored container in different places as per need" was not also followed by the rest of 3 hospitals namely Al- Manar, Al-Basar and City Hospital. Along with this, Al-Manar, Al-Basar and City Hospitals did not follow the protocol related with "kept in such distances that easily accessible to patients". Moreover, the protocol namely "containers are labeled with number" was not observed being followed by Al-Manar and City Hospital.

The question number 2 shows the distribution of hospitals by segregation of wastes according to color code protocol. The protocol namely "Segregated general wastes are in Black Container", "Segregated hazardous wastes are in yellow Container" and "Segregated recyclable general wastes are in Green container" were observed to follow by all the 5 hospitals. United, Al-Basar and Lab Aid Hospital were seen to dispose liquid wastes properly but Al-Manar and City Hospitals were not followed this protocol. Whether segregated sharp waste was in red container or not could not be observed in all the study place.

In regards to the waste collection (question 3), The protocol namely "Waste collection is properly supervised and monitored", "Waste handlers wearing safety dress during waste collection" and "Waste containers are cleaned regularly" were observed to follow by all the 5 hospitals. United, and Lab Aid Hospital were seen to keep record properly for waste collection but Al-Manar, Al-Basar and City Hospitals were not

followed this protocol.In contrast, Only Al- Basar and City hospitals had followed the protocol related to "Collection of same types of waste from different places in same container". However, the indicators namely "Proper planning for waste collection" and "Wastes is collected according to planning" could not be possible to observe.

The question number 4 was asked to observe whether the hospitals had waste transportation system. The indicators namely "Trolley is used for waste transportation" and "Containers are covered properly during transportation" were seen to present at the all 5 hospitals. But the indicators namely "Waste handlers wearing safety dress during waste transportation" was seen to present only at United and Lab aid hospital. "Specific rout is used for waste transportation" indicator could not be possible to observe at any hospitals.

Distribution of hospitals by waste storage protocol was analyzed through question 5. According to table, it can be said that all the 5 hospitals had followed the waste storage protocol related indicators of "Adequate water supply in storage area", "Not accessible for general people" and "Not nearer to kitchen". However, the indicators namely "Specific room for temporary storage", "Floor of the store is smooth" and "Sun light is restricted in storage room" could not be possible to observe.

For the purpose of gathering data regarding the safety measures hospitals take when handling their waste, question number 6 was designed. United, Al-Manar, Al-Basar, Lad-aid and City Hospitals followed the safety measures related indicators of "Protective equipment are supplied (Boot, Gloves, Apron, mask etc.) to waste handlers", "Adequate knowledge on waste management among the concerned staff" and "Cleaners wash their hand after their work". The indicators namely "Record keeping for any incident" could not be possible to observe.

In question 7, distribution of hospitals by management of waste management machineries protocol was shown. United, Al-Manar, Al-Basar, Lad-aid and City Hospitals followed the management of waste management machineries protocol related indicators of "Number of container is ok", "Protective equipment are supplied are adequate by number (Boot, Gloves, Apron, mask etc.)", and "Number of needle cutter are according to need". It was not possible to observe the indicators namely "Adequate instruments are in store" and "Record keeping for equipment".

DISCUSSION

This cross-sectional descriptive study was tried to assess the present status of waste management in the five selected different hospitals situating in Dhaka city. The present study found that none of the selected hospitals placed different colored containers in different places in the hospital as per the requirement. Medical waste from one department may move to another department or one type of medical waste may move to another container due to lack of proper containers. These can create mismanagement of hospital waste at the beginning of the procedure which may not be possible to bring it back to the right path in any way later. Therefore, hospital authorities should place appropriate number of colored containers in every designated place of hospitals according to government guidelines.

This study discovered that all the hospitals segregated their general, hazardous and recyclable waste in black, yellow and green container, respectively. However, it was noticed that the liquid waste was not properly separated by Al- Manar and City Hospital which indicates their limitations in this regard. Further, these two hospitals along with Al-Basar did not keep record properly for waste collection. Lack of data may pose difficulties in taking proper action in the management of waste. Thus, it is suggested to maintain record book at a regular basis in maintaining effective hospital waste management in every hospital.

Every year, according to the Centers for Disease Control and Prevention (CDC), roughly 500,000 people in the United States are infected by blood-borne pathogens found in medical waste, most commonly through accidental, infected or compromised needle stick injury situations [11]. In order to reduce infection, it is significant to wear personal protective equipment during waste collection, transportation, and storage by all the staff concerned. Unfortunately, Al-Basar, Al-Manar and City hospitals' waste handler did not use safety gear during waste transportation despite they were provided. This signifies that the waste handlers of those hospitals were not aware enough about the hospital acquired infection. Therefore, awareness raising program about the hospital induced infection should be arranged at a regular interval to all the hospital staff.

Limitations

This was a cross-sectional study; therefore, the waste management situation of the selected hospital may not be justified with the current situation as the data was collected about 6 months ago. In addition, some activities according to checklist were not observed due to time restrictions and COVID-19 restrictions protocols.

CONCLUSION

Healthcare waste management is overlooked in Bangladesh due to the growing number of hospitals, clinics, and diagnostic laboratories, particularly in Dhaka City, and it is under the territory of the local municipal bodies, which are incharge of collecting, removing, and disposing of various types of waste from public settings. It was intended to determine the hospital waste management system through observational checklist of five specific types of hospitals in the city of Dhaka. Regarding placement of waste container according to protocol; United and Lab aid hospital had followed almost all the indicators except “placement of different colored container in different places as per need”. All five hospitals were observed to follow the indicators of color-coded waste segregation protocol such as “Segregated general wastes in Black Container”, “Segregated hazardous wastes are in yellow Container” and “Segregated recyclable general wastes in Green container”, with the exception of the “Segregation of sharp waste in red container”. Considering waste collection into account, all 5 hospitals were found to be following the indicators "Waste collection is properly supervised and monitored,", “Waste handlers wearing safety dress during waste collection” and “Waste containers are cleaned regularly” but it was not possible to see “Proper planning for waste collection” and “Wastes are collected according to planning”. With regard to the waste transportation system, the indicators "Trolley is used for waste transportation" and “Containers are covered properly during transportation” were observed to be present at each of the five hospitals, but it was not possible to observe the indicator "Specific rout is used for waste transportation" at any of the hospitals. The waste storage protocol associated indicators of “Adequate water supply in storage area”, “Not accessible for general people” and “Not nearer to kitchen” had been followed by all 5 hospitals. However, it was unable to notice the indicators “Specific room for temporary storage”, “Floor of the store is smooth” and “Sun light is restricted in storage room” could not be possible to observe. Regarding the safety measures hospitals take when handling their waste all 5 hospitals followed the safety measures related indicators of “Protective equipment are supplied (Boot, Gloves, Apron, mask etc.) to waste handlers”, “Adequate knowledge on waste management among the concerned staff” and “Cleaners wash their hand after their work”. The indicators namely “Record keeping for any incident” could not be possible to observe. The indicators "Number of containers is ok," “Protective equipment are supplied are adequate by number (Boot, Gloves, Apron, mask etc.)”, and “Number of needle cutter are according to need” were observed by all 5 hospitals in accordance with the management of waste management machineries protocol, but it was not possible to observe the indicators "Adequate instruments are in store" and "Record keeping for equipment."

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